

DECLARATION

I hereby declare that this submission is my own work towards the M.Sc. in Development Policy and Planning and, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

Flooding has been a recurrent problem in the Aboabo river basin for many years now. It has resulted in loss of lives and properties in diverse ways. Flood management institutions and households over the years have adopted different control measures in their bid to address the problem. Despite their continuous effort to solve the problem it still persists. This research sought to identify the causes and socio-economic effects of flooding and the institutional challenges associated with flood control measures adopted in addressing these problems. Additionally, the coping strategies of residents were also investigated. To investigate the problem communities along the Aboabo River such as Dichemso, Asawase-apagyahene, Aboabo, Anloga and Amakom were selected for the study. Surveys were held with household heads in the study communities to solicit their views on the causes of flooding, effectiveness of flood control mechanisms implemented as well as the coping strategies adopted. Key officials of related institutions were also interviewed to capture their view about the problem and identify the various flood control measures put in place. It was found out that poor drainage system in the basin contributes significantly to flooding aside the obvious natural factor of precipitation. Also indiscriminate disposal of solid waste, in the Aboabo River, haphazard development on floodplain further worsens the problem. The effects were mainly health, psychological, environmental and economic related problems. Among the flood control measures implemented were desilting of the Aboabo River, construction of flood breaks, temporary drains, and clearance of choked drains. Institutional challenges of flood control include inadequate resources and logistics, poor methods of waste disposal practices in the basins and inability to fully enforce land use regulations along the river. Again, the study revealed the major coping strategies as movement to higher grounds, seeking for external support and clearance of choked drains. Finally, in order to address these problems it was recommended that in the immediate term the drainage system in the basin should be improved while methods of solid waste disposal and collection should be strictly monitored by waste management departments. At the same time land use laws and regulation should be enforced. In the long term a road map should be drawn for gradual relocation and decongestion of residents in the green belt and floodplain of river Aboabo.

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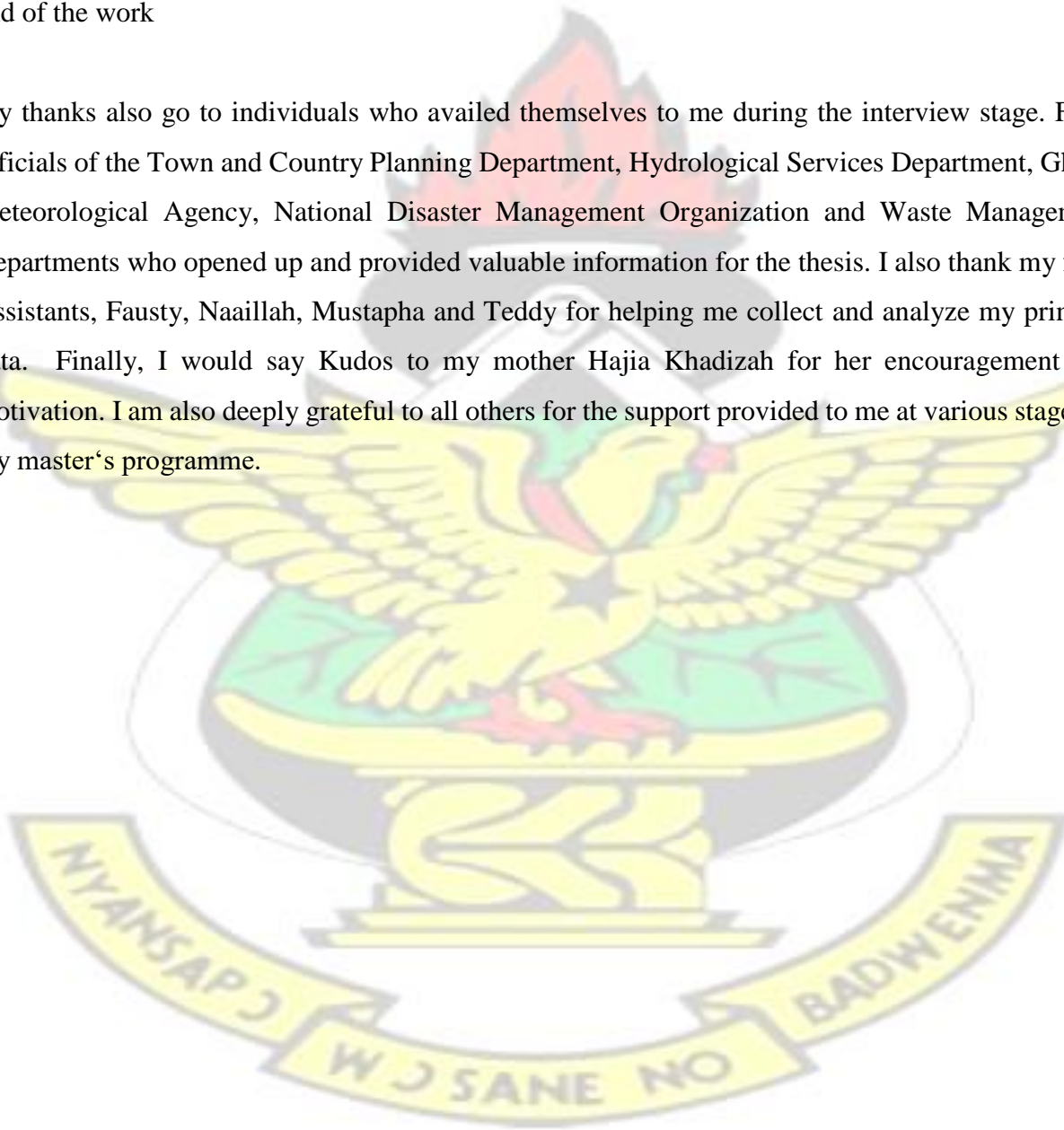


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LIST OF ACRONYMS

AMMA	Asokore Mampong Municipal Assembly
APFM	Associated Programme on flood management
GMA	Ghana Meteorological Agency
GIS	Geographic Information System
IFA	Institution for Floods in Asia
KMA	Kumasi metropolitan Assembly
MEST	Ministry of Environment Science & Technology
NADMO	National Disaster Management Organization
TCPD	Town & Country Planning Department
UNDP	United Nations Millennium Development Goal
WMD	Departments of Waste Management, KMA

KNUST



CHAPTER ONE

BACKGROUND TO FLOODING IN ABOABO RIVER BASIN

1.1 Introduction

The United Nations Millennium Development Goal Seven requires that nations should ensure environmental sustainability in their quest to development. However, the incidences of several forms of environmental hazards are likely to threaten the attainment of this goal (UNDP, 2009). These hazards among others are: wildfires, tsunamis, earthquakes, volcanic eruptions, landslides and floods. According to IFA (2005) flooding is one of the most frequent of the hazards due to the immense distribution of river floodplains, low-lying coastal areas and more days of heavy precipitation. In the opinion of Brown and Damery (2002), the impacts of floods have grown in spite of the improve systems in place to give early warning signals and the sophisticated measures put in place to monitor them when they occur. In their view, societies have therefore become more vulnerable to this natural hazard. At the same time, exposition to risk and vulnerability in flood-prone areas have been growing constantly as a result of long standing attraction for human settlement in low lying and flood prone areas.

Again, Tucci (2007) indicated that flooding occurs when water from rivers, streams and storm-water tunnels leaves its normal canal, exceed its capacity and overflows into immediate areas. Accordingly, this is caused by either natural factors such as precipitation type, relief, drainage capacity or artificial factors which include deforestation, farming and urbanization. In the light of the above, United Nations Development Programme (UNDP) (2004), argued that the effect of flooding is likely to be devastating due to the gradual increase in the world's population and gradual turning of stream's buffers into human settlements. The UNDP estimated in 2004 that on the average about 196 million people in more than 90 countries were exposed every year to catastrophic flooding (UNDP, 2004). It is evident from this exposé that livelihood and as well as human settlement are threatened. There is therefore the need to develop effective flood management system to deal with the situation as and when they occur.

Zarmina et al. (2014) asserted that flood management systems are series of coordinated flood protective measures that require extensive coordination among several stakeholders to operate and maintain.

These management systems accordingly include: mitigation; preparedness; response; and recovery. However, Smith (1997 cited in (Rogers-Wright, 2013) argued that magnitude and timing of flooding is uncertain as such it poses challenges to the existing management systems meant for addressing flood related issues. By implication, this will undermine the effectiveness of the flood management systems. In the same vein, Institution for Floods in Asia (IFA) (2005), argued that the proportion of people affected by flood in developing countries keeps increasing despite the existence of several management systems to control the situation. As a result, Manuta et al. (2005) posited that flood management systems needs to combine both structural and nonstructural measures that can significantly reduce the risks of flood disasters. These structural measures can take several forms such as dykes, levees and river channel alterations. In the same vein non-structural measures like land use management and flood warnings or awareness creations on the likelihood of flooding are also essential elements in flood management systems.

According to Aboagye (2012) several Ghanaian cities have experienced recent flooding. The author accordingly attributed this scenario to rapid unregulated physical developments coupled with uncontrolled disposal of waste along river banks in these cities. Aboabo and Asawase suburbs in Kumasi epitomizes this situation where perennial flooding has become an annual ritual in communities along the Aboabo river despite the effort put in by flood management agencies.

In this regard, institutional efforts in dealing with flood problem are likely to be thwarted if there are no coordination among the various stakeholders within the existing flood management system. Ineffective coordination between institutions and residents affects implementation of policies, programmes and projects that are meant to deal with flood issue. Again measures formulated by institutions to address flood risk are likely to be delayed for lack of clear definition of responsibility and roles among various stakeholders as well as logistical constraints. Additionally, gaps in information flow among stakeholders have always affect preparedness and response to flood in recent times. Therefore poor flood management system may increase vulnerabilities to floods and

its related disasters (Manuta et al. 2005). In any flood management system, the infrastructure, procedures and guidelines are essential to the achievement of the goals of the system. These mechanisms should be robust and complied with.

1.2 Problem Statement

Perennial flooding has been a major problem in Ghanaian cities, particularly in Accra and Kumasi (Ahadzie and Proverb, 2011). Preliminary observations show that over the years flooding has been very devastating. For instance, in 2007, thirty-two (32) Ghanaians died, several properties and infrastructure destroyed across the whole country and in 2004, Two hundred (200) homes were destroyed and about 1000 people rendered homeless in Kumasi (Ahadzie and Proverb, 2010). This was substantiated by Oppong (2011) who indicated that flooding in Aboabo has led to the loss of livelihoods, property and displacement of people. In this light, the National Disaster Prevention Management Organisation (NADMO), added that the situation even continue to deteriorate along the banks of the Aboabo river each time its floods for the past decade. Unfortunately, this deplorable picture is aggravated by the unavailability of any historical data from NADMO to give a clear picture on the incidences of floods and its effects on community. This has made it difficult to plan, monitor and take appropriate steps to control its effects despites its frequent occurrences.

Additionally, the residents in the communities along the river seem helpless in the event of flooding due to poor dissemination of information from appropriate institutions. The situations have made flooding more threatening in these areas as people are usually caught unawares. Also, there has been rapid construction of physical structures within the river's buffer. Even though the Ministry of Environment Science and Technology in 2011 stated that areas of 10 to 60m from either sides of urban river banks should be reserved as buffer to offer protection to the water body. Additionally several settlements have been erected in the nearby low lying areas beyond the buffer zone of the river which have exacerbated the situation along the river banks. This is aggravated by the indiscriminate disposal of solid waste in the river valley.

The above causes of the flooding in the Aboabo communities have not received the required responses. Also, the mitigation, preparedness and recovery strategies have not been adequately and effectively implemented in communities along Aboabo River (Oppong, 2011). For instance,

whenever the river breaks its banks and floods the communities along it; it takes about two or more days for appropriate institution to take action. This put residents in a precarious situation. This study therefore seeks to investigate the flood mitigation, preparedness, response, and recovery strategies and procedures along the Aboabo River.

1.3 Objectives

The main objective of the study is to assess the effect of flood control mechanisms along the Aboabo River.

The specific objectives include to:

1. Identify the causes and effects of floods along the Aboabo River.
2. Identify institutional or household weaknesses associated with flood control mechanisms along Aboabo River
3. Identify the coping strategies of residents in the Aboabo River basin in the event of flooding.
4. Suggest recommendations for flood risk reduction in the Aboabo River basin

1.4 Research Questions

- What factors contribute to the flooding along the Aboabo River?
- What mechanisms are in place to mitigate flooding along the Aboabo River?
- What are the challenges faced by institutions or households in controlling flooding along Aboabo River?
- What coping mechanisms are adopted by residents along the Aboabo River in the event of flooding?

1.5 Scope of study

The study was carried out in the Aboabo river basin which runs along the Kumasi metropolis and Asokore Mampong Municipality in the Ashanti region. Kumasi Metropolis is divided into 9 sub-metropolitan areas for effective administration. These sub-metropolitan areas are Bantama, Suame, Manhyia, Tafo, Kwadaso, Nhyiaeso, Subin, Asokwa and Oforikrom. Asawase sub-metro

formerly under KMA now forms the Asokore Mampong Municipal as shown in figure 1.1. Three out of five communities along the Aboabo river chosen for the purpose of this study are located in three different sub metros under KMA whiles the other two falls under AMMA. Dichemso, Anloga, Amakom are under KMA whiles Aboabo No. 1 and Asawasi - Apagyahene falls under AMMA as shown in figure 1. The river originates from Tafo-Pankrono at the northern part of Kumasi the regional capital of the Ashanti. It flows through Moshie Zongo, Dichemso, to Asawase, Aboabo, Amakom, Anloga and joins the Sisa at a confluence at Asokwa. (Omane, 2002 cited in Danquah et al., 2011).

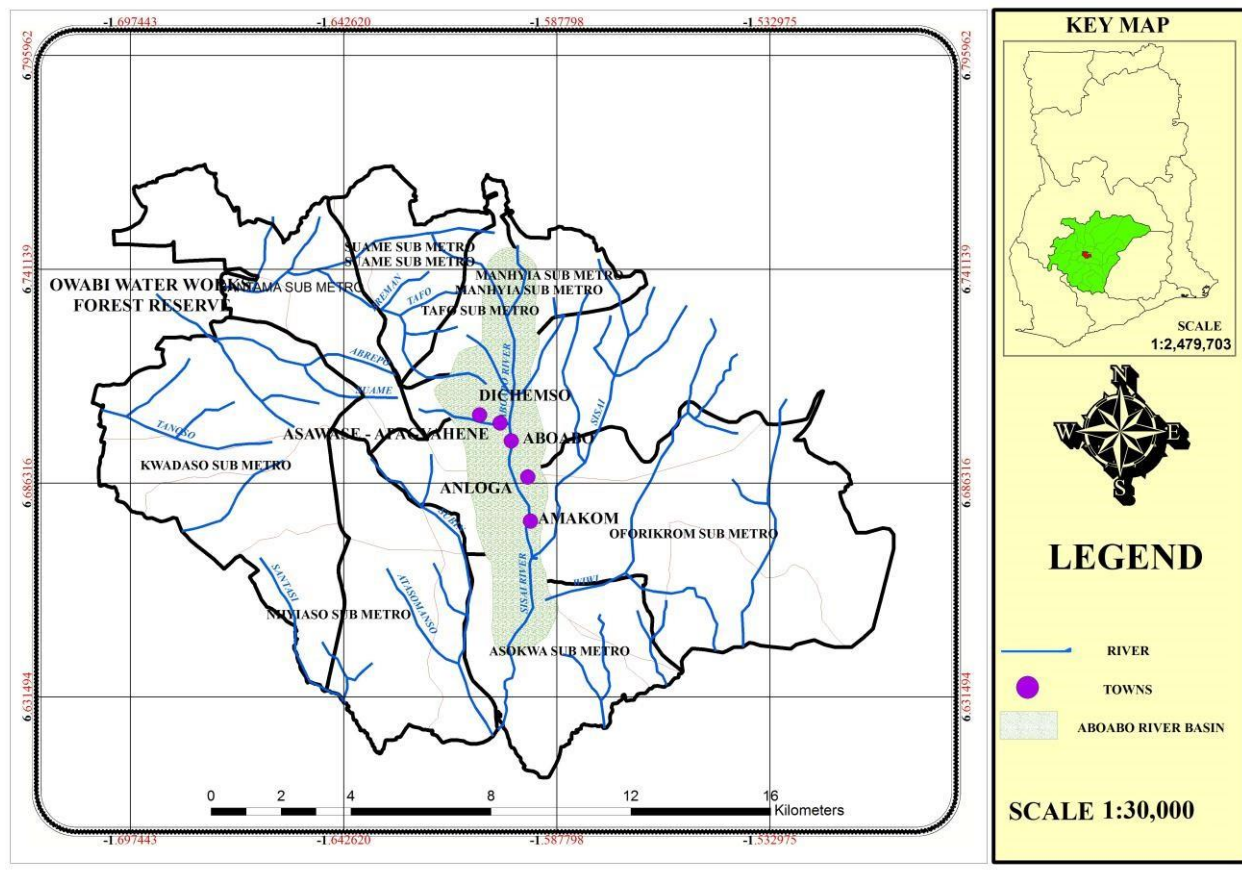


Figure: 1.1 Map of Kumasi showing the Aboabo River basin

In terms of content, the study considers the impacts of flood mitigation, preparedness, response and recovery measures to control floods. The main focus is on strategies in place to minimal the effects of floods in the community. Additionally it also considers post flooding strategies employed to deal with floods and its associated effects when they occur. At the same time the study also

addresses the coping strategies of residents as well as factors that hinder the effectiveness of these flood control strategies in the communities.

1.6 Justification of the Research

Several investigations on flooding have been carried out in different parts of Ghana providing vast information for physical planning (Oppong, 2011). In light of this, Brown and Damery (2002) stated that attempt to construct flood mitigation measures along urban rivers create a wrong impression of the river basin now becoming a safe place for habitation. This perception rather increases vulnerability levels of the people in the communities as more people are likely to settle closer to river. In the same vein, Ahadzie and Proverbs (2011) argued that despite the frequent occurrence of floods in Ghanaian cities there are no clear holistic management strategies to deal with the problem. In their view these strategies are carried in spontaneous manner. Also Braimah et al.(2014) posited that both natural and anthropogenic factors contribute to flooding in many Ghanaian cities. But all, these studies failed to address institutional capacities in flood management which have apparently become a major weakness in all these studies. This research will therefore seek to provide information that will facilitate planning along urban streams in the city of Kumasi.

This research will therefore provide important insight into the challenges confronting institutions or households in controlling floods especially in cities. It will also contribute to literature on solutions on flood management. Again, the MDG 7 draws attention to the need for amenable, efficient, safe and healthy built environments for growth and development. Additionally the results of the research will bring to the fore the various flood control strategies that are effective and efficient and those that are not. The information provided in this research could also serve as a basis for further research into the management of flood hazard areas in Kumasi and other parts of the country.

Finally, the outcome of the research will inform decision makers in the country on the appropriate and effective control strategies to be implemented to mitigate urban flooding in cities experiencing perennial flooding across the country.

1.7 Organization of the study

The study has been organized into six main chapters. The chapter one focused on the general background of the study, problem statement, objectives, research questions, the scope, justification and organization of the study. Chapter two dealt with detail review of literature and the conceptual framework on the problem of flooding. Chapter three dealt with the methodology of the study while chapter four presents a discussion of the profile of the study area. Chapter five focused on results and key findings of the study. Finally, the chapter five provided the summary of the major finding, recommendation and conclusion of the study.



CHAPTER TWO

UNDERSTANDING FLOOD MANAGEMENT SYSTEMS

2.1 Introduction

The chapter reviews relevant related literature on flooding. It focused on the nature, causes and outcomes of flood as well as its control measures. Among these are flood mitigation, preparedness,

and response measures. The study discussed issues on flood coping strategies and the capacities of relevant stakeholders in flood management. Also flood management in Ghana was also discussed. Furthermore, the chapter covered the schematic conceptualization of the study and finally a summary of the literature review.

2.2 Floods

Floods occur when rivers or streams cannot contain the volume of water discharge into it from nearby drains and subsequently overflows into the space humanity use for their activities. This happens when the normal channel of the water bodies has been disrupted or the carriage capacity has been exhausted (Tucci, 2007). However it poses a risk and can turn to be disastrous when it happen in areas where people, their property and/or environmental assets are present. In the view of Askew (1991 cited in De Lot, 2000) flooding is a natural phenomenon and thus can occur at any time in a wide variety of locations. It happens when water in a watercourse, lake, or coastal area occasionally occupies adjacent lands on a temporary basis because the capacity of the —normal channel or basin is exceeded as a result of heavy downpour. This is also confirmed by Vassileva et al. (2010) that flooding is a natural event that occurs mostly in river basin and creates similar problems wherever they occur. However, flooding does not only occur in river basin but can as well occur in other extensive flat inland areas with low water infiltration rate.

According to Zoleta-Nantes (2000) flooding occurs as a result of many factors of which some are over bank flow of rivers and lakes due to intense and prolong precipitation which are aggravated by low permeation of runoff due to encroachment on floodplains, silting of canal and riverbeds, and the obstruction of waterways due to improper construction activities.

Accordingly it happens with the incidence of storm surge which will magnify the problem of sea level rise that affects low lying coastal areas. Flooding is thus essentially the situation where water submerges dry lands for a period of time due to multiplicity of reasons.

2.3 Types of Flooding

According to Gautam and Hoek (2003) floods can be broadly classified into river floods and coastal & estuarine floods. River floods occurs when there is heavy rainfall, snow or ice-melt or ice jam

and more volume of water flows into the drainage system such that it exceeds its natural capacity and overflows onto areas near to the rivers. Also coastal and estuarine floods happen when there is coastal storm surges, tides or earthquake that affect nearby areas (Petterson, 2001; Tucci, 2007)

However Petterson (2001) stated that floods can be grouped into different types depending on the characteristics or the sources of the flood event. In his view, floods can be grouped into four types either based on the characteristics or source of the flood event. Firstly, on the characteristics it includes flash floods of a few hours duration which are most often caused by heavy downpours within a short period usually six hours or less over drainage basins. They are similar to river floods except that they occur with little, if any, warning over a short period and in a relatively small area (Knocke & Kolivras, 2007; Dhar and Nandargi, 2003; Petterson, 2001).

Also Jha et al., (2012) added that relief of the area also contributes to this type of flooding. Heavy rains collected on steep slopes rapidly raise water level in receiving basin and finally flood the area. They further added that their effects are very devastating due to their sudden occurrence and the associated cyclonic disturbance. This has made it to be considered as violent in nature as it moves with high energy carrying along sedimentary material. These characteristics usually create unsafe circumstances for people and cause wide-ranging damage to property. This was further supported by Petterson (2001) who stated that the effects of flash floods are often dangerous and may, depending on the extent of development and land use activities in the affected basin, result in large loss of life and property because of its sudden onset.

Secondly, single event flood of long duration are associated with widespread heavy rains of several days or weeks with varied intensities over drainage basin. Such heavy rainfall is mostly associated with cyclonic disturbances like slow moving or stationary thunder storms. They have a single main peak and are notably of longer duration than flash floods and mostly the cause of major flooding (Dhar and Nandargi, 2003; Petterson, 2001). In their view unlike flash flood it is a gradually occurring event which may allow enough time for evacuation and protection of properties. Also long duration floods will aggravate environmental problems because recovery measures like clean-up will be delayed and contaminants may remain in the environment for much longer time. This may eventually pose a health risk to humanity.

Thirdly, multiple-event floods occur by the movement of successive weather disturbances like low pressure or depression, low humidity with hardly a break. At the same time there is intermittent spell of rain which causes gradual rise in level of water bodies and eventual overflow onto nearby space. Even though both single and multiple event floods are associated with rainfall during multiple event the precipitation does not necessarily has to be intense. Also this type floods can be anticipated just like single event floods due to their nature of occurrence (Dhar and Nandargi, 2003; petterson, 2001).

Finally, Dhar and Nandargi (2003) indicated that seasonal floods are caused directly by heavy precipitation over a drainage basin. They are seasonal in nature often occur in the summer or winter monsoon season. Butler (2012) further supported their view when he indicated that seasonal floods are a characteristic of many tropical rivers which usually occurs during the rainy season. Therefore all these types of floods are associated with rainfall and common to all these types of floods are economic, social and environmental effect.

Similarly Peterson (2001) indicated that floods can as well be grouped based on their source or origin. These are rainfall, snow melt and sea surge or tidal floods which have their source from rain water, snow, surges in the sea respectively. However all these types of floods outline earlier fall under the broad category of revering floods or coastal & estuarine floods.

2.3.1 River or Fluvial floods

River or fluvial floods occur when rivers or streams overflows and breaks it banks to cover adjacent, low lying flood plains. This occurs when the artificial or natural watercourse do not have the capacity to contain the flow of surface water runoffs. Again the flow in the channel and the level it reaches largely depends on both the amount and duration of the precipitation (Jha et al., 2012.) Also human activities such as farming, construction in floodplains can lead to silting of river channels and subsequent reduction in its capacity. This was supported by the Environment, Heritage and Local Government (2009); Tucci, (2007) who stated that river floods occur quickly or slow depending on the gradient of the river basin. For instance when there is intense downpours

water are supplied from the hilly to the lower side of the basin in a quick manner resulting in increased in volume of river level and subsequent overflows onto nearby space. Similarly river levels in basins with gentle slope increased gradually before it finally floods adjacent lands.

2.3.2 Coastal or Estuarine flooding

These floods usually occur in the coastal belts when there is storm surge or tidal wave across the sea. The result is that sea water are drive towards the coast and are not able to return back to the sea due to obstructions by nearby structures and settlements. Also when the surge happen at the point where the mouth of the river fall into the sea. The movement of the river is restricted which results in severe overflow onto nearby coastal areas (Dhar and Nandargi, 2003; petterson, 2001).

2.3.3 Other types of flooding

Floods being a natural phenomenon may generate both adverse and beneficial changes to the environment depending on where and how it happens. There are other types of floods which are also associated with location and mode of occurrence. Among these are urban flooding, pluvial or overland flow and groundwater flooding of which also share similar characteristic with river flooding.

2.3.3.1 Urban flooding

Urban floods are more specific to lack of drains or low capacity of the drainage system in urban areas to contain volumes of surface run-off from precipitation.

Accordingly, Ten Veldhuis et al. (2009) stated that urban flooding occurs when there is the incidence of pool of water on the surfaces of land in built environment as a result of rainfall overpowering the capacity of drainage systems such as storm sewers and failure of a particular component of the drainage system. Therefore unlike river flooding which are more associated with river bodies and precipitation urban flooding are also associated with failure of drainage or sewage system in cities. In the same vein, (Jha et al. 2012) stated that urban floods arise from a complex combination of causes which can be natural, human induced or both. In this regard it occurs when precipitation or other flows inundates urban surface as a result of the low permeability of the soil

due to constant urban expansion; improper land use planning and the inability of drainage systems to cope with flow of high intensity rainfall.

