SIMON DIEDONG DOMBO UNIVERSITY OF BUSINESS AND INTEGRATED DEVELOPMENT STUDIES

FLOODS, VULNERABILITY AND INDIGENOUS FARMING SYSTEMS IN NORTHERN GHANA: IMPLICATIONS FOR LIVELIHOOD SUSTAINABILITY IN THE NORTH GONJA DISTRICT

SHAHEED ABUGRE SADIK

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JANUARY, 2023

DECLARATION

Student

I, Sadik Shaheed Abugre, this day declare that this thesis is my own research. I did cite other sources in my work in accordance with the referencing guide. I declare also that this thesis has never been presented for the award of a degree in this university or in any other tertiary institution.

Candidate's Signature .....Date 09/06/23

Supervisor

We declare that this thesis was prepared and submitted under our supervision in accordance with the guidelines of Simon Diedong Dombo University of Business and Integrated Development Studies.

Senior Supervisor's Name Prof. Samuel Ziem Bonye Signature .....

Date 09/06/2023

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Date June 9, 2023

DEDICATION

This piece of work is dedicated to my father the Chief of Gambibgo in Bolga Tanga East, Naba Alebgemogre Sadik and my beautiful late mother Amina Ayamga Sadik, may her soul rest in the bosom of the Almighty Allah.

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ABSTRACT

The North Gonja District is one of the districts in the newly created Savannah Region. The White Volta River cuts across the district and the periodic spillage of water from the Bagre Dam in Burkina Faso into the White Volta River causes the river to overflow its banks into crop farms along the river banks, overwhelming the indigenous farming systems and eventually damaging crops and reducing crop yield in the district. The aim of the study was to examine the implication of floods on livelihood sustainability of farmers in the district. This was a case study research design using the qualitative approach. Three communities namely; Daboya, Lingbinsi and Disah and 150 respondents were purposively sampled for the study. The Snowball technique was also used to identify farmers who farm some species of crops. Qualitative data were collected from primary and secondary source as well as field observation. Descriptive summaries, logical qualitative methods were used for the analysis. The results show that floods have severe negative implication on household food security, human health, economic fortunes of the farmers and the indigenous coping mechanisms which were meant to sustain livelihood. A pocket of farmers adapted modern farming, with the remaining being vulnerable because of inadequate farmlands on the higher grounds, poverty and lack of formal education. The modern farming systems adopted by smaller number of farmers were still overwhelmed by huge volumes of water spilled from the Bagre Dam, whiles inadequate infrastructural development and late arrival of warning information also limited the ability of farmers to adapt to the floods. Institutions at the local level were weak and not effectively monitored by the central government. The flagship policies were also poorly implemented, whiles the district bylaws were also not effectively enforced. The study therefore recommends that in order to obtain sustainable food security, all activities leading to climate change must be ceased, and whiles doing so, a uniform variety of crop that can take at most three months to mature should be adopted for cultivation at the riverine areas. All farmer based NGOs should channel their efforts towards promotion of community based initiatives on flood mitigation measures. Surging prices of implements and agro-products must be controlled to encourage more farmers to adopt the modern farming technologies. Government of Ghana and that of Burkina Faso should have a stakeholder meeting to address the issues of the huge volumes of water spilled.

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LIST OF ACRONYMS AND ABBREVIATION

APA	American Psychological Association
DFID	Department for International Development
DRR	Disaster Risk Reduction
FAO	Food and Agriculture Organization
GOP	Government of Pakistan
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
IFRC	International Federation of Red Cross
IPCC	Intergovernmental Panel on Climate Change
MoFA	Ministry of Food and Agriculture
NADMO	National Disaster Management Organization
NGDA	North Gonja District Assembly
SDG	Sustainable Development Goal
UNDP	United Nations Development Program
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United State Agency for International Development
WFP	World Food Program

