UNIVERSITY OF GHANA

EXAMINING THE ADAPTIVE STRATEGIES OF THE PEOPLE OF DOME IN THE GA-EAST MUNICIPALITY TO THE EFFECTS OF CLIMATE CHANGE AND VARIABILITY

BY

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DECLARATION

I, **Wendelina Acheampomah Boakye**, hereby declare that except for reference to other people's work which have been duly acknowledged, this thesis is the result of my own research carried out at the Institute of Statistical, Social and Economic Research (ISSER), University of Ghana under the supervision of Dr Simon Bawakyillenuo (ISSER).

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ABSTRACT

There is a global consensus about climate change and variability's effects as serious environmental problems. Against this backdrop, adaption and mitigation have been established as key elements for addressing them. However, adaptation to climate change has been established as an important and complementary response to mitigation. In view of this, the study examined the adaptive strategies of the people of Dome to the effects of climate change and variability. Drawing on the adaptive capacity framework, it specifically assessed the perceptions of the people of Dome about climate change and variability; the prevailing effects of climate change and variability as well as the relative adaptive strategies adopted by different people to tackle these effects. Lastly, the study assessed the adaptive capacity of the people of Dome to climate change and variability effects. A systematic random sampling technique was used to sample 371 respondents for the household questionnaire survey whilst institutional heads were purposively selected for the in-depth interviews. The study reveals that majority of respondents were familiar with the term climate change and had a fair understanding of it. Again, flooding, increased temperature and high rainfall intensity were perceived by respondents as more prevalent climate change effects compared to storms. Comparatively, majority of the respondents engage in reactive than planned adaptation measures. Furthermore, the study finds that the adaptive capacity of respondents especially, social capital, effectiveness of institutions, and early warning systems are relatively low in Dome. The study established that coping with climate change and variability is dependent on knowledge and awareness about climate change and its effects, access to technology; information and basic infrastructure, and the effectiveness of institutions. In view of these findings, the study recommends education campaigns on climate change, enhancement of early warning information dissemination and development of practical policies to improve preparedness for climate change effects.

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DEDICATION

I dedicate this to my parents Mr. Oheneba Boakye and Ms. Sabinah Debrah and to my aunt Ms. Felicia Dede Nuer. Thank you for all the guidance, love and support.

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LIST OF ABBREVIATIONS

BBC	-	British Broadcasting Corporation
GEMA	-	Ga East Municipal Assembly
GEM	-	Ga East Municipality
GHG	-	Greenhouse Gases
GSS	-	Ghana Statistical Service
IPCC	-	Intergovernmental Panel on Climate Change
NCCAS	-	National Climate Change Adaptation Strategy
NCCP	-	National Climate Change Policy
UNEP	-	United Nations Environment Programme
UNDP	-	United Nations Development Programme
UNFCCC	-	United Nations Framework Convention on Climate Change

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

There is a global consensus on the reality of climate change and variability as a critical environmental problem in the wake of overwhelming scientific evidence (Mallick *et al.*, 2005; Chambwera & Stage, 2010). The average global temperatures have increased by 0.74±0.18 ˚C and are projected to increase up to 1.1–6.0 ˚C in the coming century (Intergovernmental Panel on Climate Change (IPCC), 2007 as cited in Reidsma *et al*., 2010). The key anthropogenic pressures for global temperature increase are Greenhouse Gases (GHG). According to IPCC (2007) the key drivers for emission of these gases are consumption, international trade, population growth and economic development. Although measures are being taken through international conventions as per the Kyoto Protocol and the United Nations Framework Convention on Climate Change (UNFCCC) to reduce emission of GHG, the impacts of climate change are expected to continue and even increase in the coming years (Chatterjee *et al.*, 2005).

Even though rich industrialized countries emit the largest amount of the global GHG (Mertz *et al.*, 2009), it has been scientifically accepted that the effects of climate change are more severe in developing countries (IPCC, 2001). Climate change is manifested in temperature increase, sea level rise, changes in the distribution of precipitation, drought and cyclones (Westerhoff & Smith, 2009). Its effects include water scarcity, food insecurity, water and insect borne diseases such as cholera and malaria as well as financial insecurities (Bawakyillenuo *et al.*, 2014; Paavola, 2008). These effects are more prominent among the poor and vulnerable with less capacity and resource endowment (Mallick *et al*., 2005). Africa has been identified by the IPCC as the continent most adversely affected by the changing climate (Yamin *et al.*, 2005). In West Africa, for example, the impacts of

climate change is far-reaching because of the region's dependence on climate related economic activities such as rain fed agriculture and also limitations in social, political, economic and technical resources (Yamin *et al.*, 2005; Westerhoff and Smith, 2009; Mertz *et al.*,2009). The region is expected to experience further increase in temperature, altered rainfall patterns, changes in growing seasons, drought and water scarcity (Watson *et al.*, 1998 as cited in Westerhoff & Smith, 2009).

Addressing climate change issues in the world falls into two segments: mitigation and adaptation. Early interventions focused on mitigating the factors of climate change by enlisting industrialized countries to reduce their emission (Kates, 2000; Seck *et al.*, 2005). In recent years, however, adaptation to climate change has been established as an important and complementary response to mitigation (Gagnon-Lebrun & Agrawala, 2006). Humans have been adapting to climatic change from the beginning of the millennia (Huq *et al.*, 2005) because, most of the adverse impacts of climate variability already existed. Depending on the timing or degree of spontaneity, adaptation can be anticipatory, reactive and autonomous or planned respectively (Smit *et al.*, 2000). Adaptation reduces substantially the adverse impacts of climate change and in some instances enhances the beneficiary impacts (Burton *et al.*, 2002).

Adaptation has taken precedence over mitigation because it has become clear that climate change is inevitable due to historical emissions (IPCC, 2001 as cited in Bawakyillenuo *et al.*, 2014). Developing countries for instance are in the development process, hence, favour adaptation rather than mitigation, which would restrict their development activities. In consequence, many developing countries have prioritised adaptation because projections made by IPCC (2007) indicate that these countries would be severely hit by the impacts of climate change in the future. Also, climate change is currently being viewed as a cross-cutting issue, with adaption strategies often linked to the development of poverty alleviation programmes (Mertz *et al.*, 2009).

1.2 PROBLEM STATEMENT

Given the two-fold relationship that exists between climate change and development (IPCC, 2007), there is sufficient evidence to suggest that changing climate variability has severe impacts on development (World Development Report, 2010). Attempts by countries to prioritise their developmental needs inadvertently influence emission of GHG, thereby causing climate change, while changes to the climate on the other hand affects the very resources these countries depend on for development (IPCC, 2007). Consequently, various countries face the danger of climate related disasters that lead to loss of lives; destruction of infrastructure and resources; interruption of economic undertakings; and cause economic losses. For instance, the world lost about US$ 575 billion between 1996 and 2005 due to natural disaster, with a record loss of US$ 210 billion in 2005 alone (Muniuch Re, 2005; Leary *et al.*, 2008). In the wake of these disasters, development is disrupted and it may take several years to recover, thereby necessitating the need for climate change adaptation strategies (Leary *et al.*, 2008). Adaptation to climate change is complementary to development. It provides resilience against extreme climate hazards, thereby making development achievements and prospects sustainable (Leary *et al.*, 2008).

Adaptation has gained much international recognition as a result of its relevance for development (Mertz *et al.*, 2009). Contributions from various scholars and institutions stress on the need to integrate adaptation strategies that local officials and stakeholders can relate to (Sanchez-Rodriguez, 2009). Most studies on adaptation to climate change have been geared towards urban areas in middle-income and low-income countries because most of these countries see the problems of climate change as a long-term problem and have not mainstreamed them into the policies of the various sectors (Sanchez-Rodriguez, 2009; Leary *et al.*, 2009).

Ghana has policies pertaining to adaption of climate change at the national level including, the 2012 National Climate Change Adaptation Strategy (NCCAS) and the 2013 National Climate Change Policy (NCCP). While national level policies and strategies provide the broad framework for a country, they sometimes have varying implications at the regional or local level (Kahn-Ribeiro *et al.*, 2007). In this regard, area specific adaptive strategies are often very effective compared with the national level, because they address specific climate change impacts. The successes of these adaptive strategies are often dependent on the capacity of these locations, which can be regions/metropolis/municipalities/districts in the case of Ghana. It is therefore paramount for an assessment of regional and local capacities in order to develop appropriate local adaptation strategies towards climate change.

Although there have been several studies assessing adaptive capacities of specific locations in Ghana with varying results, most of them have been undertaken within rural areas and concentrating on the agricultural sector. For instance, studies by Bawakyillenuo *et al.* (2014) in Northern Ghana concluded that the relativity in adaptive strategies and capacities necessitate a context-specific and bottom-up approach to make them viable. Again, Asante *et al.* (2012) gave credence to the influence of technology on the adaptive capacities of farmers in Northern Ghana. Although these studies are relevant to the climate change and development discourse, studies done by Feiden (2011) and Lankao (2008) have shown that urban areas suffer the worse impacts of climate change especially, in middle to lower middle-income countries including Ghana, due to high concentration of economic activities and population.

Like other urban settings in Ghana, the adverse effects of climate change and variability have been widely felt across the Ga East Municipality (GEM) in the Greater Accra Region. For instance, incidence of flooding in communities such as Ogoha, Taifa, Dome, Okoe and Christian Village in the

past years often resulted in the destruction of properties (Ga East Municipal Assembly (GEMA), 2014). Additionally, the effects of climate variability have resulted in temperature changes and their associated heat stress. Nonetheless, there is a dearth in studies critically assessing the adaptive capacities and strategies adopted by the residents of Dome to climate change and variability. This study will therefore contribute to the knowledge building in the context of climate change effects vis-à-vis adaptive strategies and capacities within Dome in the GEM, with findings envisaged to be useful to planning and development

1.3 AIMS AND OBJECTIVES

The main aim of this study is to examine the adaptive strategies being adopted by the people of Dome to tackling the effects of climate change and variability.

The specific objectives include:

1. To assess the perceptions of people about climate change and variability in Dome over the years;
2. To examine the prevailing effects of climate change and variability in Dome;
3. To identify the relative adaptive strategies adopted by different people to tackle different climate change and variability effects in Dome;
4. To examine the determinants of the adaptive capacity of different people to tackle different climate change and variability effects in Dome

1.4 RESEARCH QUESTIONS

In view of the aforementioned objectives, the research seeks to answer the following questions:

1. How do people in Dome perceive climate change and variability?
2. What phenomena do people in Dome attribute to as the effects of climate change and variability in Dome?
3. What are the relative adaptive strategies adopted by different people to tackle different climate change and variability effects in Dome?
4. What are the determinants of the adaptive capacity of people in Dome to tackle the different effects of climate change and variability?

1.5 JUSTIFICATIONS OF THE STUDY

The study is significant for several reasons. Firstly, the study will add to existing knowledge on climate change and variability issues in Ghana especially, in Dome in GEM. More importantly it will contribute to filling the gap that exists on the relationship between adaptive strategies and the underpinning determinants in relation to urban areas because, much of the existing literature focus extensively on rural areas in Ghana.

Secondly, examining the prevailing adaptive strategies in Dome would assist in ascertaining their strengths and weaknesses. This will also reveal the extent to which different adaptive strategies being adopted will succeed or fail and why. It would also inform policy makers about the municipality's capacity to adapt to climate change and what appropriate adaptive strategies are needed.

1.6 ORGANIZATION OF CHAPTERS

The study comprises of five chapters. Chapter one gives an overview of the subject matter of the dissertation. It covers the background to the study, the problem being addressed, the aims of the study, questions the study seeks to address, justification of the study as well as the sequencing of the chapters. Chapter Two gives a comprehensive review of literature relevant for the study and the conceptual framework underpinning the study. Chapter Three covers the methodology for the study as well as a detailed description of the study area. The fourth chapter deals with the presentations, analysis and discussion of the results of the data for the study. Lastly, Chapter Five deals with summary of the key findings, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter Two examines current discourses on the subject matter of this study through reviewing literature. Importantly, the literature review is centered on the various understandings on climate change and variability; constructions around perceptions of climate change and variability; adaptation to the effects of climate change within the urban context and factors fostering successful adaptation or failure. In addition, the chapter discusses the key dimensions of the conceptual framework (adaptive capacity framework) that shapes this study. Based on the review, the chapter draws out the gaps in the literature taking into account the perspectives of this study and concludes in the last section.

2.2 UNDERSTANDINGS ON CLIMATE CHANGE AND VARIABILITY

Climate change and variability are seen as the main environmental problems of the 21st century (Reidsma *et al.*, 2010). Cudjoe & Owusu (2011) define climate change as the change in the statistics of the weather expressed in changes in the mean of climatic elements. However, a UNFCCC (1994) definition notes that climate change is not only a statistical change in weather but the influence of human activities as well as natural factors that alter the composition of the atmosphere leading to climate variability (UNFCCC, 1994 as cited in Cudjoe & Owusu, 2011). Christensen *et al.* (2007) also define climate variability as changes in the climate at all spatial and temporal level beyond various weather events. According to the IPCC (2007) climate change refers to "any change in climate over time, whether due to natural variability or as a result of human activity" (p.6). These definitions all point to the fact that climate change is a change in climatic conditions whether human-

induced or by natural causes. These changes may lead to water scarcity, food insecurity and financial insecurities (Bawakyillenuo *et al.*, 2014)

Therefore, the consequences of climate change have invariably been classified among the important international environmental challenges. Changes to the climate are inevitable due to human development endeavors, historical emissions and also the long lifespan of GHG (IPCC, 2001; Chatterjee, 2005). Thus, with the current mitigation strategies and developmental practices (IPCC, 2007), adaptation is paramount for protecting humans and the environment from the obvious effect of climate variability (Todaro & Smith, 2012; Bawakyillenuo *et al.*, 2014).

2.3 CONSTRUCTIONS AROUND PERCEPTIONS OF CLIMATE CHANGE AND VARIABILITY

Human perceptions about a phenomenon are very pertinent to assessing challenges including climate change and addressing them. Vogel *et al.* (2007) opine that ascertaining the perceptions held by people and different communities towards a risk provides a significant platform to build an efficacious structure and behavior to curtail it. Studies by Wei *et al.* (2014) suggest that the perceptions of individuals on climate change are closely linked with their adaptive behaviour and mitigation strategies. In their assessment of climate related risk and adaptive alternatives in urban areas, Andersson-Sköld *et al.* (2015, as cited in Janhall, 2015) also note that individuals' perceptions on risk and social factors such as appeal of urban areas and improved welfare are important in determining the success of climate change management. These authors further point out that adaptation to climate change must be assessed with regards to individuals' perceptions.

A study by Manandhar *et al.* (2015) in Thailand compared the perceptions of local people on climate change to scientific findings on climate change. Using both qualitative and quantitative approaches,

the study found that the perceptions of local people on rainfall variability were in close relation to the scientific findings on rainfall variability. Close relation to the scientific findings on rainfall variability. They also found that although the people were aware of changes in climate they did not associate it with increase in climatic hazards. These authors concluded with observations that awareness campaigns, early warning systems and training are very important to addressing the issues of low perceptions among local people.

The study by Deressa *et al.* (2008) on the perception of farmers in the Nile Basin of Ethiopia revealed that most farmers were aware of the increase in temperatures and decrease in rainfall. However, individuals' relative perceptions on climate change were influenced by age of the household head, the extent of access to information on climate change, wealth and social capital. Clearly, this study's findings raise the key issues of individuals' perceptions of climate change and their links to experience and other social indicators.

In a similar study by Mertz *et al.* (2008) on perceptions of farmers in rural Sahel, they also noted that all the various communities that were studied were highly aware of climate change and variability. However, the adaptive strategies that are practiced in these communities are driven by economic, political and social factors rather than climate related factors. Hence, the study suggested the need to focus on flexible adaptation option such as credit system, new crops and improved soil fertility that improve adaptive capacity as well as economic development rather than those that are geared specifically towards climatic problems.

The BBC World Service Trust (2010) undertook a study on the public understanding of climate change in Africa. Findings in this study indicate that majority of the local people are unfamiliar with the term 'climate change' and therefore, found it difficult to conceptualize and interpret it in the various local languages. Some respondents had not heard of the term before and as such interpreted it

literally. Even those who had heard of the term before were associating it with global phenomena such as the cyclones Asia and the melting of the ice caps. Also, it emerged from this study that the African understanding of the phenomenon of climate change was largely underpinned by five main themes: emphasis on trees; will of God; ozone confusion; air pollution; and localized heat. These either act as barriers or enhance effective communication of climate change related information. In situations where individuals perceive the occurrence of these phenomena as natural, efforts are made to adapt to such situation. In a study by Stephens *et al.* (1996) in low-income communities in Indore, India, efforts were made by individuals at adapting to the incidence of flooding because they perceive it as naturally occurring and seasonal.

In Ghana, a study by Gyekye (2013) on environmental change and flooding in Accra, reports that respondents had a fair knowledge about climate change but were ignorant on some climate change related issues, which were pertinent for communities and institutions to build resilience in order to overcome climate change impacts. Majority of the respondents perceived climate change as changes in weather pattern whiles others defined it as the increase in the drought period stemming from cutting down of trees. Consistent with the BBC World Service Trust' (2010) study were also expressions of perceptions of climate change being the will of God by respondents in Gyekye's (2013) study.

2.4 ADAPTATION TO THE EFFECTS OF CLIMATE CHANGE AND VARIABILITY WITHIN VARIOUS URBAN CONTEXTS

Smit and Wandel (2006) posit adaptation as responses to risks associated with interaction of environmental hazard and adaptive capacity. The concept of adaptation takes various dimensions depending on the degree of spontaneity, timing and reasons for implementation. Adaptation could be reactive or anticipatory, planned or autonomous, private or public (Smit & Pilifosova, 2001; Smit *et*

al., 2000). Autonomous and planned adaptation strategies are the two main forms of adaptation that have received extensive research. Autonomous adaptation strategies are usually undertaken by individuals or households whereas planned adaptation strategies are usually government/institutional interventions against an experience of climatic hazards or in anticipation for climate variability (Todaro and Smith, 2012). Planned adaptation could trigger autonomous adaptation and vice versa. However in certain instance planned adaptation could hinder autonomous adaptation because people may not see the need to adapt if government has already made provision (Todaro and Smith, 2012). Thus planned and autonomous adaptation could be complementary or substitutes.

The study by Carmin (2012) reports that 79% of cities worldwide have reported perceived changes in temperature, precipitation, sea level or naturally occurring disasters in the past five years. Again, myriads of studies report on the effect of climate change and variability in urban areas. Climate change is noted to amplify the incidence of water and heat stress, threaten food security, aggravate incidence of vector-borne diseases, occasion and heighten incidence of in-land flooding and drought (Paavola, 2008; Yaro, 2009; Bawakyillenuo *et al.*, 2014). It is noteworthy that urban areas are also affected by the effects of climate change and variability due to the incidence of temperature changes coupled with heat stress and in-land flooding. Against this backdrop, efforts are made to adapt to such situations. According to Adger *et al.* (2007), adaptation is about enhancing resilience or reducing people's vulnerabilities to observed or expected changes in climate. Adaptive strategies depend on various factors including the governance system, public infrastructure, resource availability, climatic and geographic conditions, housing system as well as the indigenous knowledge in decision making (Huq *et al.*, 2006 as cited in Laukkonen *et al.*, 2009; Leary *et al.*, 2009). Thus, strategies are most appropriately created and implemented on regional specific basis (Juhola *et al.*, 2012). These strategies vary between developed and developing countries and even amongst

developing countries on how they are created or implemented. However, irrespective of the timing and scale of adaptation, it is dependent on the adaptive capacity of the region (Adger *et al*., 2004; Brooks *et al*., 2005; IPCC, 2007).

In view of this, Feiden's (2011) study on climate change adaptation in cities and among the urban poor underscores the various adaptive measures often used in urban areas. These include hardening of infrastructure to make it more resilient to extreme weather conditions, building seawalls to reduce the impact of rising seas and extreme weather, improving housing quality to make it more resistant to storm events, land filling to raise elevations for new developments, relocating to alternative settlements areas, investing in cooling technologies, disaster planning to enhance effective evacuation based on improved early warning systems, public health measures to address changes in disease vectors, improved enforcement of critical building and land use regulations and settling urban migrants in appropriate parts of cities (Feiden, 2011). Accordingly, these adaptive strategies could either be autonomous or planned by the government (Feiden, 2011).

A study by Stephens *et al*. (1996) in low-income communities in Indore, India reports that households and small enterprises resort to temporary and permanent adaptation strategies to cope with the incidence of seasonal flooding. It emerged that some residents often turned to raising plinth levels and paving of their courtyards using landfills whiles others resort to the use of materials that are resistant to flooding including, furniture that are less likely to be washed away during flooding. In addition, others constructed shelves and electric wiring high above expected water levels in case of flooding. Stephens *et al.*, 1996 as cited in Satterthwaite *et al*., 2007).

With reference to how individuals and communities adapt to the effect of flooding in the urban context, Satterthwaite *et al.* (2007) argue that most of the adaptive measures put in place in the African context often times are ad hoc and short-term rather than being permanent. The study by

Wamsler (2007) reports that individuals occupying informal settlements in Nairobi often resort to digging trenches around houses before and during floods, and construction of temporary dykes or trenches to divert water away from the house. Others also shelter under structures with water proof recycled materials or prevent the entry of water via the use of sand bags (Wasmsler, 2007, cited in Satterthwaite *et al.*, 2007). Similar to the Nairobi context, individuals from Kampala carried out collective work to open up drainage channels or constructed barriers to water entry at the doorsteps and outlets at the rear of their houses (Douglas & Alam, 2006).

Again, Douglas *et al.* (2008) in their study emphasized the fact that apart from clearing of drainage channels to allow pool of water flow through the drainage in case of heavy rain in the Lagos city, resident emphasized the need to elevate the whole area using sand as a prudent adaptive strategy to cope with seasonal flooding in the area (Douglas *et al.*, 2008). In Ghana, individuals resort to land filling to raise elevations for new development or seek temporal accommodation elsewhere. For instance, residents of some flood affected communities in Ghana such as Alajo were of the view that they often use blocks, stones and furniture to create high places on which they put most of their valuable items. These are reactive adaptive response to flooding in these areas (Douglas *et al.*, 2006).