Again, the Department of Environment, Heritage and Local Government (DEHLG, 2009) ;Jha et al. (2012) added that urban floods are sometimes describe as pluvial or overland flow. They argued that it occurs in urban areas where rainfall or snowmelts are not able to permeate into the soil and flow over land before it reaches drainage systems or watercourses. The slow in permeation of rainfall or snow melt into soil was attributed to over concretization of urban surfaces. Pluvial flooding happens very often especially during the rainy season. However it drains quickly when it happens.

2.3.3.2 Groundwater flooding

According to the Department for Environment Food and Rural Affairs (defra) (2012) groundwater flooding occurs when water level in the underneath aquifer in a particular area rises until it reaches the surface level. This type of floods usually happens after prolong downpours and last for a long period. Groundwater flooding is more likely to occur in areas where the underlying bed rock is chalk. In the view of Foster et al. (2002) Groundwater flooding occurs when an aquifer formerly use for water supply is no longer put to use, the level of the water table may rise to reach the surface level and inundates the land surface. Also, in some instances where water pumps systems are installed to regulate the rise of the water table. Flooding can still occur when these pumping systems failed. Additionally Jha et al. (2012) posited that Groundwater flooding also contributes to overland or surface flooding; as such the two cannot easily be distinguished. Intense and sustained rainfall may cause water table to rise resulting in surface inundation. Therefore more surface run-off will move into rivers and drainage networks and excess overflowing onto urban surface.

2.4 Causes of Flooding

The Associated Programme on Flood Management (2008) asserted the extent, rate of occurrence, severity and duration of floods generally depends largely on both the natural and man-made phenomenon that drives these events. Accordingly the Colorado Department of Transportation, (2004) added that key among the natural drivers are the hydro-meteorological process. The

meteorological conditions include precipitation, typhoons, cyclones, hurricanes, and snowpack type; while the hydrological conditions leading to flooding may be the water cycle and drainage basin characteristics such as vegetation, soil type, surface infiltration, land use, slope, elevation and storage. In the same vein human activities particularly construction in floodplains largely influences the trend of flooding.

Additionally, Tucci (2007) posited that both meteorological and hydrological conditions usually coexist in time and space for floods to occur. In the same vein Chang et al. (2009) that natural causes of flooding are those attribute, process or events of the earth controlled by nature that could trigger flooding; thus processes which do not have any direct human influence (Tucci, 2007). On the other hand human causes of flooding are those caused by the actions or inactions of humans, there is therefore a direct human influence.

2.4.1 Natural Causes of Flood

Among the natural causes of flood include the incidence of heavy and prolongs rainfall which results in rise in water level of rivers and other water bodies beyond their carriage capacity. Eventually, these water bodies overflow its bank to occupy nearby spaces. This is the most prevalent natural cause of flooding. According to Van Alphen et al. (2006) flooding occurs when urban streams break its bank and flows onto floodplains as result of prolong rainfall. Golding et al. (2005) supported this view where they indicated that prolong and intense rainfall in North Cornwall contributed significantly to the Boscastle flood of 2004. In the same vein the National Flood Risk Advisory Group (NFRAG) (2008) indicated that storm driven ocean events including storm surge and a combination of both rainfall and cyclonic storm usually causes flooding in the eastern coast of Australia.

Secondly, the nature of relief or the drainage basin is also a natural cause of floods. The flow of rivers in low lying areas or flat land is slow. Therefore if water level increases suddenly, the carriage capacity could be overwhelmed and flooding occurs. On the other hand if the river valley is steep, more volume of water will speedily enter a river resulting in rise in its level and subsequent overbank flow. This was reaffirmed by Bull (2004) that steep slope and narrow river channel was

among the causes of flooding of River Valency; Boscastle in 2004. In this regard flood zone areas whose relief is very steep usually experience frequent flooding than in low lying areas.

Additionally, the absence of vegetation cover is an essential factor among the natural causes of flood. Forest cover intercepts precipitation and slows raindrops impact as a result surface run-off is reduced and deep infiltration encouraged. Densely vegetated river basins therefore experience less flooding compared with areas of little or no vegetative cover. This is because it has the effect of intercepting part of the precipitation that can generate runoff and reduce the amount of water that flow into nearby rivers or streams. As such urban streams devoid of vegetation cover have the tendency to flood nearby spaces owing to increased volume of run-off flowing into the river. This goes to confirm the view of Olang and Fürst, (2011) who indicated that land cover changes have increased peak discharges and flood runoff volumes within the sub-catchments of Nyando River basin, Kenya.

Finally, river discharge capacity is also a natural cause of flooding. Streams overflow onto immediate surroundings if the natural canal capacity of the stream cannot accommodate the surface water run-off directed into it after intense rainfall. In addition, pooling of surface soil can also reduce canal capacity of streams or rivers as well as the dumping waste into the canals. According to Sharma (2013); Bull (2004) intense and prolong rainfall flooding occurs when the available river channels, sewage system and draining canals present do not have the adequate capacity to contain the amounts of rain that are falling.

2.4.2. Human Causes

The action and inaction of man play a significant role in the magnitude and frequency of floods in diverse ways. Specifically, it is the human activities in water catchment areas which drastically intensify floods. In this regard, human actions associated with land use changes are the most important. Tucci (2007) argue that human causes of flooding can be grouped into structural and non- structural measures. Structural measures are those that occur as a result of the permanent phenomenon of expansion of cities onto flood plains while non structural measures are the absence of regulatory framework to deal with events or activities that can contribute to flooding. The following are some of the human causes of floods:

Urbanization has led to over concretization or tarring of urban surfaces which reduces infiltration rate of rain drops. For instance expansion of built-up impermeable surfaces like roads, parking lots and shopping malls decrease infiltration rate of precipitation. Therefore excess surface water run-off is not able to permeate into soil and thus leading to overland flow or inundation of open surfaces (Kumar et al., 2015; Davie, 2008). Also (Neto, 2001.) posited that floods results when there is heavy surface-water runoff onto dry lands as a result of prolong precipitation and excesses water are not able to permeate into soil due to extensive tarring or concreting of the earth surface.

Again Ward and Robinson (2000) asserted that the presence of forest cover serves as an intercepting layer for rainfall, which reduces the rate at which water reaches the surface. On the contrary, human activities such as farming, construction and other land use development in forested areas can gradually leads to deforestation. Deforestation however can intensify river flooding by reducing infiltration rates and reducing water carrying capacity of river canals as surface water run-off pool top soil into river channels. Also, the presence of high organic matter in forest soils make it possible to absorb high amount of water thereby reducing overland flow; whereas the reverse happens in deforested areas.

Additionally, river channel alterations also have an impact on flooding. In some cases where the river has been redirected the river simply takes its own route during extreme events regardless of the original pathway. Davie (2008) posited that restriction of river into permanent rigid channel will increase the risk of flooding even though it is supposed to offer flood protection. This often causes problems further downstream, as water travels downstream at a faster than normal rate. In the same vein, poor drainage construction can exacerbate flood events as bridging points and contained sections easily get blocked and quickly flood immediate surroundings. This was further supported by Van Alphen et al. (2006) that embankment failure, particularly due to poor maintenance, inadequate construction and/or poor design reduces river channel capacity. This results in quick rise in river level beyond the carriage capacity and subsequent flooding of immediate floodplains. Also Karley (2009) indicated that development of infrastructures

particularly in floodplains without recourse to proper planning often exacerbates flooding. For instance construction on floodplains often leads to restriction or diversion of waterways.

Lastly population pressure is perhaps the dominant human cause of floods in the world. As population continues to increase over time, there is corresponding increase in demand for natural resources and other basic necessities of life such as food and shelter; consequently there will be mounting pressure on nature. In this regard, there will be increase in agricultural practices and urbanization. This was reaffirmed by Stevens et al. (2014) that increase in the total number of reported flood events in the 20th century in the UK appears to be a function of the gradual increase in exposure due to urban expansion and population growth.

2.5 Outcomes of flooding

There are numerous effects of flooding which range from loss of livelihood, property, displacement of people and even death in some extreme situations. In the view of Lebel et al., (2006) floods turn to be disastrous when the degree of the hazard is high. Therefore it is likely to be disastrous when it occurs in areas where there is concentration of human activities and settlements. On the contrary flooding does have some positive effects aside the common negative ones. According to Few et al. (2004); Nyakundi, et al. (2012) what constitutes a flood disaster still remains a debatable issue as what is seen to be disastrous at one end is not the same at the other.

Flooding in rural areas may be regarded as beneficial for rural farmers and otherwise among the urban population. In this regard, the following are some positive and negative outcomes of flooding.

Floods serve as a means of maintaining a balance of the hydrological cycle of the ecosystem through the management of excess water from precipitation. Again when river overflow onto immediate flood plain nutrients are deposited onto the flood plain which then provide a suitable environment for plants to grow well. This subsequently protects water bodies against silting as the presence of such plants along flood plains guards the eroding of top soil into water bodies. In addition, nearby farming communities can put alluvial soil along river banks into good use as it contains essential nutrients that can enhance crops productivity. Luz-Agostinho et al. (2009) explains

that flooding enrich floodplain with the integration of nutrient-rich sediment as well as terrestrial biomass into the top soil. Similarly, these sediments that are washed into river canal also enhance the regeneration of aquatic lives in the river.

However, floods are also among the most common and destructive of all natural disaster. The effect of flooding on mankind over the years has been very devastating and is anticipated to increase as a result of continues change in climatic conditions. According to Neto, (2001) floods were among the most devastating type of natural catastrophes both in terms of human impact as well as socio-economic loses. Again, the severity of the adverse impacts of floods largely depend on multiplicity of factors such as the increase in activities and population of resident in flood prone areas and the frequency, intensity and extent of flooding. The effects of flooding usually take different forms and occur either immediately or later. The Associated Programme on flood management (APFM, 2013) classified the negative effects of flooding largely as socioeconomic and political.

Firstly, floodplain in recent time has experienced increased in concentration of human settlement and economic activities due to conduciveness for farming, poor land-use regulation and population growth. The concentration of human activities in such areas have made flood to pose more social problems whenever they occur, especially when it is in high magnitude.

Loss of human lives, deterioration of victims health condition due to disease outbreak are among the immediate social effect of flooding. Neto,(2001); further confirmed that flooding turn to be disastrous when they occurred in areas with high population density. He argued that in such instances life are lost, property are destroyed and residents are exposed to health hazards. Also APFM (2013) stated that flood victims and their families do suffer from emotional stress and trauma as a result of the disruption of their livelihood, loss of properties and loved ones. This stress can subsequently results in lasting psychological impact on flood victims.

Again, flooding can prompt mass migration and population displacement. This happens when flooding and its associated negative effect on well being persist in an area for a long period. People are forced to migrate or relocate to other areas where their well being could be improved. This subsequently results in overcrowding in other urban areas which can as well create complex social

problem (APFM, 2013). Similarly, Van Alphen et al. (2006) asserted that when flooding occurs in areas with high densities of people, assets and vulnerable infrastructure. The damage of settlements and disruption of economic activities prompt the displacement of people.

Secondly, economic activities usually slow down or come to a halt when normal lives of people are disrupted as a result of the consequence of flooding. People form the core labour of all sectors and their absence affects the demands and supply of goods or services in the market. Again, APFM (2013) stated that when inter-connective links and infrastructure such as roads, bridges, and power generation plants are damage and disrupted owing to flooding it can inhibit the regular flow of economic activity and lead to loss of livelihood. The trickling down effect of livelihood loss can also be felt on the economic activities of adjacent non-flooded areas.

Eventually, there will be shrinkage of purchasing and production capacity of people and firms.

Additionally, the economy of a region confronted with recurrent flooding may be crippled as revenue that would have been used to undertake infrastructural and other investment opportunities for development will have to be diverted into relief items, rehabilitation of infrastructure, and health care provision. Similarly flood prone areas do not attract investment especially in the private sector which does not auger well for effective economic growth and development. Migration can as well affect the supply of skilled labour which may affect productivity and subsequently the development of the region (APFM, 2013). This was supported by the National Flood Risk Advisory Group (NFRAG) (2008) who stated that the east coast of Australia has suffered from several losses in excess of billions of dollars in damage to both public and private properties from catastrophic flood event. These consequently resulted in major impacts on the Australian economy. Again, Adelye and Rustum,(2011) indicated that during flood events food stuff and livestock are washed away. This subsequently disrupts the livelihood of victims particularly where they depend on it for living. Also Poaponsakorn and Meethom (2013) added that the flood of 2011 in Thailand had negative impact on money and wage income of household living in flooded provinces. The floods overtake most of the vicinity meant for economic activities and at the same time disrupt the working hours of wage workers.

Finally, flooding has political and security implications. The inability of authorities to provide assistance to flood victims during major flood events may lead to public dissatisfaction and loss of trust in the local and national government. Similarly, if authorities fail to undertake development investment in flood prone area for fear of being destroyed by perennial flooding, it may spark social unrest which will destabilize the peace and stability of the area (APFM, 2013). In another dimension, Theiling (1998) posited that flooding also have a negative impact on the environment. He argue that the quality of water is compromised owing to its pollution by inputs of agricultural chemicals , industrial and household waste that are washed into rivers during major flood event. The fauna and flora in the flood plain are as well lost during major flooding.

2.6 Flood Management Systems

According to Neto (2001) effective flood management requires a comprehensive set of approaches and measures integrated into a composite form. In this regard both decision-making and control measures on flooding should not be disjointed. The measures applied in flood control should be coordinated whiles decision are taking in participatory manner, where all relevant stakeholders are involved. Neto again explains that the four basic approaches to flood management include: preparedness, mitigation, response and recovery.

This was further confirmed by Osti and Nakasu, (2014) that flood management tools can be classified into well before, before, during and after event activities within the scope of flood management cycle. The idea was further supported by Zimmerman and Faris (2010) that the city of London approach to flood management on the basis of the impact of climate change is based on four basic management actions: mitigation, preparation, response, and recovery. These measures form the element of the flood management systems. Again, Mekong River Commission (2008) indicated that flood control measures involves pre flood measures such as mitigation and preparedness approaches and post flood measures which are response and recovery approaches.

2.6.1 Flood Mitigation

According to Kellens et al., (2013) flood mitigation involve the procedure or actions that are taking to minimize flood impact in flood prone areas usually before any flood event emerge. These actions can either be in the form of structural and non-structural measures. Tucci (2007) posited that

structural measures are those that change the river system by means of constructional changes in the watershed or in the river to avoid overbank flows onto floodplains. Among these are construction of embankment, levee and creation of alternative route for excess overflows. Also non- structural measures are those in which regulatory or guidance measures are applied in order to minimize flood effects. These include issuance of flood warning, flood proofing and awareness creation.

Accordingly Tucci (2007) added that in order to reduce the losses from flooding, control measures should involve the combination of both structural and non-structural measures. These measures should be in place earlier in advance before the flood event. Again, Manuta et al. (2005) posited that actors involved in flood mitigation need to have the capacity to coordinate and mobilize resources in order to take critical actions. This was further supported by Lebel et al. (2011) who concluded that coordination of activities of agencies and stakeholder groups is important for flood mitigation, in particular, during the preparation and implementation of programs and projects in flood prone areas.

2.6.1.1 Structural measures

These are the physical works carried out to minimize the risk of flooding. Tucci (2007) group these measures as extensive or intensive measures as discussed below. Extensive measures are the engineering changes that occur in the watershed system. These measures are carried to influence the flow of run-off in riverside areas. Among these include the restoration of vegetation cover in floodplains to intercept precipitation resulting in decrease in volume of surface run-off directed into rivers. Also, vegetation cover control soil erosion in floodplains by reducing the speed of run-off that transports sedimentary materials into rivers. Therefore canal capacity does not shrink and the river flows are maintained at the same level without overbank flows.

In another dimension intensive measures are the engineering works carried in the river system. These include the construction of reservoirs or dam to accommodate excess flow of river which are subsequently use for water storage, irrigation and electricity generation. For instance, concrete walls known as dykes are erected few distances from the banks to protect nearby areas against overflows. However, dykes tend to pose more risk when the flow of the discharge overwhelms the

design level of the dyke. Additionally, alterations of river canal are also carried to increase the width of river such that the flows remain at the same level without overflowing.

2.6.1.2 Non-structural measures

According to Tucci (2007) non-structural measures usually complement the structural ones during flood mitigation. It focuses more on prevention rather than protection. These involve flood forecasting and warning, flood insurance, flood proof construction, zoning of flood prone areas and are discussed below. Firstly, forecasting and early warning system are instituted to determine the incidence of flooding and warn population accordingly. It begins with monitoring, compiling and transmission of weather information to forecasting agencies. This information is then processed and then use to predict possible flooding. Possible interventions are then put in place such as warning residents who are at risk, relocation, search and rescue team among others.

Again, zoning of flood prone areas requires the determination of areas susceptible to flooding and setting up the rules and regulation for development in these areas. It therefore seeks to guide land use activities in flood risk areas in order to avoid property loss. Zoning regulation will be beneficial to population if they are integrated in the bye laws of local institutions like the municipal or district assemblies so that it can be effectively enforced. Zoning therefore ensures that flood vulnerability is reduced in flood prone areas.

Additionally, flood-proofing are laid down regulations formulated to guide building standard in floodplains. The aim is to mitigate the losses from floods. These ensures the use of water resistant building materials, elevating buildings to higher height, construction of dykes around buildings and setting up warning system in buildings or communities. Finally, flood insurance seeks to lessen property damage resulting from floods. They are usually patronized by capable home owners whose projects or properties have high financial value. However, in areas where residents are of low income this kind of preventive measures are unviable.

2.6.1.3 Household mitigation measures

According to the Australian Government and Attorney General Department (2008) households mitigate flood damage through two main ways and these are contents removal and barrier methods.

Content removal involves the transport or lifting of essential items or equipments to higher areas while for barrier methods, temporary barriers are erected from sand bags, earthwork or available materials to prevent water entering into homes or yards. However in putting up the mitigation methods there should be sufficient warning time and availability of resources. Again Neto (2000) added that households rely on flood warning message to put in place necessary measures to protect their property from floods.

2.6.1.4 Institutional mitigation measures

The Australian Government and Attorney General Department (2008) indicated that institutions provide mechanisms that can minimize the impact of flooding on people living in flood prone areas. Among these are constructions of levee, river channelization and dam reservoirs. Also land use control in flood prone areas also minimize flood risk. In the opinion of APFM (2009) improvement of drainage and surface water storage systems in flood risk areas enhances the draining of surface water and at the same time regulate water level in rivers during precipitation. Also Mekong River Commission (MRC) (2008) stated that the risk of flooding could be reduced if institutions provide access to and disseminate flood warning information to vulnerable communities. For instance loud speakers are positioned at vantage points within flood prone communities and occasional flood bulletin are released to alert residents on the current trending issues on floods. They again added that community sensitization on hazards and risk associated with floods allow household to adopt the best coping mechanisms.

2.6.2 Flood Response

Flood response are the measures undertaken by agencies, communities or individuals during flood event in order to save lives, avoid injuries, minimize property damage, and protect the environment (The Australian Government and Attorney General Department, 2008). They are therefore immediate emergency activities implemented during flooding to avoid or reduce the impact on society. However it requires collaboration and cooperation between flood management agencies and communities. In the view of Manuta et al. (2006a) response to floods and potential disasters is determined by the availability of financial resources, needed equipment as well as the

appropriate expertise. Actors in flood management therefore need to have the necessary resources and expertise in order to be able to respond to flooding within a moment notice.

Furthermore, the planning and implementation of response measures in the event of flooding requires the clear definitions of roles and responsibilities of actors involved (Satterthwaite, 2011). In this regard Ellis and Revitt (2010) concluded that there is the need to define different level of responsibility that exists between and within organization during flood response to ensure consistency and harmonization in the operations of institutions. This prevents duplication of effort and ensures effectiveness during flood response operations. Flood cannot be prevented all together as such there is the need for adequate response strategies/mechanisms to exist in order to help best reduce its impact when it occurs.

2.6.2.1 Household response measures

Paul and Routray (2009) asserted that households adopt different indigenous response measures such as distress migration, moving to higher grounds and disconnection of electrical appliances during flood event.

Similarly Thieken et al., (2010) added that emergency measures carried by household in the period of flooding include safeguarding valuable household contents from flood. The effectiveness of these measures relies on knowledge of the appropriate actions to take. Again,

Van Alphen et al. (2006) asserted that people's responses to flooding are determined by their past experiences and understanding of flood warning message. They tend to delay or act swiftly depending on their previous knowledge on past flooding. For instance it was observed that in Japan people who are familiar with hazard maps evacuate earlier than those who are not.

2.6.2.2 Institutional response measures

The Australian Government and Attorney General Department (2008) indicated that institutions respond to flooding in different approach in order to save life and property. Among these measures are maintaining and securing access route, conducting search and rescue operations, evacuation of victims and quickly fixing essential service like electricity and water supply in affected areas. Additionally during evacuation operation the age of victims, characteristic of the flood inundation,

nature of roads and resources required for complete evacuation should be considered. Also, Wamsler (2006) concluded that response capacity determines the extent of the impact of flood hazard. Institutions in flood management with adequate expertise and resources are able to respond swiftly in the event of flooding as such limit considerably its damming consequence.

2.6.3 Flood Recovery

Flood recovery measures are put in place to support people return to a normal or stable state after suffering from the impact of flooding (Kellens et al., 2013). It can take several forms such as the provision of food, shelter, clothing, insurance packages etc. and usually happens after the event. Paul and Routray (2009) posited that the provision of assistance to flood victim from governmental and non-governmental organisations in order to minimize the hardships that confront them is essential in flood management as it help them recover swiftly. However such support combined with social capital can significantly improve the capacity of people and reduce the hardship that confronts them after flooding.

Accordingly, De Lot, (2000) added that the provision of emergency relief services is paramount in flood disaster management aside the implementation of both structural and non-structural measures during flood preparedness.

In another dimension, Aerts and Botzen (2011) indicated that the existence of flood insurance as a recovery measure helps people to deal with the financial consequences of floods. They again argued for the need for cooperation and collaboration among victims, national flood insurance agencies, emergency and disaster management agencies as well as City planning departments in the implementation of such measures. Furthermore, post event response and rebuilding requires coordination of activities among department and agencies (Satterthwaite, 2011). However Van Alphen et al.,(2006) added that effectiveness of flood recovery programmes depends on an adequate budget, staff and skill of actors involved. Similarly, Osti and Nakasu, (2014) affirmed that the recovery of flood victims at any point in time is dependent on the availability of both human and physical resources.

2.6.3.1 Household recovery measures

According to the Australian Government and Attorney General Department (2008) household initiate recovery function after floods through cleaning and restoration of homes and also maintain the safety of buildings through checks on electrical connectivity and structural defects.

Also, Neto (2000) added that among the non structural measures taken by households in post flooding situation are borrowing from friends, families or microcredit institutions, spending on previous savings and selling of assets.

2.6.3.2 Institutional recovery measures

According to Thieken et al. (2010) national agencies make provision for emergency funds and insurance packages to compensate for the losses suffered by flood victims. The provision of these funds ensures rapid recovery of flood victims. Also, the Australian Government and Attorney General Department (2008) added that restoring of road infrastructures, electricity and water supply enhances recovery of flood victims. Additionally recovery centers are also established to provide support for victims and move back evacuees to their various homes.

2.6.4 Flood Preparedness

Preparedness in flood management cycle is the last call of safety measures that are implemented shortly before or during flood event (Kellens et al., 2013). These includes: placing sand bags to redirect floodwaters, moving belongings to higher height and evacuation to safe place. Again, Auffrey (2002) posited that putting in place adequate structural measures like construction of flood breaks that can reduce the speed of flood waters minimize the losses resulting from flooding. Few (2003) further added that earlier flood preparedness provide adequate time space for residents in flood prone-areas to draw on their own capacities, networks and strategies to cope with floods. In the opinion of Neto (2001) large scale structural measures even though are good approaches to flood preparedness it effectiveness can be undermines as a result of some underlying factors such as inadequate funding for proper maintenance, poor constructional measures and poor land use activities in flood plain. Also, Green, (2014) asserted that implementation of preparedness measures in or about river canals to control flooding requires the powers to finance, design and implement. Institutions need the requisite capacity in order to carry and sustain these actions.

2.6.4.1 Household preparedness measures

Thieken et al. (2010) household implement precautionary measures before flooding by means of flood-proofing and retrofitting of buildings and properties. Similarly, Neto (2000) stated that households create access and evacuation route just before the occurrence of flooding. The provision of evacuation route facilitate rescue of victims caught up by flood waters. Again, Waching (2013) posited that the preparedness of individual in relation to the risk associated with flooding is dependent on their perception of the risk. However this perception is further influenced by the source and level of information they received about the flooding event.

2.6.4.2 Institutional preparedness measures

According to Thieken et al., (2010) institution issue warning information to community through loud speakers, flyers, sirens, posters, local radio stations for people to be alert of the danger of flooding so that they can protect themselves and property.

Accordingly, APFM (2009) added that flood warning messages should be clear and accurate so that communities can take the best measures to protect their life and property from flood impact.

Again, Kellens et al. (2013) argued that the existence of communication structures within the set up in flood management institutions that allow for effective dissemination of information about flood risk, or the absence of it, may have a major bearing on how well people are prepared for a disaster. Also, Garden (2007) added that good communication between potential victims of flooding and actors in flood management is essential in ensuring effective disaster preparedness. In the same vein, Nye et al. (2011) stated that sharing of flood warning information with people living in flood risk areas enables them to build their resilience capacity.

2.6.3 *Flooding Coping Strategies*

Coping in general is the way or methods in which people act within the limits of available resources to gain access to safety or livelihood (Wisner et al 2003). On the part of Few (2003) coping strategies could mean the approaches taken to prevent flooding or its adverse impacts through measures such as relocation of belongings, temporary resettlement and livelihood diversification. Additionally, Blaikie et al. (2004) asserted that coping mechanisms can be classified into two. These are preventive mechanisms and impact minimizing mechanisms. The former require people to take actions to avoid being affected by a disaster, a peculiar example is avoiding building on

waterways. Alternatively, impact minimizing mechanisms seeks to minimize loss and facilitate recovery. However these strategies can either be in the form of structural, non – structural or both. However coping strategies for perennial events which are adverse in nature are taking before, during and after, a typical example is flooding. At the same time coping strategies operate at different level: household, community and institutional.

Again, Khandker (2007) argue that in every society household resort to strategies to mitigate the adverse effects of shocks that arise from the impacts of disastrous natural events such as floods. In the view of Sirikuta and Inmuong (2014) household employed different strategies before floods in order to minimal it effect. For instance sand bags are piled on the ground to elevate houses, savings to deal with risk damage and keep essential drugs for family use. Similarly, Khandker (2007) argued that household shift electrical plugs to higher position, move family members and belongings to safer places during floods. Again Douglas et al. (2008) added that in post flood events households reduce their expenditure, sell their asset or borrow in order cater for the cost associated with flood damage.