CHAPTER ONE

INTRODUCTION

1.1 Background

In recent years, the events of extreme weather such as floods resulting from global warming are very alarming (Balaguru, Foltz, Leung & Emanuel, 2016). Flood disaster is one of the most highly destructive events with multiple effects on human livelihood and socioeconomic consequences on vulnerable households and peasant farmers (FAO, 2015). The effect of disasters (flood) on human globally is increasing; they are very disastrous and frequent in their nature (Guha-Sapir, Below, & Hoyois, 2016). Close to 170 million people are annually affected (Kazakis, Kougias, & Patsialis, 2015). The functioning of human society is negatively impacted by the destruction of floods (UNISDR, 2017). It is projected that, heavy rainfall has increased from 1% to 2% in the number of days and this will increase the rate of flooding across the globe (IPCC, 2014). Nasiri, Mohd Yusof, and Mohammad (2016) assert that floods are predicted to increase in their occurrence and more frequent.

The Global population is fast growing with about seven billion people (Hazran, Norsida, Nitty Hirawaty, & Nolila, 2017). The agriculture sector is the major source of economic growth in many countries, yet still the sector is vulnerable to flood events due to its dependence on rainfed agriculture (IPCC, 2014). Floods are speedily increasing and are one of the global devastating extreme weather events resulting from climate change (Liu, You, Zhu, Wang, & Ran, 2019). Flood disasters last longer and as far as they have long duration, crops get damaged because they are unable to survive under water for some certain periods (Rahman, Fosu, & Tetteh, 2014). The use of and dependency on natural resources for agricultural production is often susceptible to flooding and other natural disasters.

The agricultural sector in many parts of the world is threatened by excessive inundation (Kazakis et al., 2015). For instance, In United States, floods contributed to the crop production losses with monetary value of $1.6 billion within the Midwestern states in 2011 (Bailey-Serres, Lee, & Brinton, 2012). Bangladesh also experiences floods every rainy season due to many rivers that are in the country (Younus & Harvey, 2014). Small scale farmers in Bangladesh are repeatedly facing the negative impact of floods due to their dependence on agriculture for sustainable livelihoods (Fakhruddin, Kawasaki, & Babel, 2015). Myanmar had 400,000 ha of cultivated crops damaged as a result of the 2015 flooding. In proportion, 89% of paddy rice were affected that led to 30% decline in rice production compared to the year before (MOAI;

MLFRD; FAO & WFP, 2015). Recent acceleration in population growth and change in land use patterns has increased human vulnerability to floods (Yu, 2017).

The negative effects are the shortage and high prices of food, including the destruction of the amount and quality of natural resource base (Lolig, Donkoh, Obeng, Ansah, Jasaw, Kusakari & Loureiro, 2014). However, sustainable agriculture means increasing yield without negative impact (Struik & Kuyper, 2017). According to Wout et al., (2019) floods do not only destroy the growth cycles of crops and economic activities, they also undermine food security and nutrition issues and thereby make livelihoods very vulnerable. According to Onwe, Nwankwor, Ahiarakwem, Onwe, Ema, & Roland, (2016), the poor who are economically disadvantaged and cannot cope with shocks suffer a lot. This is due to high poverty, inadequate infrastructure and low capacity of adaptation accounting for the vulnerability of agrarian economies (IPCC, 2014). This assertion is supported by Ghosh and Kar (2018) who stated that, the determinant of vulnerability depends on key factors such as population, economy, livelihood strategies, infrastructural supporting systems and the ability to withstand hazardous events. Hossain, Sohel, and Ryakitimbo (2020), also stated that, vulnerability is caused by inadequate food, health, poverty, water, agricultural and non-agricultural property and week social connections.

People who reside in floodplains, steep slopes, low-lying areas and ravines, are exposed to various kinds of hazards and are therefore very vulnerable to floods (Harvey, Chacón, Donatti, Garen, Hannah, Andrade, & Wollenberg, 2014). In spite of the high risk involved in crop farming in flood areas, crop production is normally high in these places (Macedo, Teixeira, Lima, Souza, Silva, Encinas, & Neves, 2019) because floods maintain soil fertility and manage pests (Tran, Huu, Hoang, Pham, & Nguyen, 2021). This is mainly due to the indigenous farming systems practiced by smallholder farmers in these areas which are mostly intercropping (Dwivedi, 2015).