The study by Satterthwaite et al. (2007) indicates that the capacity of urban areas to adapt to climate change and variability are mostly contingent on the extent and quality of infrastructure and public services, especially for vulnerable groups. Clearly, the capacity to cope and adapt to these climate change impacts are largely influenced by individual or household resources such as income, asset base, knowledge and community resources (Satterthwaite *et al.*, 2007). According to Lwasa (2010), Kampala experiences frequent floods with the associated health and infrastructural problems that require the building of adaptive strategies. According to Lwasa (2010), three interventions of adaptation are important "community-based adaptation, institutional adaptation and adaptation of

urban infrastructure" (p. 168). The study recommended improvement in drainage infrastructure, catchment dams and planting of vegetation cover as practical adaptive strategies.

In addition, McEvoy (2007) in his review of climate change and cities in the UK addressed issues pertaining to flooding and heat stress. This study identified that the main driver of urban flooding is the increase of impermeable surface, as urban temperatures are warmer than the countryside due to Urban Heat Island (UHI). This situation is exacerbated by current changes in climate. However, the current strategies to adapt to these changes sometime aggravate the climate change situation. For instance air conditioning technologies are increasingly being used as an adaptation option to heat, however their use lead to increased carbon dioxide emissions if energy is consumed from fossil fuel sources.

In some instances, adaptation is based entirely on indigenous knowledge. For instance, in the Mekong Delta, citizens have planted mangroves to serve as protection against storm surges (UNDP, 2008). Another such strategy is seen in the case of Ganges delta in India where bamboo flood shelters are built on stilts. In Peru, farmers use "waru waru" drainage and irrigation system. After Typhoon Sisang in Philippines in 1987, typhoon resistant housing programme was implemented where houses were built to resist wind speed of 180km/h (UNFCCC, 2007). Studies done by Huq *et al.* (2005) and Leary *et al.* (2009) suggest that knowledge is very critical in the development of future adaptive capacities to climate change, thus apt knowledge should be the focus for developing adaptive strategies.

In assessing the vulnerability and adaptation in the Afram plains of Ghana, Westerhoff & Smit (2009) also used the generic vulnerability framework. The findings of the study indicated that adaptation initiatives should take into consideration people's interaction with climatic and non-climatic factors rather than focusing solely on climate change issues. The study also showed that

there are limitations to community and individual adaptive capacity because their prospects are inhibited by circumstances beyond their control. They concluded that responses to climate change may have different effect on different scales thus efforts to enhance adaptive capacity should be well managed.

2.5 GAPS IN LITERATURE

The above reviewed literature establishes a direct positive link between perception about a phenomenon and response to its effects. Studies by Stephens *et al.* (1996), BBC World Service Trust (2010), Gyekye (2013) and Wei *et al.* (2014) underscore the relationship between individuals' perception of climate change and their adaptive behaviours and mitigation strategies. Against this backdrop, the climate change adaptive strategy thesis has myriads of studies on individual's awareness and perception of climate change and variability in Ghana with respect to rural areas especially, agriculture, however, there is a dearth in studies on urban areas. The various literature sources are mostly centered on farmers' perception about climate change and their adaptive behaviour towards its effects. Nonetheless, studies by Stephen *et al.* (1996), BBC World Service Trust (2010), and Feiden (2011), acknowledge the relevance of ascertaining the perception and awareness of urban populace about climate change and their adaptive behavior towards its impact.

Again, the current literature give cognizance to the fact that autonomous adaptation are usually undertaken by individuals or households whereas planned adaptation strategies are usually government intervention against an experience of a climatic hazard or in anticipation for climate variability (Todaro and Smith, 2012). There are thus limited or no locally relevant information on how the local people resort to planned or anticipatory adaptation strategies based on their adaptive

capacities. There is the urgent need to ascertain how local communities adopt planned or anticipatory adaptive strategies in the wake of the effects of climate change and variability.

Also, there are numerous literature sources on how people adapt to incidence of flooding from the global to the local scale, however, there is very limited or no local context and location specific relevant information on how individuals adapt to temperature changes, heat waves and its associated heat stress. The scanty nature of the literature on this theme makes it ideal to ascertain the temporary or permanent adaptive strategies often adopted by the people of Dome. Although studies by McEvoy (2007) and Feiden (2011) give credence to the investment and use of cooling technologies to adapt to incidence of temperature changes and heat stress, most of them are within the developed countries and not in the developing countries where the brunt of climate change impacts are grossly felt.

2.6 CONCEPTUAL FRAMEWORK FOR STUDY - ADAPTIVE CAPACITY FRAMEWORK

The concept of adaptive capacity to climate change was introduced in IPCC Third Assessment Report (McCarthy *et al.*, 2001 as cited in Schroter *et al.*, 2004, pp. 36). It gained much prominence in current literature due its usage in IPCC's Third Assessment Report in 2001. The determinants stated in the IPCC report were technology, economic development and social factors such as social capital and network. Several research works have probed further into the determinants of the adaptive capacity although Engle (2011) maintains that the area is under-researched. Whereas some have focused on one aspect of the determinants such as institutions (see for instance, Yaro *et al.*, 2014 & Upton, 2011), others have also looked at the adaptive capacity holistically (see for instance Engle, 2011). On the other hand, some have also introduced additional and alternative approaches for determining adaptive capacity (Williamson *et al.*, 2010). All these studies, however, maintain that

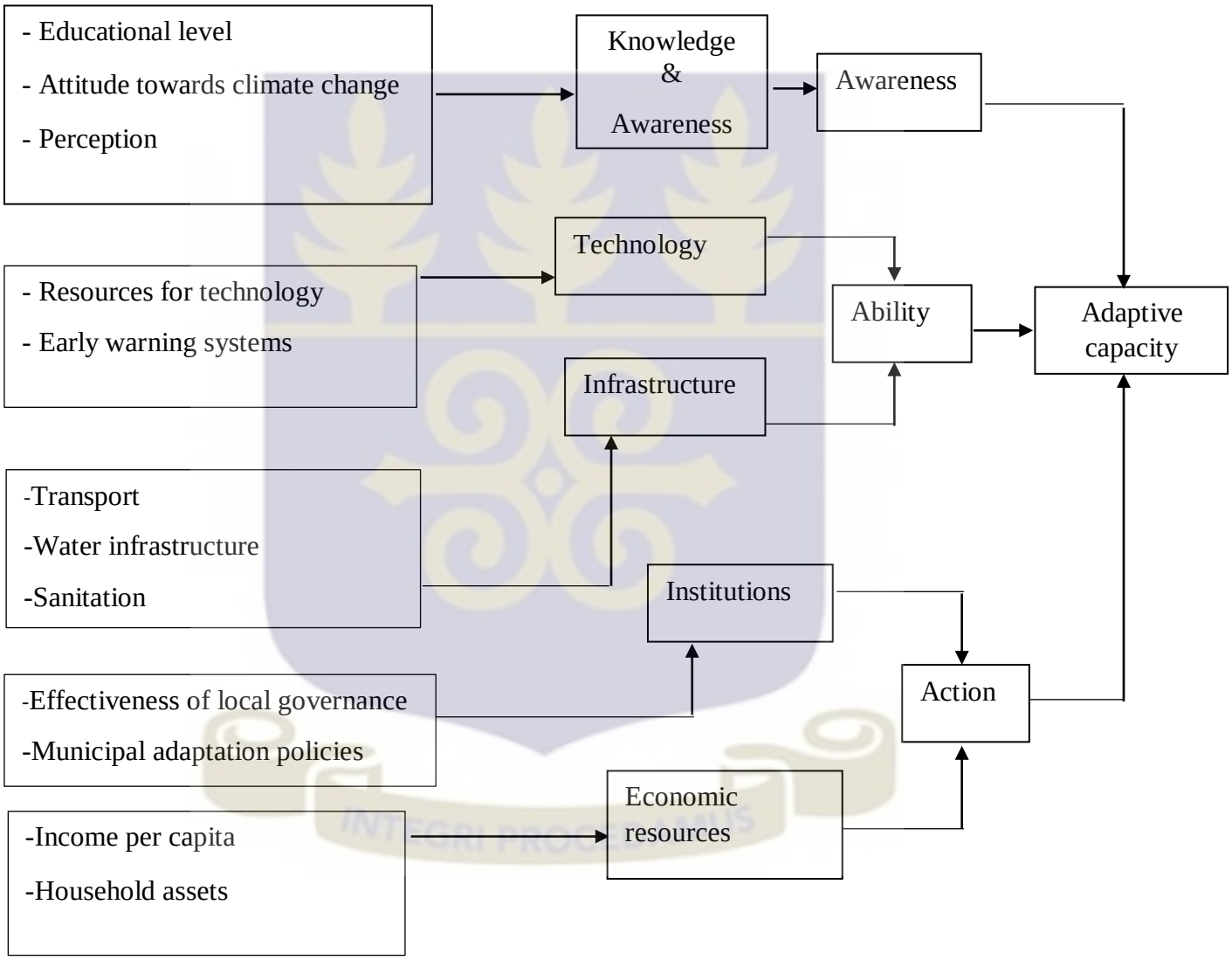
the determinants of adaptive capacity are not independent but rather complementary of each other (Juhola *et al.*, 2012).

Although it provides practical and theoretical benefits such as better understanding by practitioners and policy makers and also integration of resilience and vulnerability, it has its limitations. Williamson *et al.* (2010) in their assessment of adaptive capacity highlighted the fact that the determinants are intangible and not directly measured as the main deficit. Hence, Schroter *et al.* (2004) in their assessment of ecosystem vulnerability categorized the IPCC determinants into three main dimensions; awareness, ability and action. Awareness included the determinants of equality and knowledge. Ability comprised of determinants of technology and infrastructure. Lastly, action consisted of the determinants of flexibility and economic power.

Juhola *et al.* (2012) in their assessment of the adaptive capacity of Nordic countries acknowledge that the determinants of adaptive capacity ought to be treated with caution. Thus, they adapted the categories used by Schroter *et al.* (2004). The awareness dimension also consisted of knowledge and awareness determinants operationalized with educational commitment, computer skills and attitude towards climate change. The ability dimension comprised of technology and infrastructure determinants. This was operationalized using indicators such as resource for technology; research capacity; transport and water infrastructure; and hospital beds. A region's level of technology and ability to develop new technologies are important determinants of adaptive capacity (IPCC, 2001). The two determinants for the ability dimension are institutions and economic resources. Yaro *et al.* (2014) indicate that the role of institutions are crucial for adaptation because they legitimize norms and practices and are important for defining access to resources. Thus, power relations influence people's capacity to adapt to climate change effects. Be that as it may, the propensity to adapt is also contingent on the availability of economic resources since that may improve access to technology

(Moss *et al.*, 2001). For instance, Dinar *et al*. (2008) noted that household heads had the higher propensity to adapt because they had control over household resource. Figure 2.1 shows the adaptive capacity framework adapted for the study.

Figure 2.1 DETERMINANTS OF ADAPTIVE CAPACITY FRAMEWORK



Source: Adapted from IPCC (2001); Schroter *et al.* (2004) as cited in Juhola *et al.* (2012)

Drawing from the determinants of the adaptive capacity framework (Figure 2.1), there are three dimensions to a system's adaptive capacity: awareness, ability and action (Juhola *et al.*, 2012). The determinants of these dimensions include knowledge and awareness, technology, infrastructure, institutions and economic resources (Smit & Pilifosova, 2003). These determinants are not mutually exclusive but dependent on each other (Asante *et al.*, 2012). Thus, adaptive capacity is invariantly dependent on the knowledge on necessity to adapt; awareness of the problem; level of technology and the ability to develop new ones; socio-economic characteristics such as age, income and education; access to infrastructure; and level of institutional support (Asante *et al.*, 2012). These sets of independent or explanatory variables interplay to influence an individual's adaptive capacity towards climate change effects. The subtext of this implies that in situations where a region or local community are conscious of climate change and variability but has no resources to adopt, this negatively affects the adaptive capacity of that group. In addition to the above, adaptive strategies do not depend solely on individuals and households but also the effective institutions including traditional authorities and local groups. Thus the framework does not only assess households but the needed institutions as well.

This study adopts the determinants of adaptive capacity framework to help understand the adaptive strategies of the people of Dome in the Ga-East Municipality to the effects of climate change and variability. These are best answered by the independent or explanatory variables within the framework. For instance, in ascertaining the adaptive strategies of the people, the study aims at examining the perception and the awareness of the people about climate change and variability, its effects and the determinants of the relative adaptive strategies adopted to tackle these effects. The adaptive capacity framework categorically underscores the fact that adaptive capacity is determined by a region's awareness of the problem of climate change, their ability to tackle this problem and the

action they may take to address this problem. The assumption in the framework is that the determinants of these processes work in tandem hence in order to realize the full capacity of a region to adapt to climate variability one must draw equally on all these factors. Hence, Knowledge and awareness is the reflection of perceptions about the problem of climate variability as well as attitudes towards the problem. This would then prompt people into action in tackling the effects of climate variability depending on their ability (i.e. Technology and infrastructure).

In circumstances where there is the need to enhance autonomous and anticipatory form of adaptive strategies, both local individuals and government ought to work together in fostering it. This invariably equips both individuals and institutions in their ability to take action based on their awareness of climate change and variability effects. All these variables are duly accounted for by this framework, hence the need to adopt this framework in assessing the adaptive strategies of the people of Dome to the effects of climate change and variability.

2.7 CONCLUSION

This chapter reviewed relevant literature pertaining to climate change and variability. It also discussed literature on understandings relating to perceptions of climate change and variability from the global perspective to the local level. Again, studies on the various adaptive strategies to the effects of climate change and variability were reviewed. This enhanced the opportunity to elicit gaps in the literature. The chapter also detailed the conceptual framework – determinants of adaptive capacity – that underpinned the study.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter describes the methodology for the study. The chapter gives an in-depth overview of the main approaches that the study adopted including, data needs, approaches to gathering the data and how the data is analysed and presented. In addition, the chapter describes the characteristics of the broader geographical area (GEM) in which the study area belongs to, particularly, demographic characteristics and physical characteristic; spatial distribution of settlement patterns and household characteristics; economic activities and social services. This is then followed by the description of the characteristics of the study site – Dome.

3.2 RESEARCH APPROACH

The study adopted a mixed methodological strategy in order to obtain a thorough understanding of the issues it examined. This consisted of both qualitative and quantitative approaches. The quantitative approach, which resonates with the positivist's paradigm that perceives science as value-free, neutral and objective that aims to explain generic behaviour pattern (Teye, 2012) is useful for analysing quantifiable data and also suitable for generalisation and predictions. However, it is not very good at providing detailed account of peoples' perceptions, emotions, beliefs, experiences and behaviour (Branen, 1992). Nonetheless, the qualitative approach, which also resonates within the interpretivist's paradigm that gives priority to subjective interpretation than objective datum is very useful in explaining behaviours, perceptions and generating detailed information about experiences. However, it has been criticised for being too subjective and lacking in generalisation and predictions (Plano Clark *et al.*, 2008 as cited in Teye, 2012). These two approaches have been asserted by Teye (2012) as complementary since they make up for each other's weaknesses and very useful when

examining complex phenomena. Taking into account their complementarity, both quantitative and qualitative approaches were therefore adopted. The quantitative method of data sourcing preceded the qualitative approach to aid in explaining the various issues and themes that warranted further probing at the institutional level.

3.3 SOURCES OF DATA

Both primary and secondary data were relied on for achieving the study's objectives. The primary data were garnered through the household survey (i.e. via the use of questionnaires) and in-depth interviews with various institutional heads in Dome. The secondary data were sourced from books, Journal articles, Internet websites and reports.

3.3.1 Primary data sources

Household questionnaire survey and in-depth interview were used in sourcing primary data for the study.

3.3.1.1 Household survey

The study undertook a household survey given that information to be collected will be reflective of the household characteristics and the various adaptive measures they put in place in the events of climate change and variability effects in Dome. The quantitative data was collected using semi-structured questionnaires. The questionnaire was used to gather data on the background of respondents, their perception on climate change and variability, the adaptive strategies they use and the reasons for using them and their capacity to adapt to any climate related event. This aided in making generalizations and drawing inferences from the study. The questionnaire was first pretested at Okponglo, a suburb of East legon in Accra. This area was used because it has similar characteristics as Dome and there are reported incidence of seasonal floods and storms in the area.

This allowed for correction of errors, rephrasing of certain sentences to aid in translation in the local language before the actual data collection. Data were collected with the help of two trained and qualified field assistants. The questions were asked in either Twi or English. Data collection lasted for two weeks and, on the average about 30 questionnaires were administered daily.

3.3.1.2 In-depth interviews

In-depth interviews were conducted with the heads of institutions who partly or wholly played a part in climate change issues and whose activities support adaptation to climate change and variability in Dome area. This aided the study in sourcing out information concerning the capacity of the municipality to adapt to incidence of climate change and variability and the various strategies put in place.

3.3.2 Secondary data sources

The secondary data sources used included reports and development plans of the municipal assembly as well as sources such as books, journal articles, publications, Internet websites and working papers related to climate change and adaptation issues.

3.4 SAMPLING TECHNIQUE

According to GSS (2014), Dome has a total of 10,393 households and 5,452 houses. In view of this, the sample frame for the study was 10,393. Therefore at a significance level of 5% and a confidence level of 95%, a sample size of 371 households was drawn for the questionnaire survey.

In order to obtain this, systematic random sampling was used to select 371 houses from a sample frame of 5452 houses. Therefore the total number of houses were divided by the expected sample size. Hence a household in each house was interviewed. In instances where there was more than one household in a house, a simple random sampling technique was used to select one household. In

doing this, the name of the heads of the households were written on pieces of papers and picked randomly. This probability-based sampling technique has been reported as being effective because it is non-biased. The unit of data collection for the study was the head of the household at the time the questionnaire survey was being carried out. This is because in a similar study by Dinar *et al.* (2008), they noted that heads of household are more likely to practise adaptive strategies because they have control over the household resources. On the other hand, heads of various institutions were purposively selected for the study. The municipal planning officer was selected because he puts together the development plan for the municipality. The Administrator for the Dome Zonal council was also interviewed because he represents the Municipal Assembly in Dome. The Municipal National Disaster Management Organisation (NADMO) coordinator is also in charge of disaster management including those pertaining to climate related events.

3.5 ANALYSIS

The quantitative data were analysed using SPSS version 20. Frequency tables were generated, cross tabulation and chi-square test used to test for relationship between variables. On the other hand, recorded interviews were transcribed, categorised into various themes and subjected to content analysis. Descriptive analysis was used to provide summary description and graphical display of the variables using cross tabulation to form contingency tables (Flowerdew & Martin, 2005). Levels of variation and association among variables were tested using the Pearson's Chi-square. Table 3.1 is a summary of the linkages between research objectives, methods of data collection and analysis.

Table 3.1 Linkages between research objectives, methods of data collection and analysis

OBJECTIVES	TYPE OF DATA	APPROACH	METHOD OF DATA COLLECTION	UNIT OF DATA COLLECTION	ANALYTICAL TECHNIQUE
Assess the perceptions of people about climate change	Primary data Secondary data	Qualitative and Quantitative	Semi-Structured questionnaires	Heads of households	Descriptive analysis and Chi-square
Examine the prevailing effects of climate change	Primary data	Qualitative and Quantitative	Semi-Structured questionnaire	Heads of households	Descriptive analysis and Chi-square
Identify the relative adaptive strategies adapted by different people	Primary Data	Qualitative and Quantitative	Semi-structured questionnaire	Heads of households	Descriptive analysis and Chi-square
Examine the determinants of the relative adaptive strategies	Primary data Secondary data	Qualitative and Quantitative	Semi-structured questionnaire and In-depth interview	Heads of household Municipal planning officers Relief provision officers	Descriptive analysis and Chi-square

Source: Author's Construct

Additionally, assessment of the economic resource of respondents was done using the assets of respondents because expenditure-based assessments are deemed more reliable than income based assessment of resources (Deaton, 1997). Therefore, proxy prices were used to value the assets of respondents during analysis (Table 3.2).

Table 3.2 Proxy Prices

ITEMS	PROXY PRICES (GH₵)
Television	1000
Electric fan	100
Air-condition	600
Energy efficient refrigerators	800
Non-energy efficient refrigerators	400
Cars	20000
Motorbikes	5000
Bicycle	200
Gas stove	200
Coal pot	25

Source: Author's Field Work (June 2015)

3.6 CHALLENGES IN THE FIELD AND HOW THEY WERE OVERCOME

As a result of the technical nature of some questions, some respondents struggled to give answers immediately because they could not differentiate between certain climate related events. In consequence, the data collectors had to provide an in-depth overview of various concepts and terminologies to respondents to enhance their understandings prior to administering questionnaires. This method was time consuming and thereby required more time in the field.

In addition, the data collection period coincided with the demolition exercise of unauthorised buildings waged by the various Municipal Assemblies in the Greater Accra Region. Therefore some respondents refused to admit that they experience any climatic hazard especially flooding, out of fear that their houses may be demolished. Moreover, Dome is a flood prone area and the study was conducted in the rainy season. For that reason whenever it began to rain, the survey came to a halt.

3.6 BACKGROUND CHARACTERISTICS OF GEM

The Ga East Municipality is an elevation of former Ga East District under LI 1864 in 2008. The municipality was carved out of the Ga East District in 2004 by an act of Parliament (Legislative instrument, 1589).

3.6.1 Location and size

Ga East Municipality is located at the northern part of Greater Accra and covers a land area of about 96 sq. km. the municipal capital, Abokobi is about 29km away from the regional and national capital, Accra. The municipality is boarded on the west by Ga West Municipal Assembly, on the east by La - Kwantanang Municipal Assembly, the south by Accra Metropolitan Assembly and the north by Akwapim South District Assembly. The municipality comprises of two administrative Zonal councils: Dome Zonal council and Abokobi Zonal council (GEMA, 2014).

3.6.2 Physical characteristics

The municipality has a bi-modal rainfall pattern with average temperatures of about 28.4^{oc} in February and March and 25.1^{oc} in August. The municipality lies within the savannah agro-ecological zone. Two main vegetation covers are found in this zone, namely, Shrubs and Grassland. The western part of the municipality falls within the shrubs whereas the southern part lies in the grassland (GEMA, 2014).

There are variety of soil types found in the municipality, each supporting different types of crops thus variations in the crops produced in the municipality. However all the soils have a composition of sand and loam soil. The municipality lies in an elevation of about 300m southward and 420m northward. The two seasonal streams in the municipality are Siseme Stream at Siseme and Dakobi River at Ajako (GEMA, 2014).

3.6.3 Demographic characteristics

According to the 2010 national population census, the municipality had a population of 198,220 persons with a growth rate of 4.2% which is relatively higher compared to the regional growth rate of 3.1% and national growth rate of 2.1% (GSS, 2010 as cited in GEMA, 2014). This is due to the influx of immigrants from the central parts of Grater Accra Region. Thus the Municipal Planning Coordination Unit (MPCU) has estimated the population to be about 450,200 (GEMA, 2014).