In another dimension, López-Marrero and Tschakert (2011) posited that the effectiveness of household's resilience to natural hazards depends on the measures put in place by communities to complement the strategies adopted by households. In this regard communities implement both structural and non structural mechanisms to help residents withstand flood risk. These strategies are implemented in either pre or post flooding events. On his part, Douglas et al. (2008) stated that communities implement different level of coping strategies to help members cope with hazards and associated disaster. These include close and regular communication with members to prepare for floods, relief items and flood breaks.

Again, Sirikuta and Inmuong (2014) indicated that institutions set up enabling conditions for households to be able to cope with shocks particularly those associated with natural hazards. In the view of Khanker (2007) institutions influences local conditions by shaping up households coping capacity through education and awareness creation. Additionally, Sirikuta and Inmuong (2014) further added that agencies carry out disaster prevention and management measure to support flood

prone communities in the form of flood warning systems, relief items such as food and non-food material, and temporary health emergency centers. The provision of these support measures to affected communities eventually compensates and revives the livelihood of community members.

2.7 Flood Management Institutions

According to Bakker (2009), institutions are set of entities devised by society to shape the behavior of man or ordinarily the rules that guide society. Olsson (2003 cited in (Bakker 2009), further explains that institutions can be formal such as administrative structures which are backed by the necessary legislation or informal such as customs and practices that society itself has recognized. Additionally, Fox (1976) posited that institution can be an individual, a group, community or an organization. While the institutional arrangement refers to an interrelated set of entities and rules that organizes societies' activities so as to achieve a particular set of goals. These arrangements give the basis under which organizations and individuals can be provided with certain resources and power to carry out some prescribed task. In this regard in the remainder of this study the term —institutions‖ will mean formal government-based institution that have a responsibility or role to play in flood management and informal groups that are stakeholders in flood management such as households, Traditional authorities, religious leaders, assembly members and unit committee members.

However in the context of flood management, Manuta et al (2005a) identified various forms of flood management institutions in their study on institutionalized incapacities and practice in flood disaster management in Thailand. They classified the key agencies in flood management into two groups: (1) national flood disaster-related agencies, and (2) administrative bodies from national to local level. The national flood disaster-related agencies are further classified as strategic body and functional agencies. On one hand, the strategic body seeks to formulate measures and policies for flood management and its related risk while the functional agencies seek to operationalize these measures and policies. Thus they have the administrative duty to respond and manage flood and its related disaster from the national to local level.

In another dimension, Shaw (2004) in defining the roles of institutions in flood management; recognize that the involvement of communities in flood management creates the opportunities to improve accountability and responsiveness of state's institutions. In this regard household can be considered as a key institution in flood management. This is because they suffer the immediate effect of flood. In the same vein Manuta et al (2005) asserted that the involvement of local people in the design of measures and approaches of flood disaster management may provide valuable local insight in the planning processes. Insights from those whose livelihoods are affected by flood are helpful in determining the best flood management approach to use at any given time.

2.7.1 Institutional Capacities in Flood management

In broad terms capacity can be defined as the ability to execute task, solve problems and set and accomplish objectives (Fukuda-Parr et al., 2002). However institutional capacity can be considered to be what makes an entity or organization able or unable to carry out a task, solve problems or realize an objective. Additionally, Lebel et al. (2005b) posited that institutional capacities can be viewed in either of the following four broad ways:

*“The capacity to mobilize and coordinate resources;
The capacity to implement;
The capacity for deliberation and negotiation; and The
capacity for monitoring and evaluation.”*

In this regard, institutional capacity in flood management is the ability of institutions to perform either one or more of the following functions in any of the flood management approaches. Thus it is the ability to perform any of the functions in flood mitigation, preparedness, response and recovery. Besides interaction and collaboration between and among key institutions in flood management ensures effectiveness in the flood management cycle. This was reaffirmed by Label et al. (2011) when they concluded that coordination of activities among agencies and stakeholder groups is necessary for effective flood mitigation, especially during the formulation and implementation of programmes and policies that will reduce vulnerability to flood and its related disaster.

Again, Label et al. (2011) further added that coordination and planning in flood management can only be fruitful if institutions have the capacity to follow through and implement measures that were put in place. Thus the institutional capacity for implementation involves the appropriate use

and allocation of resources as well as the use of the best corresponding different forms of measures to execute effectively the critical actions needed during flood management. This was further supported by Lebel and Sinh (2009) that implementation of flood management measures requires technical expertise; as such institution requires the capacity in terms of both structural and non-structural measures to carry out such activities; otherwise in an attempt to reduce flood risk it is rather redistributed to other areas.

In another dimension Roling (2002) stated that stakeholders and agencies involved in flood management are required to include all interest groups during decision making, particularly the vulnerable. This is to ensure that diverse views and knowledge are brought to bear and consequently fair goals are set in all aspect of flood management. This was further explained by Ahmed et al. (2004) that if there is public participation in decision making at all phases of flood management local knowledge and capacities can be effectively utilized. Again flood related risk can be easily identified as well as the practical measures needed to address them. However in the view of Lebel and Sinh (2007) participation is not just about dissemination of information to the public. Osti (2004) further explains that participation should include empowering the vulnerable groups to be part of decision making. This will seek to ensure that their views are represented and acknowledged in any decision that is made.

Finally, institutions can only make corrections and improve on their activities if performance is monitored and evaluated continuously. Therefore monitoring and evaluation serves as a basis for learning and continuous improvement of performance in flood management. Krausmann and Mushtaq (2005) reaffirm this position by indicating that in order to understand and take account of any changing pattern of flood regime and as such enhance performance of flood management institutions; there is the need to have institutionalized monitoring and evaluation procedures. Again, Bakker, (2009) indicated that with adequate technical capability; institutions can predict, monitor the magnitude, duration, time and location of future flooding. This information therefore gives the opportunity for preparation and re-orientation in anticipating flood event.

2.8 Flood management in Ghana

Flooding has become a recurrent problem and that the impacts of such events might be aggravating given the relatively weak institutional arrangement in the Ghanaian disaster management structures. The occurrence of such events in Ghana aside the natural factors seems to be induced largely by human activities such as poor and unregulated construction practices on floodplains, and lack of adequate drainage systems. Also, there is poor consciousness of the inhabitants on flood forecasting and warning information and weak spatial planning in most cities. The impact of such events has taken different dimensions which include loss of livelihood, disease outbreak, displacement and death (Ahadzie and Proverbs, 2011).

In Ghana, a National Disaster Management Organization (NADMO) is in charge for coordinating the activities of the relevant bodies for managing all disasters including floods. Thus NADMO and other relevant stakeholders have a role to play in all the approaches in flood management. The NADMO in response to flood usually collaborate with other institutions such as the security services, health services, and metropolitan, municipal and district assemblies (Ahadzie and Proverbs, 2010). However, one major obstacle to their operations is that they can only offer advice to people in the event of disasters as they have no power of forceful evacuation.

Additionally, the Meteorological Service Department of Ghana also do have data on rainfall pattern in the country for which the Hydro-Meteorological and Geological Technical committees of NADMO can rely on in making decision on flood response. The data from these department feeds into decision making on issues pertaining to floods preparedness, response and recovery (NADMO, 2013). NADMO even though have department responsible of implementing both structural and non-structural measures to control flooding there is very little or no risk management strategy that predict and warn inhabitants of potential flooding (Ahadzie & Proverbs, 2010). Flooding in Ghana is a perennial problem that requires collective responsibility from all stakeholders in its management particularly where it's devastating effect is likely to be worsening due to climate change and other human factors. It is therefore necessary to develop integrated programmes to deal with this global threat.

2.8.1 Flood Management in Kumasi

Kumasi like most cities in Ghana has experienced perennial flooding in recent times as a result of multiplicity of factors. The management of such events rests in the arms of local disaster management agencies (NADMO), District Assemblies and other stakeholders. In spite of numerous intervention put in place by these institutions to control floods in the city the effects over the years have been devastating (Frimpong, 2010). Flood management in Kumasi over the years has largely focused on the implementation of structural measures. The Kumasi Metropolitan Assembly constructed drainage and bridges along the Aboabo river in 2007 which spans through communities like Moshie Zongo, Dichemso, Aboabo, Anloga, Asokwa and Amakom.

Additionally, Zoomlion: a waste management company occasionally desilt the river canals that run through the city. Also, city authorities occasionally embark on demolishing of buildings on waterways (Alhassan, 2009). However, very little or no attention has been devoted to non-structural measures in the management of flooding in Kumasi. According to Dohadzie and Proverb (2011) dissemination of information on flood warning and forecasting to inhabitant of flood prone areas in Ghana are not so effective. The ineffectiveness of such information has usually led to flooding catching victims unawares.

2.9 Conceptual Framework

Flooding is a natural phenomenon that occurs as a result of both natural and man-made causes. The effects of flooding on society vary from social, economic and environmental. However it requires multiple players in its management due to its nature and associated uncertainties. The concept of flood management approaches has been found to occur either before, shortly before, during and after flood event. This was further explained by Neto (2001) that the four basic approaches to flood management include: mitigation, preparedness, response and recovery.

Again, if local institutions have the capacity in terms of physical and human resources to implement certain measures effectively flood impact will be considerably reduced or prevented. These are pre flooding measures, also term as flood mitigation and preparedness measures. They can take the form of structural measures such as river embankment, levee, flood breaks or non structural measures like flood warnings. Similarly in post flooding event recovery and response measures ensures reviving the confidence and hope of victims.

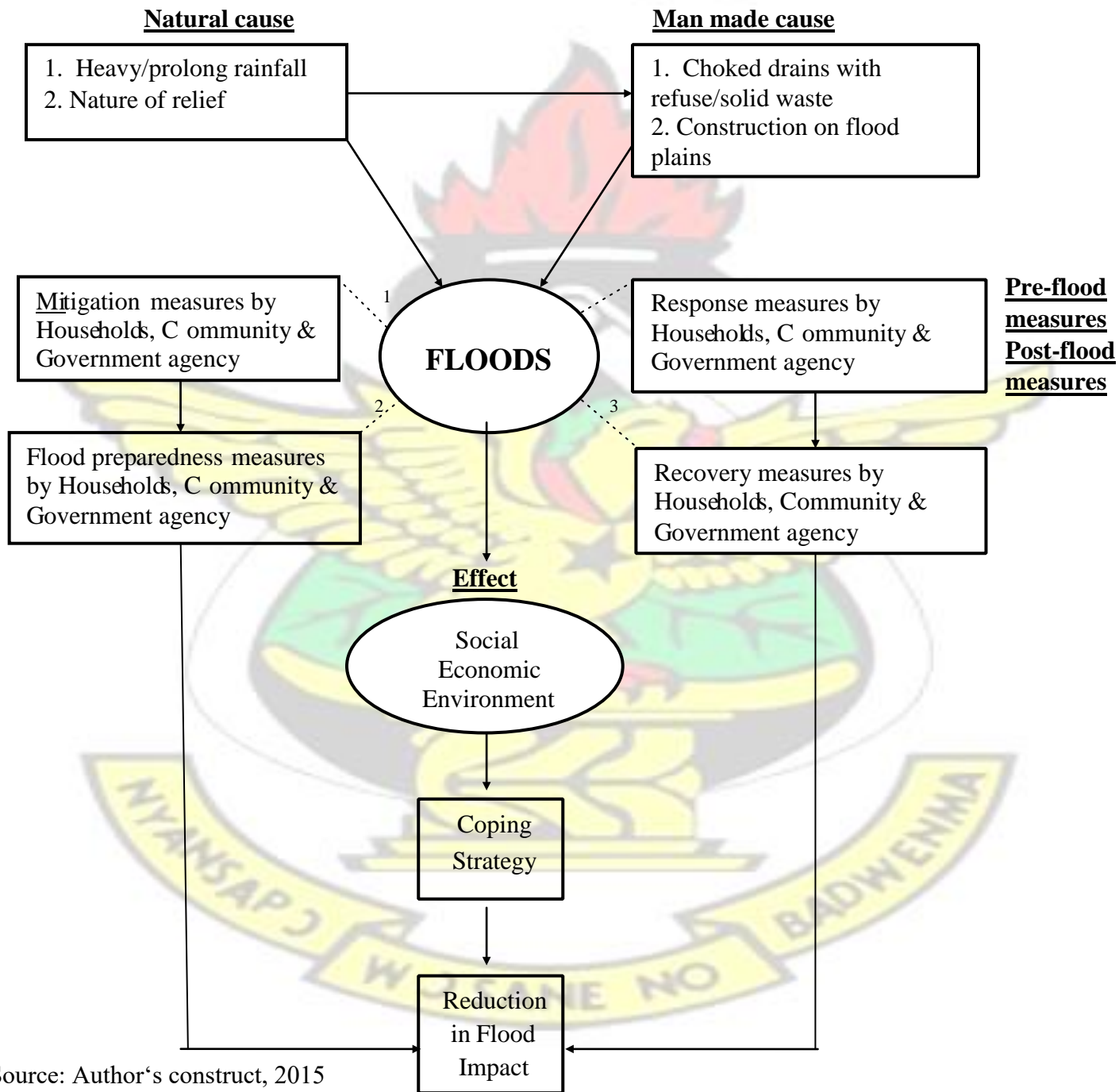
In another dimension, constant rainfall has increase the rate of flood occurrence therefore household has adopted different strategies in order to be able to cope with the impacts. Communities and government agencies also improve the coping capacity of households with the implementation of certain measures in pre or post flood events. The combination of these measures in an integrated approach during flood management will ensure that flooding and its related risk is reduced considerably. The key actors which constitute local institutions in this study include: households, community and related government agencies and departments.

These are the KMA and AMMA and their related departments, security services, Meteorological Service division and NADMO. Henceforth, if local institutions have the requisite capacity in all aspect of flood management their operation will be effective; subsequently leading to flood risk reduction.

2.9.1 Summary of Literature Review

Overall the literature review revealed that the incidence of flooding cannot all be prevented as a result of the continuous change in weather condition particularly increases in days of rainfall. At the same time other man-made actions and inactions in floodplains further worsens the situation. It also revealed the various forms of loss that people suffered as a result of flooding. However it also acknowledged some benefit of flooding; even though not so significant. The evidence available from the review demonstrates that flood management requires a combination of different approaches in a comprehensive manner, such that mitigation, preparedness, response and recovery activities are integrated effectively. Additionally, the study further elaborates the fact that all these approaches involve various actors whose operations requires the right expertise and resources to function effectively. Also, it demonstrates flood coping strategies as well as flood management in Ghana. Finally, institutional capacities in flood management can be viewed either in the following ways: the capacity to mobilize and coordinate resources; the capacity to implement; the capacity for deliberation and negotiation; and the capacity for monitoring and evaluation. It is in this view that the study seeks to assess the flood control approaches along the Aboabo River.

Conceptual Framework



¹ & ² : Measures before flooding

³ & ⁴ : Measures carried during & after flooding

CHAPTER THREE METHODOLOGY OF THE STUDY

3.1 Introduction

Research methodology contributes to the success of any academic research. It outlines the fundamental rules and principles of the research. After a review of literature on flooding, the types, causes, effects of floods and the various flood mitigation, preparedness, response, recovery measures involved. The study revealed how flooding and its associated risk have been minimized in other jurisdiction. It was therefore necessary to define the guidelines for primary data collection from both households and institutions. Also secondary data was sourced from official of institutions to complement the primary data. The information gathered will help in assessing the effect of flood control mechanisms along the Aboabo River. This chapter highlights on the reconnaissance survey carried in the field of study to familiarize with the terrain and as well establish contact with residents and relevant institutions. Additionally, it further gives insight on the research design, sampling process, type and source of data used and how the collected data was analyzed and presented.

3.2 Preliminary Field Investigation

The Aboabo River basin is located in Kumasi, the capital of the Ashanti region of Ghana (Map figure 1.1). A reconnaissance survey was carried within the study area to understand and appreciate the perennial flooding problem and its effect in the Aboabo basin; and at the same time find out how residents have cope and control flooding in the area. The survey revealed that the river has gradually become extinct with the accumulation of heap of refuse and silt in the canal. Areas along the river bank that are to be reserved as buffer to offer protection to the water body have been occupied by physical structures —kiosks. Occupants of these structures and some households dispose their solid waste into the river even though there exist a public refuse collection bin in the area. At some points along the river bank were heap of sediments scooped from the river and left unattended which are gradually been washed back into the river. Again, the river forms the main drainage in the basin to which all household drains are connected. These household drains were choked with domestic solid wastes which were likely to be washed into the river in the event of any rainfall.

Again, it emerged from the interaction with residents that the Aboabo River breaks it bank and flood onto immediate environs almost every year during rainy season. Some residents also indicated that flooding sometimes occur in off-rainy season when there is any intense and prolong rainfall. There was evidence of how previous flooding has destroyed properties in communities along the river. Also, some residents shared the ordeal they went through during flooding. This varies from loss of properties, livelihood, displacement of people and emotional trauma. The field visit presented an opportunity to interact with residents to illicit information on the strategies employed in controlling flooding in the basin. It was evident from the interaction that most measures put in place were ad hoc in nature and the response of institution to flooding in the basin has always been delayed and even sometimes it does not happen.

Finally, Local relevant institutions like the Ghana Meteorological Agency, Town and Country Planning Department of KMA and AMMA, NADMO, Waste Management Department of KMA and AMMA were also visited to gather some important information. The preliminary field survey presented opportunity for better understanding of the terrain and also establish good relationship with residents in the river basin. It also helped in the preparation of survey questionnaire and

interview guides. Subsequently the main data collection exercise commenced which are discussed below.

3.3 Research Design

A successful research is based on an appropriate choice of design and control in order to achieve the desired objectives of the study. In this study, a survey was employed to collect a data from the field. This involve the systematic collection of data at a define time from the entire or subset of a population in order to assess the prevalence of a specific condition. In this study through an appropriate sampling process a portion of the population under study was selected and from these individuals, data were gathered on flooding and its cause, effects, control measures as well as coping strategies. The study followed a logical sequence from the collection of data to its analysis after which appropriate recommendations were made

3.4 Study Population and Unit of Inquiry

In view of the fact that the study was designed to establish effectiveness of flood control measures along the Aboabo River, households in the river basin were the target population. The units of enquiry and analysis were the household heads or the next adult in charge. Additionally, relevant information was also gathered from officials of relevant institutions (Ghana Meteorological Agency, Town and Country Planning Department of KMA and AMMA, NADMO, Waste Management Department of KMA and AMMA).

3.5 Sampling Process

The combination of software approach (i.e. Geographic Information System - GIS tools) and probability sampling technique was used in selecting the sample for the study. Firstly, with the use of GIS tools, the base map of the study area was geo-referenced in order to orient it to its actual position in space. The features on the map were then digitized afterwards. The communities that fall within the river basin were identified as shown in Figure 4.1. These are Aboabo, Asawase-apagyahene, Anloga, Amakom and Dichemso.

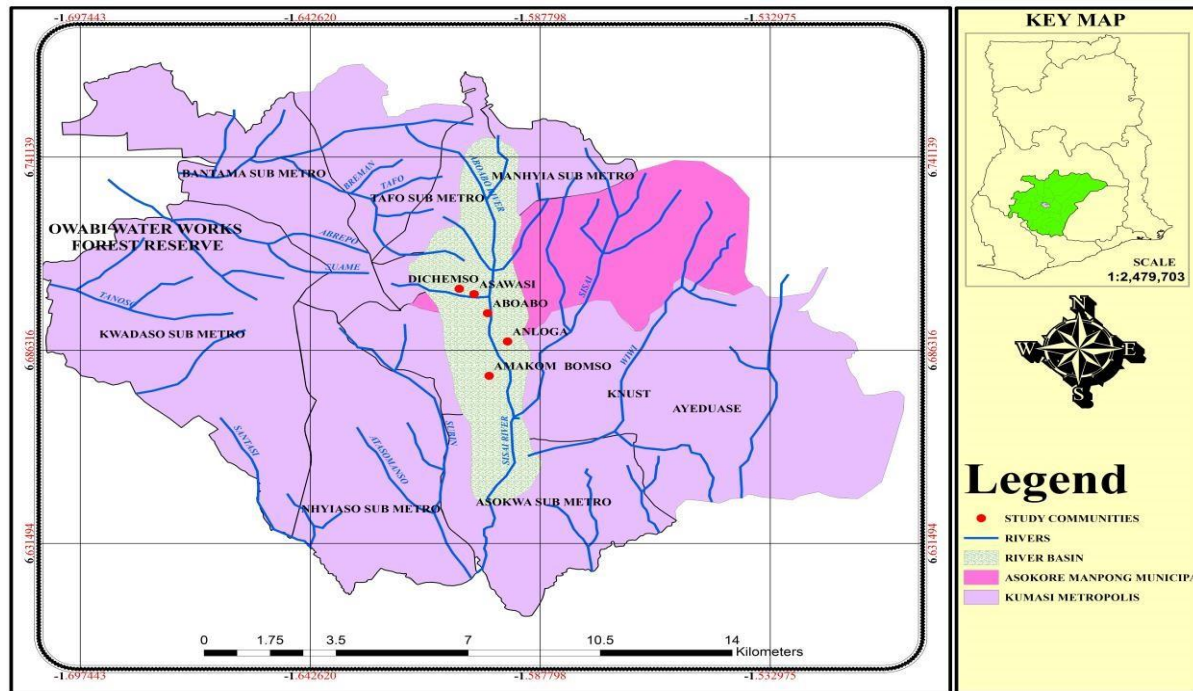


Figure 3.1: Map of Kumasi showing the study sites in the river basin

The buffer zone of the river was clearly demarcated with as shown in figure 3.2 based on the recommended width giving by the Ministry of Environment Science & Technology (2011) for urban stream. This was 100feet from the right and left banks of the river (equivalent to 31 meters from each bank). However, in the opinion of Vyas et al. (2012) the standard width of buffer zone is largely influence by the soil, slope and land use and other factors. Generally, researchers have shown that the most recommended efficient buffer width varies from 25 feet to 300 feet (Hawes and Smith, 2005).

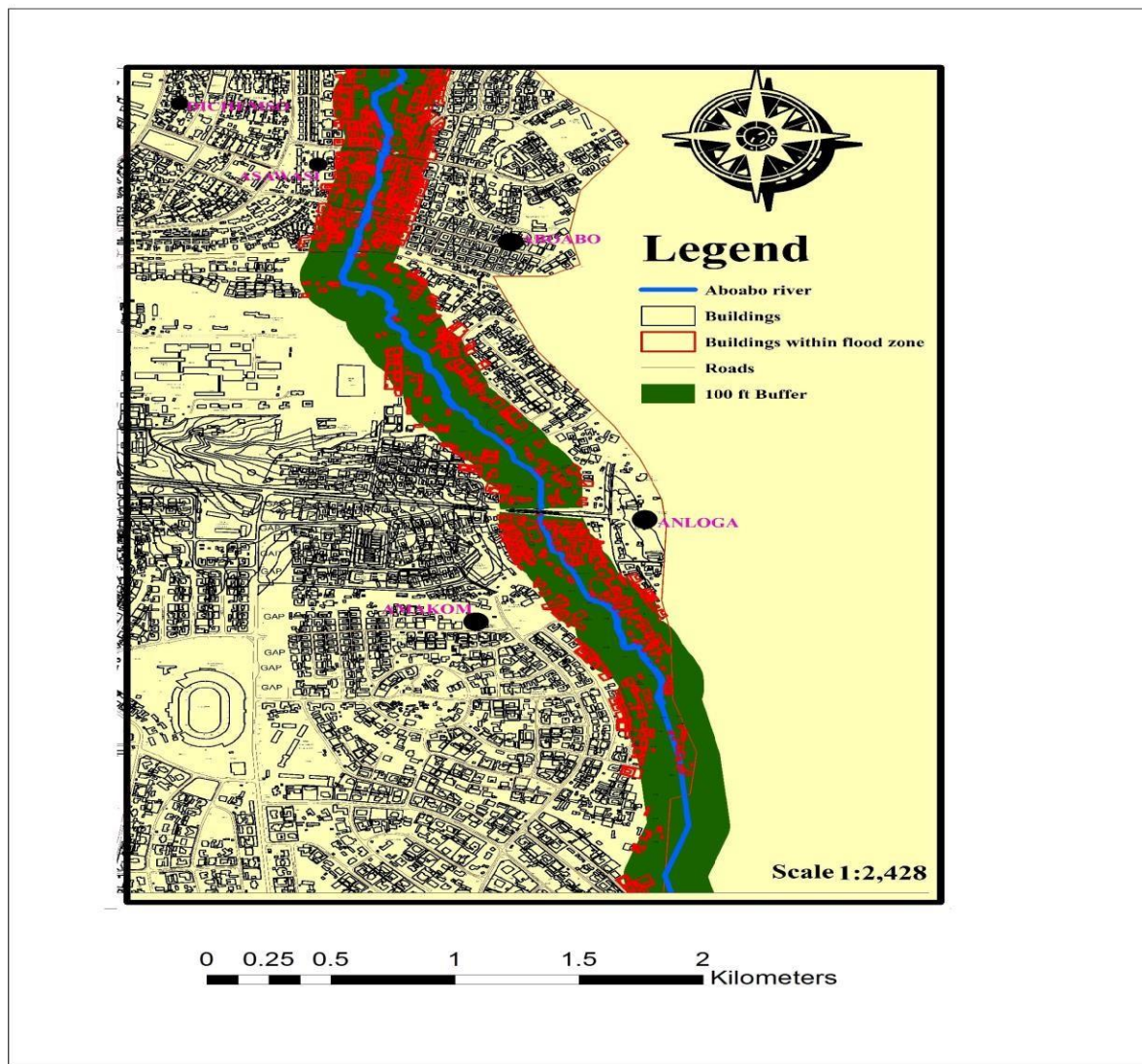


Figure 3.2: Map of study area showing 100ft buffer zone with study sites
Geographic Information System (GIS) tool were again used to identify and map out all the houses that fell within the demarcated buffer zone (Figure 3.2) and the number of houses that were within the buffer zone was counted. This was found to be 1560 units of houses from which a sample was selected. Therefore the study adopted a probability sampling technique.

In this regard the study used a sampling frame of 1560 houses and a confidence level of 95 percent and margin of error five percent, the sample size determined for the study was 306 houses. The simple random sampling technique was adopted for the selection of the 306 houses for the study. This simple random sampling technique was operationalize as follows: □ Numbering all the 1560

houses (i.e. they are given identity numbers) □ Keeping the numbers in a container and shuffling them thoroughly.

□ The right proportions were the selected (i.e. 306 unit of houses).

A questionnaire was administered to the household head or the next adult in each of the selected 306 houses. However where in a house there are two or more household, the same random sampling technique was applied. In all, the sampling size consists of 306 respondents drawn from households living within the 100feet from the bank of the river. Additionally, key officials of the Town and Country Planning Department, the Waste Management Department and the Ghana Meteorological Service, Hydrological Services Department and National Disaster Management Organization were interviewed.