The practice improves crop yields, conservation and soil fertility, limits the infections of pests and diseases; above all, it decreases the failure of crops (Dwivedi, 2015). Smallholder and medium farming are also practiced with the application of Compost, oil cake and cow dug to increase farmland fertility. Aside this, there are other practices such as the use of wood-ash, decomposed animals and herbs to protect crop from pest and diseases. The use of age long harvesting, crop threshing and seed storage is the transferred tradition (Deka & Bhagabati, 2010). Organic manure such as green manure, crop residues and the manure of animal

influences the productivity and the sustainability of soil fertility (Singh, Dwivedi, Tiwari, Majumdar, Rani, Singh, & Timsina, 2014).

In Africa, the recent trends of climate change according to Kendon, Stratton, Tucker, Marsham, Berthou, Rowell, and Senior (2019), shows that most countries will experience severe rainfall that will result in floods but instead the duration of rains will be shorter in the wet season. According to Lumbroso, Brown, & Ranger (2016), one of the major natural hazards with increasing negative effects on majority of people is floods. This has caused more severe negative impact on people than that of other hazards in the continent and are most likely to increase in their severity (Tramblay, Villarini, & Zhang, 2020). For instance, Cameroon agriculture employs 70-80% of its working population (Epule & Bryant, 2016) and 70-75% are peasant farmer who produce 80% of food crop (Yengoh & Ardö, 2014), but in recent years, it has also met decline in food production (Epule & Bryant, 2016) as a result of seasonal flooding (IPCC, 2014). Also, Malawi maize production declined by an annual average of 12% due to crops damaged by flood and the annual flood disasters experienced in the country resulting in economic losses that lead to high poverty (Pauw, Thurlow, & Van Seventer 2010)

The continents have been described as very vulnerable to the impact of climate change such as floods (Lamboni, Emmanuel, Manirakiza, & Djibib, 2019). Vulnerability is much higher in Africa than other continents due to the location. Factors that account for the vulnerability of smallholder farmers in Africa as expressed by Mavhura (2019), are inadequate sources of income, poverty, dependency on farming as a livelihood activity, farms in flood areas, land tenure, the topography and variation of climate change. For instance, Teshome (2016), outline the following; abnormal rainfall and high poverty, whiles, Derbile, Dongzagla, & File (2016) named heavy rainfall events, lack of adaptation, failure of livelihood and food shortage. In addition, susceptibility, exposure and lack of capacity to adapt new strategies are the major factors influencing vulnerability of the rural smallholder farmers in Africa (Kamanga, Tantanee, Mwale, & Buranajarukorn 2020).

Smallholder farmers in Africa rely on indigenous farming for cultivation and production of food crops. According to Myeni, Moeletsi, Thavhana, Randela and Mokoena (2019), some of the indigenous farming systems practices by rural farmers are crop rotation, intercropping and mulching. This system of farming according to Taremwa, Gashumba, Butera, and Ranganathan (2016), relies only on local practices; very cheap indigenous crop varieties are mainly used with the application of cow dung and crop residues. The application of animal

manure provides minerals, improves soil fertility and increase soil capacity (Rahman et al., 2014). They are simple indigenous practices applied to mitigate the impact of climate variability.

According to Adesoji (2016), planting different kinds of varieties, adjusting dates for planting, shifting cultivation, multiple cropping, mulching, legume and cereal intercropping also form part of indigenous farming practices of the rural farmers in Africa. This has not solved the issues of food crisis in the continent as expressed by the FAO (2015), which asserted that the majority of the people are living without secured access and stable food for the whole year due to climate variability such as floods.