The population density of the municipality based on the 2010 population census is about 1,214 persons per sq. km. which is also relatively higher than the regional density of 895.5 persons per sq. km as well as the national density of 79.3 persons per sq. km. this indicates pressure on land, natural resources as well as infrastructure. The population comprise of 51% males and 49% female. About 36.4% of this population falls within the dependency age (i.e. below 15 years and above 65 years) and about 63.6% constitute the potential labour force (i.e. from 15 to 64 years) (GEMA, 2014). Hence a dependency ratio of 1: 0.52, meaning each person in the working group has less than one additional person depending on him/her. However this ration is not homogenous in the municipality. The rural areas have higher dependency ratio of 1:53.3 compared to the urban localities of 1: 0.52. The municipality has a fertility rate of 2.67 with a crude birth rate of 24.6 (GEMA, 2014).

3.6.4 Spatial distribution

The municipality can generally be characterised as urban because about 82% of the population are in urban and peri-urban areas while the remaining 12% are in rural areas. However the urban populace inhabit 65% of the total land area (GEMA, 2014).

The municipality has 52 settlements with most of them concentrated in the urban and peri-urban areas. The important urban areas in the community include Dome, Kwabenya, Taifa, Haatso

Abokobi, Adenta West, Atomic, Agbogba, Papao (West lands) and Ashongman Estate. With New Ashongman, Christian Village, Aboman, Abloradjei, Boi, Akporman, Adenkrabi and Sesemi making up the peripheral communities. Also, hitherto rural areas are gradually growing with the location of the municipal capital at Abokobi (GEMA, 2014). Although Dome is the largest community in the municipality, Abokobi is ranked the highest community in terms of availability of resources (GEMA, 2013).

The number of households in the municipality is estimated to be 179,590 with an average household size of about 1:1 (GSS, 2010 as cited in GEMA, 2014). According to the 2010 population census, the most dominant family system in the municipality is the nuclear family (GSS, 2010 as cited in GEMA, 2014).

The municipality has seen high influx of immigrants in recent years due to the worsening socio-economic conditions of the rural areas and proximity to Accra Metropolitan Assembly. Most of these immigrants are youthful but are unskilled thus they are compelled to engage in menial jobs such as street hawking and truck pushing (GEMA, 2014).

As a consequence of the migration trend the municipality has become a cosmopolitan area with people from almost all ethnic groups in Ghana. However, in the urban areas such as Dome, Taifa and Haatso the predominant group are the Akans whilst the peri-urban and rural areas such as Abokobi are dominated by Gas. With respect to religion, Christianity is the most dominant religion although there is an Islamic presence in the municipality especially at Agbogba. Others also profess to be traditionalist whereas others maintain that they do not belong to any religion at all. However, authority at the community level is bestowed on the traditional chiefs and elders (GEMA, 2014).

3.6.5 Infrastructure

Road accessibility in the municipality is generally poor in the municipality. The district has a road network of about 350km, but only 100km has been paved thus making it difficult to travel especially during rainy seasons. Most of the communities have access to electricity however the only problem is frequent power outage. Facilities such as library and postal services are not available in most communities thus residents have to use those in other communities. With regards to telecommunication, all mobile phone networks are available in the municipality (GEMA, 2014).

3.6.6 Economic activities

The main economic activities in the municipality are commerce, industry, agriculture and service. However agriculture employs about 55% of the total labour force. This is followed by commerce especially in areas along the border with Accra Metropolitan Assembly such as Dome. This is due to the municipality's proximity to the national capital and infrastructural set-up (GEMA, 2014).Agriculture is the major economic activity in the Ga East District. It serves as the main livelihood source for 70% of the rural populace with small holder farmers forming about 95%. The main crops produced in the municipality are maize, cow pea and cassava. In addition to crop farming, some residents also rear rabbit and engage in poultry farming (GEMA, 2014). The service sector is developing rapidly compared to the other sectors of the municipal economy. In recent years, the municipality has seen a proliferation of banks and microfinance. Other services in the municipality are provided by hotels, restaurants and repair shops. However, industries in the area are found in the urban areas (GEMA, 2014).

3.6.7 Education

The municipality has 122 Early Childhood Development Centres (ECDC), 104 primary schools, 75 Junior High Schools (JHS) and 3 Senior High Schools (SHS). At all levels, most of the educational facilities are privately owned. The infrastructure in the private schools is better compared to the public schools. This is because most of the public schools are overcrowded with about 120 pupils per class. This is compounded by the increased enrolment due to the School Feeding Program and the Capitation Grant (GEMA, 2014).

3.6.8 Health

The municipality has one polyclinic (Taifa polyclinic) and other health facilities such as private clinics, health centres and CHPS compounds in various locations. The population to doctor ratio is 1: 40,246 and the nurse ratio is 1: 2,012. The most prevalent disease in the municipality is Malaria and it accounts for 40.8% of morbidity. However cholera calls for great concern due to frequent outbreaks (GEMA, 2014).

3.6.9 Climate change

Climate change in the municipality is evident through the reduction in rainfall quantity and the drying up of few rivers. The effects of climate change in the municipality include flooding and bush fires especially in the dry season. Its associated risks, however, include destruction of farmlands and properties. Flood disasters in the municipality occur in places such as Dome, Taifa, Okoe, Ogoha and Christian Village. The underlining causes of these floods are building on waterways, clearing of vegetation for sand winning, reclamation of wetlands for residential and commercial land use, inadequate drains and disposal of waste into existing drains. Measures already taken to adapt to these hazards are planting of tree in hills and along slopes, protection of wetlands, encouragement of sand

winning in drains and silted rivers, creation of wetlands in flood prone areas and construction of dams on flood prone rivers (GEMA, 2014).

3.7 THE STUDY COMMUNITY- DOME

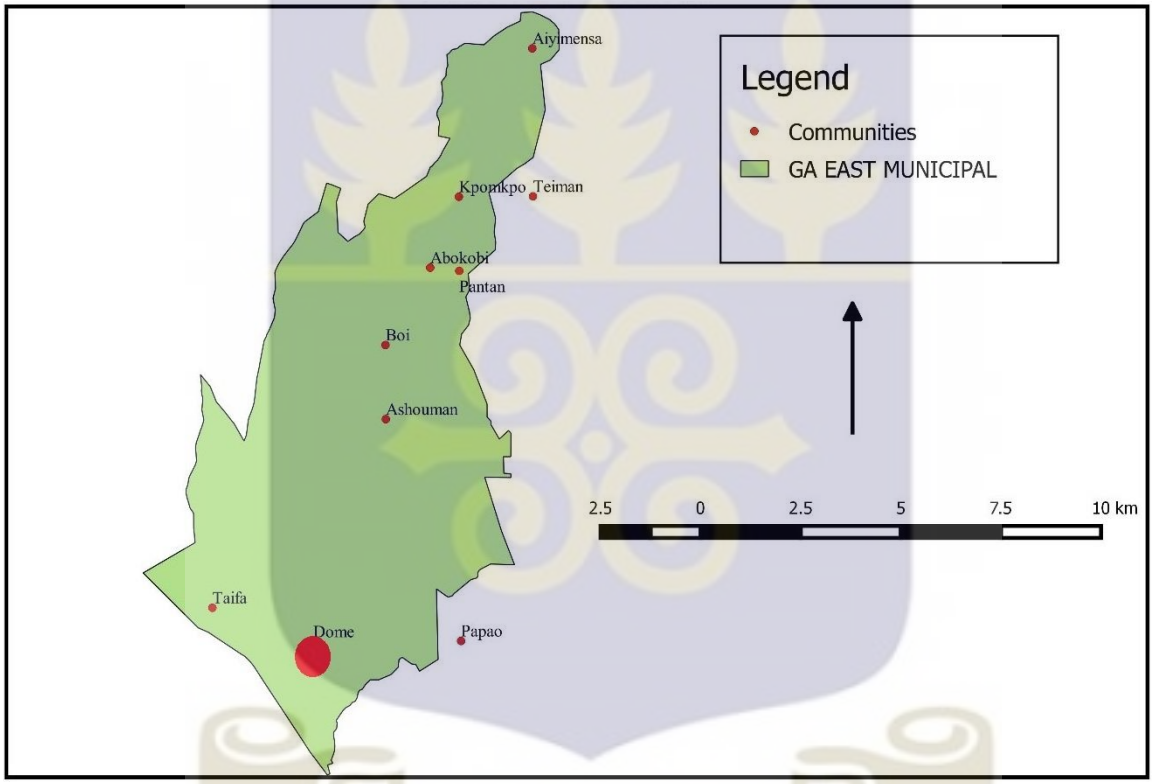
Dome is the largest urban area in the Ga East Municipality (GEMA, 2014). It is found along the municipality's border with the Accra Metropolitan Assembly (Figure 3.1). The area is located latitude $5^{o}39^{'}19.52^{''}$ and longitude $0^{o}13^{'}58.38^{''}$. According to the GSS (2014) the area has a total population of about 39,868 persons, hence being the most populous community in the municipality. About 13,493 of the population falls within the dependency age (i.e. below 15 years and above 65 years) and about 26,375 constitute the potential labour force (i.e. from 15 to 64 years), with a dependency ratio of 2: 1 (GSS, 2014). This means that every two people in the working group have one person depending on them. The population comprise of 19,668 males and 20,200 females. The community has a total of 5,452 houses however the total number of households are 10,393 (GSS, 2014).

The community is can be described as cosmopolitan due to the existence of people from all ethnic groups in Ghana with Akans forming the majority. Others include Dagbanes and the Guans (GEMA, 2014). This feature of the area is due to increase in migrants from rural parts of the municipality as well as other regions in Ghana especially the Northern part of Ghana (GEMA, 2014). The community also has the largest market in the municipality thus serving as the hub for all big businesses. As a consequent majority of the residents are involved in trading. Most of the residents are also employed in the service sector. The market serves consumers and traders in and around the area.

The major suburbs in the community are Paraku Estate, Dome market, Konka, Ayigbe-town, Grushitown and Dome Crossing. Although most parts of the community are plagued with flooding,

the residents of Dome Crossing are the most affected by this climate related event. Institutions in Dome include schools, post office, banks, churches and health posts. The community has no hospital therefore residents' access healthcare in close by community hospitals. The area has basic education level facilities, but has no secondary or tertiary education schools. All of these schools are privately owned.

Figure 3.1 Map of Ga East Municipality with Reference to Dome



3.7 CONCLUSION

The Chapter discussed the methodology used in examining the objectives of the study. It gave an explanation for the research approach, the sources of data, process of data collection and analysis. In addition, it provided an overview of the study area including, the location and demographic characteristics of the area. It also went ahead to discuss the physical, economic and social features of the study area, Dome.

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF RESULTS

4.0 Introduction

This chapter analyses results of the field data based on background characteristics of respondents; housing and assets of respondents; perceptions on climate change and variability; effects of climate change and variability on respondents; and relative adaptive strategies practised by respondents. The first section discusses the background characteristics of respondents' including sex, age, level of education, occupation and income. Following the background issues of respondents is a discussion on the perceptions of respondents about climate change and variability. This analysis was done in relation to respondents' ages and levels of education. The chapter also presents an analysis and discussion on the prevailing effects of climate change in Dome. Moreover, the relative adaptive strategies adopted to cope with the prevailing effects of climatic hazards in Dome are analysed in the chapter. Lastly, the chapter analyses and discusses the determinants of adaptive capacities in Dome.

4.1 BACKGROUND CHARACTERISTICS OF RESPONDENTS IN STUDY SITE

Out of the total 371 respondents sampled from the total number of households in Dome for the study, 63.9 percent were males while 36.1 percent were females. Also, 33.4 percent and 22.9 percent of the respondents were between the ages of 36-45 and 46-55 years respectively while those within the ages of 15-25 (4.0%) and above 65 (1.6%) were the least represented age group (See Table 4.1). These statistics show that majority of the sampled respondents' in the study area are within the labour force, with few dependents. With respect to religious affiliations, majority of respondents were Christians (84.6%) compared to the Muslims (14%). Moreover, Table 4.1 shows that 26.1 percent of respondents had attained senior secondary or vocational education compared to 19.1 percent of respondents who had received tertiary education. On the other hand, 10.5 percent of respondents had no formal education, with 22.4 percent attaining elementary or primary education. Evidence from this

study shows that out of the 371 respondents sampled, 43.4 percent have between 4-6 household dependents while those with household dependents of 10 and above were the least represented (1.1%).

Table 4.1 Distribution of Respondents by Sex, Age, Religion, Level of Education, Household Dependents and Employment Status

Demographic Variables	Frequency	Percentages (%)
Gender		
Male	237	63.9
Female	134	36.1
Total	**371**	**100**
Age		
15-25	15	4.0
26-35	106	28.6
36-45	124	33.4
46-55	85	22.9
56-65	35	9.4
Above 65	6	1.6
Total	**371**	**100.0**
Religion		
Christians	314	84.6
Muslims	52	14.0
Others	5	1.3
Total	**371**	**100.0**
Level of education		
No formal education	39	10.5
Elementary/ primary education	83	22.4
JHS/ middle school	81	21.8
SHS/O level/A level/Vocational	97	26.1
Tertiary	71	19.1
Total	**371**	**100.0**
Household dependents		
3 or less	130	35.0
4-6	161	43.4
7-9	76	20.5
10 and above	4	1.1
Total	**371**	**100**
Employment status		
Yes	336	90.6
No	35	9.4
Total	**371**	**100**

Source: Author's Field work (June 2015)

Also, 35 percent of the household respondents had 3 or less dependents whereas the remaining 20.5 percent had 7-9 dependents. From the field results, although 336 (90.6 %) of the respondents indicated they were currently employed (see Table 4.1), 370 (99.7%) reported that they were only engaged between the last two to five years. It emerged that the main sources of employment over the last five years have been artisanal work, teaching, trading, health and security service activities, financial services and civil/public servant. However, majority of the respondents in the study site are engaged in artisanal work and trading over the past five years than any other sources of employment (Table 4.2). There is an increase in the trend of economic activities in the community: trading (from 38.4% to 39.5%), financial services (from 6.5% to 8.1%) and civil /public servant (from 3.8% to 4.6%). The reverse is the case in activities such as health service (from 3.8% to 3.5%), teaching (from 7.3% to 6.8%) and artisanal work (from 31.1% to 29.5%). Students, retired personnel, and pastors constituted 7.3 percent, 8.1 percent, 6.2 percent and 5.4 percent of respondents' occupation over the five, four, three and two years respectively.

Table 4.2 Distribution of respondents by occupation over the last five (5) years

Occupation	Frequency In Years			
	5 years ago	4 years ago	3 years ago	2 years ago
Artisan	115 (31.1%)	111 (29.9%)	109 (29.5%)	109 (29.5%)
Teaching	27 (7.3%)	26 (7.0%)	25 (6.8%)	25 (6.8%)
Trading	142 (38.4)	143 (38.6%)	144 (38.9%)	146 (39.5%)
Others	27 (7.3%)	30 (8.1%)	23 (6.2%)	20 (5.4%)
Health service	14 (3.8%)	13 (3.5%)	13 (3.5%)	13 (3.5%)
Security service	7 (1.9%)	8 (2.2%)	10 (2.7%)	10 (2.7%)
Financial services	24 (6.5%)	23 (6.2%)	29 (7.8%)	30 (8.1%)
Civil/public servant	14 (3.8%)	16 (4.3%)	17 (4.6%)	17 (4.6%)
Total	**370(100%)**	**370 (100%)**	**370 (100%)**	**370 (100%)**

Source: Author's Field work (June 2015)

With respect to income, the study showed that the lowest income earned in Dome is less than GH₵300, whilst GH₵2001 and above represented the highest income earned by respondents. In view of this, average monthly income between GH₵300-600 and GH₵601-1000 merged as the majority income groups in the study area (see Table 4.3). Very few people earned incomes of GH₵1501-2000 (4.1%-7.3%), 2001 and above (2.2%-5.7%). It shows that, respondents who earned less than GH₵300 decreased from 22.8% to 14.4% and those who earned 601-1000 and 1001-1500 increased from 24.1% to 26.8% and 11.4% to 14.4% respectively in the last five years.

Table 4.3 Distribution of Respondents by Average Monthly Income over the Years

Income (GH₵)	**Frequency In Years**			
	5 years ago	**4 years ago**	**3 years ago**	**2 years ago**
Less than 300	84 (22.8%)	65 (17.6%)	47 (12.7%)	53 (14.4%)
300-600	109 (29.5%)	120 (32.5%)	111 (30.1%)	99 (26.8%)
601-1000	89 (24.1%)	90 (24.4%)	99 (26.8%)	99 (26.8%)
1001-1500	42 (11.4%)	40 (10.8%)	52 (14.1%)	53 (14.4%)
1501-2000	15 (4.1%)	21(5.7%)	25 (6.8%)	27 (7.3%)
2001 and above	8 (2.2%)	10 (2.7)	19 (5.1%)	21 (5.7%)
No income	22 (6.0%)	23 (6.2%)	16 (2.3%)	17 (4.6%)
Total	**369 (100.0%)**	**369 (100.0%)**	**369 (100.0%)**	**369 (100.0%)**

Author's Field work (June 2015)

4.2 PERCEPTIONS ON CLIMATE CHANGE AND VARIABILITY

Given that perceptions held by people and different communities towards a risk provide a key recipe to build an efficient structure and behaviour to curtail it (Vogel *et al.*, 2007), one important objective of this study was to examine the perceptions held by populace in Dome in relation to climate change and variability. Respondents familiarity with climate change was assessed in relation to their socio-demographic variables such as age and level of education (see Table 4.4)

Out of the 371 sampled respondents, 25.1 percent indicated that they were familiar with the term *climate change,* 38.5 percent less familiar while 36.4 percent were not familiar with it at all. Details from Table 4.4 shows that out of the 25.1 percent of the respondents who were familiar with the term *climate change*, 5.4 percent and 9.2 percent were within the ages of 26-35 and 36-45 respectively relative to those below 25 (1.9%) and above 65 (0.3%). Also, respondents within 26-35 age group were less familiar (11.1%) and not familiar (12.1%) with the term *climate change* than very familiar (5.4%). In all, respondents within the ages of 56-65 were familiar with the term *climate change* compared to those with the ages of 26-35 years. Age of respondents shows a significant relationship with their familiarity with the term climate change (X^2= 20.700, df (10), p value <0.05). The youth (15-45 years) were more familiar with the term *climate change* as compare to their older counterparts (46 years and above). This outcome could be attributed to factors such as level of education, literacy, economic status and sources of information. Evidence from this study resonates with findings in Moghariya and Smardon (2012) study on Saurastra and Kutch of Western India, in which respondents' familiarity with climate change decreased with increase in age.

Surprisingly, majority of respondents who had attained JHS/Middle school education were not familiar (10.5%) with the term climate change than those less familiar (7.5%) and very familiar (3.8%). This is the same for those who had achieved SHS/Vocational education (see Table 4.4). In addition, majority of respondents with no formal education were not familiar (5.1%) with the term climate change compared to those less familiar (3.5%) and very familiar (1.9%). Expectedly, majority of respondents with tertiary education were very familiar (10%) with the term climate change compared to those less familiar (7.3%) and not familiar (1.7%). In view of this, level of education shows a significant relationship with respondents' familiarity with the term climate change (X^2 =46.889, df (8), p value <0.05). Thus respondents with higher levels of education are more

familiar with climate change and vice versa. Similarly, this mirrors the study findings by Moghariya and Smardon (2012) where respondents' familiarity with climate change increased with increase in education.

Table 4.4 Respondents Familiarity with Climate Change vis-à-vis Age and Level of Education

Demographic variables	Extent of climate change familiarity			Total
	Very familiar	Less familiar	Not familiar	
Age				
15-25	7 (1.9%)	7 (1.9%)	1 (0.3%)	**15 (4.0%)**
26-35	20 (5.4%)	41(11.1%)	45 (12.1%)	**106 (28.6%)**
36-45	34 (9.2%)	37 (10.0%)	53 (14.3%)	**124 (33.4%)**
46-55	19 (5.1%)	42 (11.3%)	24 (6.5%)	**85 (22.9%)**
56-65	12 (3.2%)	14 (3.8%)	9 (2.4%)	**35 (9.4%)**
Above 65	1 (0.3%)	2 (0.5%)	3 (0.8%)	**6 (1.6%)**
Total	**93 (25.1%)**	**143 (38.5%)**	**135 (36.4%)**	**371 (100.0%)**
Chi square value= 20.700 df (10), p value <0.05				
Level of Education				
No formal education	7(1.9%)	13 (3.5%)	19 (5.1%)	**39 (10.5%)**
Elementary/ primary	16 (4.3%)	38 (10.2%)	29 (7.8%)	**83 (22.4%)**
JHS/ middle school	14 (3.8%)	28 (7.5%)	39 (10.5%)	**81 (21.8%)**
SHS/ O level/ A level/ Vocational	19 (5.1%)	37 (10.0%)	41 (11.1%)	**97 (26.1%)**
Tertiary	37 (10.0%)	27 (7.3%)	7 (1.7%)	**71 (19.1%)**
Total	**93 (25.1%)**	**143 (38.5%)**	**135 (36.4%)**	**371 (100.0%)**
Chi square value= 46.889 df (8), p value <0.05				

Author's Field work (June 2015)

Respondents who indicated that they were very familiar with the term climate change offered their views on what *climate change* denotes. Some explained it as changes in rainfall while others described it as changes in climate. One respondent's view on *climate change* was that:

> *"Climate change means changes in the pattern and amount of rainfall received at a place over a long period of time"* (32 year old artisan).

In some instances, some respondents associated *climate change* with increase in temperature and its associated heat stress. On the other hand, some aligned it to changes in weather patterns at different

locations. However, other respondents explained it in the context of changes in more than one climatic variables. For instance, among these respondents, one indicated that:

> *"Climate change means changes in climatic conditions such as rainfall, temperature, wind, and humidity"* (55 year old retired teacher).

In all, respondents were either very familiar or less familiar with the term and had a fair understanding about what *climate change* denotes compared to those who were not familiar with it and thus had no or limited knowledge about it. This is in contrast with the findings of the study by the BBC World Service Trust (2010) on public understandings of climate change in Africa where majority of the local people were unfamiliar with the term climate change and therefore found it difficult to interpret in the various local languages.