Research Instruments and Methods

Questionnaire was the main research instrument whiles observation and interviews were the methods used for data collection during the study. The use of questionnaires during research presents an opportunity for quick, efficient and large amounts of information on the problem under study to be collected from a large number of people in a short period of time (Bulmer, 2004).

Observation also served as a means to reemphasize the information gathered with the questionnaire and further clarify on issues that was difficult to capture with the questionnaire while the interview also provided means of eliciting extra information that are deem sensitive from respondents. Also cameras were very useful in acquiring some images of the existing situation on the ground. The blend of more than one instrument strengthens the credibility of the study which is essential when seeking to establish the internal validity of the study.

Pre-testing of the instruments

The questionnaire was pre-tested on some household's heads within the study area. This was to improve upon the reliability and validity of the instrument used. The section of the instrument that has any ambiguity was refined. The result from the pre-testing set the tone for the researcher to commence with the study.

3.6 Method of Data Collection

Structured questionnaires and interview guide were used to collect data on the field. Experienced Research Assistants were hired to administer the questionnaires to the respondents. The research assistants were trained on the translation of the households questionnaire from English language to the local dialects (Twi and Hausa). The interview guide was also used to solicit information from key officials of the local institutions outlined earlier. Observation was one of the methods used in data collection. Through this, the effects of flooding on various physical structures were observed and noted and some pictures were taken.

Table 3.1: Summary of Data Required & Sources

Research objectives	Type of Data Required	Source of Data	Methods of Data Collection	Tools
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Identify the causes and effects of floods along the Aboabo River.	<ul style="list-style-type: none"> Causes of floods Effects of floods 	Household heads	Questionnaire sampling □ Random	Questionnaire
	<ul style="list-style-type: none"> Causes of floods Flood reports Recommendation for flood control 	Officials of institutions (AMMA & KMA TCPDs, WMDs, GMA	Face-to-face Interview - Purposive sampling	Interview guide
Identify institutional or household weaknesses associated with flood control mechanisms along Aboabo River	<ul style="list-style-type: none"> Impacts of Flood control methods adopted by household : Mitigation, Preparedness, Response & Recovery measures Factors that affect flood control measures □ Recommendation for flood control 	Household heads	Questionnaire - Random sampling	Questionnaire
	<ul style="list-style-type: none"> Flood control methods implemented by institutions: Mitigation, Preparedness, Response & Recovery measures. Flood reports Recommendation for flood control Factors that affect flood control measures 	Officials of institutions (AMMA & KMA planning department, NADMO)	Face-to-face Interview - Purposive sampling	Interview guide

Source: Author's construct

Table 3.1: continued

Research	Types of Data Required	Source of	Methods of Data	Tools
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objectives	Data	Collection
Identify the households to heads strategies of residents in the Aboabo River basin in the event of flooding.	<p>□ Measures adopted to minimize/ prevent flood effects</p> <p>□ Measures implemented by institutions to minimize/ prevent flooding effects</p>	<p>Household Questionnaire</p> <p>Questionnaire coping by</p> <p>□ Random sampling</p> <p>Face-to-face Interview</p> <p>Interview guide</p> <p>Officials of institutions (AMMA & KMA planning department , NADMO)</p>

Source: Author's construct

3.6.1 Primary Data

Primary data were gathered from both selected household heads and institutions. Information sought included demographic and socio-economic characteristics of respondents, the causes and effects of flooding as well as the coping strategies. Also respondent views on flood control measures adopted by both households and government were also gathered. Some information were also gathered from related institution about the causes of flooding, their primary functions, specific roles in flood management within Kumasi and what measures they have put in place to control flooding within the region.

3.6.2 Secondary Data

Both qualitative data and quantitative data were collected. In-depth interviews with institutions were conducted to obtain qualitative data on the causes of floods; role in flood control, and flood control measures implemented along the Aboabo. Quantitative Secondary data in the form of population figures and rainfall figures were also sourced from the Population Census Report of

2000 and Ghana Meteorological Agency respectively. These were carefully studied and reviewed to extract relevant information that will be useful in the execution of the research study.

3.7 Data Analysis

Before the data analysis, the completed questionnaires were edited to check completeness, accuracy and consistency. Data gathered from interviews were also summarized into qualitative data. The edited questionnaires were then coded and the responses entered into Statistical Package for Social Sciences (SPSS 20.0) software for the analysis. In general, summary statistics in the form of frequencies, relative percentages were generated to facilitate the analyses of the quantitative data. The qualitative data were summarized and used to complement the quantitative during the analysis. The specific tools of the package utilized include cross tabulations, percentages, pie charts and bar graphs. Maps of the drainage basin of the Aboabo River and the selected communities especially in low lying areas were also analyzed to show the areas around the Aboabo River which are most liable to flooding. Various forms of tables and charts have been used in descriptive analysis of both qualitative and quantitative data gathered.

The processes of sampling a portion of the population were followed for the study. Additionally, the type and source of data would be presented and analyzed. Additional factors would be considered. This chapter therefore presents the study area and its environs to give an idea of its characteristics. The perennial flooding problem in the basin. The local characteristics of the river basin would be discussed. The socio-economic characteristics of the study area based on the data collected during the study.

The previous chapter highlighted on the processes of sampling a portion of the population that will provide the necessary information needed for the study. Additionally, the type and source of data were outlined as well as how these data would be presented and analyzed. Additionally, the research design of the study was also considered. This chapter therefore presents the physical background of Aboabo River basin and its environs to give an idea of its characteristics. It shows how these characteristics influence the perennial flooding problem in the basin. The location, size, population, climate, and drainage characteristics of the river basin would be discussed. The chapter also presents a discussion on the socio-economic characteristics of the study area based on primary and secondary sources of data gathered during the study.

KEY MAP

Upper West
Northern
Brong Ahafo
Ashanti
Eastern
Western
Central
Accra

Legend

- SELECTED TOWNS
- OTHER TOWNS
- MAJOR ROADS
- ASOKORE MANPONG MUNICIPAL
- KMA BOUNDARY

SCALE 1:3,322,820

0 175 350 700 1,050 1,400 Kilometers

The Aboabo river is within Kumasi, the capital of the Ashanti region of Ghana. Kumasi is located about 270km North- West of Accra the capital of Ghana and between latitude $6^{\circ} 35' - 6^{\circ} 40'N$ and longitude $1^{\circ} 30' - 1^{\circ} 35'W$ and on an elevation which ranges between 250 and 300 meters above sea level with an approximate area of 254 sq km(Figure 4.1). The estimated population of the city is about 2,035,064 (KMA, 2010). Kumasi is bordered by five districts namely Kwabre East to the north, Atwima Nwabiagya to the west, Atwima Kwanwoma to the south-west, and Ejisu-Juaben to the east and Bosomtwe to the south. The Kumasi Metropolis is divided into 9 sub-metropolitan areas for effective administration. Also the river basin runs along the central part of the city as shown in figure 1.1.

4.3 Climate

The climatic conditions of Kumasi are not harsh. It is of the wet sub-equatorial type. The city usually experiences average minimum and maximum temperatures of about $21.5^{\circ}C$ and $30.7^{\circ}C$ respectively. Also the average humidity is about 84.16 percent at 0900 GMT and 60 percent at 1500 GMT and a double rainfall regime (214.3 mm in June and 165.2mm in September). The moderate temperature, humidity and rainfall pattern have made it a favorable place for habitation. This characteristic has made Kumasi see the influx of people from areas beyond its frontiers. (KMA D-Plan, 2010 – 2013). Similarly, these climatic conditions are also experienced in the Aboabo river basin. Intense and prolong rainfall are usually experience in the city during these rainfall regime. This rainfall pattern contributes immensely to the flooding problem in Aboabo basin aside other human factors such as construction on watercourses and indiscriminate disposal of solid waste in the river valley. Again, the influx of people from other parts of the country to the city has a direct influence on population growth which has led to the expansion of settlement onto floodplains.

4.4 Relief and Drainage

Kumasi lies within the plateau of the South–West physical region which ranges from 250-300 meters above sea level (KMA D-Plan, 2010-2013). The topography of the area is undulating, and is characterized by lowlands and highlands. A number of rivers and their tributaries run through the city which includes Subin, Sisa, Daban, Wiwi, and Aboabo (Figure 4.2) (Cornish *et al.*, 1999).

The flow of the Aboabo River is slow due to its gentle slope and therefore water level quickly rises after precipitation and flow over its bank.

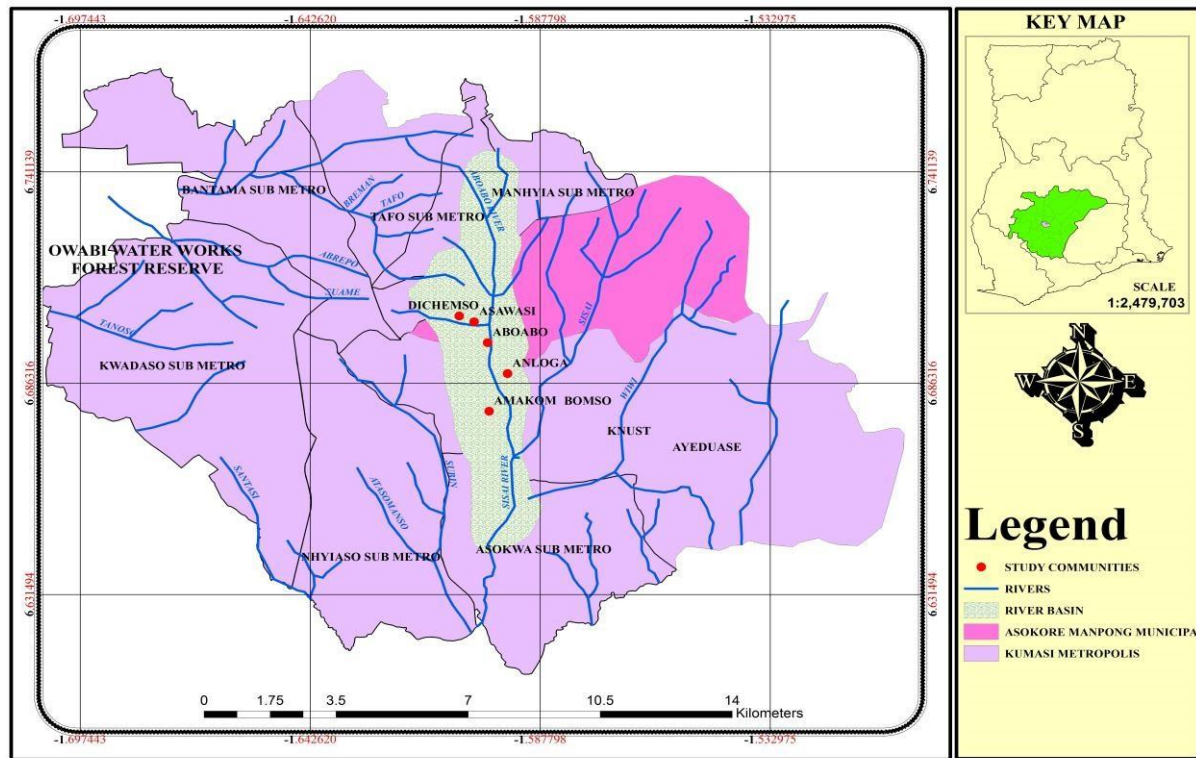


Figure 4.2: Drainage Map of Kumasi showing Aboabo River basin

Again, the length of the Aboabo river is 6,050 meters (6.05 km). It is about 25 meters wide upstream and 30.5 meters wide downstream and lies at the central part of the city (Hydrological Services Department, Kumasi). Therefore it forms the major drainage in the basin to which all households drains are connected. Again, the drains in Kumasi are concentrated in the central part and generally exhibit a dendritic pattern of drainage as shown in figure 4.2. The valleys in which the river flows are very wide with floodplains found in the valley floor. Therefore greater volumes of surface run-off from precipitation as well as household liquid waste are directed to the Aboabo river. The water level rise steadily and flood nearby areas. The situation has therefore made areas within the river basin liable to floods. At the same time the human occupation in the floodplain such as construction and indiscriminate disposal of solid waste in the river valley has led to the gradual shrinkage of the canal and extinction of the water body.

Therefore the discharge capacity of the river is easily overwhelmed by precipitation and sewage inflows. This subsequently leads to flooding.

4.5 Soil and Vegetation

Kumasi falls within the moist semi-deciduous ecological zone. The predominant tree species in the city includes Ceiba, Triplochlon, Celtis among others. There are other patches of vegetative cover scattered over the peri-urban areas of Kumasi. The presence of vegetation cover intercepts raindrops and reduces the amount of water flowing as run-off into rivers and streams. However, the vegetation in the Aboabo basin has diminished over the years due mainly to urbanization. Areas along the river bank that are supposed to be reserved as green belt to provide vegetative cover have been encroached upon with buildings and other physical structure. The absence of this green belt further worsens the flooding problem in the river basin (CEDAR, 1999 cited in (Suraj, 2004).

The major soil type in Kumasi is the forest ochrosol which is rich in nutrients that support tropical foodstuff cultivation. However, the high demand for residential properties has displaced most agricultural lands. Similarly these soil types occur fairly extensively in the entire Aboabo basin. The soils mainly found within the study area are the Asuansi, Akroso, Densu and Nta running from the central to southern low lands of the basin (CEDAR, 1999 cited in (Suraj, 2004). It is thus not surprising that floods do occur in the Aboabo basin. These soils are generally clay and are able to hold much water for a long time. It is also known that relative to sandy and loamy soil types, it takes a longer time for water to pass through clayey soils due to poor porosity. Thus, excess overflows of the river do not seep through the soil quickly and so it runs over the land spreading further to other areas.

4.6 Settlements and Housing

The settlements patterns in the river basin are of the nucleated type. The settlements constitute a contiguous compressed development with very little breaks in the contiguity at certain places. Most of these settlements have been extended onto the floodplain due to the increasing population of the basin over the years. There is also growing number of unauthorized physical structures in the basin particularly along the river bank. The extension of settlements and erection of structures on the

floodplain have compromise the purpose of the floodplain which further worsens the flooding problem of the area.

Again, majority of the housing units located in places like Aboabo and Moshie Zongo are described as substandard (KMA, 2010). Compound and separate housing units can be identified in each of the communities in the river basin. Most residents in the river basin live in compound houses with high room occupancy rates and large numbers of households per house. In Aboabo some of the housing units have been built close to the river and when it rains, these houses get flooded easily. Also temporary structures erected along the river bank structures have no means of solid waste disposal and plumbing or sewage connection. As a result the occupants have turned the river valley into dumping sites and sewers which could increase flood risk.

4.7 Economic activities

Kumasi is the socio-economic hub of the region with various economic activities which centered on trade, service, commerce, industry and agriculture. This has made the city to be highly commercialized. (KMA D-Plan, 2010-2013). Among the numerous economic activities in the city include urban agriculture, manufacturing, construction, retail trade, hotel and restaurant, transportation and public administration. Small and large scale industries are also present in the city providing large scale employment to many. The Aboabo basin which lies in the central part of Kumasi has similar socio-economic characteristics. Among the major economic activities in the area include the Anloga wood industry (wood processing and manufacturing of all kinds of furniture), metal cooking pot production, trading, carpentry and patches of small scale vegetable and livestock farming. Economic activities in parts of Kumasi are slowed with the incidence of flooding in the Aboabo basin. The flow of transport across the city is obstructed as the basin lies in the central part of the basin. Therefore the supply of goods and services across the city are considerably reduced which has an adverse impacts on the livelihood of residents.

4.8 Population Characteristics

Kumasi is the administrative capital of the Ashanti region with a population of about 2,035,064 comprising 972,258 males and 1,062,806 females representing 36.2 percent of the Ashanti regions total population (KMA, 2010). The 2010 Population and housing census shows that Kumasi has a

population density of 5,319 persons per sq km. This is due largely to daily influx of people who commute to the city from within and beyond the region for various economic activities (KMA D-plan 2010-13). Also, the higher population density of the city is partly due to the fact that it has the second largest urban economy in Ghana attracting trade and commerce in industry, services and government administrative functions (KMA, 2010).

The Aboabo River Basin (Map Figure 4.2) has a very large percentage of the population of the city. In 1984 and 2000 the population of the study site was 126797 and 178945 respectively as shown in table 4.1 (GSS, 2000). This means that the estimated current population is 234786 based on growth rate of 0.01857. This means that the population from 1984 has increased by one 40% by 2000. The growing trend of the population has therefore cause the expansion of settlement and other human activities onto the floodplain of the river. This further worsens the problem and exposes more people to flood risk. For instance activities in floodplain have led to the indiscriminate disposal of solid waste into the river which obstructs the free flow of the river.

Table 4.1: Population trend of study area

Communities	Year			
	1984	2000	Growth rate	*2015
Aboabo	22636	34206	0.02114	46815
Dichemso	14695	21281	0.01934	28365
Asawase-apagyahene	36429	46243	0.01326	56346
Anloga	26455	38155	0.01916	50721
Amakom	26582	39060	0.01996	52539

* Estimated.

Authors construct

NB: Growth rate (r) = $\frac{P_o - P_f}{P_o \div (2000 - 1984)}$

$$P_f \div (2000 - 1984)$$

Where P_o = Original population, P_f = Future population

» Estimated population = $(1 + r)^{2015 - 2000} \times P_t$

4.9 Solid and liquid waste management

The Waste Management Departments of AMMA and KMA are charged with the responsibility of managing solid and liquid waste generated in the Aboabo river basin. The Aboabo River basin generates an estimated amount of 270 metric tons of waste per day, approximately 40 percent of the total amount of waste generated by the Kumasi city per day, at the rate of 0.5kg/person/day (Omane, 2002). It is also estimated that Kumasi's households produce in total about 255,000 tons of solid wastes per year (700 tons per day).

However, the Waste Management Departments (WMD) are not able to fully address all waste generated in the city. Close to 57 percent of total solid waste generated by households in the city are left unattended by the departments. These solid wastes end up being burnt, buried or indiscriminately dumped in river valley. At the same time others dispose in open drains or left in the open which are eventually washed by surface run-offs into nearby rivers or streams (Suraj, 2004). The accumulation of solid waste in rivers such as Aboabo reduces their canal capacity and obstructs their flow. Therefore rivers readily get overwhelmed by precipitation inflows and overflows onto adjacent areas.



Figure 4.3 solid waste disposed in drains and Aboabo River at Anloga

CHAPTER FIVE

DATA, ANALYSIS & DISCUSSION

5.1 Introduction

This chapter reports on the analyses and discussion of the data collected through the use of interviews and structured questionnaire from some selected residents along the Aboabo River. This was carried out to present good picture on the issues of flooding and its effects on residents living in the basin. This chapter further gave detail insight on the causes and various control measures implemented by both households and institutions to manage flooding in the basin. It again gives useful information on household or institutional weakness associated with flood control. Finally, it serves as basis for the next chapter that focuses on summary of findings, conclusion and recommendations.

5.2 Socio-economic Characteristics of Household heads

The demographic characteristics of 306 household heads carefully selected from the study area are discussed below. Also how these characteristic influence the flood control measures adopted by household was also considered.

5.2.1 Age

The results of the study indicated that 10.7% of the respondents were 65 years and above while the rest were 64 years or less as shown in table 5.1.

Table 5.1: Age of Household Heads

Variable	Category	Frequency	Percent
Age			
	25 - 64 Years	273	89.3
	65 + Years	33	10.7

Source: Field Survey, 2015

Table 5.1 shows that about 89% of the household heads are young people. The result is even more relevant considering the fact that the elderly (65+ years) forms about 3.6% of the population of

Kumasi (Ghana Statistical Service, 2014). Additionally, a local NADMO coordinator indicated that

“During flooding in communities along the Aboabo River young people play a critical role in the evacuation of victims caught up by flood waters especially women & children. Also household with more young persons are able to put in place adequate preparedness measures to protect their property from flood impacts”.

This shows that majority of households are dominated by young people who could put in place adequate flood preparedness measures in the face of impending flooding. To understand how the age of household heads affect the ability of household to prepare for flooding, a cross tabulation of the two variables was carried out.

Table 5.2: Flood preparedness and age

Household Flood Preparedness Measures	Age of Household head		Total
	25-64	65+	
Build emergency kit	5(100.0)	0	5
Construct sand bag barriers	58(82.9)	12(17.1)	70
Dig flood breaks	25(78.2)	7(21.9)	32
Clear choked drains	110(70.1)	47(29.9)	157
Construct temporary drains	23(71.9)	9(28.1)	32
Be alert	19(79.2)	5(20.8)	24
Develop family Communication plan	39(78.0)	11(22.0)	50
Develop evacuation procedure	55(63.4)	21(27.6)	76
Insurance (property & valuables)	7(87.5)	1(12.5)	8

Source: Field Survey, 2015

* Percentages in bracket

The result shows that the major preparedness measure carried by households is the clearance of choked drains (157) to allow for free flow of floodwaters and surface run-off during flooding. Also close to 70% of the respondent who implemented such measures are less than 65 years as shown in table 5.2. Similarly only 17% and 22% of the respondent who constructed sand bag barriers and dug flood breaks were over 65 years of age.

At the same time only nine of them constructed temporary drains to redirect floodwater from their homes (Table 5.2). Therefore persons that are 64 years or less were able to implement adequate structural measures before flooding than those above. This is because these measures are labour intensive and the elderly are likely to have challenges with it implementation due to their weak physical strength. Therefore the elderly are more likely to be vulnerable to flooding. This finding is in consonance with the study of Jonkman et al. (2009); Aboagye (2012) who indicated that households with more young people are able to prepare for flooding adequately and help other household members than older ones in the event of flooding. Also, the elderly have difficulty in putting in place necessary measures that will make their house less vulnerable.

Furthermore, of all the preparedness measures carried out by the households, building of emergency kit 5 (1.9%) and flood insurance (3.1%) were the least implemented among both young people and elderly (Table 5.2). Flood emergency kit is a pack that contains food items, clothing and other household accessories that is meant to support victims in the event of flooding.

The implication to development planning is that National disaster management agencies should educate households to consider insuring their property and as well make flood emergency kit available in their homes well before any flooding occurs. At the same time disaster management planners should give more priority to the elderly in responding to flood events since they are likely to be more vulnerable to flood impact even though they form the minority of the population.

5.2.2 Sex

The results of the study revealed that about 54% of the respondents were male with 46% being female (Table 5.3).

Table 5.3: Sex of household heads

Variable	Category	Frequency	Percent
Sex of Respondent	Male	165	53.9
	Female	141	46.1

Source: field survey, 2015

Therefore males form the dominant household heads in the population. This observation could be due to the Ghanaian traditional system which recognizes the man as the head of the household. However this observation is in disagreement with the 52.2% of females in the population of Kumasi (Ghana Statistical Service, 2014). Therefore even though males dominate among the household heads surveyed, female could form the majority at the household level based on the 2010 population and housing census.

Again, in the view of Aboagye et al. (2013) poverty in Ghana has a feminine face, it could be inferred that female headed household are disadvantaged in their bid to seek for economic resources to mitigate flood impacts. This observation supports the view of Zoleta-Nantes (2000) who stated that more women suffer from flood impact than men due to their inability to mobilize adequate economic resources to mitigate the impact of floods.

Also, the Ghanaian traditional system recognizes women with the responsibility of household domestic chores as well as caring for children and the elderly. This responsibility further limit their movement in seeking for opportunity to access economic resources, information and skills that will put them in the best position to implement adequate flood protection measures in case of flooding. Again, a local NADMO coordinator stated that:

“Communities usually do not involve women in committees or groups responsible for undertaking for flood control strategies and decisions that will protect their properties from flood impacts. Women are left in homes to carry household chores. The reason is that women are seen to be lacking the adequate physical strength required for the implementation of such strategies”.

These observations is in line with the study of Asian and Pacific Institute on Domestic Violence, (2011) who stated that women are not able to prepare adequately towards flood event as a result of

huge domestic responsibility and other household activities. Their inability able to prepare adequately towards flood event makes them the most affected when flooding strikes couple with the fact that they are physically weak and can endure less as compared to men (Shrestha et al., 2011).

Additionally, cross tabulation of sex of household heads and flood preparedness measures shows that 54.3%, 56.1% and 71.9% of household heads who constructed sand bag barriers, cleared choked drains and constructed temporary drains respectively to protect their properties from flood impacts were males (Table 5.4). Even though these preparedness measures are taken at the household level, female headed household could be disadvantaged due to their inability to gather adequate economic resources that will help the household implement such measures effectively.

Table 5.4: Flood preparedness measures and sex of household heads

Flood Preparedness Measures	Sex of respondent	Total	Male	Female
Build emergency kit	5(100)	0	5	
Construct sand bag barriers	38(54.3)	32(45.7)	70	
Clear choked drains	88(56.1)	69(43.9)	157	
Construct new drains	23(71.9)	9(28.1)	32	
Be alert	17(70.8)	7(29.2)	24	
Develop family communication plan	30(60.0)	20(40.0)	50	
Develop evacuation route	46(60.5)	30(39.5)	76	

Source: Field Survey, 2015

* Percentages in bracket

The implementation of these structural measures requires adequate and rigorous labour which favors male dominated household as compared to their female counterpart. This could be due to availability of adequate and effective labour in male dominated household. This observation supports the view of local NADMO official indicated earlier. The implication to planning is that at every stage of flood management cycle women should be made part of decision making body in

order to get them appreciate and act effectively during flood preparation. Additionally, local residents should be encouraged to share flood warning information to all intended users particularly women.

5.2.4 Ethnicity

The result of the study shows that there was mixture of different ethnic groups in the communities. Close to three-quarters (72.9%) of the respondents were from Northern tribes with about 19% being Asante and the rest non-Ghanaians as shown in table 5.5. These ethnic groups include Asante, Dagomba, Gonja and Frafra.

Table 5.5: Ethnicity of household heads

Variable	Category	Frequency	Percent
Ethnicity			
	Asante	58	19.0
	Dagomba	82	26.8
	Gonja	83	27.1
	Frafra	58	19.0
	Others - non Ghanaians	25	8.2

Source: field survey, 2015

This implies that about 73% of the respondents are from the northern parts of Ghana. Observation from the field revealed that they co-exist peacefully and have strong social cohesion. This observation is relevant since it presents a picture of the ethnic diversity that exists in the study area and further informs the kind of social cohesion among residents. Also community and household approaches to flood mitigation rely on cooperation and cohesion among members. In this regard cross tabulation of ethnicity and flood response was carried out to understand how the different ethnic groups in the population respond to flooding.

The result shows that quick evacuation is the major approach adopted across the different ethnic groups in the population. The result of the study shows that among those who provided or sought assistance during flooding to save life and property were Dagomba's (34%), Gonjas (31%) , Frafra (29%) and the rest Asantes (Table 5.6). This shows that irrespective of the diverse ethnic

groups in the study area household rely or support each other in response to flood events due to their peaceful coexistence and the affection they have for themselves.