In West Africa for example, Benin had 476 ha of farm crops flooded out of 1256 ha in 2012 that led to decrease in crop yield as a result of prolonged floods. (Bonou, Wünscher, Adégbidi & Diaw 2018). The following year, an estimated amount of $20 million value of crops was lost. (USAID, 2018). In the 2012 floods in Adamawa state in Nigeria, above 35% of vegetation cover was affected and the affected farmland cover was estimated to be 56% and in 2014, floods affected 42% of vegetation cover with 51% of farmland cover inundated (Musa & Shabu, 2019). Also, in the Dagiri Community in Abuja, farm land always gets flooded and food crops are always washed away due to floods, leading to food insecurity. This has severe negative impact on living standards of the individual, group and the entire community (Idoko, 2016).

Ghana is one of the West African countries most prone to floods due to its geographical location. Farming is the major occupations and source of livelihoods for the majority of people in Northern Ghana (Bawa, Al-hassan, & Abukari 2015). Floods occur annually, which negatively affects people livelihoods, destroys property including infrastructure, displaces people and make some homeless (Mensah & Ahadzie, 2020; Selase, Xinhai & Worlanyo 2017). This causes the country to be vulnerable especially the northern regions where floods have been experienced every rainy season (UNDP, 2012). In addition to that, it is the most frequent stressor on livelihood and the safety of food security status (Musah & Akai, 2014).

In Northern Ghana, the main occupation of the rural people is agriculture, and the North is often referred to as the bread basket of the Ghanaian economy. The Sustainable Development Goal (SDGs) 1and 2 is poverty eradication and end to hunger
(UNDP, 2015) but ooccurrences of annual heavy rains and flash floods coupled with exposure in Northern Ghana negatively affects farming activities and the production of food crops

(Derbile, Chirawurah, & Naab 2022). On the other hand, increasing farming activities and sustainable food security will lead to the achievement of SDGs 1 and 2 but according to Macnight Ngwese, Saito, Sato, Agyeman Boafo and Jasaw (2018), floods in recent years are one of the major extreme events that have severe negative impact on rural livelihoods. Aside this, farmers in Northern Ghana have testified to the fact that floods have increased and have destroyed food crops for a decade now (Kassim, Alhassan & Appiah-Adjei 2021).

In addition, Nyamadi, Abagye & Obodai (2018), stated that the major devastating and negative impact of floods are food shortage and declining crop yield in the region. For instance, in 2005 floods destroyed crops worth 955,050 tons (Dosu, 2011) and in 2007, a total of 70,500 hectares of crops were affected including production losses of 144,000 metric tons in Northern Region (UNOCHA, 2007). Also, 8,760 acres of farms in the Northern Region were destroyed by the 2010 floods (IFRC, 2010), and an estimate of 257,076 tons of Food was lost (Arthur & Irene, 2011). During the 2010 floods, 23,588 acres of farm crops were submerged across the affected communities (IFRC, 2010).

The Savannah Region is one of the Northern Regions which was carved out from the Northern Region in 2018 for the purpose of access to national development. The sustainable livelihood of the people largely depended on rain-fed agriculture. This has also been affected by annual floods that occur from the Black and White Volta Rivers that cut across the region (Stanturf, Warren, Charnley, Polasky, Goodrick, Armah, & Nyako, 2011). Before the region was carved out, some districts within the region, were already experiencing flood disasters. In Yapei for instance, 2,980 acres of crops were destroyed by the floods, whiles in Buipe, 8,100 farm crops were also destroyed within the same flood period in 2010 (Armah, Yawson, Yengoh, Odoi & Afrifa, 2010).

There were also 55 communities that got affected in the region during the same period that included some communities in North Gonja District such as Daboya, Lingbinsi and others. Communities in the Region have similar traditions, cultural and social characteristics that are passed on to generations. People in one district have the same characteristic with other people in the same region. For instance, over 80% of people in the Central Gonja District continue to use hoes, cutlasses, bullock's ploughs, family labor, cow dugs and mulching, for their farming activities as well as compound, bush and riverine systems, which are all their practices (CGD Assembly, 2010). This indigenous means of farming applies to all communities in Savannah Region.