4.2.1 Perceptions about changes in climatic conditions

Owing to respondents' familiarity with climate change and their awareness about climatic conditions, an attempt was made to assess their perceptions about changes in climatic conditions such as rainfall and temperature in the past 20 years. This was to aid in the ascertainment of their awareness about climate change and variability and also to identify their perceptions about the causes of these changes. The assessment was carried out in relation to demographic variables such as age and level of education.

Of the 371 sampled respondents, 89.2 percent indicated that there are changes in rainfall relative to 10.8 percent who perceived no changes in rainfall pattern and amount in the past 20 years. All the respondents above the age of 65 noted changes in rainfall likewise majority of respondents between the ages of 56-65 years (see Table 4.5). Again, 79.5 percent of the total respondents indicated that there were changes in temperature while 20.5% indicated the opposite. Also, 74 percent out of the

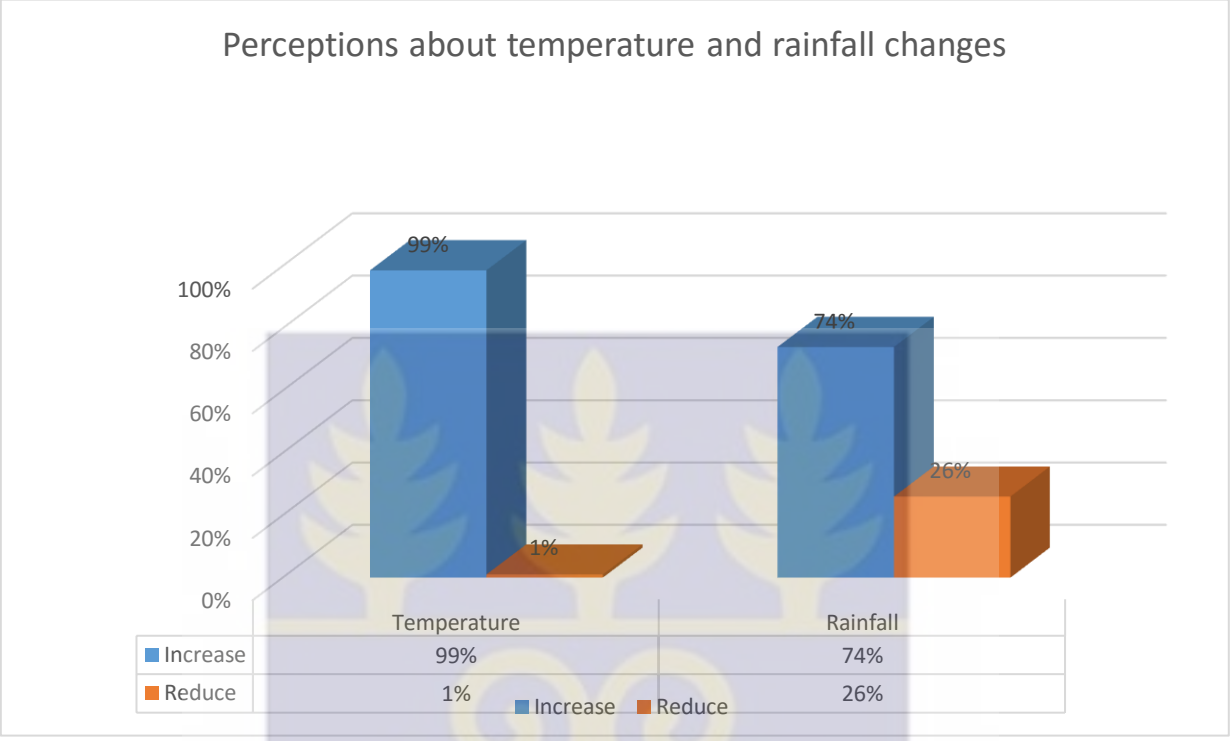
total respondents who perceived changes in rainfall for the past 20 years were of the view that there has been an increase in rainfall relative to 26 percent who indicated a reduction in rainfall amount (see Figure 4.1). In the same vein, 99 percent of the total respondents who perceived changes in temperature indicated that there is an increase in temperature while the remaining 1 percent perceived that there has been reduction in temperature (see Figure 4.1). These findings from the study mirror the findings from Deressa *et al.*'s (2008) study on the perception of farmers in the Nile Basin of Ethiopia in which most farmers observed that there was an increase in temperature. However, majority of respondents in this study perceived an increase in rainfall, which contrasts the findings in the same study by Deressa *et al.* (2008) in which farmers reported decrease in rainfall.

Table 4.5 Perceptions about Changes in Rainfall and Temperature in Dome

Demographic Variables	Changes in Rainfall		Changes in Temperature	
	Yes	No	Yes	No
Age				
15-25	14 (3.8%)	1 (0.3%)	13 (3.5%)	2 (0.5%)
26-35	83 (22.4%)	23 (6.2%)	72 (19.4%)	34 (9.2%)
36-45	114 (30.7%)	10 (2.7%)	100 (27%)	24 (6.5%)
46-55	80 (21.6%)	5 (1.3%)	71 (19.1%)	14 (3.8%)
56-65	34 (9.2%)	1 (0.3%)	34 (9.2%)	1 (0.3%)
Above 65	6 (1.6%)	0 (0.0%)	5 (1.3%)	1 (0.3%)
Total	**331 (89.2%)**	**40 (10.8%)**	**295 (79.5%)**	**76 (20.5%)**
Level of Education				
No formal education	35 (9.4%)	4 (1.1%)	32 (8.6%)	7 (1.9%)
Elementary/ primary	76 (20.5%)	7 (1.9%)	68 (18.3%)	15 (4%)
JHS/ middle school	68 (18.3%)	13 (3.5%)	62 (16.7%)	19 (5.1%)
SHS/ O level/ A level/ Vocational	86 (23.2%)	11 (3.0%)	75 (20.2%)	22 (5.9%)
Tertiary	66 (17.8%)	5 (1.3%)	58 (15.6%)	13 (3.5%)
Total	**331 (89.2%)**	**40 (10.8%)**	**295 (79.5%)**	**76 (20.5%)**

Source: Author's Field work (June 2015)

Figure 4.1 Perceptions about Temperature and Rainfall Changes in Dome



Source: Author's Field work (June 2015)

4.2.2 Perceptions about Causes of Changes in climate

In view of respondents' understanding and perceptions about the causes of changes in climatic conditions, they were further asked to indicate their perceptions about the causes of changes in rainfall and temperature. Their responses on these climatic variables are presented in Tables 4.6 and 4.7 respectively. Out of the total sampled respondents, 15.7 percent were of the view that changes in rainfall are as a result of deforestation and 4.8 percent attributed changes in rainfall to air pollution. Furthermore, 5.7 percent of the total respondents sampled were of the view that changes in rainfall are as a result of urbanisation whilst 18.7 percent attributed them to natural causes. Also, 16 percent of the total respondents sampled associated changes in rainfall to multiple factors including, deforestation and urbanisation. Evidently, majority of the total respondents sampled (39 %) perceived the will of God as the cause of changes in rainfall relative to the impact of human activities.

Comparatively, evidence from Table 4.6 shows that respondents within the ages of 36-45 (15.7%) and those with no formal education (6.0%), primary education (13%), and JHS/Middle school education (9.7%) and SHS/O level/A level/ Vocational education (9.1%) comprise of majority of respondents who attributed changes in rainfall to the will of God relative to human induced activities. Against this backdrop, level of education showed a significant relationship with respondents perceptions about the causes of changes in rainfall (X^2=84.513 df (20), p value <0.05) compared to age which showed no significant relationship with their perceptions about the causes of changes in rainfall (X^2=25.205 df (25), p value >0.05) (see Table 4.6). Consistent with the findings in this study are the studies by Gyekye (2013) and BBC World Service Trust (2010), in which most of the respondents expressed their views on the changes in the climatic conditions to 'the will of God'. More so, these findings resonate with the findings from the study by BBC World Service Trust (2010) where African's understandings of climate change related phenomena were underpinned by emphasis on trees; will of God; ozone confusion; air pollution and localised heat.

Table 4.6 Perceptions about Causes of Changes in Rainfall in Dome

Variables	Causes of Changes in Rainfall						Total
	Defores-ation	Air pollution	Urbani-sation	Natural causes	Will of God	Deforestation & Urbanisation	
Age							
15-25	3 (0.9%)	2 (0.6%)	1 (0.3%)	2 (0.6%)	5 (1.5%)	1 (0.3%)	14 (4.2%)
26-35	18 (5.4%)	6 (1.8%)	2 (0.6%)	13 (3.9%)	30 (9.1%)	14 (4.2%)	83 (25.1%)
36-45	15 (4.5%)	5 (1.5%)	8 (2.4%)	19 (5.7%)	52 (15.7%)	15 (4.5%)	114 (34.4%)
46-55	13 (3.9%)	2 (0.6%)	5 (1.5%)	22 (6.6%)	24 (7.3%)	14 (4.2%)	80 (24.2%)
56-65	3 (0.9%)	1 (0.3%)	2 (0.6%)	6 (1.8%)	14 (4.2%)	8 (2.4%)	34 (10.3%)
Above 65	0 (0.0%)	0 (0.0%)	1 (0.3%)	0 (0.0%)	4 (1.2%)	1 (0.3%)	6 (1.8%)
Total	52 (15.7%)	16 (4.8%)	19 (5.7%)	62 (18.7%)	129 (39.0%)	53 (16.0%)	331 (100%)
Chi square value=25.205 df (25), p value >0.05							
Level of Education							
No formal	3 (0.9%)	0 (0.0%)	0 (0.0%)	7 (2.1%)	20 (6.0%)	5 (1.5%)	35 (10.6%)
Elementary/ primary	10 (3.0%)	3 (0.9%)	3 (0.9%)	8 (2.4%)	43 (13%)	9 (2.7%)	76 (23.0%)
JHS/ middle School	7 (2.1%)	7 (2.1%)	5 (1.5%)	6 (1.8%)	32 (9.7%)	11 (3.3%)	68 (26.0%)
SHS/ O & A level/ Vocational	25 (7.6%)	1 (0.3%)	5 (1.5%)	15 (4.5%)	30 (9.1%)	10 (3.0%)	86 (26.0%)
Tertiary	7 (2.1%)	5 (1.5%)	6 (1.8%)	26 (7.9%)	4 (1.2%)	18 (5.4%)	66 (19.9%)
Total	52 (15.7%)	16 (4.8%)	19 (5.7%)	62 (18.7%)	129 (39.0%)	53 (16.0%)	331 (100%)
Chi square value=84.513 df (20), p value <0.05							

Source: Author's Field work (June 2015)

With regards to temperature increase, respondents attributed several factors to it causes in the study area. Out of the total sampled respondents, 26 percent and 11.8 percent were of the view that changes in temperature are as a result of deforestation and air pollution respectively. Also, 9.1 percent of respondents were of the view that urbanisation and natural causes account for changes in temperature in Dome respectively. Meanwhile, 13.9 percent of the total sampled respondents attributed changes in temperature to multiple causes including deforestation and urbanisation. Similar to the perception held by respondents on the causes of rainfall, majority of the total respondents sampled perceived changes in temperature to be associated with *the will of God* and not the impact of human induced activities. Comparatively, this view is held highly by respondents within the ages of 36-45 (13.2%) and those with no formal education (6.1%), primary education (10.5%) and JHS/Middle school education (7.8%) (Table 4.7). Owing to this, age of respondents showed no significant relationship with their perceptions about the causes of changes in temperature (X^2=28.841 df (25), p value >0.05) relative to level of education which showed a significant relationship with respondents' perceptions about the causes of changes in temperature (X^2=64.368 df (20), p value <0.05) (see Table 4.7). Therefore, the higher the level of education the more knowledge the respondent has about climate change. This is consistent with Toan *et al.*'s (2014) study on Hanoi in Vietnam where people with higher level of education had more knowledge on climate change as compared to those with lower levels of education. Also, this resonates with the studies by Gyekye (2013) and BBC World Service Trust, in which most of the respondents expressed that changes in the climatic conditions are as a result of God's will. More so, evidence from this study is consistent with the study by BBC World Service Trust (2010) where African's understandings of climate change related phenomena were underscored by emphasis on trees; will of God; ozone confusion; air pollution and localised heat.

Table 4.7 Perceptions about Causes of Changes in Temperature in Dome

Variables	Causes of Changes in Temperature						Total
	Defores-tation	Air pollution	Urbani-sation	Natural causes	Will of God	Deforestation & Urbanisation	
Age							
15-25	4 (1.4%)	3 (1.0%)	1 (0.3%)	0 (0.0%)	4 (1.4%)	2 (0.7%)	14 (4.7%)
26-35	20 (6.8%)	9 (3.0%)	2 (0.7%)	11 (3.7%)	17 (5.7%)	13 (4.4%)	72 (24.3%)
36-45	22 (7.4%)	10 (3.4%)	11 (3.7%)	8 (2.7%)	39 (13.2%)	10 (3.4%)	100 (33.8%)
46-55	22 (7.4%)	10 (3.4%)	9 (3.0%)	4 (1.4%)	17 (5.7%)	9 (3.0%)	71 (24.0%)
56-65	9 (3.0%)	3 (1.0%)	2 (0.7%)	4 (1.4%)	10 (3.4%)	6 (2.0%)	34 (11.5%)
Above 65	0 (0.0%)	0 (0.0%)	2 (0.7%)	0 (0.0%)	2 (0.7%)	1 (0.3%)	5 (1.7%)
Total	77 (26.0%)	35 (11.8%)	27 (9.1%)	27 (9.1%)	89 (30.1%)	41 (13.9%)	296 (100%)
Chi square value=28.841 df (25), p value >0.05							
Level of Education							
No formal	5 (1.7%)	0 (0.0%)	1 (0.3%)	3 (1.0%)	18 (6.1%)	5 (1.7%)	32 (10.8%)
Elementary/ primary	11 (3.7%)	7 (2.4%)	2 (0.7%)	8 (2.7%)	31 (10.5%)	9 (3.0%)	68 (23.0%)
JHS/ middle School	13 (4.4%)	11 (3.7%)	8 (2.7%)	2 (0.7%)	23 (7.8%)	5 (1.7%)	62 (20.9%)
SHS/ O & A level/ Vocational	27 (9.1%)	11 (3.7%)	9 (3.0%)	7 (2.4%)	15 (5.1%)	7 (2.4%)	76 (25.7%)
Tertiary	21 (7.1%)	6 (2.0%)	7 (2.4%)	7 (2.4%)	2 (0.7%)	15 (5.1%)	58 (19.6%)
Total	77 (26.0%)	35 (11.8%)	27 (9.1%)	27 (9.1%)	89 (30.1%)	58 (19.6%)	296 (100%)
Chi square value=64.368 df (20), p value <0.05							

Sources: Author's Field work (June 2015)

4.3 EFFECTS OF CLIMATE CHANGE AND VARIABILITY

Central to this study is the ascertainment of respondents' understanding on the prevalence of climate related effects such as increased temperature, high intensity of rainfall, floods and storms in Dome. With regards to temperature increase, 27.5 percent and 63.6 percent of the respondents' perceived effects of temperature increase very prevalent and prevalent in the study site respectively, compared to 8.1 percent and 0.8 percent of respondents that perceived it as less prevalent or non-existing at all in Dome respectively (see Table 4.8). Respondents attributed increasing heat stress especially during nights as some imminent indicators to account for prevalence of increase temperature in Dome. Inferences can be made that respondents who perceived increase temperature as less prevalent or non-existing do not experience the effects associated with increase temperature and ultimately heat stress compared to those that bears the brunt of this climate related event.

With respect to high rainfall intensity, 16.7 percent and 63.9 percent of respondents indicated that it is very prevalent and prevalent in Dome respectively. On the other hand, 18.6 percent and 0.8 percent of respondents also pointed out that high intensity of rainfall is either less prevalent or does not occur in Dome respectively. It is instructive to mention that this can largely be informed by respondents' length of stay in Dome in order to give room for comparison over the years and enable them account for either low or high intensity of rainfall in the study area. However, majority of respondents were conscious of the prevalent nature of high rainfall intensity in the region within the past 20 years. In view of this, majority of the respondents pointed out that floods were very prevalent (90.6%) whereas the rest indicated that floods were prevalent (9.2%) and less prevalent (0.3%). Respondents' awareness of incidence of flooding in Dome within the past 20 years can be wholly attributed to the seasonal incidence of flooding in the study area as shown in Plate 4.1. Some respondents were of the view that they would be astonished if there is someone resident in Dome that is not aware of the

seasonal incidence of flooding in the area owing to the significant damage it has on the belongings and livelihoods of those in the flood prone areas. One of the respondents remarked

"I will be very surprised if someone who stays in Dome isn't aware of floods in the area. It happens every year and people lost their properties" (42 year old Driver).

On the other hand, majority of the respondents indicated that Storms were less prevalent (60.4%) and not prevalent at all (24.0%). Some of the respondents were also of the view that storms were very prevalent (0.5%) and prevalent (15.1%). The seldom occurrence of storms in the region were reported by some respondents. One of the respondents remarked

"Storms do not happen very often like rainfall and floods in this area. I can't even remember the last time a heavy storm occurred in this area which was very destructive" (42 year old Driver).

It is evident from Table 4.8 that climate related events such as floods were perceived by respondents as more prevalent than temperature increase and storms. This is because the effects of floods are more tangible and destructive compared to temperature increase. Also, most respondents found it difficult to distinguish between rainfall and storms.

Table 4.8 Perceptions about Prevalence of Climate Related Events in Dome

Climate related event	Level of prevalence			
	Very prevalent	Prevalent	Less prevalent	Not at all
Increased Temperature	102 (27.5%)	236 (63.6%)	30 (8.1%)	3 (0.8%)
High Intensity of rainfall	62 (16.7%)	237 (63.9%)	69 (18.6%)	3 (0.8%)
Floods	336 (90.6%)	34 (9.2%)	1 (0.3%)	0 (0.0%)
Storms	2 (0.5%)	56 (15.1%)	224 (60.4%)	89 (24.0%)

Source: Author's Field work (June 2015)

Plate 4.1 Picture Showing Flooding at Dome-Crossing

Source: Google (2015)

Aside their perceptions regarding the prevalence of climate change effects, it is important to tease out respondents' direct experience of these effects. Out of the total sampled respondents, 52.3 percent had experienced flooding before whilst the remaining 47.7 percent had not had any experience of flooding in Dome. However, majority of the respondents had experienced increased temperature (78.4%) compared with 21.6 % of respondents who indicated that they had not experience increased temperature. Furthermore, 46.2 percent of respondents had also experienced storms while 53.6 percent indicated they had not experienced any storms in Dome. Although from Table 4.8 most respondents were of the view that flood were prevalent majority had experiences temperature increase more than flood because floods occur in certain parts of the community whereas temperature increase occurs simultaneously in the whole community.

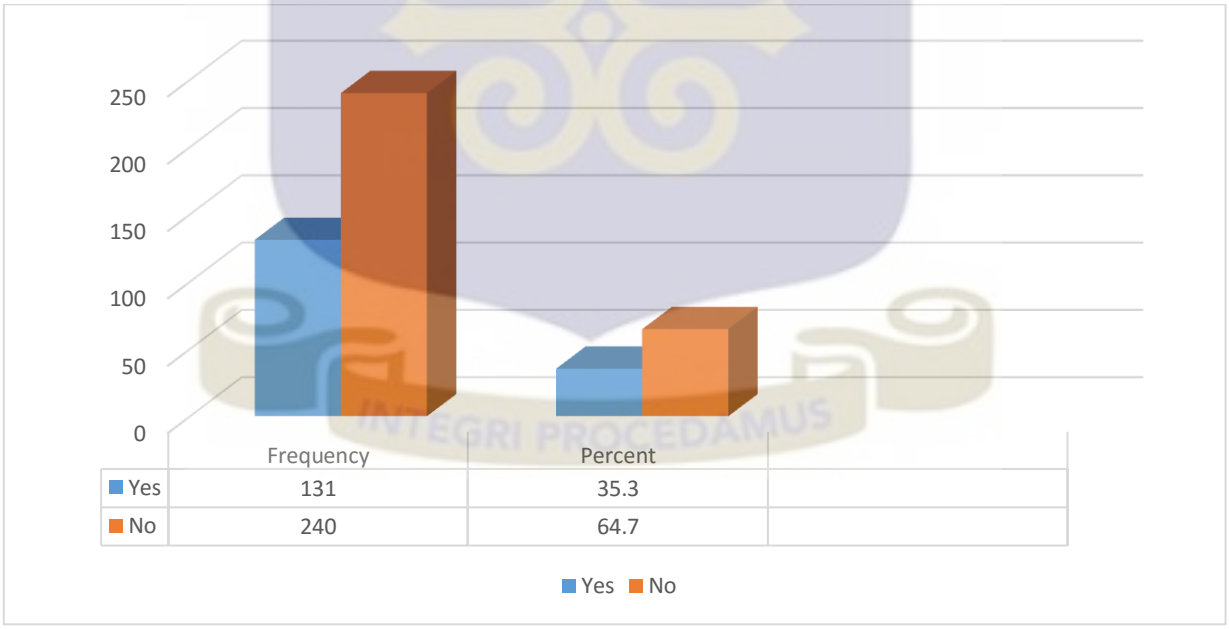
Table 4.9 Experience of Climate Change Effects

Climate Change Effects	Experience	
	Yes	**No**
Flood	194 (52.3%)	177 (47.7%)
Increased temperature	291 (78.4%)	80 (21.6%)
Storms	172 (46.2%)	199 (53.6%)

Source: Author's Field work (June 2015)

Furthermore, the study assessed the losses respondents sustained during their experience of the climate related events. Out of the total respondents sampled, 35.3 percent indicated they had suffered losses due to climate related events. On the other hand, 64.7 percent indicated they had not lost anything due to the climate events under examination.

Figure 4.2 Report of Losses Due to Climate Change Related Effects



Source: Author's Field work (June 2015)

Out of the total respondents who had suffered losses, 127 of them were due to floods. Out of this number, 77.2 percent had lost their belongings as a result of floods and 5.5 percent also lost their

livelihoods due to floods. Additionally, 2.4 percent lost both their belongings and livelihoods to incidence of flood whereas 15 percent suffered destruction on their houses and belongings as a result of the same climate related event in Dome. Some respondents who suffered destructions as a result of flooding in the study area were of the view that the incidence of flooding is seasonal and they lose their properties anytime the rains sets in and beget flooding in Dome. One of the respondents who is a victim of flooding and had stayed in Dome for 12 years remarked that

> *"I stay around Ayigbe town (a surburb of Dome) and the house I live in gets flooded all the time when it rains. Last two years, I lost all my belongings including my essential documents as a results of flooding. So if you come to my room right now I have nothing to show for all the years I have worked as a mobile banker"* (28 year old Mobile banker).