Table: 5.6 Flood response measures and ethnicity

Flood response measures	Ethnicity of household heads					Total Others - non
	Asante	Dagomba	Gonja	Frafra	Ghanaians	
Quick evacuation	36(18.1)	54(27.1)	58(29.1)	37(18.6)	14(7.0)	199
Seek assistance from NADMO	5(19.2)	8(30.8)	6(23.1)	4(15.4)	3(11.5)	26
Seek assistance from family members	2(4.9)	14(34.1)	13(31.7)	12(29.6)	0	41
Stay on high grounds	0	6(37.5)	8(50.0)	2(12.5)	0	16
Search & rescue operations	4(10.5)	11(28.9)	9(23.)	10(26.3)	4(10.5)	38

Source: Field Survey, 2015

* Percentages are in bracket

This finding is in line with the view of Alesina and La Ferrara (2000), who stated that there is high rate of community support among residents where there is peaceful coexistence and social cohesion. Community members easily come together to assist each other in the event of flooding to protect their properties and family from floods impacts. Also, Adams et. al (2013) agreed that peaceful coexistence in community with diverse ethnic groups influence how flood warning information are transferred and utilized. Thus communities with good social cohesion share flood warning information among members in the face of impending floods. The implication to development is that policy makers could rely on their peaceful coexistence to enforce land use regulations and standards in communities, encourage the consolidation of resources among residents to carry out community based flood mitigation measures.

5.2.5 Occupation & Income level

Fifty seven percent (57.2%) of the respondent were traders while 10.1% were unemployed. This indicates that about 82% of the respondent are employed and the rest being unemployed (Table

5.7).

Table 5.7 Occupation and Income of household heads

Variable	Category	Frequency	Percent
Occupation of respondent	Trader	175	57.2
	Government worker	18	5.9
	Artisanship	41	13.4
	Schooling	24	7.8
	Unemployed	31	10.1
	Farming	17	5.6
Monthly Income	< GHC 50	48	15.7
	GHC 50 - 150	120	39.2
	GHC 151 - 250	63	20.6
	GHC 251 - 350	35	11.4
	> GHC 350	40	13.1

Source: Field Survey, 2015

The results of the study shows that only 40 household heads earn more than GHC350 while the rest earn less (Table 5.7). This means that majority of household heads in the study area are of lower and middle income class. This observation is a reflection of the general income level of the population based on the Ghana Living Standard Survey report of 2008 (Ghana Statistical Service, 2010).

Even though flood recovery measures adopted are at the household level and varies based on the impact of floods, the decision is largely influenced by the household heads. This is due to the fact that the Ghanaian traditional system recognizes household heads as key decision makers and household welfare officer. It can therefore be inferred that the income of household head could influence the recovery measures adopted by household in post flooding events. In view of that a

cross tabulation of income of household head and flood recovery measures was carried out. The major recovery measure adopted by households after flooding to restore normalcy in their homes is cleaning of mess (235) caused by flooding while the least considered is medical health care (25) as shown in table 5.8. This means that the quest for medical checkup after flooding was given less attention among households. Because victims consider health checkup as secondary issues unless there are epidemics. Table 5.8 suggests that only 5.3% of household heads who relied on other family members for support earn above GHC350 (Table 5.8). Again, this means that 94.7% of household heads who sought for assistance from other close associates were as well low earners.

Table 5.8: Income level and Flood recovery measures

Recovery measures	Monthly income(GHC) of household head					< 50
		50 - 150	151 - 250	251 - 350	> 351	Total
Clear mess	39(16.6)	93(39.6)	51(21.7)	22(9.4)	30(12.8)	235
Medical care	4(16.0)	13(52.0)	4(16.0)	1(4.0)	3(12.0)	25
Property repair	17(11.2)	55(36.2)	35(23.0)	23(15.1)	22(14.5)	152
Rely on family & friends	3(7.9)	18(47.4)%	8(21.1)	7(18.4)	2(5.3)	38

Source: Field Survey, 2015

* Percentages are in bracket

This finding is in consonance with the study of Ludy and Kondolf (2012) who indicated that the levels of income of individual have a correlation with the recovery measures adopted by individual in situation of flooding. Low income earners depend on close associate for support and other less costly measures. In another dimension, a cross tabulation of income and mitigation strategies adopted by households reveal that households who carried less costly mitigation measures earn less than GHC350. These measures include construction of sand bag barriers 88.6% (62 out of 70) to protect their homes from floods, clearing of choked drain 89.2% (140 out of 157) and construction of temporary flood drains 87.5% (28 out of 32) to direct flood waters out of their homes (Table 5.9). Again, local NADMO coordinator stated that:

“Most household in the study area implement temporary and less costly flood mitigation measures to protect their property from flood impacts. This is largely due to their low income status”.

Therefore household with low income resorts to strategies that were ad hoc in nature and less costly during flood mitigation.

Table 5.9: Income level and Mitigation measures

Mitigation measures	Monthly Income of respondent					Total
	<GHC 50	GHC 50-150	GHC 151-250	GHC 251-350	> GHC 351	
Build emergency kit	0	3(60.0)	0	0	2(40)	5
Construct sand bag barriers	11(15.7)	25(35.7)	16(22.9)	10(14.3)	8(11.4)	70
Dig flood breaks	4(12.5)	16(50.0)	6(18.8)	3(9.4)	3(9.4)	32
Clear choked drains	21(13.4)	70(44.6)	40(25.5)	9(5.7)	17(10.8)	157
Construct temporary drains	4(12.5)	16(50.0)	8(25.0)	0	4(12.5)	32

Source: Field Survey, 2015

* Percentages in bracket

This finding complies with the study of Ludy and Kondolf (2012) who stated that poor households resort to temporary and low-cost measures in preparing towards impending flooding as compared to wealthier household. This observation shows that majority of household in the study area could be in the low income brackets and mostly affected by floods impacts due to their inability to implement permanent flood mitigation measures. Also they cannot effectively deal with the cost of repair and replacement of damaged property. Therefore disaster planners should ensure adequate relief and support services are made available to victims immediately flood strikes. This could minimize the impact and thus bring back life to normalcy quickly in the flood hit areas.

5.2.6 Level of Education

Thirty two point seven (32.7%) percent of the respondents are completely illiterate while 7.5% of them having obtained tertiary education as shown in table 5.10.

Table 5.10: level of education of household heads

Variable	Category	Frequency	Percent
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Education		
Primary	63	20.6
Secondary	90	29.4
Tertiary	23	7.5
Middle school	30	9.8
Uneducated	100	32.7

Source: Field survey, 2015

Similarly, according to the Ghana Statistical Service (2010) level of education in the study area are generally low. Level of education has a relation with the behavior of individuals towards flood mitigation. In view of that Ludy and Kondolf (2012) stated that levels of education of individual have a correlation with how best flood information is utilized in order to adopt the appropriate preventive measures. In this regard a cross tabulation was carried out to understand how level of education influence the use of flood warning information provided by government agencies through the print or electronic media. The result of the study shows that 89 out of the 306 household heads utilized flood information while the rest (217) did not. The information received from government agencies prompted them to ensure the movement of valuables to higher grounds. It also led to the creation of flood breaks around their homes and as well saving of foodstuff and cash which they could depend on in the event of flooding. However 76 out of the 89 who relied on the flood information to implement preventive measures had obtained secondary and tertiary education (Table 5.11).

Table 5.11: Level of education and use of flood information

Level of education	Alertness & Use of Flood Information (N= 306)		Total
	Yes	No	
Primary	6(9.5)	57(90.5)	63
Secondary	57(63.3)	33(36.7)	90
Tertiary	19(82.6)	4(17.4)	23
Middle school	2(6.7)	28(93.3)	30

	Uneducated	5(5.0)	95(95.0)	100
Total		89(29.1)	217(70.9)	306

Source: Field Survey, 2015

** Percentages are in bracket*

This means that majority of household heads who did not consider flood warning information relevant were uneducated and basic school graduates. Therefore flood warning information is treated with less seriousness; as a result floods usually caught them unawares.

However they only begin to construct flood breaks and temporary drains to direct flood waters on the occurrence of rainfall. Therefore during dissemination of flood warning information, the message should be clear and straight forward to allow local residents to appreciate and utilize it as expected. Additionally it should be in the language best understood by majority of the people.

5.2.7 Housing Tenure

Fifty-three point three (53.3%) percent of the respondents were tenants and 29.1% being free occupant while the rest were owners (Table 5.12). Free occupants are those people who were living in houses without paying anything and as well not owning the house. This means that about 70% of household heads are living in houses they do not own. This is relevant because it is reflected in the issue of house maintenance and protection from flood impacts. Even though flood mitigation measures are carried at the level of household, as a leader, household head decision influences the measures adopted. Again table 5.13 shows how house tenure ship influence flood mitigation measures.

Table 5.12: Housing tenure of household heads

Variable	Category	Frequency	Percent
Housing Tenure	Free occupant	89	29.1
	Tenant	163	53.3
	Owner occupant	54	17.6

Source: Field survey, 2015

The result of the study shows that 18.8% of the households who constructed permanent flood breaks were house owners while the rest were not as shown in table 5.13. Similarly, the only four household heads who also expanded drains around their homes permanently were house owners. This means that about 80% of household heads who implemented permanent mitigation interventions like drain expansion, erection of fence wall and flood barriers around their homes do not own those houses. This finding contradicts with the study of Laska (1986); Grothmann & Reusswig (2006), when they concluded that homeowners are willing to invest their time and take more precautionary actions to protect their properties than those who are not but are merely at risk from flooding.

Additionally, it opposes the view of Proverbs and Brebbia (2014, p.209) who argue that owner occupier households are more likely to mitigate flood risks through actions such as yard raising, constructing permanent flood breaks and drains while other occupiers resort to temporary measures. However, only few household heads (32 out of 306) implemented these permanent measures (Table 5.13). Therefore, these findings also suggest that tenants living in flood prone areas do implement permanent mitigation measures because they want to protect their life, family and personal household appliances. Therefore behavior of tenants towards flood management is not different from house owners along the Aboabo River. However only 8 household heads insured their possessions to cater for unintended damage and all of them were not house owner (Table 5.13).

Table 5.13: House tenure and Flood mitigation measures

Mitigation Measures	House Tenure of Household heads			Total
	Free occupant	Tenant	Owner occupant	
Construct sand bag barriers	18(25.7)	35(50.0)	17(24.3)	70
Construct flood breaks or wall (permanently)	13(40.6)	13(40.6)	6(18.8)	32
Clear choked drains	41(26.1)	90(57.3)	26(16.6)	157
Expand drains (permanently)	8(25.0)	20(62.5)	4(12.5)	32

Insurance (property & valuables)	2(25.0)	6(75.0)	0	8
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Source: Field Survey, 2015

* Percentages are in bracket

This implies that city planners need to check on households during construction of permanent mitigation measures such that their activities will not create further problems elsewhere. Also, flood management agencies should embark on public education on the need for household to subscribe for flood insurance packages in order to be able to forestall the impacts of floods.

5.2.7 Length of Stay in Community

Only 12.7% of the household heads stated that their households have lived in the community for less than five years with the rest spending ten or more years (Table 5.14).

Table 5.14: Household Heads duration of stay in community

Variable	Duration	Frequency	Percent
Length of Stay in Community			
	0 - 5 years	39	12.7
	5 - 10 years	109	35.6
	10 years +	158	51.7

Source: Field Survey, 2015

According to Aboagye (2012) people who had stayed in a particular area for longer period learn to cope with hazard associated with that area and those with less years of experience cannot cope but rather leave. In view of this a cross tabulation of length of stay in community and flood experience was carried out to understand ability of household to cope with flooding. The results of the study indicated that 274 out of 306 household heads indicated that their household had experience flooding while the rest did not. However, only 38 out of the 274 household heads stated that they have lived in the community for less than 5 years while the rest had stayed for six or more years (Table 5.15). This means that majority of households who are able to cope with flooding have lived in the community for more than ten years due to their accumulated years of flood experience.

Table 5.15: Household length of stay in community and flood experience

length of stay in	Flood experience
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Community	Yes	No	Total
0 - 5 years	38(13.9)	1(3.2)	39(12.7)
6 - 10 years	90(32.8)	18(58.1)	109(35.6)
10 years +	146(53.3)	12(38.7)	158(51.6)
Total	274(89.5)	31(10.1)	306(100)

Source: Field Survey, 2015 (* Percentages in bracket)

In another dimension Heryenti (2012) indicated that there is decrease in perception of flood threat with longer time of stay in flood prone areas. Therefore senior dwellers see flooding as a usual event and give it less priority concern than new settlers. This usually makes the impact devastating as the magnitude is usually unpredictable. This implies that disasters management planners need to demystify public perception about floods through public education and thus urge residents to treat any warning information with the necessary seriousness it deserves. Additionally, policy makers can rely on experience of residents in designing flood mitigation strategies. For instance evacuation procedures will be effective if existing and commonly used routes are utilized.

5.2.8 Household Size Characteristics

Table 5.16 shows that 49.7% and 20.3% of the respondents have between 2-5 and 6 -9 persons respectively living in their household. Again, 93% of the respondents stated that they reside in houses with multiple households (Table 5.16). This explains why the Aboabo river basin is densely populated.

Table 5.16: Household characteristics

Variable	Category	Frequency	Percent
Number of Households per Housing unit			
	1	22	7.2
	2 - 5	112	36.6
	6 - 9	86	28.1
	10 +	86	28.1

Number of persons per household			
1	18	5.9	
2 - 5	152	49.7	
6 - 9	62	20.3	
10 +	74	24.2	

Source: Field Survey, 2015

Again, to understand how household size influences preparedness measures adopted by household in the event of flooding a cross tabulation of the two variables was carried out. Table 5.17 suggests that 67 out of 70 household heads who stated that they implemented flood breaks around their homes had household size of three or more. Similarly, out of 157 household who cleared choked drains around their homes to facilitate free flow of flood waters 95% of them had household size of three or more (Table: 5.17).

This means that household with smaller size implemented less preparedness measures as compared to others with bigger sizes. This is because bigger households are likely to have adequate labour they can rely on during flood mitigation activities. Also, observation made from the field revealed that communities along the river are densely populated such that whenever there is flooding the effect on lives and properties are enormous. This implies that exposures to flood impacts are likely to be high along the river and therefore residents need to be cautioned to put in place adequate measures before floods. At the same time disaster managers can tap from the labour of local residents during implementation of flood mitigation strategies.

Table 5.17 Cross tabulation of household size and flood preparedness measures

Flood preparedness measures	Household				Total
	1-2	3 - 5	6 - 8	9 +	
Construct flood breaks	3(4.3)	40(57.1)	8(11.4)	19(27.1)	70
Clear choked drains	8(5.1)	85(54.1)	34(21.7)	30(19.1)	157
Construct temporary drains	0	18(56.3)	8(25.0)	6(18.8)	32

Source: Field Survey, 2015

** Percentages are in bracket*

Also, households in compound houses rely on each other to pool resources to implement measures that can prevent their property from flooding. Most importantly they have the human capital they can rely on during the implementation of flood mitigation strategies. This finding is in consonance with the study of Blaikie et al. (1994) who concluded that household with bigger size have high ability to cope with flood disaster than those with smaller size due to the presence of additional labour support. This implies that institutions should consider this attribute during implementation of mitigation measures along the river.

5.3 Causes of Flooding

Among the objectives of the research was to investigate the causes of floods in the Aboabo river basin. The study established different causes of floods in the river basin; most of which were induced by human activities. These include issues related to the drainage system in the basin, building on water courses, poor solid waste management, physical planning, hard landscaping and low lying nature of the environment. Additionally, review of literature on urban flooding reveals that the incidence of intense and prolong rainfall also causes flooding in urban areas. Figure 4.1 displays the causes of flooding based on the information gathered from the selected household heads.

5.3.1 Rainfall Pattern

Secondary data collected from the Ghana Meteorological Agency in Kumasi on monthly precipitation figures was compared with primary data from the field. This is to prove if the incidence of high rainfall could be the cause of flooding in the Aboabo river basin. The monthly precipitation figures obtained from the agency spanned over a period of 10 years and could be found in appendix IV. The figures in appendix IV shows that highest precipitation is usually recorded in the months of June and October (averagely 227.5mm and 199.2mm respectively) across the 10 year period. Also 78.4% and 70.3% of household heads indicated that flooding is more frequent in the months of July and August along the Aboabo River (Figure 5.1.). This observation could be deduce from the fact that rainfall pattern is very high during the rainy season

which span from June to October. Even though both Hydrological Service Department and NADMO, Kumasi could not give the historical data of the incidence of flooding along the Aboabo River, media reportage also confirms that flooding incidence in Kumasi is usually around this period. For instance Dapatem (2015) reported in graphic online,

“Communities along the Aboabo River have been experiencing perennial flooding between the months of June and August almost every year and situation continue to worsen over the past decade”.

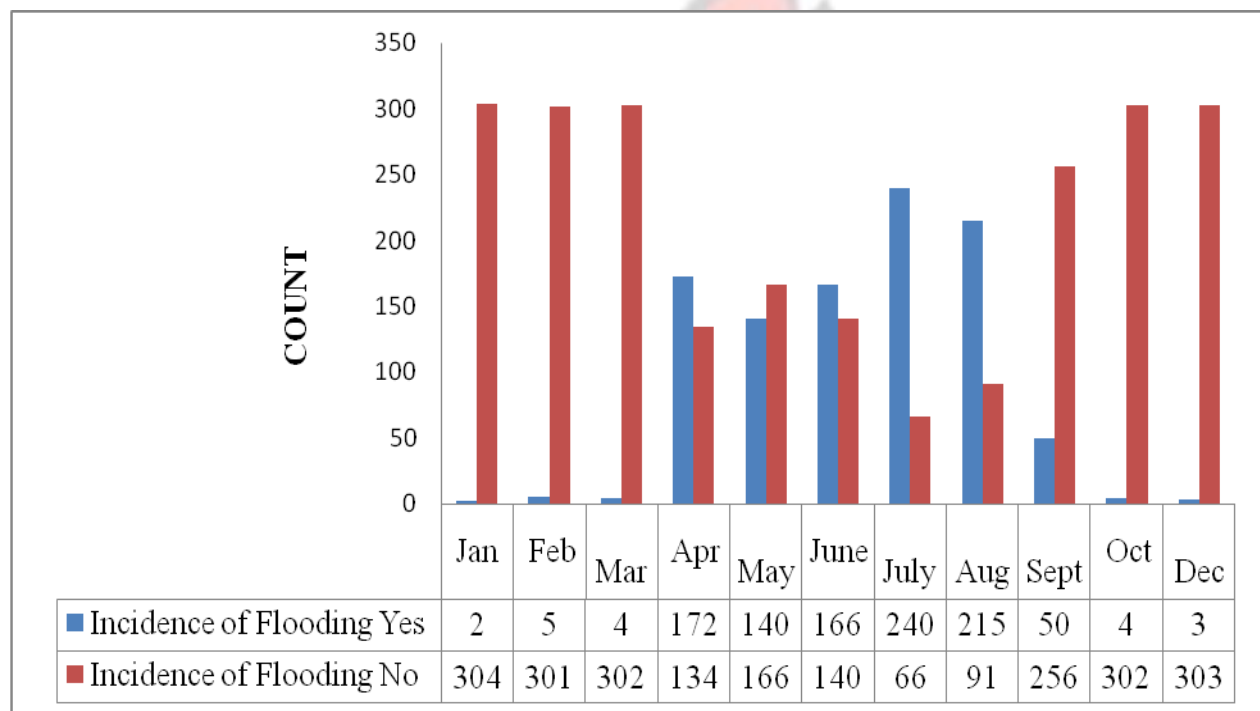


Figure 5.1: Months of frequent incidence of flooding along the Aboabo River. Source: Field survey, 2015.

5.3.2 Drainage System

According to the household heads the most paramount causes of flooding in the area has to do with the drainage system in the area. They assign poor design of drains (19.8%), choked drains (20.3%), inadequate drainage capacity (13.1%) and lack of drains (5.3%) as the causes of flooding in the river basin (Figure 4.1). Therefore 56.6% of the respondent indicated that issues related to the drainage system are the main causes of flooding in the Aboabo river basin.

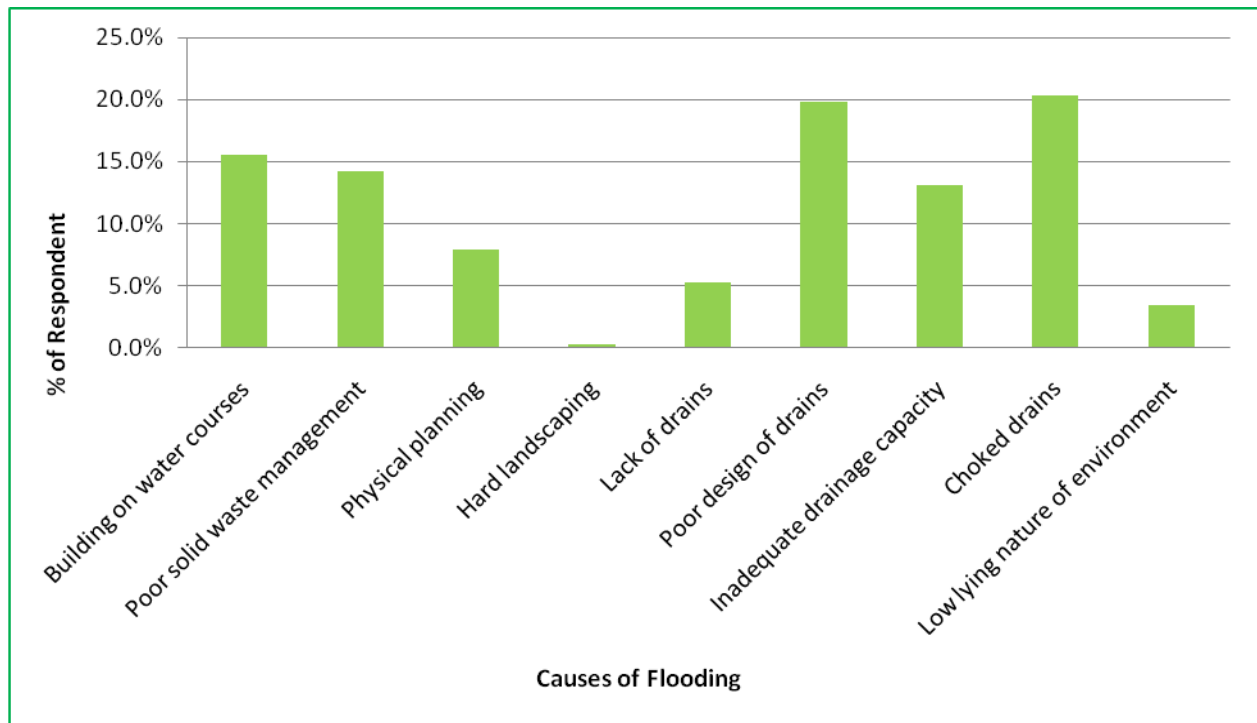


Figure 5.2: Causes of Flooding

Source: Field survey, 2015.

Observation made during survey of the area proved that most places in the study area do not have proper drainage system. The drains are either not present or choked with refuse where they exist; particularly the Aboabo river. Again, in places where they exist they are poorly constructed and connected to the Aboabo stream. Therefore the flow of flood waters are obstructed as a result it spills over onto nearby spaces. Additionally, the head of physical planning department of KMA stated that:

“The drainage system in the Aboabo basin is not able to contain the volume of surface water runoff from precipitation due to choking of drains with garbage, absence or improper construction of drains”.

This results is in line with the study of Davie (2008); Van Alphen and Lodder (2006), who indicated that when drains are poorly designed and constructed it obstruct the free flow of rushing water which can subsequently spill and flood nearby areas especially when there is incidence of rainfall.



Figure 5.3: Drain choked with refuse connecting to the Aboabo River at Aboabo

This implies that in areas where public drains exist way leave/easement should be provided along the drain and must remain free from any development to allow free flow of floods. The minimum width of any easement shall be 3.0m on either side of the drain according to the Ministry of Environment Science & Technology (MEST) and Town & Country Planning Department (TCPD, 2011). Also in the design and construction of public drains it should be made to meet the flow capacity. Additionally, waste management departments should routinely clear choked drains to allow free flow of the drains. At the same time filth cleared from drains should not be left unattended but rather moved to appropriate designated location. Moreover, sanitary inspector should embark on continuous monitoring of activities of households to check for recalcitrant individual who disposes refuse into public drains.



Figure 5.4: Poorly constructed drain within the Aboabo basin at Anloga

5.3.3 Building on Water Courses

A total of 15.6% of the household heads surveyed assigned the causes of flooding to the erection of structures on water ways (Figure 5.1). It was evident from the field survey that the floodplains along the Aboabo River have been encroached upon with buildings. Again, spaces along the river that are supposed to be reserved as vegetative cover in order to check erosion has been occupied with temporary structures. As the local NADMO coordinator put it,

“Erection of kiosk along the bank of Aboabo River and construction on nearby floodplains further exacerbate the perennial flooding in the basin”.

Therefore the overflows of the river are obstructed by these structures and could not return into the river during precipitation. Again, the absence of these vegetative cover also enhances the siltation of the river through erosion and subsequent obstruction of the river flow. Therefore the carriage capacity of the Aboabo River has gradually shrunk to the extent that it readily overflows onto the immediate surroundings with the least rainfall.

These findings corresponds to the view of Tucci (2007), who asserted that construction in flood prone areas particularly water ways are among the key human activities that trigger flooding. This

implies that a minimum buffer width needs to be maintained along either side of the Aboabo river in order to provide protection to the water body. According to the Ministry of Environment Science & Technology (MEST) (2011), the minimum recommendation for urban streams is 30 to 35 meters (100ft) from either side of the river. This buffer zone should be free from any development that can compromise its purpose while structures that have been erected within the zone should be cleared.



Figure: 5.5 physical structures erected along the bank of Aboabo river at Anloga

5.3.4 Poor Physical Planning

Seven point nine (7.9%) percent of the respondents indicated that poor physical planning in the river basin also contributes to flooding in the area (Figure 5.1). It was evident from the field survey that houses in the area were built in haphazard manner without taking cognizance to any building standards and regulations. Residential properties in the basin are developed without proper coordinated drainage system to allow for free flow of sewage and rain waters. Besides some properties are erected on drains while others are very close to the drains.

The normal course of some drains has been redirected to allow for expansion of properties in the Aboabo basin. The head of the physical planning department of KMA further added that,

“Households do not comply with the Ghana building standards and regulation for flood prone areas when undertaking constructional activities in the river basin”.

Therefore the flows of drains during precipitation are restricted and rushing water subsequently flood nearby areas. This finding supports the view of Karley (2009), who concluded that lack of proper planning and control of development of infrastructure causes flooding especially where drainage channels are compromised. This implies that city planners should serve notice to residents who have change the course of public drains to reverse them to their normal course or face the necessary punishment. Again, there is the need to enforce the requirement for building permit before the commencement of any development within the Aboabo River basin.