1.2 Problem Statement

The North Gonja District is one of the districts in the newly created Savannah Region. The White Volta River cuts across the district, and serves as an alternative water source for domestic use and animal rearing but at the same time it is a major stressor on crop farming. Rain-fed agriculture is predominantly the livelihood support of the people in the District. But farmers in the district are vulnerable due to prolonged rains and the presence of the White Volta River, which causes perennial flood disasters on crops in communities along the river. The farmers apply their indigenous adaptation strategies such as creation of bunding and crop rotation, the use of cow dung and mulching etc. in order to overcome such vulnerability to guarantee their livelihood, but these indigenous adaptation practices are also overwhelmed by the floods which damage crops on the farms leading to economic losses and high level of poverty (Armah et al., 2010).

For instance, UNOCHA (2007), stated that the district was part of West Gonja District under the northern region during the flood disasters in 2007, where an estimateed number of 70,500 hectares of crop farms were affected, which resulted in food crop production losses of an estimated 144,000 Tonnes. Daboya, Lingbinsi and Disah were also part of the communities in the Northern region that got affected by the 2010 floods, where 832 acres of crop farms were destroyed by the floods in the district (DREF, 2011). The crops that got destroyed by the flood in 2020 prompted the Regional Director of NADMO to appeal for food aid for the people in the district due to prolonged floods as a result of the Bagre Dam spillage and heavy rainfalls in September 2020 (North Gonja Flooding, 2020).

In view of the above, several studies have also been conducted to assess the impact of floods on farming activities in the district. However, there is a seeming gap in the efforts to ascertain the livelihood sustainability of the vulnerable farmers in the North Gonja District. This study therefore seeks to bring to light the implications of floods on livelihood sustainability among the farmers in the North Gonja District.

1.3 Main Research Objective

The main objective of this study is: To examine the implications of floods for livelihood sustainability in North Gonja.

1.3.1 Objectives of the Study

1. To assess the effects of floods on farming systems in the North Gonja District.

2. To examine indigenous coping mechanisms used by farmers to sustain their livelihoods in times of floods.
3. To assess the challenges farmers face in adaptation strategies during floods in North Gonja District.
4. To ascertain whether existing policies/district bylaws are in place to mitigate the effects of floods on farming systems in the North Gonja District.

1.4 Main Research Question

The main research question of this study is: What are the implications of floods for livelihood sustainability in North Gonja?

1.4.1 Questions of the Study

1. What are the effects of floods on farming systems in the North Gonja District?
2. What are the coping mechanisms used by farmers to sustain their livelihoods in times of floods?
3. What challenges farmers face in adaptation strategies during floods in North Gonja District.
4. What policies/bylaws are in place to mitigate the effects of floods on farming systems in the North Gonja District?

1.5 Relevance of the Study

This study examine the implication of flood on livelihood sustainability of farmers in the North Gonja District of Savannah Region. The findings and the study recommendation will provide insights and serve as a blueprint for government as well as other stakeholders in the formulation of policies that may improve farmers' coping and adaptation strategies to flood disasters. As a result, this may lead to the improvement of economic fortunes and livelihood sustainability of the vulnerable farmers in the district. Secondly, the findings may also be useful to other districts and regions that are faced with similar flood disasters to plan adequately in order to mitigate the effects of flood disasters. This adds to knowledge base in the arena of flood disaster risk reduction in Ghana. The study could also be useful to the academic field for students who may want to commence similar studies.

1.6 Scope of the Study

The study was conducted in Daboya, Lingbinsi and Disah communities in the North Gonja District of the Savannah Region of Ghana where floods severely occur annually in the

district. Farmers who fall victims to flood disasters on their farms, with age of 35 years and above, who also had 15 years of farming experience and 20 years of stay in the community, including some key community and District Assembly members, NADMO and MoFA Directors were both selected because they were those who could provide the study with a good data relating to floods and crop farming in the district. The study was conducted from September 2021 to January 2023. The district is located in the North West of the Savannah Region, at latitude 9°39'01" to the North and longitude 1°23'23" to the West. It covers an area approximately 2315.272 Km² and shares borders with Tolon in the East, Mamprugu Mogduuri to the North, to the West with West Gonja and to the South with Central Gonja District.