Another respondent who had suffered from flooding in the study area also indicated

> *"My shop is around Dome crossing and I lost all the things I sell to floods last year. I couldn't save anything that was in the shop"* (36 year old Trader).

On the other hand only 20 respondents had suffered losses due to storms. Out of this number 10 percent lost their belongings, 10 percent lost their livelihoods and 80 percent suffered destructions on their houses. Respondents who had suffered destruction as a result of storms were of the view that it resulted in destroying their wooden structure *(Kiosk)* or destroying the roof of their building or structure. One of the respondents who was a squatter remarked

> *"The roof of my kiosk was destroyed by the storms some time ago when there was a heavy storm in this area"* (32 year old artisan).

However, none of the respondent gave an indication of losses due to Temperature increase. Due to the gradual nature of destructions caused by temperature increase respondents were not aware of the

destruction it causes. Thus they perceive floods and storms as precarious climate change and variability effects than temperature increase and its associated heat stress.

Table 4.10 Effects of Climate Change Related Hazards in Dome

Climate related hazard	Losses				
	Belongings	Livelihood	House	Belongings & livelihood	Belongings and house
Floods	98 (77.2%)	7 (5.5%)	0 (0.0%)	3 (2.4%)	19 (15.0%)
Storms	2 (10%)	2 (10%)	16 (80%)	0 (0.0%)	0 (0.0%)
Temperature increase	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Source: Author's Field work (June 2015)

4.4 RELATIVE ADAPTIVE STRATEGIES TO COPE WITH CLIMATE CHANGE EFFECTS

There exists a relationship between peoples' perceptions about the causes of a phenomenon and their adaptation or coping strategies towards these phenomena (Stephens *et al.*, 1996). In circumstances where individuals perceive the occurrence of climate change as naturally occurring, efforts are made to adapt to such situations. Stephens *et al.* (1996) in their study in low-income communities in Indore, India, acknowledged the fact that efforts were made by individuals to adapt to incidence of flooding because they perceived it as naturally occurring and seasonal. In some circumstances, these adaptive measures could be in the form of reactive adaptive strategies or planned or anticipatory adaptive strategies, given the fact that these effects are seasonal and naturally occurring. Against this back drop, one of the important components of this study was to assess how respondents in Dome respond to the incidents of climate change and variability effects including flooding, temperature increase and storms. These climatic hazards were assessed in relation to whether respondents have experienced them and if they engage in any form of reactive or autonomous response towards it.

Out of the 52.3 percent of respondents who had experienced flooding in Dome before, 41 percent indicated that they engage in some form of reactive or autonomous adaptive strategy while 11.3 percent do not react in case of any incidence of flooding in Dome. However, 34.5 percent of the total sampled respondents indicated that they practised some form of anticipatory or planned adaptive strategy in Dome relative to 65.5 percent of respondents who do not plan in the advent of any incidence of flooding. On the other hand, out of the 78.4 percent of respondents who experience incidence of increased temperature, 69.5 percent indicated that they respond whiles 8.9 percent do not respond to incidence of increase temperature. With respect to anticipatory adaptive response, 54.4 percent of the respondents indicated that they plan towards it whilst 45.6 percent do not engage in any planned adaptive strategy in the advent of increase temperature. Majority of respondents practice adaptive strategies in relation to temperature increase because it is widespread and occurs very often.

In another related climate change effect, 3.2 percent of respondents out of the 46.2 percent of respondents who had experienced incidence of storms indicated that they react whilst 43 percent do not respond. However, 22.6 percent of the total respondents were of the view that they practise some form of anticipatory adaptive strategy in the wake of any storm while 77.4 percent do not. The finding from this study supports the argument made by Stephens *et al.* (1996) that in situations where individuals perceive the flooding as naturally occurring and seasonal, efforts are made to adapt to it.

Table 4.11 Experience and Response to Climate Change Effects

Climate Change effects	Experience		Autonomous Response		Anticipatory Response	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Flood	194 **(52.3%)**	177 **(47.7%)**	152 **(41.0%)**	42 **(11.3%)**	137 **(36.9%)**	234 **(63.1%)**
Increased temperature	291 **(78.4%)**	80 **(21.6%)**	258 **(69.5%)**	33 **(8.9%)**	207 **(55.8%)**	164 **(44.2%)**
Storms	172 **(46.2%)**	199 **(53.6%)**	12 **(3.2%)**	160 **(43.0%)**	81 **(21.8%)**	280 **(78.2%)**

Source: Author's Field work (June 2015)

4.4.1 Relative Adaptive Strategies to Cope with Incidence of Flooding in Dome

Adaptation has become more pronounced as a key response to risks associated with environmental and climatic hazards (Smit & Wandel, 2006), given that climate change effects occasion and heighten incidence of in-land flooding (Paavola, 2008; Yaro, 2009; Bawakyillenuo *et al.*, 2014). As a result, various forms of adaptation measures i.e. autonomous and anticipatory are undertaken to cope with these hazards. Against this backdrop, the study sought to ascertain the various relative adaptive measures, which respondents put in place to adapt to incidence of flooding in Dome, considering the fact that 39.6 percent and 34.5 percent of the total sampled population react and plan respectively in the advent of flooding in the study area (see Table 4.11).

From Table 4.12 it is evident that out of the 152 respondents who respond with adaptation measures in case of flooding in Dome, 18.4 percent resort to digging of trenches and temporal dykes as a reactive response in order to divert water from houses. Respondents within the ages of 15-25 and above 65 do not respond to flooding using this adaptive response (see Table 4.13), likewise respondents who had attained tertiary education (see Table 4.14). In addition, 3.9 percent out of the 18.4 percent resort to this adaptive measure because they perceive it as the only available and easiest alternative response at the time of the flooding while 10.5 percent turned to this autonomous response because they perceived it as the only efficient alternative. One respondent indicated that:

> *"I start digging a small trench in front of my house to the big drain at the opposite side because that is all I can do to prevent all my things from flooding"* (30 year old trader).

The findings of the study reflect findings in a study by Wamsler (2007) in Nairobi in which people often resort to digging of trenches around houses and construction of dykes to divert water from the house. Also, 32.9 percent of the respondents indicated that they resort to using blocks and furniture as temporal places of high elevation during incidence of flooding in the region. Comparatively,

respondents within the ages of 26-35 often respond to flooding using this adaptive strategy than those between 15-25 (1.3%), 46-55 (2.6%) and above 65 years (see Table 4.13). Also, majority of respondents with primary (9.2%) and JHS education (11.2%) respond to flood events using this adaptive measure (see Table 4.14). Additionally, 17.8 percent of sampled respondents revealed that they resort to this reactive adaptive measure because it was the only available option as at the time the flood incidence occurred whereas 13.8 percent turn to it because that was the only efficient means of responding to flooding compared to other reactive response at their disposal. One respondent indicated that:

> *"I put the valuable things I have in the house on tables, chairs and bed in the house whenever it rains and the house and rooms I occupy get flooded, because that is the best way of preventing my things and my things from flooding"*(45 years old steel bender).

The use of this strategy by respondents resonates with the results of a study by Douglas *et al.* (2008) in Ghana where inhabitants in communities often affected by floods, such as Alajo in Accra usually resort to the use of blocks, stones and furniture to create places of high elevation on which they put most of their valuable items. Furthermore, 32.2 percent of the respondent who react to incidence of flooding often fall back on temporal relocation to alternative settlement areas as an autonomous adaptive strategy to flooding in the area. Evidence from Table 4.13 shows that majority of respondents within the ages of 46-55 (6.6%) and those who had attained SHS/ Vocational education preferred this autonomous adaptive response to flooding compared to the other adaptive measures. Preference for this adaptive measure can be partly attributed to the gross safety associated with this adaptive. Of the 32.2 percent, 11.8 percent make use of this alternative because they perceive it as necessary, as 11.2 percent preferred to use this alternative because of its efficiency to cope with the incidence of flooding in Dome relative to the digging trenches or creating temporal places of high

elevation using furniture, sand or blocks. More so, 8.6 percent preferred this reactive adaptive measure because that was the only available alternative to them in the event of flooding. This resonates with the views of Feiden (2011) on climate change adaptation in cities where an adaptive response such as relocation to alternative settlements areas are often used to adapt to climate change effects in urban areas.

Moreover, 11.2 percent out of the 152 respondents that react to incidence of flooding in Dome turn to use of sand bags to prevent water from entering their homes and work places. Of this percentage of respondents, 4.6 percent resort to this alternative because it is the only available and efficient alternative respectively to them while 2 percent preferred it as a necessary reactive adaptive strategy to flooding in the region. Apparently, this finding resonates with the outcome of the study by Wamsler (2007) in Nairobi where people often fall back on the use of sand bags to prevent water from entering their houses. Additionally, some respondents resort to use of multiple autonomous adaptive measures to cope with the incidence of flooding in the area. For instance, 5.3 percent of the respondents resort to both digging of trenches to divert from houses and use of sand bags to prevent water entry as a react.

In all, respondents often resort to digging of temporal trenches and dykes to divert water from houses; use of blocks and furniture as temporal places of high elevation; temporal relocation to alternative settlement areas; and use of sand bags to prevent water entry as various relative adaptive strategies to incidence of flooding in Dome. The age of respondents shows no significant relationship with the various autonomous adaptive measures' respondents resort to in the events of storms in Dome (X^2= 27.857, df (20), P value >0.05). Similarly, the study showed no significant relationship between respondents' level of education and the various relative adaptive strategies they resort to in the events of flooding in Dome. In addition, majority of the respondents (40.8%) often use these

adaptive measures because they perceive it as the only efficient adaptive measure and 38.2 percent respond to flooding using these adaptive strategies because these were the only available adaptive strategies to them. In addition, 20.4 percent of the respondents resort to use of these reactive adaptive measures because it was necessary and urgent to use them while a small section of the respondents (0.7%) indicated that they respond to flooding using these adaptive measures because they were affordable.

Table 4.12 Various Relative Adaptive Strategies to cope with flooding in Dome

Reactive response to flood	Reasons for response				Total
	Only available option	Only affordable option	Only efficient option	Necessary alternative	
Dig trenches or temporal dykes to divert water from houses	6 **(3.9%)**	0 **(0.0%)**	16 **(10.5%)**	6 **(3.9%)**	28 **(18.4%)**
Use of sand/blocks/furniture as temporal places of high elevation	27 **(17.8%)**	0 **(0.0%)**	21 **(13.8%)**	2 **(1.3%)**	50 **(32.9%)**
Temporal relocation to alternative settlement areas	13 **(8.6%)**	1 **(0.7%)**	17 **(11.2%)**	18 **(11.8%)**	49 **(32.2%)**
Prevent entry of water via use of sand bags	7 **(4.6%)**	0 **(0.0%)**	7 **(4.6%)**	3 **(2.0%)**	17 **(11.2%)**
Dig trenches to divert water from houses and use of sand bags to prevent water entry	5 **(3.3%)**	0 **(0.0%)**	1 **(0.7%)**	2 **(1.3%)**	8 **(5.3%)**
Total	58 **(38.2%)**	1 **(0.7%)**	62 **(40.8%)**	31 **(20.4%)**	152 **(100.0%)**

Source: Author's Field work (June 2015)

Table 4.13 Relationship between Respondents Age and Various Relative Adaptive Strategies to cope with flooding in Dome

Reactive response to flood	Age of respondents						Total
	15-25	26-35	36-45	46-55	56-65	65+	
Dig trenches or temporal dykes to divert water from houses	0 **(0.0%)**	5 **(3.3%)**	9 **(5.9%)**	9 **(5.9%)**	5 **(3.3%)**	0 **(0.0%)**	28 **(18.4%)**
Use of sand/blocks/furniture as temporal places of high elevation	2 **(1.3%)**	16 **(10.5%)**	20 **(13.2%)**	4 **(2.6%)**	8 **(5.3%)**	0 **(0.0%)**	50 **(32.9%)**
Temporal relocation to alternative settlement areas	4 **(2.6%)**	14 **(9.2%)**	19 **(12.5%)**	10 **(6.6%)**	2 **(1.3%)**	0 **(0.0%)**	49 **(32.2%)**
Prevent entry of water via use of sand bags	0 **(0.0%)**	3 **(2.0%)**	6 **(3.9%)**	6 **(3.9%)**	1 **(0.7%)**	1 **(0.7%)**	17 **(11.2%)**
Dig trenches to divert water from houses and use of sand bags to prevent water entry	0 **(0.0%)**	1 **(0.7%)**	4 **(2.6%)**	2 **(1.3%)**	1 **(0.7%)**	0 **(0.0%)**	8 **(5.3%)**
Total	**6 3.9%**	**39 25.7%**	**58 38.2%**	**31 20.4%**	**17 11.2%**	**1 0.7%**	**152 100.0%**
Chi square value (X^2)= 27.857, df (20), P value >0.05							

Source: Author's Field work (June 2015)

Table 4.14 Relationship between Respondents Age and Various Relative Adaptive Strategies to cope with flooding in Dome

Reactive response to flood	Respondents Level of Education					Total
	No Formal	Primary	JHS/ Middle	SHS/O'/A level Voc/Tec	Tertiary	
Dig trenches or temporal dykes to divert water from houses	4 **(2.6%)**	9 **(5.9%)**	5 **(3.3%)**	10 **(6.6%)**	0 **(0.0%)**	28 **(18.4%)**
Use of sand/blocks/furniture as temporal places of high elevation	6 **(3.9%)**	14 **(9.2%)**	17 **(11.2%)**	10 **(6.5%)**	3 **(2.0%)**	50 **(32.9%)**
Temporal relocation to alternative settlement areas	7 **(4.6%)**	10 **(6.6%)**	11 **(7.2%)**	19 **(12.5%)**	2 **(1.3%)**	49 **(32.2%)**
Prevent entry of water via use of sand bags	2 **(1.3%)**	4 **(2.6%)**	3 **(2.0%)**	6 **(3.9%)**	2 **(1.3%)**	17 **(11.2%)**
Dig trenches to divert water from houses and use of sand bags to prevent water entry	1 **(0.7%)**	3 **(2.0%)**	3 **(2.0%)**	1 (0.7%)	0 **(0.0%)**	8 **(5.3%)**
Total	**20 (13.2%)**	**40 (26.3%)**	**39 (25.7%)**	**46 (30.3)**	**7 (4.6%)**	**152 (100%)**
Chi square value (X^2) = 12.683, df (16), P value>0.05						

Source: Author's Field work (June 2015)

Additionally, the study sought to examine the various anticipatory or planned adaptive strategies, which respondents undertake to adapt to the incidence of flooding in the study area, given that 36.9 percent of the total population sampled practise some form of anticipatory or reactive adaptive strategy (see Table 4.11). This was done in relation to the status of the place respondents live. To

begin, 61.3 percent of the total sampled population resort to opening up blocked drainage channels as an anticipatory adaptive response to incidence of flooding in the area (see Table 4.15). Of this percentage (61.3), 35.8 percent were tenants while 17.5 percent were owners of the houses they live in. Also, all the respondents who were care-takers (1.5%) and majority of the respondents who were squatters, i.e. 6.6% out of 8.8% resort to opening up of block drainage channels as a form of planned adaptive strategy to the incidence of seasonal flooding in the area (see Table 4.15). Findings in Douglas *et al.* (2008) work lend support to this particular outcome in this work as it emerged that respondents in that often resort to clearing of drainage channels as an adaptive strategy to allow pool of water to flow through the drainage in Lagos city. Additionally, this finding resonated with those in Douglas and Alam (2006) study whereby individuals from Kampala carried out collective work to open up drainage channels to prevent flooding.

Also, 27 percent of the total population fall back on monetary savings as an adaptive strategy to the incidence of flooding in the region. Respondents noted that savings are used to purchase new belongings whenever they are lost in the floods and repair those they can, since the floods occur seasonally. These savings serve as insurance towards climatic hazards albeit it is done informally. Also, majority of respondents (21.9%) who resort to this form of planned adaptive strategy were tenants compared to 2.9 percent and 2.2 percent who were owners and squatters of the place they live respectively. Moreover, 7.3 percent of the respondents were of the view that they plant vegetation cover in anticipation of preventing or coping with the incidence of flooding in the region. Of this number, 5.8 percent were owners of the house they live in relative to 1.5 percent who were tenants. None of the respondents who were care-takers or squatters engaged in the practices of planting vegetation cover as a planned adaptive strategy to the incidence of flooding in Dome. Majority of those who use this strategy are house owners because in order to plant this vegetation one would need

to have control over the land they are planting on. However, tenants could also get permission from their landlords but squatters and caretakers on the other hand have little or no jurisdiction over the lands they live on and their stay are mostly temporary.

Furthermore, 1.5 percent and 2.2 percent of the population indicated that they resort to use of waterproof recycled materials for building and moving of belongings to alternative areas respectively in anticipation of preventing flooding and loss of belongings. For instance, none of the respondents who were tenants, care-takers and squatters indicated that they use waterproof recycled materials for building compared with house owners (1.5%). This can be attributed to limited authority of the tenant or care-taker to build in relation to the houses they live in and limited resources and temporal occupancy of the squatters. This is an antithesis of the study by Wamsler (2007) where some informal settlements occupants in Nairobi sheltered their structures with water proof materials. Against this backdrop, respondents' status of the place they live showed a significant relationship with the various planned adaptive strategies they often resort in anticipation of incidence of flooding in Dome (X^2=30.510, df (15), P value <0.05)

Table 4.15: Various Planned Adaptive Response to Flooding in Dome

Planned Response to Flood	Respondents Housing Status				Total
	Owner	Tenant	Care-taker	Squatter	
Planting of vegetation cover	8 (5.8%)	2 (1.5%)	0 (0.0%)	0 (0.0%)	**10 (7.3%)**
Use of waterproof recycled materials for building	2 (1.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**2 (1.5%)**
Opening up drainage channels	24 (17.5%)	49 (35.8%)	2 (1.5%)	9 (6.6%)	**84 (61.3%)**
Savings	4 (2.9%)	30 (21.9%)	0 (0.0%)	3 (2.2%)	**37 (27.0%)**
Move belongings to alternative areas	0 (0.0%)	3 (2.2%)	0 (0.0%)	0 (0.0%)	**3 (2.2%)**
Building with water proof recycled materials and opening up of drainage channels	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.7%)**
Total	**39 28.5%)**	**84 (61.3%)**	**2 (1.5%)**	**12 (8.8%)**	**137 (100%)**
Chi-square value (X^2) 30.510, df (15), P value <0.05					

Source: Author's Field work (June 2015)

4.4.2 Relative Adaptive Strategies to Cope with Temperature Increase and Heat Stress in Dome

Owing to the perceived changes in temperature and prevalent effects of increased temperature and its associated heat waves and heat stress in urban areas, this study sought the need to ascertain the various adaptive strategies people put in place to cope with this climate change and variability effect, considering the fact that 69.5 percent and 55.8 percent of the total respondents react and planned towards incidence of increase temperature and heat stress in the community (see Table 4.11).

Out of the 258 respondents who undertake adaptive strategies in case of increased temperature and heat stress, 75.6 percent resort to the use of fan as an adaptive response to cope with the heat stress associated with increase temperature (see Table 4.16). Also, 40.7 percent of the respondents indicated that they prefer to use this adaptive measure because that is their only available alternative they have

to cope with the heat associated with temperature increase in Dome relative to 22.5 percent who fall back on this adaptive response because that is the only cooling system they could afford. In addition, 5.4 percent resort to use of fan because they preferred it and 7 percent depended on it as an adaptive response to heat stress because of its efficacy compared to spending nights outside. In all, majority of respondents that resort to this adaptive response are within the ages of 26-35 years (21.7%) and 36-45 years (28.3%) (See Table 4.17). Compared to the other autonomous adaptive response, majority of respondents with some formal or no formal education often resort to use of Fan as an adaptive respond to incidence of heat stress (see for instance Table 4.18). A respondent who turned to the use of fan because it is affordable indicated that

> *"I prefer to use fan because it very affordable and doesn't consume a lot of energy, compared to the air conditionings which is expensive and consumes a lot of power"* (25 years old student).

Also, 10.1 percent of the respondents indicated that they preferred to spend nights outside the room due to heat stress. In addition, 6.2 resort to this alternative because they preferred it to investing in cooling systems like fan and air conditionings whilst 1.6 percent preferred this option because of its efficiency. Moreover, 2.3 percent indicated that they preferred this adaptive response because that is the only available option to them. This is because they do not have any of the cooling systems and thus fall back on spending nights outside the room when the heat stress sets in. In all, none of the respondents within the ages of 15-25 resort to this adaptive measure in the events of heat stress compared to those within the ages of 26-35 (3.5%) and 36-45 years (35%) (See Table 4.15). One of the respondents who preferred this option indicated as follows;

> *"I lost my standing fan to the floods so all I can do when there is heat in the room is to spend the night outside"* (39 years old trader).

Furthermore, out of the 258 respondents who respond in case of temperature increase and heat stress, 5 percent of them resort to air conditionings as an autonomous adaptive response. Out of the 5 percent of respondents, 3.5 percent were within the ages of 46-55 years (see Table 4.15). Also, 3.5 percent indicated that they react to temperature increase using this adaptive measure because it is the only efficient alternative whilst 1.5 percent turn to use of air conditionings because they preferred it to other cooling systems.

On the other hand, 3.1 percent of the respondents indicated that they resort to use of both fans and air conditions as an adaptive response to cope with incidence of temperature increase and heat stress. Also, 6.2 percent of the total respondents turn to use of fans and spending nights outside the room as an autonomous adaptive response to temperature increase and heat stress in Dome. Additionally, 2.3 percent and 2.7 percent were of the view that they resort these adaptive measure because they were the only available and preferred option respectively. One of the respondents indicated that:

> *"I often use fan when the room is warm because it is the only thing I can use to cool the room but I also prefer to spend the night outside when we have no electricity to power the fan."* (30 years old health worker).

Some of the findings in this study are similar to other findings in studies by McEvoy (2007) and Fieiden (2011). These studies gave credence to the use of cooling technologies as adaptive measures to temperature increase especially air-conditions by urban dwellers. However, preference for spending nights outside room due to increase temperature and heat stress in urban areas is one interesting theme unravelled by this study.