5.3.5 Poor Solid Waste Management

Fourteen point two (14.2%) percent of the household head surveyed attributed poor waste management to the causes of flooding in the study area (Figure 5.1). Again, from Appendix III the total estimated tonnage of solid waste uncollected in the study communities is about 66914.01tons which could be indiscriminately disposed. Observation from the field revealed that the only dump site in the study area where majority of residents dispose their solid domestic waste is situated close to the Aboabo River. Also the head of the waste management department of KMA stated that,

“The indiscriminate disposal of refuse into drains and Aboabo River further worsens the flooding problem in communities along the river”.

Fig 5.5 shows the method of waste disposal in the study area according to the respondents. Only 7.9% of the respondents have their solid waste not dispose close to the river. This is because it is being collected and disposed by a registered waste management company (Zoomlion) at a land fill site outside the study area. Twenty-two point one (22.1%) percent dispose their refuse through public container —skipl which is situated on the bank of the river, 11.9% dump in a public dump site located within the floodplain while 11.4% dump directly into the river.

It was clear from the field survey that the river canal has shrunk in volume as a result of accumulation of refuse and silt. Thus the river easily overflows and flood nearby areas after any prolong rainfall. However a total of 31.5% of the respondents dispose their refuse through

individual waste collection agents. These are mainly residents who lives far and cannot travel to the dump site. Interestingly these agents also offload their refuse loads either at the dump site or in a public container —skip along the river bank.

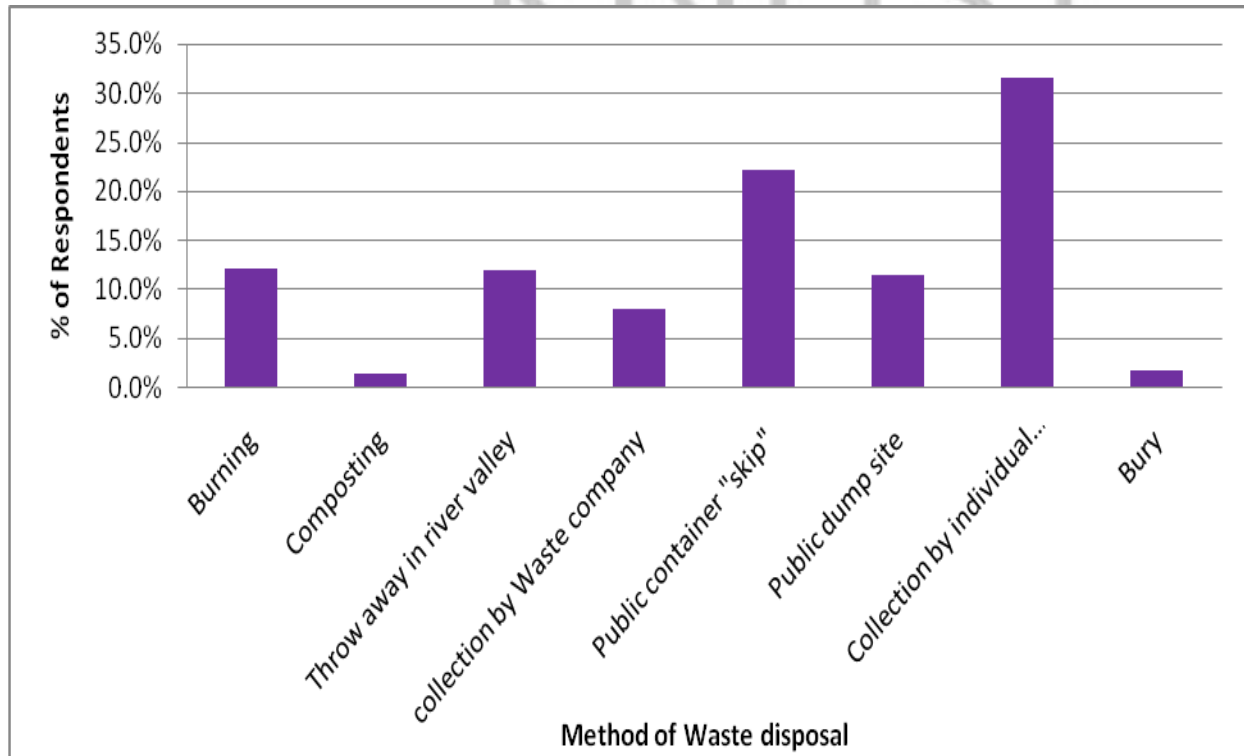


Figure 5.6: Methods of waste disposal in the study area Source: Field survey, 2015.

The implication to development is that Waste Management Departments needs to engage more sanitation companies to help in the collection and disposal of solid waste in the Aboabo river basin. Besides the public container —skip should be well managed by ensuring routine off loading and replacement in order to avoid spillage into the river valley. Additionally, the activity of individual solid waste collectors should be regulated to ensure that wastes are properly disposed into public —skip. Alternatively, they should be made to dispose their loads in a nearby landfill site outside the river basin.

5.3.6 Topography of the Area

According to Bull (2004) the nature of relief and narrow channel of River Valency largely accounted for the massive flooding that occurred in Boscastle, Cornwall in 2004. The results of

the study revealed that 3.4% of the respondents attributed low lying nature of the area to the causes of flooding in the Aboabo river basin (Figure 5.1). The Hydrological Service department added that the river basin is characterized by high lands at the upper segment and low lands in the middle to lower portion. Also, the river has a gentle slope and flows slowly. Therefore this allows for the collection of large quantity of water in the river valley after any incidence of rainfall. However, due to the reduction in the carriage capacity of the Aboabo River caused by years of accumulation of silt, the river readily overflows onto nearby spaces. This finding corresponds to the view of Bull (2004) on the causes of Boscastle flood. The implication to planning is that the Aboabo River needs to be desilted routinely before any flooding season set in. This could therefore allow for free flow of the river and reduced overflows.

5.3.7 Hard Landscaping

Davie (2008) indicated that increase in impermeable surface as result of concretization of surface increases surface runoff and reduce infiltration of precipitation which subsequently leads to inundation of surfaces. In the same vein Kumar et al. (2015), stated that unwise land use/land cover planning (indiscriminate expansion of cities) are responsible for the increasing flooding of Inning city. This is as a result of low water infiltration due to concretization of urban surfaces. The results of the study reveal that 0.4% of the household heads assigned Hard Landscaping of the area as the causes of flooding along the Aboabo River.

Observation from the field revealed that the river basin is characterized by increase infrastructural development due to rapid population growth which has led to most surfaces either tarred or concretized. Therefore falling rains are less absorb into the soil and thus rushed into the Aboabo river valley which subsequently leads to the overflow of the river when its carriage capacity is exhausted. This finding is in consonance with the study of Davie (2008) and Kumar et al. (2015) indicated earlier. The implication to planning is that city planners should ensure that areas within the river basin that are to be preserved as open public space should be covered with ornamental grass instead of concretes. Again, leave ways along public drains should as well not be tarred but rather grass. Additionally, buffer zones along river banks should be made free from any form of development that may hinder vegetative growth of the area.

5.4 Effects of Flooding

The study having revealed the causes of flooding, it further seeks to examine its effects in the river basin. This section will therefore present insight on the economic, social, environmental and other effects of flooding.

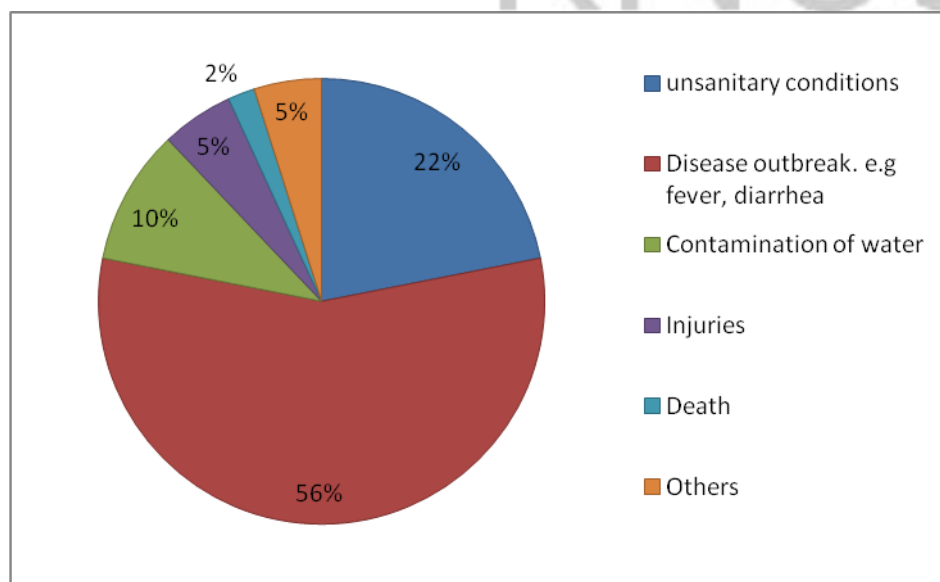


Figure: 5.7 Social effect of flooding

Source: Author's field survey, 2015.

5.4.1 Social Effects

Figure 5.6 presents the social effect of flooding in the communities according to the respondents. More than half (56.2%) of the respondents indicated that flooding in the area leads to the outbreak of diseases such as malaria, cholera and fever while unsanitary conditions accounts for 21.9%. Additionally, 9.8% and 5.2% of the respondents assigned contamination of water and injuries respectively as some of the outcome of flooding in the Aboabo river basin. However, only two of the respondents reported death as a consequence of flooding in the study area. Malaria and other disease outbreaks results from the presence of stagnant water which remains in ditches after flooding. This serves as breeding grounds for mosquitoes which can transmit the malaria parasite.

Again, floodwater also do wash away refuse from dump site and other choked drains onto nearby spaces which subsequently serves as convenient place for flies and rodents to thrive. The unsanitary

situation created by this event could therefore leads to the outbreak of cholera and other related diseases. In places where resident rely on hand dug well for water supply. Floodwater usually fills these wells thereby making it inappropriate for consumption and other use, however residents who have no option still rely on it for their domestic use which could pose a health risk. Flood events have also led to injuries on the part of some residents in an attempt to save themselves and others from flood catastrophes.

These findings is in line with the study of Neto (2001), who indicated that among the immediate impacts that often confront flood victims include deterioration of health conditions as well as death in some cases. This implies that disaster managers should include awareness creation in post flooding response to educate the public on the need to beware of what they consume due to possible disease outbreak. Again, waste management department should engage sanitation companies to conduct mass cleaning exercise and open spraying to destroy breeding ground of rodents and insects.

Additionally, the remaining 5% of the respondents attributed the social effects of floods to other reasons like displacement of people, migration, loss of security related to destruction of properties particularly fence wall of buildings, emotional and psychological trauma associated with loss of property, homes or life. Observation from field survey along the Aboabo River reveals that flooding has rendered some houses uninhabitable as it is being taken over by floodwaters. This has forced residents to move to other areas to seek for refuge. Again during flooding the security of the area is compromised as thieves thrive on the vulnerability of victims to steal their valuables. These findings is in line with the study of APFM (2013); Van Alphen and Lodder (2006) who stated that flooding can prompt mass migration and displacement of people. Additionally, flood victims suffer from stress and psychological impacts due to disruption of livelihood and death of loved ones. In some instances respondents recount how their wards have to absent themselves from school for couple of days as a result of flooding in the area. This implies that make-shift shelters should be put in place at appropriate location as part of the preparation measures before any impending flooding set in. Additionally, resident should be advised to make alternative shelter arrangement with family and friends in the face of impending flooding. Additionally, in post

flooding situations security agencies should increase surveillance particularly in the night in order to deter crime and ensure safety within the environs.

5.4.2 Economic effects

The research also established that flooding have some economic effects aside the social effects outlined earlier. According to the Associated Programme on Flood Management (APFM, 2013), loss of livelihood and other personal properties results in the decline in purchasing capacity of victims. Again, Adelye and Rustum (2011), asserted that during heavy downpours rivers overflows their banks, collapsed nearby buildings and washed away livestock and other food stuffs. This therefore could have knock-on effect on the livelihood of flood victims particularly where they depend on these assets for survival.

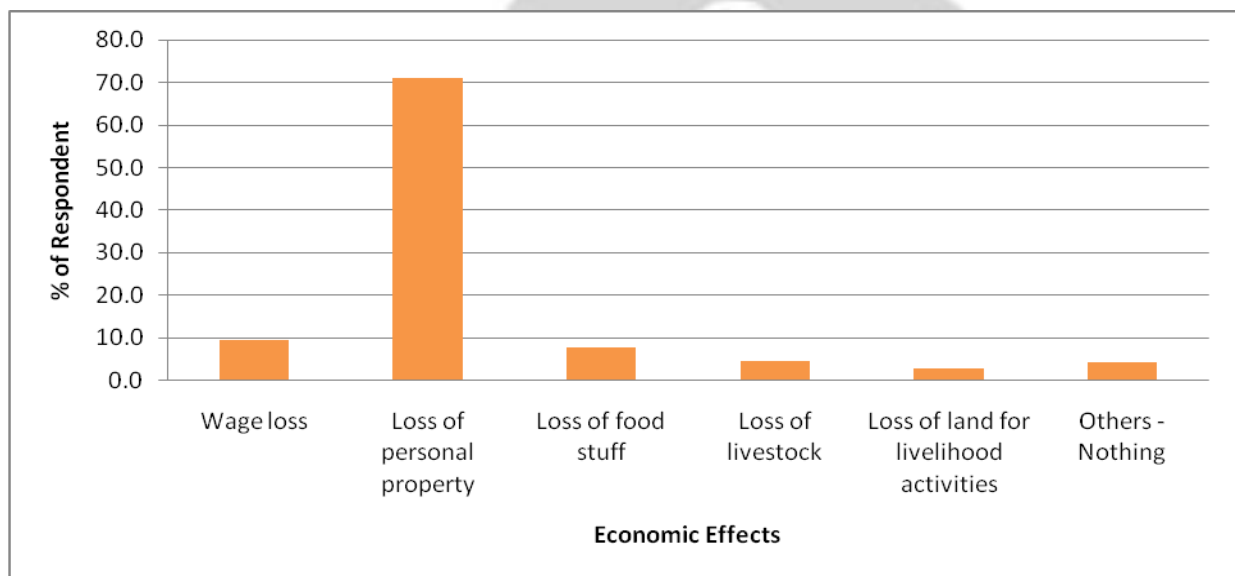


Figure: 5.8 Economic Effects of flooding Source: Field survey, 2015.

Also Poaponsakorn and Meethom (2013), asserted that when floods overtake most parts of vicinity meant for economic activities, it disrupt the working hours of wage workers. This therefore have negative knock-on effect on money and wage income of household working in these areas. Figure: 5.7 displays the economic effects of flooding in the river basin according to the respondent. According to the respondents loss of personal property accounted for 70.9% on the aftermath of flood event. These include destruction of household appliances, clothing, working tools or gadgets,

raw materials and buildings. Also the impact of this loss has been so huge as a result of under estimation of the magnitude of impending flooding. This is largely due to ineffective dissemination of flood warning information to residents in the river basin. The cost of replacing or repairing these damage properties further strains the available budget of households. This finding is in agreement with the study of APFM, (2013).

Moreover, 9.5% of the household heads loss their wages through absenteeism from work while 7.8% had their food stuff spoiled as a result of flooding. Usually, when flooding occurs it takes resident's couple of days to clear the mess caused by flood waters and as well restock lost food stuffs. This subsequently leads to the loss of productive hours that could have been used to earn some income elsewhere. Also floods led to the loss of livestock (4.6%) and land space meant for trading activities (2.9%). This finding also is in consonance with the study of Adelye and Rustum (2011); Poaponsakorn and Meethom (2013) stated earlier.

However, 4.3% of the respondents indicated that there were no economic effects of flooding in the Aboabo basin at least as far as they are concerned. These are generally those who have their jobs or businesses located in areas outside the river basin. Since their livelihoods are not directly affected, they believed that the floods did not have direct economic effects on them though they may have experienced it indirectly. This implies that Information Service Departments should ensure that flood warning information get to intended users early enough to enable them put their houses in order so as to minimize the impact of any impending flooding. Also, insurance agency should be advised to intensify public education on property insurance within the basin for capable household to take advantage of the insurance. However, the premiums should be flexible and moderate including the terms and conditions of service.



Figure 5.9: Building destroyed by floodwaters at Aboabo

5.4.3 Environmental Effects

According to Theiling (1998), flooding compromise the quality of flowing streams as a result of waste material washed into it by running flood waters. In the same vein Bariweni et al. (2013), indicated that the effect of flooding are felt on both built and natural environment. Flood waters damage bridges, causes dams to overflows, submerge buildings and blocked road links, railways and thereby causing disruption in transport network. At the same time flooding also pollutes streams with silt or debris and as well inundates open agricultural and recreational space. Observation made during field survey confirmed that flooding situation have affected both the built and natural environment. Thus the environmental effect of flooding is equally important as the social and economic. It was observed that a number of buildings are gradually submerging as a result of the annual occurrence of flooding. Again, some buildings have their foundation exposed with others having cracked and broken walls due to the perennial flooding in the area. In some places some houses have been abandoned as it was no longer safe for habitation.



Figure 5.10: Floodwaters took over building and open space at Aboabo

According to the respondent the major environmental effects of flooding are erosion (31%) followed by pollution of Aboabo River (26%), distribution of hazardous substances into homes (19%), choked drains (14%), loss of open lands used for public gathering (5%) and silting of the Aboabo River (4%) (Figure 5.5). Ditch created by erosion can be seen in most part of the communities along the river. These ditches serve as safe havens for breeding mosquitoes and dangerous traps which can cause harm to residents. To add to that flooding has contaminated most of the hand-dug well used by residents as a source of water supply. These findings are in agreement with the study of Theiling (1998) and Bariweni et al. (2013).

Additionally, the Aboabo River which is gradually becoming extinct as a result of refuse washed into it by rushing floodwaters. This has subsequently led to the loss of fauna and flora of the river. This implies that disaster managers should partner with the community during preparation towards flooding to construct flood breaks at strategic areas and desilt drains in order to control the flow of floodwaters. Again, control of refuse/solid waste disposal and restoration of the vegetative cover along the river could help in the protection of the river.

This could subsequently lead to the restoration of the lost fauna and flora. Moreover, public education on possible cholera outbreak needs to be intensify after any flood event in order to minimize the impact.

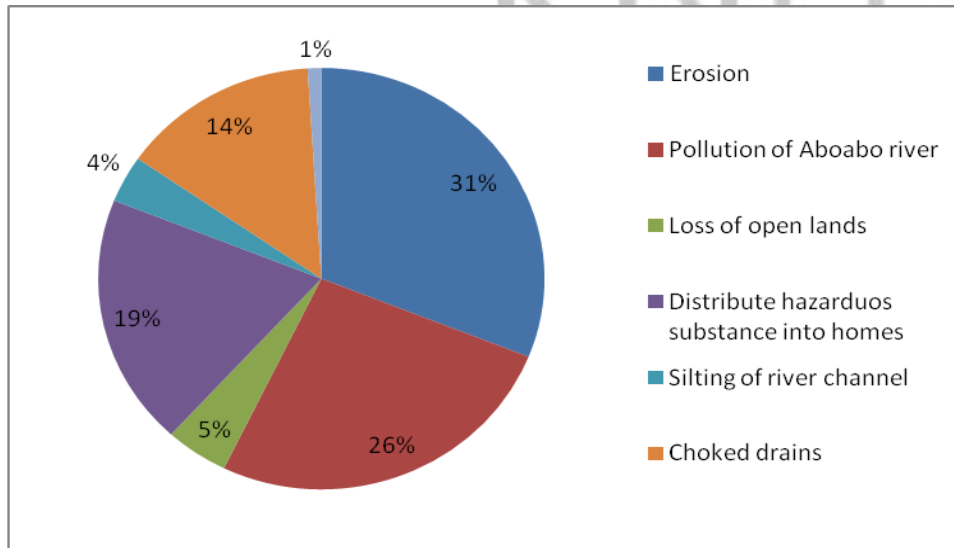


Figure: 5.11 Environmental effects of flooding

Source: Author's field survey, 2015.

5.5 Capacity of Institutions to Mitigate Flooding along the Aboabo River.

Over the years flood management institutions and stakeholders have put in place several measures to control the perennial flooding along the Aboabo River however the problem still persist. Investigations were made in the field to determine the ability of these institutions to deal with the problem of flooding effectively. The researcher wanted to know what the various stakeholders such as households, communities, and local government agencies or departments have put in place in addressing the problem. Among these institutions are the Asokore Mampong Municipal Assembly (AMMA), Kumasi Metropolitan Assembly (KMA) and the National Disaster Management Organization (NADMO). However they are supposed to collaborate with other government departments like Meteorological Service Division (MSD), Fire Service Division (FSD), security services in carrying out their operations.

5.5.1 Households Capacity to Mitigate Flooding

According to Paul and Routray (2009) in the event of flooding households adopt different local strategies to save their life and property from its impact. These include distress migration, moving to higher grounds and disconnection of electrical appliances. Again Van Alphen and Lodder (2006) stated that people with adequate expertise, knowledge and resources are able to respond to flooding swiftly than those who do not nor have less resource. This subsequently determines the extent of flood impact on their life and property. Fifty-seven percent of respondents stated that they could prevent or reduced flood waters from the overflows of Aboabo River and other nearby drains from getting to their home while the rest (42.8%) stated otherwise. Chi-square goodness of fit was conducted to find out the significance difference of household capacity to mitigate flooding. There was significance difference at ($\chi^2 = 6.327$, $df = 1$, $N = 306$, $P = 0.012 < 0.05$) (Table 5.18).

Table 5.18: Capacity of Household to mitigate flooding

Institution	Capacity	Frequency	Percentage	χ^2	P - value	df
Household	Yes	175	57.2	6.327	0.012	1
	No	131	42.8			
	Total	306				

Source: Field survey, 2015

Therefore 57.2% of households in the Aboabo river basin have the capacity to prevent floods from getting to their property. They believe with proper structural measures such as clearing of choked drains, construction of temporary drains, and creation of flood breaks the flow of flood waters into their homes can be minimized or prevented. Besides with proper ways of disposing waste in the community drains will gradually be free from filth and refuse. Thus drains will run freely when it rains and less debris will be washed into the Aboabo River. However these efforts should be complemented by local authorities (KMA) with the routine desilting of the Aboabo River and routine monitoring of method of waste disposal in the river basin.

Therefore households put more emphasis on structural measures than non -structural ones during floods mitigation. This is because most non-structural measures like emergency preparedness plan, flood warning system require some technical know- how which most household may be lacking.

Additionally, households have adequate labour at their disposal to implement most structural measures. This finding is in agreement with the study of Paul and Rautray (2009) indicated earlier. The implication to planning is that city planners should complement the effort of household by the implementation of non – structural measures such as issuance of flood warnings and enforcement of land use regulation along the river.

On the other hand, 42.8% of the respondents who indicated that households do not have the capacity to prevent their homes from being flooded believed that flooding is a natural phenomenon as such cannot be prevented. They again added that there are no enough drains in the area to carry flood waters and the few ones that exist cannot accommodate the huge volumes of flood waters. Again controlling flooding in the area requires heavy machinery to desilt the Aboabo River routinely before the flooding season set-off which households are unable to acquire. This is also in agreement with the study of Van Alphen and Lodder (2006) who stated that people needs adequate resources to implement flood mitigation measures effectively.

This implies that flooding in the area is likely to be increasing due to increase in rainfall pattern couple with inadequate drainage system in the river basin. Therefore policy makers should help residents develop variety of coping strategies. Again, implementation of some structural measures like construction of levee, desilting of river channels should be a major priority during district medium term plan preparation.

5.5.2 Community Capacity to Mitigate Flooding

Lebel et al. (2011) posited that effective flood mitigation requires the coordination of activities of all stakeholders especially during the formulation and implementation of programmes and projects that will reduce vulnerability to flood and its related disaster. Again De Graaf (2008) stated that the ability of society to implement these measures is determined by the availability of logistical and financial resources in addition to technical expertise. Fifty-seven point eight (57.8%) percent of the respondents indicated that the community as a whole have the capacity to mitigate flooding in the area whiles the remaining 42.2% indicated otherwise due to a number of reasons. Again, chi-square goodness of fit was conducted to find out the significance difference of the capacity of

the community as a whole to mitigate flooding. There was significance difference at ($\chi^2 = 7.529$, $df = 1$, $N = 306$, $P = 0.006 < 0.05$) (Table 5.19).

Table 5.19: Capacity of Community to Mitigate Flooding

Institution	Capacity	Frequency	Percentage	χ^2	P - value	df
Community	Yes	177	57.8	7.529	0.006	1
	No	129	42.2			
	Total	306				

Source: Field survey, 2015

This implies that 57.8% of households in the river basin believe the communities along Aboabo River have the capacity to mitigate flooding. According to the respondents this could be achieved by organizing communal labour to clear choked drains and setting up task force to monitor and prevent solid waste disposal in the Aboabo river valley and nearby drains. This will subsequently allow for free flow of all drains in the river basin as well as the Aboabo River and subsequently mitigate the flooding problem in the area. Additionally, the communities have the labour force at their disposal which they can pool together to clear drains from silt and refuse. This finding supports the study of Label et al. (2011); De Graaf (2008) outlined earlier. This implies that waste management departments and communities should collaborate and coordinate their activities to monitor and control methods of solid waste disposal along the Aboabo River as it has the potential to trigger flooding.

In another dimension, 42.2% of the respondents who stated that the communities do not have the capacity for flood mitigation believe inadequate resources, relief of the area are the major issues that affect the ability of communities to mitigate flooding effectively. This is because Implementation of flood mitigation requires a lot of financial and logistical resources aside the human capital. However the community cannot provide these resources adequately. At the same time the topography of the area coupled with more days of precipitation in the river basin makes flooding inevitable as majority of running waters from rainfall are directed into the river.

However there are others who are of the conviction that any effort carried by the community will not make any difference. This finding is in line with the study of Tucci (2007) who stated that the

planning of strategies to mitigate flooding and its effects requires the availability of adequate and appropriate capacity on the part of actors involved.

These observations implies that structural measures such as desilting of Aboabo River, construction of bridges and expansion of drains that require heavy machinery, finance and knowhow cannot be implemented by the communities. This is because majority of the households are of low or middle income status and do not have the adequate resources to implement such measures. In this regard, local authorities should assist communities in the implementation of such structural measures. Additionally, the communities do not have powers to control and regulate land use activities along the river that has the potential to trigger flooding e.g. construction practices. Thus city planners should set up joint task force with the community to embark on routinely monitoring of land use activities along the Aboabo River. Also, there should be regular dissemination of flood warning information to households in living in flood prone areas. Again, there should be flood emergency preparedness plan for the river basin. This plan should be drawn in a holistic manner in consultation with all relevant stakeholders.