1.7 Organization of the Project Report

This study is presented in five chapters. Chapter one comprises the introduction of the project work, the background, problem statement, research questions, research objectives, justification of the study. Chapter two outlines the conceptual and theoretical perspective of the study. Chapter three of the study present the study area, methodology, study design, research approach, source of data, sample size determination, data collecting instruments, data analysis plan. Chapter four present the results and discussion of the study and chapter five is the last chapter that provides summary of the entire thesis, outlines the conclusion remarks and provides the recommendations of the major findings of the study.

CHAPTER TWO

THEORETICAL AND CONCEPTUAL PERSPECTIVES

2.1 Introduction

This chapter is directly focused on both the conceptual and empirical review of literature on floods, vulnerability, indigenous farming systems and livelihood sustainability. It also provides further theoretical information and concepts including empirical evidence, approaches and methods used by researchers in similar studies (Babbie, 2005). The chapter first of all review conceptual and theoretical perspectives and the way they influence rural community development as well as discussions of various definitions of the concepts.

2.2 Theoretical Issues

In recent year, food insecurity has become a major topic and an issue of concern around the globe. People are making efforts in order to understand the issues in relation to food crisis and how this can be minimized using individual or group effort. This led the study to adopt two theories so as to understand why people experience entitlement failures. The study also adopted the systems theory to examine how systems are working together in order to provide a fair direction and explanation of the purpose of this entitlement bundles. The two theories are used to complement one another and address the study issues. Systems theory puts emphasis on human being, resources and structures that should be established as a working body to enhance food security and its sustainability in a given area whiles entitlement theory deals with how people can access food. According to Sen (1981), livelihoods vulnerability to stressors arises when individuals have no sufficient wealth or income and when previous endowments break down.

2.2.1 Entitlement theory

The study adopted the entitlement theory because it guided the study to ask the questions relating to the challenges farmers face in coping and adapting to the floods. The theory was evolved in the beginning of 1980s by Amartya Sen and published in 1981. Amartya Sen used the theory to analyze poverty and famine among the population within a given society. Sen (1984), defines entitlement theory as ‘the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she can command. The entitlement theory assumes that food insecurity and scarcity of food are

caused by the laws and regulations that are applied in a particular area. According to Sen (1981), laws/policies are barriers standing between access to food and food entitlement.

This was used as a guide to examine the causes of farmers' entitlement failures to cope with and adopt to the floods, because the theory assumes that every individual in the society is entitled to some potential coping and adaptation strategies to avert the effects of the floods and that entitlement can eventually change depending on its availability or prices. Floods in the district may not lead to the food shortage in the market and which does not also mean that there were no food products in other place. The food shortage could be as a result of disrupted food supply channels. As argued by Sen (1981), circumstances where the distribution of government resources and implemented policies are unbalanced such as institutions and infrastructure can cause these entitlement failures within areas that are lacking these resources.

For instance, poor transportation links between the regions and rural areas can be the result of food shortage in the market and can lead to high price of goods and services which will also worsen people's entitlement failures. According to Tiwari (2007), it does not also mean only individual or household economic entitlements but a range of factors such as skills, level of education, individual productive ability and infrastructure such as good roads, hospitals, markets, extension services, information and policy initiative

2.2.2 Systems theory

Systems theory was developed to understand the structure of a system and its properties in respect to the relationship between different parts that come together to work as a whole (Bertalanffy, 1950). The theory with decades of history was first originated when the bylaws for Society for General Systems Research foundation was written by Ludwig von Bertalanffy and others in 1954 but its foundation was propounded by Ludwig von Bertalanffy in the 1950s.