Table 4.16 Various Relative Adaptive Strategies to cope with Temperature Increase and Heat Stress in Dome

Reactive response	Reasons for response				Total
	Only available option	Only affordable option	Only efficient alternative	Preference	
Use of air conditionings	0 **(0.0%)**	0 **(0.0%)**	9 **(3.5%)**	4 **(1.5%)**	13 **(5.0%)**
Use of fans	105 **(40.7%)**	58 **(22.5%)**	18 **(7.0%)**	14 **(5.4%)**	195 **(75.6%)**
Preference for spending nights outside the room due to heat	6 **(2.3%)**	0 **(0.0%)**	4 **(1.6%)**	16 **(6.2%)**	26 **(10.1%)**
Use of both air conditions and fans	0 **(0.0%)**	2 **(0.8%)**	6 **(2.3%)**	0 **(0.0%)**	8 **(3.1%)**
Use of fans and spending nights outside the room	6 **(2.3%)**	2 **(0.8%)**	1 **(0.4%)**	7 **(2.7%)**	16 **(6.2%)**
Total	117 **(45.3%)**	62 **(24.0%)**	38 **(14.7%)**	41 **(15.9%)**	258 **(100%)**

Source: Author's Field work (June 2015)

In all, age of respondents showed a significant relationship with the type of autonomous adaptive response people in Dome resort to in the events of temperature increase and heat stress (X^2= 36.143, df (20), P value <0.05) (see Table 4.17). This implies type of reactive adaptive measure respondents turn to in the event of increase temperature and heat stress has an association with their age. This can be attributed to the fact that the youth often prefer to use fans as an adaptive response to heat stress whilst the aged (46 and above) prefer to use of air conditioning and spending nights outside because of their health needs. Also, older people may have more experience in the event of *climate change and variability effects* and as a results have developed preference for certain strategies to cope with it. Similarly, the study showed a significant relationship between respondents level of education and the various reactive adaptive measures they fall back on in the events of increase temperature in the region (X^2 = 33.463, df (16), P value <0.05) (see Table 4.18). This implies that respondents level of

education have a significant relationship with the type of autonomous adaptive strategy they opt for in coping with temperature increase and its associated heat stress in Dome.

This very finding could also be ascribed to the fact that respondents with high level of education who are conscious of the various cooling systems and can afford them preferred to use fans and air conditionings than spend nights outside the room, compared to those with low levels of education. Clearly, an individual's use of certain autonomous adaptive measure in the event of increase temperature will depend on the knowledge, awareness and experience about the effects and the affordability of the adaptive measure he or she resorts to.

Table 4.17 Relationship between Age and Various Relative Adaptive Strategies to cope with Temperature Increase and Heat Stress in Dome

Reactive response to temperature increase	**Age of respondents**						**Total**
	15-25	26-35	36-45	46-55	56-65	65+	
Use of air conditions	1 (0.4%)	0 **(0.0%)**	2 **(0.8%)**	9 **(3.5%)**	1 **(0.4%)**	0 **(0.0%)**	13 **(5.0%)**
Use of fans	8 **(3.1%)**	56 **(21.7%)**	73 **(28.3%)**	38 **14.7%**	18 **(7.0%)**	2 **(0.8%)**	195 **(75.6%)**
Preference for spending nights outside the room due to heat	0 **(0.0%)**	9 **(3.5%)**	9 **(3.5)**	4 **(1.6%)**	2 **(0.8%)**	2 **(0.8%)**	26 **(10.1%)**
Use of both air conditions and fans	0 **(0.0%)**	2 **(0.8%)**	1 **(0.4%)**	3 **(1.2%)**	1 **(0.4%)**	1 **(0.4%)**	8 **(3.1%)**
Use of fans and preference for spending nights outside the room	0 **(0.0%)**	4 **(1.6%)**	5 **(1.9%)**	3 **(1.2%)**	3 **(1.2%)**	1 **(0.4%)**	16 **(6.2%)**
Total	**9 (3.5%)**	**71 (27.5%)**	**90 (34.9%)**	**57 22.1%**	**25 (9.7%)**	**6 (2.3%)**	258 **100.0%**
Chi square value (X^2) = 36.143, df (20), P value<0.05							

Source: Author's Field work (June 2015)

Table 4.18 Relationship between Respondents' Level of Education and Various Relative Adaptive Strategies to cope with Temperature Increase and Heat Stress in Dome

Reactive response to temperature increase	Respondents Level of Education					Total
	No Formal	Primary	JHS/ Middle	SHS/O'/A level Voc/Tec	Tertiary	
Use of air conditions	2 **(0.8%)**	2 **(0.8%)**	2 **(0.8%)**	5 **(1.9%)**	2 **(0.8%)**	13 **(5.0%)**
Use of fans	19 **(7.4%)**	41 **(15.9%)**	53 **(20.5%)**	52 **(20.2%)**	30 **(11.6%)**	195 **(75.6%)**
Preference for spending nights outside the room due to heat	7 **(2.7%)**	11 **(4.3%)**	2 **(0.8%)**	6 **(2.3%)**	0 **(0.0%)**	26 **(10.1%)**
Use of both air conditions and fans	1 **(0.4%)**	1 **(0.4%)**	0 **(0.0%)**	2 **(0.8%)**	4 **(1.6%)**	8 **(3.1%)**
Use of fans and preference for spending nights outside the room	1 **(0.4%)**	2 **(0.8%)**	2 **(0.8%)**	6 **(2.3%)**	5 **(1.9%)**	16 **(6.2%)**
Total	**30** **(11.6%)**	**57** **(22.1%)**	**59** **(22.9%)**	**71** **(27.5%)**	**41** **(15.9%)**	258 **(100%)**
Chi square value (X^2) = 33.463, df (16), P value <0.05						

Source: Author's Field work (June 2015)

In addition, the study examined the various anticipatory or planned adaptive strategies which respondents put in place to cope with incidence of temperature increase and heat stress in Dome, in view of the fact that 207 (55.8%) of the total respondent indicated that they engage in some form of planned adaptive strategies (see Table 4.11). Furthermore, this was assessed in relation to respondents' status of the dwelling they occupy, given that an individual planned adaptive strategy may be contingent on that. Of the 207 respondent who engage in planned adaptive measures in the advent of increased temperature and heat stress, 86.5 percent resort to investing in cooling systems

like air conditionings and fans. Out of this percentage, 61.4 percent were tenants and 19.3 percent were owners of the dwelling they occupy (see Table 4.19). Also, 3.9 percent and 1.9 percent were care-takers and squatters respectively.

Moreover, 8.7 percent of respondents, comprising of 5.8 percent and 2.9 percent who were owners and tenants respectively were of the view that they invest in traditional window systems as an adaptive measure to enhance aeration. Besides, only one respondent (0.5%) out of the total respondent engages in tree planting as an adaptive measure to cope with temperature increase and heat stress in Dome. Nonetheless, this is as an apt adaptive measure to cope with temperature increase and heat stress. Lastly, 4.3 percent of the respondents engage in both investment in traditional windows and cooling systems as an anticipatory adaptive measure to cope with temperature increase and heat stress in Dome. Clearly, findings from this study mirrors findings in studies by McEvoy (2007) and Fieiden (2011) where there increasing investment in cooling technologies as an adaptive measure to cope with temperature increase and heat stress. In all, respondents' status of the place they live showed a significant relationship with the various planned adaptive strategies they often resort in anticipation of temperature increase and heat stress in Dome (X^2= 34.337, df (9), P value <0.05) (see Table 4.19). This implies that respondents who are owners of the dwelling they occupy practiced specific planned adaptive response compared to those who are tenants, caretakers or squatters. This can largely be attributed to limited authority of the tenants, care-takers or squatters to build any permanent adaptive measure in relation to the houses or structure they live in due to the limited resources and temporal status of their occupancy

Table 4.19: Various Planned Adaptive Response to Temperature increase and Heat Stress in Dome

Planned Response to Temperature increase & heat stress	Respondents Housing Status				Total
	Owner	Tenant	Care-taker	Squatter	
Investment in traditional window system to enhance aeration	12 **(5.8%)**	6 **(2.9%)**	0 **(0.0%)**	0 **(0.0%)**	18 **(8.7%)**
Investment in cooling systems like air-condition, fans etc	40 **(19.3%)**	127 **(61.4%)**	8 **(3.9%)**	4 **(1.9%)**	179 **(86.5%)**
Planting of trees	1 **(0.5%)**	0 **(0.0%)**	0 **(0.0%)**	0 **(0.0%)**	1 **(0.5%)**
Investment in traditional windows and cooling systems	8 **(3.9%)**	1 **(0.5%)**	0 **(0.0%)**	0 **(0.0%)**	9 **(4.3%)**
Total	**61 (29.5%)**	**134 (64.7%)**	**8 (3.9%)**	**4 (1.9%)**	**207 (100%)**
Chi-square (X^2) = 34.337, df (9), P value <0.05					

Source: Author's Field work (June 2015)

4.4.3 Relative Adaptive Strategies to Cope with Storms in Dome

Against the backdrop that 3.2 percent of respondents out of the 46.2 percent who have experienced storms in Dome before engage in autonomous adaptive response, this study also sought to examine the various relative adaptive strategies respondents put in place to adapt to storms in Dome. All the respondents (3.2%) that react to incidence of storms in the area (see Table 4.11) were of the view that they relocate to a temporal area whenever they experience storms and suffer from destruction of belongings or property in the area in order to give ample time for them to replace and repair their losses. This was representative of all the age groups except respondents within the ages of 55-65 years (see Table 4.22). Of this number of respondents, 83.3 percent deemed it very necessary and urgent to relocate while 16.7 percent resort to relocating temporarily because that was the only option they have. One of the respondents indicated that:

"When the storms destroyed the roof of my building I had no option than to move my belonging and family to another area (Taifa) for a while so I can fix it" (64 year old retiree).

Table 4.20: Adaptive response to Storms in Dome

Reactive response to storms	Reasons for response			Total
	Only available option	Only efficient alternative	Necessary alternative	
Temporal relocation to other settlements	2 **(16.7%)**	2 **(16.7%)**	8 **(66.7%)**	12 **(100.0%)**
Total	2 **(16.7%)**	2 **(16.7%)**	8 **(66.7%)**	12 **(100.0%)**

Source: Author's Field work (June 2015)

This research found that respondents hardly engaged in any form of autonomous or reactive adaptive response to storms in Dome, albeit 46.2 percent of the respondents have experienced it. The study then made an attempt to ascertain the various anticipatory or planned adaptive response respondents put in place to cope with storms in Dome, considering the fact that 21.8 percent of the respondent plan in anticipation of incidence of storms in Dome. Once more, anticipatory adaptive measures of respondents towards floods were assessed in relation to status of the house they live in. In all, 58 percent of respondents engage in savings as an anticipatory adaptive measure to incidence of flooding in Dome. All the respondents who were squatters and caretakers practiced act of savings as anticipatory response in case they experience any incidence of storms in the region 1(see Table 4.21). They do not resort to any form of tree planting or use stronger building materials as a planned adaptive response because of the temporal and informal nature of their settlement. They rather preferred to save and replace or repair their destructed belongings or structure in case they are affected by storms. One of the squatters indicated

"My wife and I have been saving towards damages the storms causes. The roof of my structure was destroyed by the storms and I had no money to repair it so we had to relocate to St Johns (another community) for a while. It took some time for me to replace it. I then decided to save afterwards in case that happens again" (35 years old artisan).

Also, 39.5 percent of the respondents use stronger building materials for their structure as an adaptive response to the incidence of storms in the area. This constituted 23.5 percent of respondents who are owners of their building and 16 percent who are tenants. This resonates with the findings in the study by Feiden (2011) on climate change adaptation in cities where he reported that hardening of infrastructure to make it more resilient to extreme weather conditions and improving of housing quality to make it more resistant to storm events were some of the adaptive strategies often used in urban areas. Lastly, only owners of respective houses were engaged in tree planting as an anticipatory or planned adaptive response to storms in the region. In all, respondents' status of the place they live showed a significant relationship with the various planned or anticipatory adaptive strategies they often resort to in case of storms in Dome (X^2) = 29.511, df (6), P value <0.05). Clearly, savings as a planned adaptive response to storm events is one of the interesting themes unravelled in this study.

Table 4.21: Various Planned Adaptive Response to Storms in Dome

Planned Response to storms	**Respondents Housing Status**				**Total**
	Owner	**Tenant**	**Care-taker**	**Squatter**	
Planting of trees	2 **(2.5%)**	0 **(0.0%)**	**0 (0.0%)**	0 **(0.0%)**	2 **(2.5%)**
Using stronger building materials	19 **(23.5%)**	13 **(16%)**	0 **(0.0%)**	0 **(0.0%)**	32 **(39.5%)**
Savings	4 **(4.9%)**	36 **(44.4%)2**	2 **(2.5%)**	5 **(6.2%)**	47 **(58%)**
Total	**25 (30.9%)**	**49 (60.5%)**	**2 (2.5%)**	**5 (6.2%)**	**81 (100%)**
Chi-square (X^2) = 29.511, df (6), P value <0.05					

Source: Author's Field work (June 2015)

Table 4.22: Relationship between Respondents Age and Various Planned Adaptive Response to Storms in Dome

Reactive response to Storms	Age of respondents						Total
	15-25	26-35	36-45	46-55	56-65	65+	
Temporal relocation to other settlements	1 **(8.3%)**	2 **(16.7%)**	2 **(16.7%)**	6 **(50%)**	0 **(0.0%)**	1 **(8.3%)**	12 **100.0%**
Total	1 **(8.3%)**	2 **(16.7%)**	2 **(16.7%)**	6 **(50%)**	0 **(0.0%)**	1 **(8.3%)**	12 **100.0%**

Source: Author's Field work (June 2015)

4.5 Determinants of Adaptive Capacity to Climate Change and Variability Effects in Dome

Juhola *et al.* (2012) established the fact that there are three dimensions to a system's adaptive capacity, viz. awareness, ability and dimension. Smit and Pilifosoya (2003) also posited that a set of independent or explanatory determinants including knowledge and awareness, technology, infrastructure, institutions and economic resources interplay to influence individual's adaptive capacity towards climate change. In view of this, the study examined the adaptive capacity of the respondents in Dome. This was examined in relation to the various dimensions and determinants accounted for in the adaptive capacity framework. These include their infrastructure and technology which influence their ability to adapt, the various institutions and their economic resources.

4.5.1 Access to Technology

The study by Asante *et al*. (2012) establish the fact the capacity to adapt to climate change effect is invariantly contingent on the knowledge and necessity to adapt; awareness of the problem; level of technology and the ability to develop new ones; access to infrastructure; access to infrastructure and level of institutional support. According to the Adaptive capacity framework, level of technology is determined by resources, early warning systems and the capacity to undertake research. Against this backdrop, the study examined if respondents receive any early warnings on climate change hazards in

Dome. This will invariably account for their level of technology knowhow in their ability to adapt to climate change effects. This was done in relation to whether the early warnings they receive inform them to engage in planned adaptive strategies, in light of the fact that adaptive capacity is usually considered when efforts are made to adapt to prospective climate change effects (Vincent, 2007)

Out of the 371 respondents sampled, 38.5 percent indicated that they receive early warnings on incidence of flooding whilst 61.5 percent do not. In the same vein, out of the 137 respondents who engage in planned adaptive response to incidence of flooding, 14.5 percent receive early warnings of impending flooding in Dome whilst 24 percent do not. Also, of the 63.1 percent who do not plan in anticipation of flooding in Dome, 24 percent receive early warnings while 39.1 percent do not. In all, the level of technology of the people is low in terms of early warnings on impending flooding in the area (see Table 4.23). Additionally, of the 143 respondents who receive early warnings on potential flooding in the area, 62.9 percent were of the view that they do trust the source of their information relative to 37.1 percent who do not trust the source of their information on prospective climate change effects. Also, 35.6 percent get their information from television, 32.2 percent from radio and 32.2 percent from family and friends. Comparatively, majority of respondents (62.9%) trusted the source of their information than they do not (37.1%) (See Table 4.24). One of the respondents who receive early warning indicated that

> *"I know Dome gets flooded anytime it rains heavily so whenever I get information from GTV that it will rain heavily in Accra I prepare myself for flooding in my area"* (46 year old civil servant).

On the other hand, some respondents who receive early warning but do not engage in any form of planned adaptive response were of the view that they live in flood prone areas and don't see the need to engage in any form of anticipatory adaptive strategy when their belongings and houses will

ultimately get flooded. A respondent who receive early warning but do not engage in any anticipatory adaptive response to incidence of flooding in the area remarked that

> *"I often hear of impending flooding in the area from friends and sometimes some passengers. There is nothing I can do about it when it happens than to save the little belongings I have when my house gets flooded"* (42 year old Driver).

This clearly shows that though access to technology via early warning systems serves to enhance the adaptive capacity of people, some people's location and predisposition do not afford them the opportunity to engage in any form of planned adaptive strategy. Similarly, though findings in a study by UNEP (2014) in Gambia indicated that early warnings increase the adaptive capacity of people, it can be deduced from the findings of this study that majority of those who receive early warning on flooding do not engage in anticipatory adaptive measure due to the fact that most of them do not trust the source of the information. Therefore the early warnings do not increase their adaptive capacity in this context.

In relation to storms, 34.2 percent (127) of respondents indicated that they receive early warnings on impending storms in the area relative to 65.8 percent who do not (see Table 4.23). Of the 21.8 percent of respondent who had experienced events of storms in Dome before, 3.1 percent indicated that they receive early warnings whiles 18.6 percent do not receive early warnings. In view of this, inferences can be made based on the fact that the ability of the people to adapt to prospective storms event is low since they do not receive early warnings. Alternatively, out of the 127 respondents that receive early warnings on imminent storms in Dome, 37.8 percent get their information from television, 25.2 percent from radio, 33.9 percent from family and friends and 3.1 percent from both family and friends. Again, 55.9 percent of respondent trusted the source of the early warnings they get relative to 44.1 percent who do not trust their information sources. Nonetheless, respondents that

get their early warnings from radio, family and friends distrusted their early warning information than trust them, compared to early warnings from television (see Table 4.24)

Table 4.23 Planned Adaptive Strategies and Early warning information in Dome

Planned Adaptive Strategies	Early warnings		Total
	Yes	No	
Flooding			
Yes	54 (14.5%)	83 (22.4%)	**137 (36.9%)**
No	89 (24.0%)	145 (39.1%)	**234 (63.1%)**
Total	**143 (38.5%)**	**228 (61.5%)**	**371 (100.0%)**
Storms			
Yes	12 (3.1%)	69 (18.6%)	**81 (21.8%)**
No	115 (31.0%)	175 (47.2%)	**290 (78.2%)**
Total	**127 (34.2%)**	**244 (65.8%)**	**371 (100.0%)**
Temperature increase			
Yes	13 (3.5%)	194 (52.3%)	**207 (55.8%)**
No	8 (2.2%)	156 (42.0%)	**164 (44.2%)**
Total	**21 (5.7%)**	**350 (94.3%)**	**371 (100.0%)**

Source: Author's Field work (June 2015)

On the temperature increase front, 94.3 percent (350) do not receive early warning information compared to 5.7 percent (21) of respondents who receive early warning information about temperature increase. Of the 55.8 percent (207) of respondents who've experienced temperature increase, 52.3 percent (194) do not receive early warnings relative to 3.5 percent (13) that receive early warning information about temperature increase (see Table 4.23). In addition, 81 percent and 19 percent of respondent that receive early warnings on temperature increase get their information from television and radio respectively. In all, 85.7 percent indicated that they trust the source of their information relative to 14.3 percent that do not trust their source. Comparatively, respondents indicated that they trust the information they get from televisions compared to radio (see Table 4.24). Although, majority of the respondents do not receive early warning with regards to temperature, most of them adapt to this climate change effect due to its predominance and extensiveness. Also adapting to temperature is inexpensive compared to other climatic hazard.

Table 4.24 Sources of Information on Early Warnings and Respondents Trust in the Information Sources in Dome

Source of information on early warnings	Trust in the source of information		Total
	Yes	No	
Flooding			
Television	38 (26.6%)	13 (9.1%)	**51 (35.6%)**
Radio	27 (18.9%)	19 (13.3%)	**46 (32.2%)**
Family and friends	25 (17.5%)	21 (14.7%)	**46 (32.2%)**
Total	**90 (62.9%)**	**53 (37.1%)**	**143 (100.0%)**
Storms			
Television	35 (27.6%)	13 (10.2%)	**48 (37.8%)**
Radio	14 (11.0%)	18 (14.2%)	**32 (25.2%)**
Family and friends	18 (14.2%)	25 (19.7%)	**43 (33.9%)**
Television & Radio	4 (3.1%)	0 (0.0%)	**4 (3.1%)**
Total	**71 (55.9%)**	**56 (44.1%)**	**127 (100.0%)**
Temperature increase			
Television	17 (81.0%)	0 (0.0%)	**17 (81.0%)**
Radio	1 (4.8%)	3 (14.3%)	**4 (19.0%)**
Total	**18 (85.7%)**	**3 (14.3%)**	**21 (100.0%)**

Source: Author's Field work (June 2015)

4.5.2 Access to Infrastructure

Asante *et al*. (2012) acknowledged the fact that access to good infrastructure and level of institutional support can boost the adaptive capacity of individuals. The infrastructure could be in the form of access to transport facilities, water infrastructure, sanitation and energy supply (Juhola *et al*., 2012). Moreover, the determinants captured in the IPCC report (2011) make reference to social factors like social capital and network as key elements that influence the capacity of individual's to adapt to climate change effects. Given that access to infrastructure and social capital are key contributory elements to the capacity of individuals' and communities to adapt to climate change effects, this study examined the adaptive capacity of sampled respondents in Dome in relation to these determinants. Respondents' social capital was assessed in relation to the support they get from

neighbours in times of climatic hazards. Neighbours were used as proxy for the household's social capital considering the fact that they are often the proximate point of call in any climatic hazards, albeit friends, family, groups and traditional leadership were used by Vincent (2007) as proxies for household's social capital in villages. The study gave credence to the fact that indicators for social capital should be selected based on cultural context. Also respondents' access to infrastructures like transport, water and sanitation were also examined.