5.5.3 Capacity of Government Institutions and Agencies to mitigate flooding

Institutions need to have the capacity to coordinate and mobilize resources in order to take critical actions for flood control and mitigation. In addition, the activities of all stakeholders should be coordinated during the design and execution of programs and projects. At the same time public participation during the implementation of such measures at all phases of flood management ensures effective utilization of local knowledge and skills (Manuta et al., 2005; Lebel et al., 2011; Ahmed et al., 2004). Again (Lebel & Sinh, 2009) Lebel and Sinh (2009), asserted that institutions require technical expertise as well as physical resources for effective implementation of flood management measures.

Eighty eight point six (88.6%) percent of the respondent stated that local authorities (i.e. Kumasi Metropolitan and Asokore Mampong Municipal Assemblies, NADMO – Kumasi) have the capacity to mitigate flooding in communities along the Aboabo river while the rest (11.4%) indicated otherwise. Chi-square goodness of fit was conducted to find out the significance

difference of the capacity flood management institutions or agencies to mitigate flooding. There was significance difference at ($\chi^2 = 182.0$, $df = 1$, $N = 306$, $P = 0.000 < 0.05$) (Table 5.20).

Table 5.20: Capacity of Government Institutions and Agencies to Mitigate Flooding

<u>Institution</u>	<u>Capacity</u>	<u>Frequency</u>	<u>Percentage</u>	<u>χ^2</u>	<u>P - value</u>	<u>df</u>
Flood Management Institutions or Agencies	Yes	271	88.6	182.0	0.000	1
	No	35	11.4			
	Total	306				

Source: Field survey, 2015

Therefore 88.6% of household heads in the river basin believe that flood management agencies have the capacity to mitigate flooding along the Aboabo River. This is because local institutions (KMA, AMMA & NADMO) have the financial and logistical resources as well as the requisite expertise to implement both structural and non-structural measures. E.g. construction and expansion of new or existing drains, desilting of Aboabo River, flood forecasting and land zoning. Again, institutions have well established departments and units who have the responsibility of enforcing land use regulation through punishment and undertake public education on flooding. At the same time these institutions (KMA, AMMA & NADMO) have the legislative backing to regulate land use activities along the river. However this could be best achieved if there is cooperation and collaboration among institutions and residents.

Again, flood management Institutions have the personnel with the requisite expertise that can educate and alert the public on floods. However observation from the field revealed that these non-structural measures such as public education and awareness creation on floods are not given much attention during implementation of flood management measures in communities along the river. These findings correspond to the study of Manuta et al. (2005); Lebel et al. (2011) and Ahmed et al. (2004). Moreover at every stage of this management cycle institutions should involve the community in order to ensure effectiveness.

The implication to development is that institutions need to be further strengthened by allowing it to operate without interference. Additionally collaboration and sharing of flood information among agencies particularly the Information service departments, city planners, meteorological agencies and disaster management organisations should be enhanced to allow for its effective dissemination and utilization.

However of the remaining 11.4% of the respondents who indicated that local institutions do not have the capacity to mitigate flooding in the river basin believed the institutions are under resourced and thus cannot fully implement the necessary measures as expected. Again the authorities do not at all times involve the community in decision - making and implementation of measures on flood control thereby rendering any measures taken ineffective. Additionally the attitude of individuals in the community makes it difficult for authorities to discharge their obligations effectively, particularly land use activities. Also the culture of impunity within the river basin has made the role of institutions virtually ineffective. Therefore flood management institutions give less priority to non structural measures such as flood alerts information and environmental sanitation campaign. This finding is in conformity with the study of Lebel and Sinh (2009) who stated that lack of physical resources and collaboration among relevant stakeholders affects effective implementation of flood measures. This implies that there should be broad consultation and collaboration with the community before any flood mitigation decision is taken.

5.6 Perspective of Local Institutions on Flooding along the Aboabo River

In a bid to clarify the observations and views gathered from respondents on the causes , effects and mitigation of floods in the area, attempt were made to illicit the views of institution to verify these concerns. Additionally, in order to assess institutional capacity in controlling flooding along the Aboabo River, there is the need to understand the role of flood management institutions and the factors that obstruct their effort in discharging their responsibility. This was achieved through structured interview with the Town and Country Planning Departments (TCPD), Waste Management Departments (WMD), National Disaster Management Organization (NADMO), and Ghana Meteorological Agency (GMA) all within the city of Kumasi. The responses were as follow:

5.6.1 Town and Country Planning Departments (TCPDs), Kumasi

According to the TCPD, their mandate is to guide the spatial growth and physical development of the city of Kumasi. This is to ensure orderly and sustainable use of the physical space and is achieved through revision and rectification of old planning schemes, rezoning, and regularizing of layouts. They also control and regulate physical development in the city as well as providing advice to the public and Assemblies.

Again, the TCPD indicated that they have develop maps for flood prone areas in Kumasi based on information from the Survey Department of KMA; for which the Aboabo river basin is one. According to the map areas 100ft on either side along the Aboabo River are to be reserved as buffer zone; however observation made from the field showed that these areas have been encroached upon. They however indicated that their effort have usually been thwarted by influential persons in society in their bid to enforce the plans. Key persons in society have always come to seek pardon for offenders of land use regulation. They also indicated that in developing land use maps for areas within Kumasi they collaborate with all relevant stakeholders however the level of collaboration was not satisfactory. This is because citizenry some time feels that the activity of TCPD is a threat to their operations. Furthermore, the TCPD indicated that they do not have adequate human, financial and logistical resources to carry their operations effectively.

KMA had 4 personnel instead of 14 personnel manning 9 sub metros; no computers and one old vehicle. Similarly, AMMA had 3 personnel, no computers and no vehicle. Observation at the department revealed that record keeping is poor due to lack of computers.

Also, the TCPD indicated that residents in the Aboabo river basin are exposed to various degree of suffering as a result of the perennial flooding along the river. They attributed the causes of flooding in the area to the limited carriage capacity of the river channel as a result of years of cumulated silt. Again, construction on waterways particularly in the buffer zone and disposal of refuse in the river also contributes to the problem. They suggested that opinion leaders, unit committee members and Assemblymen should work hand-in-hand to educate members to desist from construction on water ways and disposal of refuse in the river. They added that central government should support department and agencies with adequate funding to enable them execute their mandates effectively.

5.6.2 Waste Management Departments (WMDs), Kumasi

The core function of the WMDs is to ensure a clean and healthy environment in the city through efficient and effective ways of managing solid and liquid waste at all premises and public spaces. This is achieved through safe removal and disposal of liquid and solid waste, cleansing & routine maintenance of drain and public education on environmental cleanliness. However observation from the field revealed that waste management in the city leaves much to be desired.

According to the WMDs poor means of waste disposal in the Aboabo river basin contribute to the perennial flooding in the area in addition to other land use activities such as construction on water ways. They however added that they do not have any special regulation to control land use activities in flood prone areas. They indicated that in attempt to ensure proper ways of disposing waste in the basin, a public waste collection container —skip— was situated in the area. However observation made in the field and information gathered from respondents revealed that some individuals still dispose their solid waste in the river. Additionally the —skip— which is situated close to the river bank are not off-loaded routinely as such refuse spill over and are washed into the river by running water during incidence of rainfall.

In addition, they indicated that decongestion exercise is carried along the river bank from time to time, however the people still move back after some time since authorities do not ensure continuous monitoring thereafter. Furthermore, the WMD indicated that they are aware that the Aboabo river channel was expanded in order to reduce the incidence of flooding in 2007. However according to the residents in the basin the river channel could not contain the huge volume of floods.

This is due to the siltation of the channel, at the same time portion of the channel are shallow while others are not. They again added that issue of flood control in the basin even though they have some role to play the sole responsibility rest with NADMO. The departments also revealed that they do not have enough funds and logistics to carry their routine activities. Also, in their attempt to enforce laws they are challenged by the political atmosphere in the country particularly during decongestion and punishment of offenders. Influential persons in society usually interfere when the departments want to enforce the laws. The WMDs indicated that in order to control flooding in the area, the recently National Sanitation Day introduce should be encouraged, this could result

in attitudinal change among the citizenry on ways of disposing waste. Again, Building Inspectors must be motivated to undertake regular monitoring of land use activities along the Aboabo river and institutions must be allowed to work without interference. They added that there should be collaboration between their departments, TCPD, Public works Department and residents in order to manage and mitigate flooding along the Aboabo River.

5.6.3 National Disaster Management Organization (NADMO), Kumasi

The mission of NADMO is to manage disaster through the coordination of activities of all stakeholders and improve the capacity of communities to respond to disaster effectively. They as well seek to improve the livelihood of victims through special projects and programmes. According to the department they have consistently provided support to victims whenever there is flooding along the Aboabo River. Interaction from the field revealed that they only respond after flooding has occurred and do not play any role before flooding occurs. They explained that their responsibility is to manage disaster.

Again, they acknowledge the fact that flooding along the river has been devastating over the years and attributed the causes to dumping of refuse in the river and erection of structures along the river bank.

Again the department indicated that they do not have enough logistics and finance to carry their operations effectively. Again, there is always delay in the release of funds and they were not able to provide record of flooding and related disaster that has occurred over the years along the river. Information gathered also revealed that NADMO is effective at the national level and weak at the local level. Checks at the local level indicate that resources are released to the national Head office in Accra not the local department in the district. The district department has to liaise with the national in order to access the resources which usually take a longer time.

Furthermore, NADMO believed that the situation can be addressed if all stakeholders collaborate to implement measures that will help address the situation. These include enforcement of land use regulation, public education on river pollution, pool resources together to carry routine desilting of the river channel. Additionally, funds allocated for disaster management should be released to the district Assembly for the local NADMO to access at the district level.

5.6.4 Ghana Meteorological Agency (GMA), Kumasi

The GMA exist to provide meteorological information to the public. This is done after this information has been collected, compiled and analyzed. They do not undertake any special exercise in controlling flood in flood prone areas but only give prior warning of the likelihood of intense rainfall to people living in flood prone areas.

According to the GMA flooding along the Aboabo area is caused by intense and prolong rainfall in the area couple with poor land use along the river bank. Dumping of refuse in the river also contribute to flooding in the area as it obstruct free flow of the river. They indicated that to help address flooding situation in the Aboabo river basin, NADMO and the general public are periodically informed on the possibility of any intense and prolong rainfall for them to prepare towards any unforeseen flooding. However interaction with the agency has revealed that they do not have meteorological data on specific location within the metropolis like the Aboabo river basin.

The GMA do not have adequate logistical and human resources to operate as expected. The agency indicated that they lack modern equipment that can help them discharge their duties effectively. Most of the equipment as well as the technology they are using are obsolete. Besides, they also need more personnel to facilitate the collection and compilation of data. In the view of GMA flooding in the area can be managed if Building Inspectors undertake continuous monitoring on land use activities in the river basin. Again, citizenry should be educated to desist from throwing refuse into the river. Besides, authorities should set up sanitation court to deal with offenders. Community should be educated and encouraged to set up task force that will monitor and apprehend those disposing refuse in the river. Additionally, GMA should be resourced with both personnel and modern logistics to be able to deliver accurate and reliable information to its end users. Also both new and existing personnel should be giving training on the use of modern technology in carrying their work.

5.7 Coping Strategies of Residents to Floods

Flood coping strategies is forms part of the flood management systems along the Aboabo river. In this regard the study investigated the different coping strategies employed by households and the

community as a whole before, during and after flooding. Additionally what authorities have put in place to help residents cope with the problem was also considered. According to Sakijege et al. (2012) coping strategies for flood events occur at different level: individual, community and institutional. The following are the different coping mechanisms employed at the above level before, during and after flooding in the Aboabo river basin.

5.7.1 Community Coping Strategies before Floods

The results of the study show that 247 out 306 respondents stated that communities implemented some pre flood measures to enable residents cope with flooding. Among these are clearance of choked drains, construction of flood barriers, construction of temporary drains, awareness creation, identification of flood prone areas, communication plan and flood management committee to liaise between residents and disaster management agencies.

Firstly, out of the 247 respondents 53 (22%) stated that the community undertake awareness creation to inform members to be alert on the likelihood of flooding (Table 5.21). This allow household to safeguard their assets such that they can withstand the impacts of floods when it occurs. Also sensitization of residents about flood issues prepares their psyche such that psychological stress associated with flood impact will be minimal.

Secondly, 19 (7.9%) indicated that the leadership of the community identify and inform residents living in extremely vulnerable areas to evacuate or secure their valuables before the onset of the rainy season (Table 5.21). The information is usually carried in places of social or religious gathering. However most of the households do not get this information while the few that had do not put it to use. This is because the medium of information dissemination is ineffective as not all household members attend these events. Also since the magnitude of the event is unknown such information is sometimes treated with less seriousness.

Additionally, other structural measures implemented by community include flood barriers at certain specific locations to prevent the inflow of floodwaters into home. Also temporary drains are constructed and choked gutters cleared through communal labour to allow free flow of floodwaters (Table 5.21).

Similarly, only two (0.8%) and 1.2% (3) stated that opinion leaders set up committee and establish contact with disaster management agencies respectively before the onset of rainy season. The composition of this committee is mainly the youth together with some opinion leaders. They are to collaborate with disaster management agencies to provide support to victims in the event of flooding; particularly during rescue operations. Also 28 (11.6%) added that the community draw a communication plan to help in the effective interaction between victims, committee and disaster management agencies (Table 5.21). The plan is fundamentally indicative of where to seek for assistance particularly the immediate point of call in case of emergency.

Table 5.21: Community coping strategies before floods

Period	Coping Strategy	Respondent	% of Respondent
Before floods		(N= 247)	
	Awareness creation	53	22.0
	Identify flood prone areas	19	7.9
	Construct flood barriers	16	6.6
	Set up flood management committee	3	1.2
	Develop community communication plan	28	11.6
	Establish contact with flood management agencies	2	0.8
	Construct temporary drains	15	6.2
	Clear choked drains	83	34.4
	Do nothing	110	45.6

Source: Field survey, 2015

Therefore clearing of choked drain and sensitization on flood issues are the fundamental strategy employed by community in order to enable households cope with any impending flood. The existence of communal cohesion as a result of similar cultural background shared by residents along the Aboabo River contributes to the success of these approaches. However about 45% of the household heads interviewed stated that the community does not put in place any measure to help residents withstand the impact of flooding.

5.7.2 *Community coping strategies during Floods*

The study reveals that 297 out of 306 respondents indicated that communities implement some measures to help residents during flooding. Among the measures implemented are search and

rescue operation, monitoring, issuance of flood warnings and interaction with disaster management agencies.

Firstly, out of the 297 respondents 38 (12.8%) stated that search and rescue operations to secure residents caught up by floods are carried by community flood management committee while 28 (8.4%) assigned close monitoring of events as it unfolds (Table 5.22). Even though the committee have been tasked to do the monitoring, residents are also encouraged to do the same and report any untoward happenings to the committee. Information gathered is further disseminated to both residents and agencies to implement the necessary measures to prevent or reduce potential flood damage.

Table 5.22: Community coping strategies during floods

Period	Coping strategy	Respondent (N= 297)	% of respondent
During Flooding	Flood warning information	24	8.1
	Inform flood management agencies	9	3.0
	Close Monitoring by rescue team	28	9.4
	Search & rescue operations	38	12.8
	Do nothing	235	79.2

Source: Field survey, 2015

Additionally, 24 (8.1%) stated that residents are warned to move to high grounds during flooding. Also 9 (3.0%) of the respondent added that information about the trend of event are liaise between residents and flood disaster management agencies as well as other relevant stakeholders (Table 5.22). However about 80% of the respondent indicated that the community do not implement anything to help household be resilient to the impacts of any flood event. This shows that the strategies implemented by communities to help households cope with flooding only serve small portion of communities. This is either due to inadequate physical and human resources to cater for wider section.

5.7.3 *Community Coping Strategies after floods*

The study reveals that 267 out 306 respondents stated that communities carried strategies to assist in the recovery of residents after floods. These measures include: cleaning exercise, clearance of choked drains, closure of temporary drains, report to authorities for relief support and counseling. The results of the study reveals that 152 out of the 267 respondents (56.9%) stated that the community conduct clean up exercise through joint labour to clear the mess caused by flooding. Also, 82 (30.7%) indicated that temporary drains that were created before flooding to direct flood waters are closed after the rainy season.

Whiles 11 of the respondents added that opinion and religious leaders occasionally provide counseling to flood victims in order to ease them from the psychological trauma they suffer as a result flooding. This usually happens at places of social or religious gathering particularly during the period of perennial flooding. At the same time 20.6% of the respondents stated that the leadership of the community seeks relief items for flood victims from local disaster management agencies (Table 5.23).

Table 5.23: Measures put in place by community after flooding

Period	Coping strategy	Respondent	% of Respondents
After Flooding		N= 267	
	Clean up exercise	152	56.9
	Clear choked drains	82	30.7
	Report to authorities for assistance	55	20.6
	Close temporary drains	6	2.2
	Counseling and guidance	11	4.1
	Do nothing	120	44.9

Source: Field survey, 2015

All these measures are carried out in order to bring life back to normalcy in the community. However the major activity carried by the community after flooding is clean up exercise. On the

contrary the impact of this measure on flood recovery is minimal as majority of flood effects have to do with property damage and livelihood loss. Therefore communities along the Aboabo river undertake strategies that rely heavily on labour which are readily available and ignore cash demanding ones.

These findings comply with the study of Srikuta and Innuong (2014) who stated that communities communicated well among their members to be unified in order to be able to deal with flood impacts. Therefore household are able reduce environmental health risk with close communication between community leaders and government agencies. Again, community health surveillance, flood evacuation practice, and flood preventive measures are of value in assisting households cope with flooding

However these measures are inadequate which explains why household along the river still suffer from flood impacts. The implication to development is that disaster management agencies and local assemblies should collaborate with community flood management committees in the implementation of flood preparedness measures. Additionally, public education should be intensified to encourage the formation and expansion of local committees to render support services during flooding. Also disaster management organization should partner with the leadership of communities to identify and assess the impacts of flooding. This is to ensure that relief items are given to intended beneficiaries.

5.8 Household Coping Strategies

Households in the Aboabo river basin do undertake different coping strategies in the face of impending flooding. These strategies are carried before the onsets of flooding in order to avoid any adverse impact. Also there are some strategies that are undertaken during flood event to minimize the effect on both life and property while others are carried to bring life to normalcy after flooding. According to Paul and Routray (2009) households have different home-grown strategies they adopt to cope with any flood event. These include creation of flood breaks before flooding set in, moving to higher grounds, disconnection of electrical installations during flooding and relying on family & friends for sustenance after flooding. In the same vein Few (2003), asserted that earlier flood

preparedness provide adequate time space for residents in flood prone-areas to draw on their own capacities, networks and strategies to cope and respond to floods.

5.8.1 *Households coping strategies before floods*

The flood preparedness measures adopted by households to help avoid or reduce flood impacts are construction of sand bag barriers, digging of flood breaks, alertness, communication plan, evacuation procedure, building flood emergency kit and flood insurance. The results of the study shows that 70 (27%) out of the 259 respondents stated that they construct sand bag barriers while 12.3% (32) assigned digging of flood breaks as some of the measures they put in place around their home to avoid the inflow of floodwaters and its subsequent impact. Again, a total of 157 (60.6%) assigned clearance of nearby choked drains to allow free flow of floodwater in the event of flooding. Similarly temporary drains are created where necessary to redirect floodwater out of their homes. However other non-structural strategies such as alertness, communication plan, evacuation procedure and insurance of property were some of the measures adopted by households before flooding begins (Table 5.24).

Table 5.24: Households coping strategies before floods

Period	Coping Strategy	Response	% of Responses
Before Floods		(N=259)	
	Build emergency kit	5	1.9
	Construct sand bag barriers	70	27
	Dig flood breaks	32	12.3
	Clear choked drains	157	60.6
	Construct temporary drains	32	12.3
	Be alert	24	9.3
	Develop family communication plan	50	19.3
	Develop evacuation procedure	76	29.3
	Insurance (property & valuables)	80	30.9

Source: Field survey, 2015

Households usually alert members to secure their belongings and valuables before the onset of the flooding season. At the same time point of call are made familiar among members to allow effective interaction and flow of information. This shows that clearing of nearby drains is the main

strategy adopted by households in order to minimize flood impacts even though other structural measures like flood breaks and temporary drains are also put in place. However non structural approach of coping with flood effect are given less priority by household as less than 31% of household heads adopt such measures.

5.8.2 *Household coping strategy during floods*

Among the strategies put in place by households during flooding are movements to higher ground, staying away from floodwaters, disconnection of electrical connections, listening to news, alertness, seeking help from family & friends and calling to inform authorities for assistance. The results of the study shows that 140 (47.1%) out of the 298 respondent stated that households move to higher ground during flooding.

Also, 35.6% (106) and 20.5% (61) indicated that households stay away from flood water and disconnect electrical appliances respectively (Table 5.25). Usually floodwaters move into households premises and takes couple of hours to move out. Residents therefore keep their family in safe areas and at the same time ensure that all electrical connections are disconnected to prevent electrical shock or fire outbreak.

Table 5.25: Households coping strategies during floods

Period	Coping Strategy	Response (N= 298)	% of Responses
During Flooding	Move to higher grounds	140	28.1
	Stay away from flood water	106	21.2
	Disconnect electrical appliances	61	12.2
	Listen to news during flooding	9	3
	Be alert	20	6.7
	Call to inform authorities	24	8.1
	Wait & see	127	42.6
	Seek help from family & friends	12	4

Source: Field survey, 2015

Again, 3% indicated that they follow media reports to get latest information about the magnitude and trend of flooding so they can reorient themselves to withstand any effect. Alertness is another means households employed in order to secure their family and property according to some

respondents (6.7%). However this is usually based on information gathered from the media and neighbours. Additionally some households also seek help from family & friends or call to inform authorities for assistance as shown in table 5.25. However 123 (41.3%) out the 298 respondents stated that they adopted the wait & see approach (Table 5.25). This group is usually of the view that once there is flooding there is nothing you can do about it and calling for assistance will not yield any response as previous once has failed. Therefore the main coping strategy of household during flooding is to move their valuables and family to areas that are beyond the reach of floodwater. However greater proportions of households also adopted the wait and see approach.

5.8.3 *Households coping strategy after floods*

The strategy adopted by households to recover from the impacts of flooding in the Aboabo river basin include cleaning of premises, clearing choked drains, property repairs , healthcare services and assistance or loan to sustain their livelihood. Firstly 80.2% (235) out of the 293 respondent assigned clean up exercise, while 52.6% (154) and 31.7% (93) stated that repair of damaged property and clearance of choked drains respectively were some of the activities carried out after any flood event. These measures are taken to ensure serene environment and as well restore life to normalcy after flooding has occurred. Again only one respondent indicated that they secured loan from close associates to sustain themselves and also cater for the cost of property repairs. Similarly there are others who relied on relief items supply by local disaster management agencies. This is usually made of food, mattresses, bed sheet, blanket and other household accessories.

However these relief items are usually supplied late and inadequate, while some of the items also do not get to the intended beneficiaries. Additionally, other households also relied on family & friends for assistance for their sustenance as shown in table 5.26. However 25 of the respondents indicated that they usually seek for medical care to maintain a healthy life after flooding. Flooding in the Aboabo basin is usually poses health risk particularly with cholera and fever (Table 5.26).

Table 5.26: Households coping strategies after floods

Period	Coping strategy	Responses	% of Responses
After Flooding		(N= 293)	
	Clean up exercise	235	80.2

Report to authorities	17	5.8
Seek medical care	25	8.5
Repair damage property	154	52.6
Seek for Loans	1	0.3
Clear choke drains	93	31.7
Rely on family & friends	38	13
Do nothing	23	7.8

Source: Field survey, 2015.

Therefore the main activities carried by majority of household in the Aboabo basin to restore life to normalcy in their homes are repair and replacement of damage property or assets. Additionally, filth and flood waters are cleaned to prevent disease outbreak. However less priority is given to health check unless there is the pressing need for it.

These findings on coping strategies of households before, during and after flooding is in line with the study Paul and Rautray (2009); Few (2003), as indicated earlier. The implication of these to development is that well before the flooding season state insurance agencies should be task to educate households on the need insure their properties against flood in order to be compensated for any damage. Additionally, Disaster management agencies need to be adequately resource to intensify their operations to cater for majority of the populace during flooding. Again, in post flooding situation District health manages in collaboration with disaster management agencies should conduct free health screening exercise as well as health education in areas hit by floods.

5.9 Institutional measures

The District Assemblies, local NADMO outlets and other stakeholders from time to time implement certain measures in the Aboabo basin to help residents cope with prevailing flooding situation. These measures are either carried before, during or after flooding. The following are the measures put in place by institutions to help households cope with flood impacts.

5.9.1 Institutional measures before flooding

Among the activities carried by KMA, AMMA in collaboration with other stakeholder institutions to help prevent or reduce the impact of flooding on households include decongestion exercise along the Aboabo River as well as desilting of the river. These activities are carried well before the

flooding season. However other activities such issuance of flood warning information and land use control are occasionally carried. Eighty-seven point three (220 out of 252) percent of the respondents stated that flood management agencies do not put any preparedness measure that will help residents cope with any impending flooding. A total of 22 out of 252 (8.7%) and 9.5% of the respondents indicated that the District Assemblies (KMA &AMMA) desilt the Aboabo river and demolish structures erected along the river bank respectively.

This is to facilitate free flow of the river when flooding occurs. Again, 18 (7.1%) indicated that institutions occasionally issue flood forecasting & warning information to residents and other end users to take necessary action to avoid or reduce the impact of flooding. Also other measures like the establishment of contact with residents and land use control were among some of the non-structural measures carried by the District Assembly before flooding (Table: 5.27).

Table 5.27: Institutional measures before flooding

Period	Measures	Respondent (N= 252)	% of Respondent
Before Flooding			
	Desilting of Aboabo river	22	8.7
	Construction of dykes	13	5.2
	Flood forecasting & warning	18	7.1
	Decongestion	24	9.5
	Establish contact with residents	20	7.9
	Land use control	15	6.0
	Do Nothing	220	87.3

Source: Field survey, 2015

These measures seek to alert residents of possible flooding so they can adjust themselves to overcome flood impact when it happens. Therefore desilting river Aboabo is the major activity carried by the local assembly in preparing towards the perennial flooding. However observation from the field revealed that debris scooped from the river is dumped on the river bank which is gradually washed back into the river by rain. Additionally, most residents are not satisfied with the flood preparedness measures of institutions.

5.9.2 Institutional Measures during flooding

The results shows that 20(6.8%) out of 296 of the respondents indicated that officials of KMA do move around to assist victims caught up by flooding and at the same time warn residents to stay at safe places respectively. However 99.6% indicated that institutions do not undertake any measures in ensuring that residents are able to cope with the flood problem but only respond couple of days after the event (Table 5.28).