The systems theory was also adopted and it guided the study to examine the functions of the institutions, policies/bylaws in the district as an interrelated part of the central government system in providing development to enhance the ability of farmers in the study area to access alternative solutions to cope with and to adapt to the effects of flood disasters in the district. According to Article 240 of the 1992 Constitution, provision is made for the Parliament of Ghana to enact an Act to decentralize government systems to the local level with the aim of creating adequate spaces for the development of local areas (Republic of Ghana, 1992).

The Local Government Act 936 (2016) was also enacted to improve the capacity of the local level authority to be able to strategically plan, initiate, coordinate, manage and execute government policies at the local areas on matters that affect the local people (Republic of Ghana, 2016). As defined by Gwirayi (2012), "a system is a unified collection of consistent and mutually dependent parts that are either artificial or natural". The theory was therefore used as a lens in the assessment and evaluation of government systems and resources in the district which have the ability to accomplish a specific goal.

According to Lich, Urban, Frerichs and Dave (2017), the systems theory approach can potentially enhance the understanding of stakeholders to a system of different parts which are linked in a complicated manner. The system examines the structure being the reasons for problems because in some cases it leaves out components which are found outside this complex system. For instance, food insecurity within the study area could be as a result of infertile soil, pattern of rainfall and poor farming tools. Notwithstanding this, external factors such as globalization, floods, lack of irrigation facilities also exacerbate farmer inability.

The theory was also used to examine the operational aspect of government institutions in the district in terms of resources availability that determine the linkage of the system by tracking the process of development that may empower the farmers to minimize their vulnerability to floods in the district through the examination of the causes, the intense pressures as well as unwholesome community locations (Khazai, Kunz-Plapp, Büscher & Wegner, 2014). According to Bola, Mabiza, Goldin, Kujinga, Nhapi, Makurira and Mashauri (2014), the analysis of the study were based on the livelihood capitals such as financial, physical, natural, social, political and human capital.

This led the study to also adopt the sustainable livelihood approach framework to demonstrate the link between government structures and resources availability to the society. This provided the avenue for the study to question and examine a range of factors that the rural households and smallholder farmers in the area were entitled to and the highlights social disparities in relation to vulnerability (Adger, 2006).

2.3 Conceptual Issues

2.3.1 Introduction

The concepts were applied in the study to create the linkage to the understanding of every issue that was being dealt with in the area of the study. This provided the detail description of floods, vulnerability, indigenous farming systems, livelihood and livelihood

sustainability and how they were linked simultaneously to provide a clear understanding and the relationship between each of the concepts.

2.3.2 Conceptualizing Flood

Flood has been given different definitions by different writers, but they all carry similar meaning. For example, IPCC (2012), defined it as "the overflowing of the normal confines of a stream or other body of water or the accumulation of water over areas not normally submerged. This means water that comes out from its normal stay to places that have no water. The definition by Oxford Dictionary states that, it is water which is rising or swelling that overflow on land usually not covered. On the other hand, Vojtek and Vojtekova (2016), define flood as an excessive amount of water discharged compared to the drainage capacity.

Aderogba (2012), also defined flood as the natural response of rivers, streams, drainage systems, valley or channel with excess water to cope with. The Center for Research on the Epidemiology of Disasters (CRED) defines it as "a significant rise of water level in a stream, lake, reservoir or coastal region." According to Ching, Baharudin, Mohd Ekwhan, Lee, Maimon and Salmijah (2013), flood is "any high-water flow that dominates the natural or artificial banks in any part of the river system". Noting from the definitions, I view flood as the systematic process of an overflow of water either from a river, stream, lake or heavy rainfall that disrupts and displaces life and property within a defined geographical location.