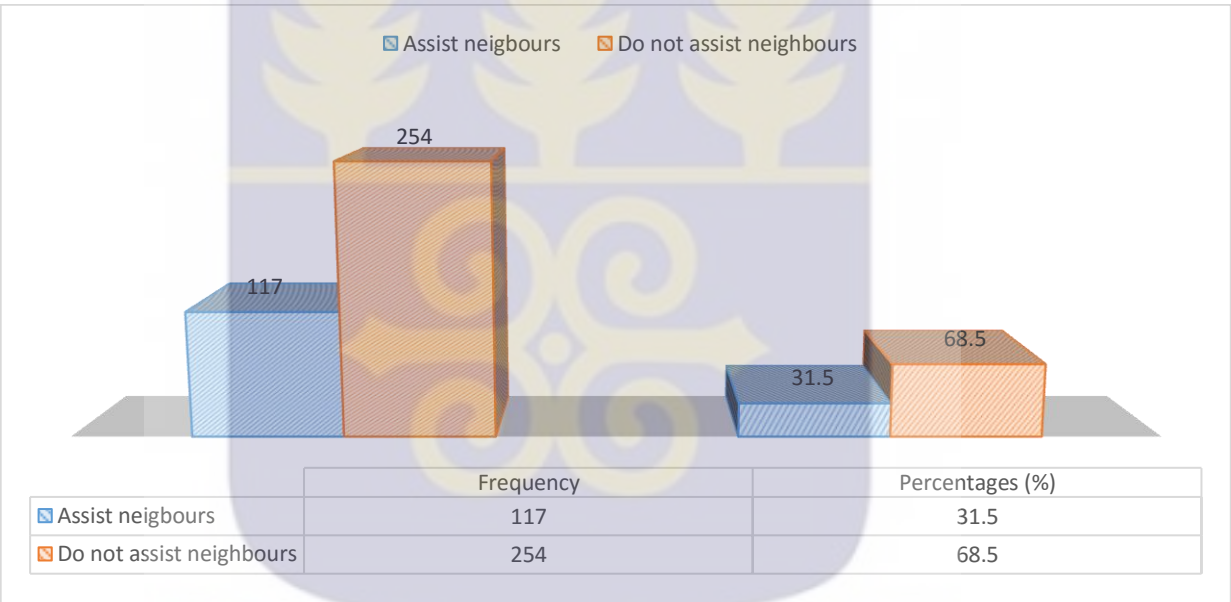
Evidence from Table 4.25 shows that out of the 52.3 percent of respondent who revealed that they have experienced flooding in Dome before, majority (29.9%) did not receive assistance from neighbours compared to 22.4 percent that received help from their neighbours. Besides, of the 78.4 percent that experience temperature increase and heat stress in Dome, 54.7 percent do not get assistance from neighbours in the event of heat stress. Also, of the 46.4 percent that revealed experiencing incidence of storms in the area, majority (29.6%) did not receive any form of assistance from neighbours whilst 16.7 percent received some form of help from their neighbours. Conversely, 68.5 percent of the respondents sampled were of the view that they do not offer any form of help to neighbours in the events of any form of climate change effect contrary to 31.5 percent who offered some form of assistance to neighbours (see Table 4.26). Apparently, this shows that the people offer very limited help to each other in the events of climatic hazards and thus further depicts the low level of social capital in the study area. This further shows the weak state of the adaptive capacity of the people in terms of the social support they get from people in case of any climate change hazard, given that adaptive capacity is usually considered when efforts are made to adapt to prospective climate change effects (Vincent, 2007).

Table 4.25 Social Capital and Experience of Climate Change Related Events

Social capital	Experience of climate change related event		
	Flooding	Temperature increase	Storms
Get assistance from Neighbours	83 **(22.4%)**	88 **(23.7%)**	62 **(16.7%)**
Do not get assistance from Neighbours	111 **(29.9%)**	203 **(54.7%)**	110 **(29.6%)**
Total	194 **(52.3%)**	291 **(78.4%)**	172 **(46.4%)**

Source: Author's Field work (June 2015)

Figure 4.3 Social Capital in Relation to Climate Change Related Event



Source: Author's Field work (June 2015)

Furthermore, respondents' access to sources of water; mode of transportation; mode of waste disposal; access to health facilities and mobile phones were assessed. In relation to access to mobile phones, 95.1 percent of respondents indicated that they have access to mobile phones relative to 4.9 percent who did not have access. This clearly shows that the ability of the people to access information technologies was high in the event of any climate change hazard. Additionally, the adaptive captive of the people in terms access to information is high.

Also, 93.3 percent of respondent have access to health facilities in the area compared to 6.7 percent that indicated that they do not have access. Clearly, in the events of any health effects associated with climate change effects in the area, the people have greater access to health facility and can utilise the health services rendered by these health institutions. For instance, considering the high accessibility of health facilities in the area, reported incidence of cholera as some of the health consequences of flooding, injuries as a results of storms and flooding, and diseases associated with heat stress can be attended to, thus enhancing the adaptive capacity of the people. Owing to easy accessibility to health facilities in the area the capacity of the people to adapt to climate change effects is high.

Moreover, 68.2 percent of respondents resort to use of public transport as a mode of transportation and 28.6 percent turn to use of private transport. Only, 1.1 percent and 2.2 percent of respondents' main modes of transportation in the area are on foot and motorcycle respectively. This implies that majority of the people have access to transport facilities, either private or public. In relation to the method of waste disposal in the Dome, the main modes are via door to door collection (48.5%) and disposal at central container (36.9%). Only 13.5 percent of respondents dispose of waste via incineration or burning and 1.1 percent via recycling. This implies that with respect to waste disposal, the populace in Dome have a high adaptive capacity to cope with potential climate change effects.

Furthermore, with regards to respondents' main sources of water, 45.8 percent depend on water from boreholes and 34 percent depend on pipe borne water. A small percentage of respondents gets their main source of water from commercial water tankers (8.1%) and well water (12.1%). Clearly, most of the respondents have access to water but majority depend on underground water. This clearly shows the people have access to water and thus have the ability to adapt in the events of any climatic hazards.

4.5.3 Effectiveness of institutions

Local institutions provide the enabling environment within which people can exercise their capacities to adapt because they are more sensitive to the peculiarity of the local people in adapting to climate change (Yaro *et al*., 2014). In view of this the study assessed the views of respondents about effectiveness of local institutions in their bid to take action to enhance the adaptive capacity of the people of Dome to climate change effects. Formal institutions found in Dome include Municipal Assembly, National Disaster Mobilisation Organisation (NADMO) and Non-Governmental Organisations (NGO's), financial organisations and civil society groups. However, respondents were of the view that the Municipal Assembly and NADMO are the only organisations that help them to adapt to the climate related events. Given that the Municipal Assembly plays indirect roles by incorporating climate change in their development plan and also providing infrastructure, attempts were made to ascertain the views of the people on their effectiveness as well as support they receive from them in case of climate related events. Due to the uniformity of the exposure to climate related disaster, the role of NADMO has become very important in easing the aftershock. Therefore, the study also examined the support provided by NADMO in the events of climate related disaster. These are represented in Table 4.26 and Table 4.27

Table 4.26 Respondents' Views about the Effectiveness of the Municipal Assembly to Climate Change adaptions in Dome

Effectiveness of Municipal Assembly	Frequency	Percentage
Effective	32	8.6%
Less effective	219	59.1%
Indifferent	120	32.3%
Total	**371**	**100.0%**

Source: Author's Field work (June 2015)

With regards to the effectiveness of the Municipal Assembly, only 8.6% of the total respondents were of the view that the municipal assembly was effective. The remaining 59.1 percent and 32.3 percent

perceived the role of the Municipal Assembly as either less effective or indifferent respectively. When asked why they thought the Municipal Assembly was not effective, some respondents said they did not even know who that was or where they can be found. One of the respondents indicated:

> *"The flooding in this area became severe about four years ago. This happened after the Municipal Assembly contracted someone to construct a new bridge and drains to allow free flow of water. They did a shoddy work. They built a smaller drain and elevated the road therefore when it rains the water come straight into our homes. I think they are not doing their work well at all"* (55 years old businessman, Dome crossing).

The above view corroborates the views of the Administrator of the Dome Zonal Council in an interview where he remarked that:

> *"The drains get chocked up because the contractor built small drains instead of the ones they are contracted to build. After the construction it becomes very difficult to make changes"* (Administrator, Dome Zonal Council in an interview, 23rd, June 2015).

Majority of respondents indicated that the Municipal Assembly ought to be proactive in putting in place adaptive measures to occasions of seasonal flooding in the area by demolishing buildings on waterways. Also respondents called for construction of big drains and desilting of old drains in the region respectively as an adaptive measure by institutions like the Municipal Assembly and NGOs to prevent events of flooding in the region. In addition, respondents called for the conservation of wetlands in the community while others proposed relocation of people in flood prone area as an adaptive strategy that ought to be undertaken by the Assembly and the traditional council. Issues of educational campaign on planned adaptive strategies to climate change effects; provision of early warning information on climatic hazards; and provision of aid to vulnerable people in flood prone

areas by the Assembly were also proposed by the respondents as adaptive measures to be undertaken by NGOs and the Municipal Assembly towards enhancing the adaptive capacity of the people to climate change effects in Dome. They were of the view that these measures if put in place will aid in enhancing the adaptive capacity of the people of Dome to climate change hazard like flooding. Also, tree planting and provision of early earning were proposed as an adaptive measure to be undertaken by institutions towards climatic hazards in the region.

All the respondents who experience losses due to climate related events revealed that they did not receive any support from the Municipal Assembly (see Table 4.27). This is because of the indirect role the Municipal Assembly plays in case of these climate related events. In an in-depth interview with the planning officer of the municipality, he indicated that

> *"During these disasters the assembly support by providing funds to the NADMO office in the municipality to procure relief items. Aside from this the municipal assembly also perform regulatory functions by denying people permit to build in water ways, demolishing of unauthorised building, building of new drains, desilting of drains and provision of sanitary bye-laws."* (Planning Officer, Ga East Municipal Assembly, 23rd June 2015).

This resonated with the study done by Yaro *et al*. (2014) where they also noted that the role of district assemblies in northern Ghana was indirect.

Table 4.27 Support provided by Various Institutions

Support after Destructions	Yes	No	Total
Support from municipal assembly (GEMA)	0 **(0.0%)**	131 **(100.0%)**	131 **(100.0%)**
Support from other institutions (NADMOetc.)	53 **(40.5%)**	78 **(59.5%)**	131 **(100.0%)**

Source: Author's Field work (June 2015)

Inferences from Table 4.27 also show that 40.5 percent of those who suffered losses as a result of climate related disasters received support from other formal institutions apart from the municipal assembly. The remaining 59.5 percent however did not receive any support from any other institution. All the respondents who received support indicated NADMO as the only institution that come to their aid. The aid they provide come in the form of relief items (mattresses, rice, buckets, blankets, sandals, pillow, sanitary kits, clothing, mosquito nets and coils, shito, soaps etc.). These items were confirmed during an interview with the Municipal NADMO coordinator. According to the NADMO coordinator, these items are provided by the municipal assembly, NGOs, donor agencies and corporate bodies such as Action Aid, World Bank and MTN. Those who did not receive from any institution also mentioned that the institutions only come to assess their situation but do not provide any support. Some respondents indicated;

> *"Even when the relief items are brought in, they give it anyone who come to the collection point therefore by the time we get there they are finished. Sometimes, they ask us to come for the items ourselves from their offices and that is very far from here thus we are not able to go"* (36 year old trader, Dome crossing, 21st June 2015).

In view of this the Municipal NADMO coordinator indicated that,

> *"The institution first goes in after the disaster has occurred to do an assessment of affected people. The list of these people is then sent to donor for help. Therefore the items we receive depend on the affected people. They are then given the items according to the same list. So if a person's name is not on the assessment list then he or she does not receive it. However during the assessment some people do not admit they have been affected because of the fear of demolishing but when they realise their neighbours our receiving those items they then begin to complain that the organisation left them out. I am not saying we do not take some of*

> *the blame. Because there have been instances where it's been reported that some of our staff refuse to assess certain houses because the place is too muddy"* (NADMO coordinator, Ga East Municipal Assembly, individual interview, 23rd June, 2015).

In an attempt to ascertain the knowledge of the people about local policies pertaining to climate change and variability, respondents were asked about their knowledge on policies in the municipality. All respondents indicated they did not know of any climate related policies. During an in-depth interview, the municipal planning officer also indicated that:

> *"The municipality adopts the national climate change policy. Nevertheless, there are indirect policies pertaining to climate change and variability but these policies are indirect. For instance the municipality has policies with regards to tree planting, sanitation and locations of buildings. These policies are formulated through a bottom up approach."* (Municipal planning officer, Ga East Municipal Assembly, individual interview, 23rd June 2015).

4.5.4 Economic Resources

The propensity to adapt is dependent on resources available to a person. In order to adapt, there is the need for economic resources to plan, implement and build strategies (Satterthwaite *et al*, 2007). Therefore the study assessed the resource base of respondents using assets as relative measure of wealth. This was done by examining the economic resources of respondents in relation to the relative adaptive strategies they employ.

Table 4.28 Economic resources in relation to relative adaptive strategies of flooding

Relative adaptive strategies	Value of total asset			Total
	Low asset value (GH₵ 25 - 2000)	Medium asset value (GH₵ 2001 - 10000)	High asset value (GH₵10000-100000)	
Dig trenches or temporal dykes to divert water from houses	0 **0.0%**	19 **12.5%**	9 **5.9%**	28 **18.4%**
Use of sand/blocks/furniture as temporal places of high elevation	4 **2.6%**	36 **23.7%**	10 **6.6%**	50 **32.9%**
Temporal relocation to alternative settlement areas	4 **2.6%**	31 **20.4%**	14 **9.2%**	49 **32.2%**
Prevent entry of water via use of sand bags	0 **0.0%**	11 **7.2%**	6 **3.9%**	17 **11.2%**
Dig trenches to divert water from houses and use of sand bags to prevent water entry	0 **0.0%**	8 **5.3%**	0 **0.0%**	8 **5.3%**
Total	8 **5.3%**	105 **69.1%**	39 **25.7%**	152 **100.0%**

Source: Author's Field work (June 2015)

Inferences from Table 4.28 shows that households with low asset value either resort to the use of sand/blocks/furniture as temporary places of high elevation (2.6%) or prevent water from entry by use of sandbags during floods (2.6%). Majority of households are found within the medium asset base and use all the adaptive strategies listed. However majority of households with medium asset value resort to the use of sand/blocks/furniture as temporal places of high elevation (23.7%). 20.4 percent of respondent also relocate to alternative settlements during flooding. 12.5 percent of respondent dig trenches or temporal dykes to divert water from houses. 7.2% of respondents with medium asset value also prevent entry of water via use of sand bags and the remaining 5.3% dig trenches to divert water from houses and use of sand bags to prevent water entry. With regards to those with high value assets 5.9% dig trenches or temporal dykes to divert water from houses; 6.6%

use sand/blocks/furniture as temporal places of high elevation; 9.2% relocate temporarily to other settlements; and 3.9% prevent entry of water using sand bags.

Table 4.29 Economic resources in relation to relative adaptive strategies of temperature increase

Relative adaptive strategies	Value of total asset			Total
	Low asset value (GH₵ 25 - 2000)	Medium asset value (GH₵ 2001 - 10000)	High asset value (GH₵10000-100000)	
Use of air-conditions	0 **0.0%**	3 **1.2%**	10 **3.9%**	13 **5.0%**
Use of fan	5 **1.9%**	130 **50.4%**	60 **23.3%**	195 **75.6%**
Preference for spending nights outside the room due to heat	4 **1.6%**	19 **7.4%**	3 **1.2%**	26 **10.1%**
Use of both air conditions and fan	0 **0.0%**	2 **0.8%**	6 **2.3%**	8 **3.1%**
Use of fan and preference for spending nights outside the room	0 **0.0%**	11 **4.3%**	5 **1.9%**	16 **6.2%**
Total	9 **3.5%**	165 **64.0%**	84 **32.6%**	258 **100.0%**

Source: Author's Field work (June 2015)

An individual's economic resources are noted to influence his or her ability to take action in the event of any climate change related hazards, ultimately influencing their adaptive capacity to certain adaptive measures. This implies that level of wealth could either constrain or enhance adaptive capacity of individual. Thus, those with high level of wealth are perceived to have high adaptive capacity to adapt to climate change effects relative to those with low level of wealth. Evidence from Table 4.29 shows that air conditions are used by 1.2 percent of respondents with medium asset value and 3.9 percent of respondents with high asset value to adapt to climate change and variability but those with low asset values do not use air conditions for adaptation (0.00%). Majority of those who use fans for adaptation have medium asset value (50.4%) followed by 23.3% who have high asset

value and 1.9% with low asset value. Therefore there is a high propensity to use fans when you have medium or higher asset value. Although fewer people spend nights outside to cope with temperature increase, most of them have medium asset value (7.4%) with 1.6 percent and 1.2 percent having low asset value and high asset value respectively. Also more people with high asset value use both air condition and fans (2.3%) as compared with those with medium asset value (0.8%). Nevertheless, more people with medium asset value (4.3%) use fans and spend nights outside to adapt to increase temperature compared to the 1.9 percent who have high asset value.

Table 4.30 Economic resources in relation to relative adaptive strategies of storms

Relative adaptive strategies	Value of total asset		Total
	Medium asset value (GH₵ 2001 - 10000)	High asset value (GH₵10000-100000)	
Temporal relocation to other settlements	8 **66.7%**	4 **33.3%**	12 **100.0%**
Total	8 **66.7%**	4 **33.3%**	12 **100.0%**

Source: Author's Field work (June 2015)

4.6 Conclusion

This chapter examined perceptions about climate change and variability in Dome. It again examined the effects of climate change and variability in the study site and the various relative adaptive strategies the people of Dome resort to in the events of climate related events. Lastly, the adaptive capacity of the people of Dome was examined. The analysis shows that majority of the household respondents in Dome were familiar with the term climate change. Respondents attributed causes of rainfall and temperature increase in Dome to human activities such as deforestation, air pollution, and urbanisation. In addition, respondents perceived flooding and temperature increase as the most prevalent climatic hazards in the study area relative to storms. Consequently, destruction and loss of belongings and sources of livelihood were reported as some of the effects associated with these

climatic hazards. In spite of this, most of the respondent have experienced and adapted more to temperature increase than any of the climatic hazards examined. The study also revealed that autonomous or reactive adaptive measures were commonly undertaken by the people in the event of flooding, temperature increase and storms than anticipatory adaptive strategies.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATION

5.0 Introduction

This chapter presents the summary of the study's findings in relation to the study's objectives. Also, it concludes based on the study's findings and the adaptive capacity framework that underpinned the focus of the study. Lastly, some recommendations are further discussed based on the findings of the study.

5.1 Summary of Key Findings

This study examined the adaptive strategies of the people of Dome in the Ga-East Municipality to the effects of climate change and variability. Specifically drawing on the adaptive capacity framework, it assessed the perceptions of people about climate change and variability in Dome over the years; the prevailing effects of climate change and variability; the relative adaptive strategies adopted by different people to tackle different climate change and variability effects in Dome; and lastly to examine the determinants of the adaptive capacity of the people of Dome. A systematic random sampling method was used in selecting 371 household respondents for the survey and key personal interviews were conducted with authorities of the Municipal Assembly, the traditional and zonal council and NADMO for the qualitative facet of the study. The major findings in this study are discussed below.

5.1.1 High Level of Knowledge and Awareness of Climate Change and Variability in Dome

Comparatively, majority of respondents were either very familiar or less familiar with climate change and had a fair understanding of what it denotes than those who were not familiar with the term. Majority of them linked it with changes in climatic variables while others associated it with changes in weather pattern. Against this backdrop, age of respondents and their level of education showed a

significant relationship with their familiarity with climate change. It emerged clearly that this finding contrasts the findings in the study by the BBC World Service Trust (2010) in which majority of the local people in Africa were not familiar with the term climate change. In relation to changes in climatic conditions such as rainfall and temperature increase, majority of respondents perceived increase in both rainfall and temperature within the last 20 years. This mirrored the study by Deressa *et al*. (2008) in relation to temperature increase but contradicts it in relation to changes in rainfall. Additionally, some respondents attributed human induced activities such as deforestation, air pollution, natural causes and urbanisation as the causes of changes in climatic conditions like rainfall and temperature. Conversely, majority of respondents attributed changes in rainfall and temperature to supernatural causative factors like the will of God. Age of respondents showed no significant relationship with their perceptions about the causes of changes in rainfall and temperature relative to their level of education which showed a significant relationship. Again, this resonates with the studies by Gyekye (2013) and BBC World Service Trust, where most of the respondents expressed changes in the climatic conditions as the will of God. More so, evidence from this study is consistent with the study by BBC World Service Trust (2010) were African's understandings of climate change related phenomena were underscored by emphasis on trees; will of God; ozone confusion; air pollution and localised heat.

5.1.2 High Prevalence of Temperature and Floods Effects of Climate Change and Variability

In relation to the effects of climate change and variability in Dome, majority of respondents' perceived floods, high rainfall intensity and temperature as prevalent in the region compared to storms. Comparatively, majority of respondents sampled had experienced events of floods and increase temperature than storms in the region. In view of this, incidence of floods and temperature increase were reported as the prevalent effects of climate change and variability in the area. As a

result, respondents reported loss and destruction of belongings; source of livelihood and houses as some of the effects of floods, temperature increase and storms in Dome.

5.1.3 Adaptive Strategies to Incidence of Flooding

Another major finding in this study is that majority of respondents that experience flooding in Dome, engage in some form of autonomous or reactive adaptive response to this climate related event. Majority of people often resort to temporal relocation to alternative settlement areas and use of sand or blocks or furniture to create temporal places of high elevation as reactive response to flood in Dome. This is in line with the views of Feiden (2011) on climate change adaptation in cities where an adaptive response like relocation to alternative settlements areas are often used to adapt to climate change effects in urban areas. Additionally, some turn to dig trenches or temporal dykes to divert water from houses in the events of flood and others use sand bags to prevent water from entering the house. Evidence from this study also resonates with the study by Wamsler (2007) in Nairobi where people often fall back on the use of sand bags to prevent water from entering their houses. However, the use of these reactive adaptive responses was not significantly associated with specific age group of respondents or respondents who have attained a certain level of education. In relation to the type of planned adaptive response respondents resort to in the events of flooding, the study reports opening up of drainage channels as an anticipatory adaptive response to as one of the key adaptive strategy respondent turn to in anticipation of flooding events in Dome. This resonated with the studies by Douglas *et al*. (2008) and Douglas and Alam (2006) whereby respondents resorted to clearing of drainage channels as an anticipatory adaptive response to flooding. Also, others fall back on the use of waterproof recycled materials for building, savings and moving of belongings to alternative areas as a planned adaptive response to flooding in the region. The study also showed that the type of anticipatory or planned adaptive strategies an individual resort to are mostly contingent on

power relation, i.e. the respondents' status of the property he or she occupies. For instance, the study showed that none of the respondents who were tenants, care-takers and squatters indicated that they use waterproof recycled materials for building as a planned adaptive response to flooding compared with house owners. This can be attributed to limited authority of the tenant or care-taker to build in relation to the house they live in and limited resources and temporal occupancy of the squatter. Nonetheless, the contrast of this was reported in the findings of the study by Wamsler (2007) where some informal settlements occupants in Nairobi sheltered their structures with water proof materials.