Table 5.28: Institutional measures during flooding

PERIOD	Measures	Respondent (N= 296)	% of Respondent
During Flooding	Search & rescue operation	20	6.8
	Monitoring & reporting	17	5.7
	Flood warning information	7	2.4
	Do nothing	295	99.6

Source: Field survey, 2015

Therefore institutional interventions during flooding are ineffective as almost all households do not appreciate the impact of their activities.

5.9.3 Institutional measures after flooding

Local institutions undertake some measures in post flooding event to restore hope and confidence in the life of affected victims. The outcome of the study revealed that 25 (8.4%) out of the 299 respondents indicated that local disaster management agencies (NADMO) provide relief items to help sustain families of flood victims while 7.0% assign awareness creation of possible disease outbreak e.g. cholera are among the activities implemented after flooding. Again the results also reveals that some measures like clearance of choked drains, repair of damage infrastructure like roads and water supply were also carried out by authorities in affected communities. The clearance of choked drains is carried by joint collaboration between Zoomlion (Private waste management company) and KMA (Table 5.29). Therefore provision of relief support to flood victims is the major activity implemented by institutions after flooding.

Table 5.29: Institutional measures after flooding

PERIOD	Measures	Respondent (N= 299)	% of Respondent
After Flooding	Provision of relief items	25	8.4
	Awareness creation on disease outbreak	21	7.0
	Repair damage infrastructure	2	0.7
	Clear choked drains	9	3.0
	Do nothing	271	90.6

Source: Field survey, 2015

These findings comply with the study of Obeta and Hanif (2014) who stated that measures implemented by institutions in pre and post flooding events help reduce the potential damage that might be inflicted on people living in flood prone areas. Even though the finding of the study suggested that some attempts have been made by institutions to help people living along Aboabo river cope with flooding, the impact has not been so significant. This implies that policy makers should prepare a comprehensive flood disaster management preparedness plan which will ensure progress and continuous implementation of response and recovery measures.

CHAPTER SIX

SUMMARY OF MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS 6.1

Introduction

The research having explored the causes and effects of flooding along the Aboabo River, capacity of institution to mitigate the perennial floods, factors that affect the effectiveness of flood management institutions as well as the coping strategies adopted by residents; interesting revelations were observed. This chapter presents a summary of the major research findings, conclusions and recommendations.

6.2 Causes of Flooding

Flooding along the Aboabo River is an inevitable natural phenomenon particularly with the constant period of rainfall coupled with increasing land use activities in floodplains. The major

cause of flooding identified has to do with the drainage system in the area. Drains in the basin are few and poorly constructed and connected to major ones that link up to the Aboabo River. Most drains in the study area are trenches dug out by residents to direct floodwaters which cannot contain the huge volume of surface run-off. Additionally, these drains are mostly choked with refuse and stagnated. Additionally, indiscriminate disposal of refuse in the study area also contribute to flooding along the Aboabo River. Refuse are dumped onto the bank of the Aboabo River which eventually spill over into the river. In the same vein, some residents dump refuse into drains as well as the river valley which obstructs the free flow of the river on the incidence of rainfall.

Again, another cause of flooding is the erection of physical structures along the bank of the river. These areas are supposed to serve as vegetative cover that will protects the river from siltation as a result of erosion. However the absence of this reserve has resulted in the accumulation of silt in the river. This has subsequently reduced the volume of the river channel thereby causing excess overflows onto nearby floodplains. In another dimension, institutional failure also contributes to the incidence of flooding along the Aboabo River. The physical planning departments of KMA and AMMA have not been able to enforce land use regulation along the river. This has resulted in encroachment of the floodplain which is supposed to serve as buffer for the river. Also, dredging of the river is done in an ad hoc manner such that it only happens after the incidence of any devastated flood events. At the same time the silt scooped from the river are dumped on the river bank to serve as levee but are washed back into the river by surface run-offs. Besides, there is also poor coordination between and among agencies in preparing towards flooding.

6.3 Effects of Flooding

The annual incidence of flooding along the Aboabo river has affected residents in diverse ways. These effects vary from social, economic and environmental.

6.3.1 Social Effects

Flooding has exposed residents in the river basin to health risk. Flood waters has contaminated majority of the hand dug well in the communities that are used for domestic purposes. Observation from the field revealed that cholera, malaria and fever are among the common diseases residents

suffer in post flood events. Again, people living in this area live in fear as their buildings are gradually cracking and submerging as a result of the consistence inundation of their houses by flood waters. At the same time residents are prone to the attack of pests, rodents and reptiles washed into their homes by flood waters. Moreover, residents have to seek refuge with family and friends during flooding as they cannot get access to their houses. Some houses in the communities have been abandoned as a result of the flooding.

6.3.2 Economic Effects

Flooding has also affected the economic livelihood of people living along the Aboabo river. Income of most people shrinks as a result of increase in expenditure in post flooding events. This expenditure includes the cost of repairing and replacing damage properties, medical care and food stuff. Besides, open public space meant for conducting business activities are lost to floodwaters. Additionally, wages are lost due to work absenteeism from work as a consequence of flooding.

6.3.3 Environmental Effects

Flooding has affected both the natural and built environment in the river basin. Most houses have crack walls and are gradually submerging due to the recurrence inundation of buildings by flood waters. Additionally, flooding has eroded most part of the communities along the river. This has created ditches and gullies with stagnated flood waters that provide breeding grounds for mosquitoes and can be dangerous trap as well. The Aboabo river has lost its fauna and flora as a result of siltation resulting from flooding.

6.4 Institutional capacity to mitigate flooding

The ability of related institution to mitigate the perennial flooding along the Aboabo river was considered at three different levels. These are household, community and government agencies. The study reveals that both households and communities have the capacity to mitigate flooding. Similarly the study further reveals that government agencies do also have the capacity to address

the issue of flooding in the Aboabo basin. However all these institution have not been able to deal with the problem effectively to the latter due to a number of reasons.

6.4.1 Factors that affects institutions in executing their mandate

The study shows that both community and households still suffer from floods and its effects even though they have the capacity to mitigate the situation. This is because their efforts towards addressing the problem are not coordinated and not well planned. Measures implemented to address the situation are ad hoc in nature thus they are only carried once there has been flooding. Again, the attitude of individuals such as unwise land use practice makes it difficult for households to address the problem effectively.

Furthermore, government agencies are constrained in the discharge of their responsibilities in flood control due to a number of reasons which include:

Firstly, institutions are constrained with limited cash and material resources to deal with the problem. Funds and materials needed to run flood control programs are released untimely and inadequate which stifle the operations of institutions. At the same time agencies are not able to serve the teeming huge population with relief supports in post flooding events.

Again, agencies have not been able to enforce laws or make policies that outlaw or reduce floodplain invasion. Institutional efforts in ensuring land use regulations are adhered to have been compromise due to interference in their operations. At the same time due to low level of cooperation authorities finds it difficult to advise residents not to risk investing in flood prone areas but rather flood free areas.

Additionally, successive governments have not invested in flood mitigation measures along the river on sustainable basis. This has made the problem to be overwhelming when it occurs. Finally, there is no regulatory framework that synchronizes the activities of all stakeholder institutions which bind and entreat them to act collectively in addressing flood issues. The result is that institutions therefore relax and expect others to implement certain measures and subsequently nothing is done unless disaster strikes.

6.5 Flood coping strategies

Households implemented various strategies before, during and after flooding in order to be able to avoid or reduce the impact. Similarly, both the community and government agencies carried some measures to help residents cope with flood impacts. These are discussed below:

6.5.1 Household coping strategies

The major households coping strategies before floods involves the piling of sand bags and clearing of choked drains around houses to prevent the inflow of floodwaters into homes. Also, new drains are dug to redirect floodwaters out of homes. However less attention is given to flood insurance and emergency savings in terms of cash, food items and medical supplies. Additionally, during flooding households move valuables and family members to areas that are safe and secured. However greater proportions of households also adopt the wait and see approach. Finally, in post flooding event households repair and replace damage property or assets in order to restore normalcy. Also, filth and flood waters are cleared to prevent disease outbreak. However health check is not considered to be necessity unless there is epidemic.

6.5.2 Communal measures

Communities usually draw their labour together to clear surrounding drains from refuse and silt to avoid blockage of floodwater and subsequent spillage into homes. Again flood warning information is shared among members in order to be alert and prepare adequately towards flooding. Furthermore, community task force closely monitors the trend of events during flooding in order to provide assistance to victims caught up by floods. Additionally they warn residents to move away from flood waters. Finally, in post flooding communal clean up exercise is organized to clear the mess caused by floods. Also religious leaders cease the opportunity in public gathering to counsel flood victims in order to ease them from psychological trauma. Community leadership also communicates with government agencies to support victims with relief items.

6.5.3 Institutional measures

The major pre flooding activity carried by KMA, AMMA in collaboration with other stakeholders is desilting of the Aboabo River to allow free flow of floodwaters. Even though residents are

warned of impending floods; the message gets to small portion of the population. Again, during flooding the response of institution is slow as such not much is implemented to help residents withstand the impacts. Relief items such as food and bedding materials are given to victims after flooding. Additionally the flood preparedness measures of institution are inadequate as most residents are not satisfied with these measures. At the same time the relief items supplied only serve small portion of the population and in some cases do not get to the intended beneficiaries.

6.6 The roles of stakeholder institutions

The related institutions the researcher engaged in the course of the study all fall under the jurisdiction of KMA and AMMA. The operations of these stakeholder institutions towards flood management in the Aboabo basin still leave much to be desired. Institutional activities towards flood control along the Aboabo River have not been effective as expected. This is due to the financial and logistical constraints they are faced with in executing their mandate. Even though occasionally effort are made to implement some measures to address the problem, people behavior such as erection of structures and dumping of refuse along the river bank makes it difficult to gain some success.

6.7 Conclusion

The issues of flooding in the Aboabo basin is a natural phenomenon even though are exacerbated by man-made activities such as erection of structure and dumping of refuse along the river bank. In recent time the annual incidence of flooding with its associated social, economic and environmental impacts keeps increasing due to the behavior of man plus the changing rainfall pattern. However despite the measures put in place by institutions to address the situation the problem still persist due to non enforcement of laws. In this regard it is therefore the responsibility of policy makers and people living in the Aboabo basin to consolidate their effort towards the formulation and implementation of flood disaster management plan on sustainable basis before the problem get out of hand.

6.8 Recommendations

In view of the findings of the study the following recommendations are being made to address the perennial problem. However due to the multi faceted nature of the problem it should be addressed in the short and long term.

6.8.1 Short term recommendation

In the short term, KMA & AMMA should ensure that the all stakeholders (i.e. NADMO, GMA, WMD, Physical Planning Units & Residents) are integrated during the implementation of flood preparedness, mitigation, response and recovery measures in order to ensure effective flood management. Again, the central government should ensure timely release of funds and logistics to appropriate institutions in order for institutions to be able to discharge their responsibilities effectively. For instance with adequate funds and logistics NADMO can continuously dredge the Aboabo River and expand their relief support services to cover wider areas. The Meteorological Service Departments could engage in continuous collection of data on climatic conditions for specific areas in order to feed end users with relevant information. Also, NADMO and the Hydrological Service department should collaborate to ensure regular collection of data on incidence of flooding in flood prone areas. The availability of such information will help in making proactive decisions on flood management.

Again, KMA & AMMA should enforce laws protecting flood zones and sanction trespassers accordingly to deter others. National Commission for Civic Education in collaboration with waste management department of the assemblies should educate the public on the best waste disposal practices. At the same time the national sanitation day campaign initiated by the presidents should be intensified in the Aboabo basin by KMA & AMMA. Lastly, city engineers of the Assemblies should assess the drainage system in the basin to determine its discharge capacity, availability and make appropriate recommendation for further expansion and construction where necessary. Also, areas where physical structures and solid waste has blocked drains should be accordingly be cleared.

6.8.2 Long term recommendations

In the long term KMA & AMMA should task a team of experts to prepare road map to guide the gradual relocation of residents in the floodplains and subsequent conversion of the area into protective vegetative cover. This will therefore reduce the number of people who are exposed to the flood impact. In the same vein indiscriminate disposal of refuse in the river valley will be minimal. Additionally, the Ministry of Environment Science & Technology in collaboration with Local Government Ministry, Water Resources Ministry should ensure a national flood management policy and plan is prepared to guide the implementation and/or coordination of flood control structures on sustainable basis in flood prone areas.

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APPENDIX I

DEPARTMENT OF PLANNING

COLLEGE OF ARCHITECTURE AND PLANNING

Kwame Nkrumah University of Science and Technology, Kumasi

HOUSEHOLD QUESTIONNAIRE

The intention of this study is mainly to assess the flood management system along the Aboabo river. It will as well investigate the causes and effect of flooding, institutional challenges associated with flood control measures and flood coping strategies. Finally, suggest recommendations to

remedy the problem. Information given will be used purely for academic purpose and will be treated as confidential.

BACKGROUND INFORMATION

1. Identification of respondent:
2. Sex: Male () Female ()
3. Age:
4. Ethnicity:
5. Household status
 - a. Household head () b. Next adult in charge () c. Family member ()
6. Occupation
 - a. Trader () b. Government worker () c. Artisan ()
 - d. Farmer () e. Schooling () f. Unemployed ()
 - h. Apprentice ()
 - j. Other (Specify)
7. Educational attainment:
 - a. Primary () b. Secondary () c. Tertiary ()
 - d. Middle school () e. None () 8. How long have you live in this community? f. Other (Specify)
 - a. 0 – 5 years () b. 6 – 10 years () c. 11 – 15 years ()
 - d. 16 – 20 years () e. above 20 years ()
9. Residential status:
 - a. Free occupant () b. Tenant () c. Owner occupant ()
10. How many households are in your compound?
 - a. 1 () b. 2-5 () c. 6-9 () d. 10 and Above ()
11. On the average how many persons are in your house hold?
 - a. 1 () b. 2-5 () c. 6-9 () d. 10 and Above ()
12. Marital Status:
 - a. Married () b. Single () c. Divorced ()
 - d. Widowed () e. separated () f. Others (Specify).....
13. On the average what is your monthly income in GHC?

- a. Below 50 () b. 50- 150 () c. 151- 250 ()
d. 251 - 350 () e. above 351 ()

14. How long have you live in this dwelling unit?

- a. < 12months () b. 1-5yrs () c. 6- 10yrs ()
d. 11 – 15 years () d. 16 – 20 years () e. above 20 years ()

15. How do you dispose of your solid waste in this community?

- a. Burning ()
b. Composting ()
c. Throw away in river valley ()
d. Door to door collection ()
e. Throw in public container _skip‘ ()
f. Dump in public dump site ()
g. Collected by individual sanitation contractors ()
h. Bury ()
i. Other (specify)

CAUSES OF FLOODING ALONG THE ABOABO RIVER

16. Has your household in this community been flooded before?

- a. Yes () b. No ()

17. How many times does your community floods in a year? Number of times.....

18. In which month do you normally experience flooding?

19. How long does the flood normally last any time it occurs?

- a.Hours b.Days c.Weeks
d.Months e. Other (specify)

20. What do you think are the causes of these floods? (*Tick as many as applicable*)

- () Building in water courses
() poor solid waste management
() poor physical planning
() Hard Landscaping
() Lack of Drains

() Poor design of Drains

() inadequate drainage capacity

() Choked drains

() low lying nature of environment

() other (specify)

21. In your opinion, do the activities of the individuals affect the flooding situation in the community?

a. Yes ()

b. No () move to 24

22. Explain how they contribute to the flooding situation?

23. How can they be prevented from contributing to the problem?

24. Why did you say so?

25. In your opinion, does the attitude of the community as a whole contribute to the flooding situation in this community?

a. Yes ()

b. No () move to 28

26. Explain how they contribute to the flooding situation?

27. How can they be prevented from contributing to the problem?

28. Why do you say so?

29. In your opinion, do you think the attitude of institutions/authorities in charge of flood management in this community contribute to the flooding situation in this area?

a. Yes ()

b. No () move to 32

30. Explain how they contribute to the flooding situation?

31. How can they be prevented from contributing to the problem?

32. Why did you say so?

33. How are solid waste dispose of in this community? (*Tick as many as apply*)

a. Burning ()

b. Composting ()

c. Throw away in river valley ()

d. Door to door collection ()

e. Throw in public container —skipl()

f. Dump in public dump site ()

- g. Collected by individual sanitation contractors ()
- h. Other (specify).....
34. Do you think the methods of solid waste disposal in this community contribute to flooding in the community?
- a. Yes () b. No () move to 37
35. Explain how they contribute to the flooding situation?
36. What do you think can be done to control the method of solid waste disposal in this community?
37. Why did you say so?

EFFECTS OF FLOODING IN THE ABOABO RIVER BASIN

38. How does the flood affect your livelihood?
- a. Wage loss ()
- b. Loss of personal property ()
- c. Loss of food stuff ()
- d. Loss of livestock ()
- e. Loss of land for livelihood activities ()
- f. Purchasing power declined ()
- g. Other (specify)
39. What are your livelihood coping strategies after flooding?
- a. Seek for credit or loans ()
- b. Rely on others for food and shelter ()
- c. Sell domestic assets ()
- d. Seek for alternative or additional job ()
- e. Petty trading ()
- f. Increase out migration for work ()
- g. Other (specify)
40. How does the flood affect your health?
- a. Unsanitary conditions
- b. Diseases outbreak e.g fever, diarrhea

c. Contamination of water ()

d. Injuries ()

e. Death ()

f. Other (specify)

41. What are the effects of flooding on your environment?

a. Erosion ()

b. Pollution of water bodies (Aboabo river) ()

c. Loss of open lands ()

d. Distribute hazardous substances into homes ()

e. Silting of river channel ()

f. Choked drains ()

g. Other (specify)

42. How much did it cost you the last time the community flooded? Amount in GHC.....

43. Explain how the cost came about
.....
.....

44. Due to the flood, did you lose any income from your job or livelihood?

a. Yes () b. No ()

45. If yes, your income loss was due to (check all that apply)

a. Lost job (permanent) ()

b. Forced absenteeism from work days ()

c. Lost business activity ()

d. Other (please describe) ()

FLOOD COPING STRATEGIES ALONG THE ABOABO RIVER

46. As an individual how do you prepare before flooding occurs? (*tick as many as apply*) a.

Build an emergency kit ()

b. Construct sandbag barriers ()

c. Dig flood breaks ()

- d. Clear choked drains ()
- e. Construct temporary drains ()
- f. Be alert- monitoring whether reports, local radio & TV
- g. Develop family communication plan ()
- h. Develop an evacuation procedure ()
- i. Insurance () – Safeguard your possession & valuables
- j. Other (specify)

47. As an individual what do you do when flooding occurs in your community?

- a. Move to higher grounds ()
- b. Stay away from flood waters ()
- c. Disconnect electrical appliances ()
- d. Listen to news for latest information ()
- e. Be alert- monitoring whether reports, local radio & TV ()
- f. Call to inform authorities immediately
- g. Wait and see ()
- h. Call family & friends for help ()
- i. Other, specify

48. How do you rescue yourself from flooding immediately it occurred?

- a. Evacuate quickly ()
- b. Call for assistance from flood management agencies eg NADMO ()
- c. Call for assistance from families & friends or neighbors ()
- c. Put on life jacket and stay on high grounds ()
- d. Do nothing ()
- e. Other (specify)

49. As an individual what immediate action do you do to bring life back to normalcy immediately after flooding?

- a. Clear the mess caused by the flood ()
- b. Report to authorities for assistance ()
- c. Service the damage systems (H₂O & electricity) in the property ()
- d. Seek necessary medical care ()

e. Repair damage property ()

f. Seek for credit or loans ()

g. Clear choked drains ()

h. Rely on families & friends ()

i. Other (specify)

50. What is the preparedness measures put in place by the community as whole to reduce flooding in this community before it occurs? a. Awareness creation ()

b. Identify flood prone areas ()

c. Construct flood barriers ()

d. Set up flood management committee

e. Develop community communication plan ()

f. Establish contact with flood management agencies ()

g. Construct temporary drains ()

h. Clear choked drains ()

i. Other (specify)

51. What is the rescue mechanisms put in place by the community in the event of flooding in this community?

a. Community evacuation centers ()

b. Community rescue Team ()

c. Community communication plan ()

d. Evacuation route ()

e. Emergency contact cell phone number ()

f. Emergency Kit

i. Other, specify

52. What does the community do as a whole immediately flooding occurs in this community? (during flooding)

a. Give Flood warning information through local radio/ PA system ()

b. Inform Flood management agencies by (committees) ()

c. Close monitoring by rescue team ()

d. Search and rescue operations

e. Do nothing ()

f. Other, (specify)

53. What does the community do to bring back life to normalcy immediately after any flood event in this community?

a. Clear the mess caused by the flood ()

b. Clear choked drains ()

c. Report to authorities for assistance ()

d. Close created temporary drains ()

e. Provide counseling & guidance

e. Other, (specify)

54. How satisfied are you with the activities taken by the community to control flooding in this area.

a. Not satisfied ()

b. No opinion ()

c. Very satisfied ()

55. What are the things they did that made you satisfied?

.....

56. What are the things they did that made you not satisfied?

57. What do you think they should have done?

58. How do you think these measures can be improved to make it more effective?

59. What preparedness measures are put in place by flood management institutions to manage floods in the community before flooding occurs? (*tick as many as apply*) a. Desilting of river channels ()

b. Construction of dykes, levee & flood embankment ()

d. Flood forecasting & warning ()

e. Decongestion of structures on waterways ()

f. Establish contact links with residents ()

g. Land use control ()

h. Other, (specify)

60. What do flood management institutions do during flooding in this community? (*tick as many as apply*)

a. Search & rescue operations ()

b. Distribute live jacket ()

c. Flood warning information through radio/tv/public PA system () d. Nothing ()

e. Others (), specify

61. What do flood management institutions do immediately after flooding to bring back life to normalcy in this community? (*tick as many as apply*) a. Provide relief items ()

b. Assist flood victims to process claims ()

c. Create awareness on possible disease outbreak ()

d. Repair damage infrastructures (bridges, electricity & water) ()

e. Clear choked drains ()

f. Nothing ()

g. Other (specify)

62. How satisfied are you with the approaches taken by flood management institutions to control flooding in this community?

a. Not satisfied ()

b. No opinion ()

c. Very satisfied ()

63. If satisfied; what are the things they did?

64. If not; why do you say so?

65. Explain what do you think they should have done?

CAPACITY FOR FLOOD MANAGEMENT

66. In your opinion, do you think the individual in the community have the capacity to prevent their homes from being flooded? a. Yes () b. No ()

If yes, in what way?

67. If no; why do you say so?

68. In your opinion do you think the community as a whole has the capacity to control flooding in this area? a. Yes () b. No ()

If yes; in what way?

69. If no; why do you say so?

70. In your opinion do you think flood management institutions have the capacity to control flooding in this community? a. Yes () b. No ()

If yes; in what way?

71. If no; why do you say so?

72. Were you told by officials (during the flood) that your home was at risk from the flood (i.e. official notification)?

a. Yes () b. No () c. don't know ()

73. If yes, how were you told?

.....

74. Additional Comment/Observation (if any):

.....

.....

.....

.....

.....

.....

APPENDIX II

INSTITUTIONAL INTERVIEW GUIDE

1. Name of Institution

2. Official position Held.....

3. What are the primary functions of this institution.....

4. (a) Do you have any special regulations to control activities in flood prone areas of the city such as the Aboabo river basin? Yes [] No [] (b) If yes, are they being enforced? Yes [] No []

(c) What are they

(d) Do you think improper waste disposal activities are responsible for the flooding of communities in the Aboabo river basin? Yes [] No []

Give reasons

5. (a) Are you aware of any programmes/projects aimed at reducing the incidence of flooding in the Aboabo river basin? Yes [] No []
- (b) If yes, which one(s)
6. (a) What specific actions do you take to reduce flooding in the Aboabo river basin
.....
- (b) What specific actions do you take in flood management in the Aboabo river basin?
.....
- (c) Is the institution adequately resourced to carry out its responsibilities?
Yes [] No []
- (d) If No, in what areas are you challenged?
- i. Human
.....
....
- ii. Financial iii.
Logistics &
Equipment.....
- iv. Others (specify)
- (e) What steps are being taken to address them?
7. (a) Do you collaborate with any agencies in flood management and mitigation with specific reference to the Aboabo river basin? Yes [] No []
- (b) If Yes, which one(s)?
- (c) Are you satisfied with the level of collaboration? Yes [] No []
- (d) If no, why?
.....
8. What do you think are the causes of flooding in the Aboabo river basin in Kumasi?
.....
9. (a) Do you involve the citizenry in the Aboabo river basin in the activities of the institution? Yes [] No []
- (b) If yes, at what level?
- (c) How do you rate their level of participation?
- High [] Average [] Low [] Nil []

(d) What do you think accounts for this level?

(e) If No, why?

10. What do you think the following should do to solve the problem of flooding in the Aboabo river basin?

Households

Communities

Metropolitan Waste Management Departments, KMA.....

Central Government.....

Additional Observation/Comments (if any):

APPENDIX III

Estimated Tonnage of waste generated and uncollected/person/day for the study communities

Communities	Estimated population (2015)	Estimated tonnage of waste generated /per/day.	Estimated Tonnage of Waste uncollected /per/day
Aboabo	46815	$46815 \times 0.5 = 23407.5$	$23407.5 \times 0.57 = 13342.3$
Dichemso	28365	$28365 \times 0.5 = 14182.5$	$14182.5 \times 0.57 = 8084.0$
Asawaseapagyahene	56346	$56346 \times 0.5 = 28173$	$28173 \times 0.57 = 16058.6$
Anloga	50721	$50721 \times 0.5 = 25360.5$	$25360.5 \times 0.57 = 14455.5$

Amakom	52539	$52539 \times 0.5 = 26269.5$	$26269.5 \times 0.57 = 14973.6$
		117393.0	66914.01

0.5kg of waste generated per person per day in Kumasi (Omane, 2002; KMA D-plan, 2010- 2013)

57% of waste generated in Kumasi uncollected (Waste Management department of KMA; KMA D-plan, 2010- 2013)

APPENDIX 1V

Average monthly precipitation figures (mm) of Kumasi (2004 – 2013)

	2004	2005	2006	2007	2008	2009	2011	2010	2012	2013
January	20	19	21	18	19	20	21	19	20	19
February	57	55	56	53	56	55	57	56	54	55
March	139	130	132	119	130	133	134	138	134	135

April	140	142	141	126	134	136	137	138	137	139
May	184	181	184	170	184	183	182	181	180	183
June	234	234	232	191	220	230	233	234	235	232
July	125	124	121	119	123	125	124	122	123	120
August	74	73	72	69	70	71	72	73	73	74
September	173	173	168	160	173	172	170	173	172	174
October	201	201	201	185	198	197	200	199	203	201
November	99	97	99	91	92	98	100	101	97	96
December	32	30	27	26	27	30	29	31	30	31

Source: Ghana Meteorological Agency, Kumasi