5.1.4 Adaptive Strategies to Incidence of Increased Temperature

In response to incidence of increase temperature and heat stress, majority of respondents resort to use of fan and preference for spending night outside the room as an autonomous adaptive measure. They preferred the use of fan because that is the only available and affordable adaptive measure whilst majority preferred to spend night outside because of preference and the only option available to them. Also, respondents who resorted to use of air conditionings as an adaptive measure preferred it because of its efficiency compared to the other forms of cooling systems. In all, the type of relative autonomous adaptive strategy people resort to in the events of temperature increase and heat stress had a significant relationship with the age of the individual and the level of education attained. This implies that respondents who were older (46 and above) preferred use of fan and preference for spending nights rooms compared to those within the youth age (15-45) preferred use of air conditionings and fan. Also, respondents with high level of education preferred use of cooling systems like fan and air conditionings to spending nights outside room. In anticipation of incidence of temperature increase and heat stress in the region, majority of respondents often invest in cooling systems like the air conditionings and fans, while very few invested in tree planting and traditional window systems to enhance aeration. Clearly, evidence from this study mirrors the studies by

McEvoy (2007) and Fieiden (2011) whereby there are increasing investments in cooling technologies as an adaptive measure to cope with temperature increase and heat stress.

5.1.5 Adaptive Strategies to Incidence of Storms

In relation to incident of storms in the Dome, the study showed that respondents' hardly engaged in any form of autonomous or reactive adaptive response to storms in the region, although very few people resort to relocate temporally to alternative areas to help them fix or replace losses or properties that are destroyed in the event of the storms. Respondents who resorted to this reactive adaptive measure were of the view that it was the only available alternative they had as at the time of the incidence. With regards to the relative adaptive measures respondents put in place in anticipation of storm events, the study showed that majority of respondents resort to savings and use of stronger building materials for their structures. Also, planting of trees was reported by very few respondents as an adaptive measure to incidence of storms in the region. Clearly, savings as an anticipatory adaptive response to storm events is one of the interesting themes unravelled in this study. Although this is an informal form of insurance, respondents preferred this adaptive measure because it enables them to replace their losses and repair destructed ones.

5.1.6 Low Technology as a Determinant of Low Climate Change Adaptive Capacity

Determinants of the adaptive capacity of the people of Dome to climate change and variability effects were assessed in relation to their access to technology; access to basic infrastructure and social capital, effectiveness of institutions and economic resources. Evidence from the study showed that majority of respondents do not receive early warnings on potential incidence of flooding, storms and temperature increase compared to those that get early warning information. The television, radio and family and friends were reported as main sources of early warning information on these climate related events. In all, respondents that get their early warnings from radio, family and friends

distrusted their early warning information than trust them compared to early warnings from television. The heavily reliance on ad hoc adaptive measures like temporal relocation, digging of trenches or dykes to divert water from houses, preference for cooling systems and opening of draining channels accounts for the low adaptive capacity of the people. Owing to the low level of technology and heavy reliance on ad hoc reactive adaptive measures the adaptive capacity of the people of Dome can be termed low.

5.1.7 Low Social Capital as a Determinant of Low Climate Change Adaptive Capacity

Furthermore, using neighbours as a proxy to assess the social capital of respondents, the study shows that majority of respondents do not get assistance from neighbours in the events of climate change related events like flooding, temperature increase and storms. In the same vein, majority of respondents do not offer any assistance to neighbours in case of climate change events like flooding, increase temperature and storms. Relatively, this shows the low adaptive capacity of the people of Dome in terms of the social support they get from people in case of climate change hazards, given that adaptive capacity is usually considered when efforts are made to adapt to prospective climate change effects (Vincent, 2007). Also, majority of respondents have access to basic infrastructure like water, waste disposal, health facilities and mobile phones. This implies that with respect to ability to access basic infrastructure, the populace in Dome have a high adaptive capacity to cope with potential climate change effects.

5.1.8 Weak Institutions as a Determinant of Low Climate Change Adaptive Capacity

Moreover, institutions like the Municipal Assembly, NADMO and the local traditional council were reported by respondents' as local institutions that are actively engaged in climate change adaptions. However, majority of respondents perceived the Municipal Assembly as less effective and indifferent to climate change adaptation in Dome. Also, none of the respondent who had suffered losses as a

result of climatic hazards in the area indicated that they receive any support from the Assembly. The study revealed that NADMO was the only organisation that offers relief support to affected flood victims in the area. Respondents called on the Municipal assembly to be proactive in climate change adaptation by demolishing buildings on waterways, conservation of wetlands in the region, educational campaign on planned adaptive strategies.

5.1.9 Inadequate Economic Resources as Determinant of Low Climate Change Adaptive Capacity

Economic resources as determinant of climate change was also assessed in this study. The findings showed that majority of respondent have medium assert values using proxy values. Those with the medium assert value tend to practice more of every adaptive strategy in relation to flooding, temperature increase and storms. Relatively those with low asset values tend to adapt less. Therefore economic resources have an effect on the adaptive strategies practice by respondents.

5.2 Conclusions

On the backdrop of the findings of this study, it is evident that adapting to climate change effects is mostly contingent on individuals' knowledge and awareness about climate change and its effects; the ability to access technology; information and basic infrastructure, and the effectiveness of institutions. Undeniably, perceptions held by people about causes of climate change and its effects influence their awareness and ultimately their adaptive capacity. Also, the relative adaptive responses they resort to are contingent on their ability to access information and basic infrastructures. Lastly, effectiveness of institutions plays a pivotal role in influencing the adaptive capacity of the people. Consistent with these are the determinants outlined in the adaptive capacity framework (IPCC, 2001; Schroter *et al.*, 2004; Juhola *et al.*, 2012). The study further suggests that factors such as preference, lack of economic resources to afford a certain adaptive strategy, and certain location and

predisposing factors often interplay to influence the various relative adaptive strategies often resorted to in the events of climate change related hazards. Thus, the study concludes that knowledge and awareness about climate change; access to technology and infrastructure, effectiveness of institutions and social dynamics interplay to influence adaptive capacity to climate change effects.

5.3 Recommendations

On the basis of the findings of this study, the following recommendations are made:

- The study suggests that although early warning influence the tendency of people to adapt, it is not significant because some of the respondents did not trust the source of these warnings. In view of this, early warnings should be communicated through television and radio because most respondents indicated they trust these sources. This will enable them prepare and put in place adaptive measures before the event of climate related hazards
- There is the need for GEMA, NADMO and other civil society organisations in the municipality to educate the people on climate change and variability, the dangers associated with it and some environmental friendly adaptive strategies such as tree planting and planting of vegetative covers. There is also the need to communicate information on scientific evidence regarding climate change to the people. This will enhance the peoples understanding of climate change and variability and the severity of the dangers associated with it. Hence the propensity for them to heed to these warnings.
- With regards to flooding, there is the need to improve drainage system to allow the free flow of rainwater. In view of this, the GEMA should construct new drains and existing ones should be expanded and dredged. During construction, projects should be properly monitored to make sure the project they are carried out well. Expanding the drainage system within the community will enhance the flow of rainwater.

- Already existing laws and policies related to climatic change and its effects should be reinforced and the appropriate punishment effected. As part of this, policies specific climate change and variability should be clearly defined, be practical and communicated to the people by GEMA and other stakeholders involved. In addition, plans to implement these policies should be stated and target set. Channels of feedback should be established in other to correct the shortfalls of these policies.
- Also, planning and implementation of climate related projects and programmes should be participatory. Institutions should seek the knowledge of residents in Dome community especially those with low adaptive capacity. These people experience the brunt of these climate related events and can therefore give insights on the extent of damages caused by these climate related agents. Soliciting the views of the people would make them feel that these strategies are demand-driven and would be more inclined to maintain them.
- With respect to resources, those with high and medium assets value tend to adapt more than those with low assets value. Therefore, there is the need for NADMO and GEMA to initiate planned adaptation measures first of all by mapping the assets base of different people to get a robust database. Such a database will serve as an important source of determining who to support in times of climate change hazards such as floods, etc., especially, those with low asset base.

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APPENDIX A

INSTITUTE FOR SOCIAL, STATISTICAL AND ECONOMIC RESEARCH, UNIVERSITY OF GHANA, LEGON

HOUSEHOLD QUESTIONNAIRE

This questionnaire is designed for a study entitled "examining the adaptive strategies of the people of dome in the Ga-East Municipality to the effects of climate change and variability" to be submitted to the university of Ghana in partial fulfilment of the degree of Master of Art in Development Studies. The views obtained are intended for academic purposes only and shall be treated confidential.

SECTION A: BACKGROUND CHARACTERISTICS OF RESPONDENTS

1. How long have you lived in Dome? 1. Less than 1 year 2. 1 – 5 years 3. 6 – 10 years 4. 11-15 years 5. More than 15 years
2. Sex: 1. Male 2. Female
3. Age:
   1. 15-25 2. 26-35 3. 36-45 4. 46-55 5. 56-65 6. Above 65

4. Religion (voluntary)
   1. Christian 2. Muslim 3. Traditionalist 4. Other (Specify) ……

Level of Education	Code	Level of Education	Code
No formal education	1	Senior Secondary school (SSS)/ Ordinary level,/Advanced Level/ Vocational/ Technical	4
Elementary/primary education	2	Tertiary	5
Junior Secondary School / middle school	3	others(6)	

5. Number of household dependents
   1. 3 or less 2. 4-6 3. 7-9 4. 10 and above
6. Are you currently employed? 1. Yes 2. No

7. What are the main sources of livelihoods and average monthly income for your family within the following timeframes?

Code	Timeframe	Occupation	Average monthly income (in GH₵)
1	5 years ago		1. Less than 300 2. 300-600 3. 601-1000 4. 1001-1500 6. 1501-2000 7. 2001 and above
2	4 years ago		1. Less than 300 2. 300-600 3. 601-1000 4. 1001-1500 6. 1501-2000 7. 2001 and above
3	3 years ago		1. Less than 300 2. 300-600 3. 601-1000 4. 1001-1500 6. 1501-2000 7. 2001 and above
4	2 years ago		1. Less than 300 2. 300-600 3. 601-1000 4. 1001-1500 6. 1501-2000 7. 2001 and above

SECTION B: HOUSING AND ASSETS

8. What is your status in relation to the place you live?
   1. Owner 2. Tenant 3. Care-taker 4. Squatter

9. How much do you pay as rent each month?
   1. Less than GH₵100 2. GH₵ 100 - GH₵ 200 3.GH₵ 201 - GH₵300
   4. GH₵ 301 - GH₵400 5. GH₵401 - GH₵ 500 6. More than GH₵ 500

10. What is the main material used for the following parts of the building

Building parts	Materials used
Outer walls of the house	a. Metal/slate/asbestos b. stone/burned bricks c. cement/sandcrete block d. other……
Floor	a. Cement/concrete b. ceramic/tiles c. Stone d. other……

11. What is the main type of cooking fuel used by your household?
   1. Gas/LPG 2.Electricity 3.Charcoal 4.Wood
   2. Other (specify)……..

12. How many of the following goods does your household own?

GOODS	Number	GOODS	Number
Television		Car	
Electric Fan		Motorbike	
Air-condition			
Refrigerator Energy efficient → Non-energy efficient →		**Stove** Gas Stove → Kerosene Stove →	

SECTION C: PERCEPTIONS ON CLIMATE CHANGE AND VARIABILITY

13. To what extent are you familiar with the term climate change?
    1. Very familiar 2.Less familiar 3.Not familiar
14. If very familiar, what is your understanding of climate change?
    ……
    ……
15. If less familiar, what is your understanding of climate change?
    ……
    ……
16. What is your main source of information on issues pertaining to climate change?

Source of information	Code	Source of information	Code
Media	1	Friends and Family	4
School	2	Personal Experience	5
Internet	3	Other (Specify):	

17. Have there been changes in the rainfall pattern in the past 20 years?
    1. Yes 2. No
18. If yes, has the rainfall pattern been reducing or increasing?
    1. Increase 2. Reduction
19. If yes, what are the causes of these changes in rainfall?

Cause of changes in rainfall	Code	Cause of changes in rainfall	Code
Deforestation	1	Natural causes	4
Air pollution	2	Will of God	5
Urbanisation	3	Other	6

20. Have there been changes in temperature in the past 20 years?
    1. Yes 2. No
21. If yes, has it been increasing or reducing?
    1. Increase 2. Reduce
22. If yes, what are the causes of these changes in temperature?

Cause of Climate change	Code	Cause of Climate change	Code
Deforestation	1	Natural causes	4
Air pollution	2	Will of God	5
Urbanisation	3	Other	6

SECTION D: EFFECTS OF CLIMATE CHANGE AND VARIABILITY

23. To what extent are the following climate change effects prevalent in Dome over the past 20 years?

Climate related event	Level of prevalence			
	Very prevalent(1)	Prevalent (2)	Less prevalent(3)	Not at all (4)
Increased Temperature				
High Intensity of rainfall				
Floods				
Storms				

24. Have you experienced any of the following climate change effects in Dome within the past 20 years?

Climate change Effects	Yes	No
1. Flooding		
2. Increase in temperature (Heat stress)		
3. Storms		

25. Have you suffered from any destruction as a result of climate change related agent in Dome over the past 20 years? 1. Yes 2. No
26. If yes, please indicate losses and climate change related agents that caused the destruction or loss.

Losses(Human life, House, Belongings)	Climate change related agents that caused destruction

27. What were the main effects of the climate change destructions?
……
……
28. Did you get support from the Municipal Assembly during these disasters?
1. Yes 2. No
29. If yes, what form of support did you receive?
……
30. Did you get support from any other institution apart from the Municipal Assembly?
1. Yes 2. No
31. If yes, please name these institutions and the support you received.

Institution	Support

SECTION E: RELATIVE ADAPTIVE STRATEGIES

32. Do you often respond once the following effects of climate change and variability befall you?

Climate change Effects	Yes	No
4. Flooding		
5. Increase in temperature (Heat stress)		
6. Storms		

33. If yes, how do you often respond following the incidence of flooding?

Autonomous/Reactive adaptive strategies in case of flooding	Code
Dig trenches or temporal dykes to divert water from houses	1
Use of Sand/blocks/furniture as temporal places of high elevation	2
Temporal relocation to alternative settlement areas	3
Prevent entry of water via use of sand bags	4
Other (Specify):	

34. Why do you respond to flooding using the above indicated strategy?

.....

35. If yes, how do you often respond following an increase in temperature (heat stress)?

Autonomous/Reactive adaptive strategies temperature increase	Code
Use of air-conditions	1
Use of fan	2
Preference for spending nights outside the room due to heat	3
Other (Specify):	4

36. Why do you respond to temperature increase using the above indicated strategy?

……

37. If yes, how do you respond following an incidence of storm?

Autonomous/Reactive adaptive strategies storms	Code
Temporal relocation to alternative settlement areas	1
	2
	3

38. Why do you respond to storms using the above indicated strategy?

……

39. Have you started practicing any form of an individual/community planned adaptive strategies to overcome future occurrences of:

Climate change Effects	Yes	No
1. Flooding		
2. Increase in temperature (Heat stress)		
3. Storms		

40. If yes, what kind(s) of individual/community planned adaptive strategies are you undertaking to adapt to flooding?

Anticipatory/planned adaptive strategies in case of flooding	**Code**
Planting of vegetation cover	1
Use of water proof recycled materials for building	2
Opening up drainage channels	3
Savings	4
Other (Specify):	5

41. If yes, what kind(s) of individual/community planned adaptive strategies are undertaking to adapt to heat stress?

Anticipatory/planned adaptive strategies in case of heat stress	**Code**
Investment in traditional window systems to enhance aeration	1
Investment in cooling systems like air-conditions, electric fan etc.	2
Planting of trees	3
Other (Specify)	4

42. If yes, what kind(s) of individual/community planned adaptive strategies are undertaking to adapt to storms?

Anticipatory/planned adaptive strategies in case of storms	**Code**
Planting of trees	1
Using stronger building materials	2
Savings	3
Other (Specify)	4

43. In your opinion what climate change adaptive strategies should be put in place by the following stakeholders?

Institution	**Climate change effects**	**Adaptive strategies**
Municipal Assembly	Flooding	
	Heat stress	
	Storms	

NGO's	Flooding	
	Heat stress	
	Storms	
Traditional Authority	Flooding	
	Heat stress	
	Storms	

SECTION F: DETERMINANTS OF ADAPTIVE STRATEGIES

44.

In the last five years, do you get weather forecast information on the following?	**1-Yes** **2-No**	If yes, where did you get this information from **1-Television, 2-Radio 3-Internet, 4-School, 5-Family & Friends 6-Text messages/Phone calls, 7-others**	Do you trust the source of this information? **1-Yes, 2-No**
When expected rains begin?			
When expected rains will end?			
The amount of rains Dome will receive?			
Expected Temperature increase?			
Expected Storms in your area?			

45.

Do you receive early warnings on any of the following climate change effects?	**1-Yes** **2-No**	If yes, where did you get these early warnings from? **1-Television, 2-Radio 3-Internet, 4-School, 5-Family & Friends 6-Text messages/Phone calls, 7-others**	Do you trust the source of this information? **1-Yes, 2-No**
Flooding			
Storms			
Temperature Increase			

46. Do you get any help from neighbours in case of climatic hazard?
    1. Yes 2. No
47. Do you provide help to others in the community during climatic hazard?
    1. Yes 2. No

48. Have you developed any technology in your bid to adapt to climate change?
    1. Yes 2. No

49. What have you innovated?
    ……

50. What climatic hazard does it help you to adapt to?
    ……

51. Do you have access to mobile phones? 1. Yes 2. No

52. Do you have access to health facilities? 1. Yes 2. No

53. How do you dispose of waste in this community

Method of waste disposal	**Code**	**Method of waste disposal**	**Code**
Incineration (burning)	1	Recycling	3
Door to door	2	Disposal at central container	4
Other (specify) 6			

54. What is your main mode of transportation?

Mode of transportation	**Code**	**Mode of transportation**	**Code**
Private car	1	Public transport	3
Bicycle	2	Foot	4
Other (6)			

55. What is your main source of water?

Source of water	**Code**	**Source of water**	**Code**
Pipe borne water	1	Water tankers	3
Well water	2	Bore holes	4
Other (6)			

56. How effective do you think the district assembly has being to climate change adaptation? 1. Very effective 2. Effective 3. Less effective 4. Indifferent

57. Do you know of any local policies pertaining to climate change? 1. Yes 2. No

58. If yes, mention some of these policies?
    ……
    ……

APPENDIX B

INSTITUTE FOR SOCIAL, STATISTICAL AND ECONOMIC RESEARCH (ISSER),

UNIVERSITY OF GHANA, LEGON

INTERVIEW GUIDE FOR THE GA EAST MUNICIPAL ASSEMBLY

SECTION A: GENRAL INFORMATION

1. Respondent's position:
2. Name of institution: ……
3. How long have you worked in this institution? ……..

SECTION B: CLIMATE CHANGE AND VARIABILITY

4. Do you think climate change has occurred in dome in the last 20 years?
5. What do you think are the main drivers of these changes?
6. How do you see these changes manifest in the Dome?
7. Are these changes enough to influence the activities and lives of the people in Dome?

SECTION C: EFFECTS OF CLIMATE CHANGE AND VARIABILITY

8. What have been the prevalent effects of flooding in Dome in the last 20 years?
9. What have been the prevalent effects of storms in the last 20 years on the people of Dome?
10. What have been the prevalent effects of increased temperatures in Dome in the last 20 years?
11. What are the causes of these events?

SECTION D: SUPPORTING ADAPTIVE STRATEGIES OF DOME PEOPLE EXPOSED TO EFFECTS OF CLIMATE CHANGE

12. What does your institution do to help the people in the aftermath of flooding?

DIFFERENT EFFECTS	**INSTIUTIONAL SUPPORT**	**GROUP OF PEOPLE IN DOME**

13. What does your institution do to help the people of Dome in the aftermath of a storm?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

14. What does your institution do to support the people of Dome during heat stress?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

15. What mechanisms have been put in place by this institution in the last 5 years to prevent flooding from occurring in dome?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

16. What mechanisms have been put in place by your institution in the past 5 years to prevent storms from happening in Dome?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

17. In the past 5 years, what strategies have been put in place to reduce heat stress?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

18. Do you consult the people in relation to implementation of adaptive strategies?
19. What methods do you use?
20. Do you get feedbacks concerning the efficacy of these implemented strategies?
21. Is the Municipality well-resourced in the advent of any effect of climate change and variability?
    - Institutional capacity
22. Does this institution have policies pertaining to climate change?
    - National, regional and local
    - How are these policies enforced
23. Do you engage in top-down or bottom-up approach in the formulation of local adaptive strategies and climate change policies in this Municipality?

APPENDIX C

INSTITUTE FOR SOCIAL, STATISTICAL AND ECONOMIC RESEARCH (ISSER),

UNIVERSITY OF GHANA, LEGON

INTERVIEW GUIDE FOR THE NGO's

SECTION A: GENRAL INFORMATION

1. Respondent's position:
2. Name of institution: ……
3. How long have you worked in this institution? ……..

SECTION B: CLIMATE CHANGE AND VARIABILITY

4. Do you think climate change has occurred in dome in the last 20 years?
5. What do you think are the main drivers of these changes?
6. How do you see these changes manifest in the Dome?
7. Are these changes enough to influence the activities and lives of the people in Dome?

SECTION C: EFFECTS OF CLIMATE CHANGE AND VARIABILITY

8. What have been the prevalent effects of flooding in Dome in the last 20 years?
9. What have been the prevalent effects of storms in the last 20 years on the people of Dome?
10. What have been the prevalent effects of increased temperatures in Dome in the last 20 years?
11. What are the causes of these events?

SECTION D: SUPPORTING ADAPTIVE STRATEGIES OF DOME PEOPLE EXPOSED TO EFFECTS OF CLIMATE CHANGE

12. What does your institution do to help the people in the aftermath of flooding?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

13. What does your institution do to help the people of Dome in the aftermath of a storm?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

14. What does your institution do to support the people of Dome during heat stress?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

15. What mechanisms have been put in place by this institution in the last 5 years to prevent flooding from occurring in dome?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

16. What mechanisms have been put in place by your institution in the past 5 years to prevent storms from happening in Dome?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME

17. In the past 5 years, what strategies have been put in place to reduce heat stress?

DIFFERENT EFFECTS	INSTIUTIONAL SUPPORT	GROUP OF PEOPLE IN DOME