2.3.2.1 Types of flooding

Having knowledge of various kinds of flood is an added advantage for development strategy and implementation of preparedness plan for mitigation. Floods occur in many forms, some of which are urban floods, river floods, flash floods, pluvial floods, coastal floods, glacial lake outburst floods and sewer floods (IPCC, 2012), but in this study, only the very key ones will be expatiated on. The key floods according to Diakakis, Deligiannakis, Pallikarakis and Skordoulis (2016), are river (fluvial), flash and surface floods (pluvial), groundwater floods and storm surge (coastal) and the impact of these floods depends greatly on the severity of rainfall, geographical location, the condition of the surface and for this study, the rainfall distribution within an area.

2.3.2.2 Coastal flooding

This type of floods occurs close to and around coastal areas. It is the excessive rise of water from the sea, caused by storm systems usually low pressure and measured as the waters

beyond the normal expected region (Prime, 2018). According to Jalili and Najafi (2020), this happen when strong wind pushes water from the sea offshore. The severity of coastal flooding is attributed by the size, speed, track and the magnitude or ability of the storm (Fernández-Montblanc, Vousdoukas, Ciavola, Voukouvalas, Mentaschi, Breyiannis, Feyen & Salamon, 2019). According to Takagi et al, (2016) they are classified as minor, moderate, and major. This flood causes a lot of devastating loss of property and of life due to the nature of low lands in which it overflows (Gallagher, Duncombe & Steeves, 2020).

For instance, Hinkel, Lincke, Vafeidis, Perrette, Nicholls, Tol and Levermann (2014), posited that, majority of the global population will suffer the effect of floods due to the prediction of the rising level of the sea by an estimated magnitude of 25-123 cm in the 21st century. According to Hinkel et al. (2014), if nothing is done about the impact of rise in the level of the sea, the world will lose an estimated gross domestic product worth 0.3-9.3%, which is unacceptable.

2.3.2.3 Fluvial flooding

Rainfall occurs in every rainy season but when heavy rains occur over a long period of time they cause many rivers to exceed their carriage capacity (Nace, 2017). From the statement of Nabangchang, Allaire, Leangcharoen, Jarungrattanapong and Whittington (2015), excessive snowmelt can result in floods that come along with widespread damage because waters in many rivers will overflow their banks and eventually smaller rivers will be affected in the downstream. Paprotny, Kreibich, Morales-Nápoles, Castellarin, Carisi, and Schröter (2020), explain that, dikes and dams can break as a result of floods. Over the bank floods is a fluvial flood that occurs due to rising water and overflows river edges (Cook, Andermann, Gimbert, Adhikari & Hovius 2018). According to Paprotny, et al. (2020), soil that is already saturated through the accumulation of precipitation including the nature of the land area, causes fluvial floods. Lands that remain wet is the contribution of water rising slowly. When rain continues the soil becomes saturated and cannot contain excess the water which will eventually turn into runoff water.

2.3.2.4 Pluvial flooding

This type of flood occurs as a result of heavy rains that overstretch the natural and artificial drainages and are mostly seen occurring in the urban cities (Thieken, Kienzler & Bubeck 2019). According to Pommeranz and Steininger (2019), the capacity of urban drainage systems is usually limited and mostly overwhelmed by excess rain. Poor construction and

blockage in some urban drainage systems coupled with excess rains causes flooding (Rosenzweig, McPhillips, Chang, Cheng, Welty, Matsler & Davidson, 2018).

According to Netzel, Heldt, Engler and Denecke (2021), pluvial floods are only seen occurring in places far from water bodies and are usually in two forms; Surface water floods and flash floods. Urban areas experience surface water flooding due to water saturation. As argued by Noy, Nguyen and Patel (2017), drainages in urban areas are usually saturated to the extent that the system cannot hold more water, and structures and streets are mostly occupied by these waters. Drainage systems are built with cement and concrete blocking waters from being absorbed by the soil. On the other hand, flash floods occur in mountainous places. This affects people living close to mountains (Rözer, Müller, Bubeck, Kienzler, Thieken, Pech & Kreibich 2016). As expressed by Cassar, Healy and Von Kessler (2017), whether there is flood warning or not flash floods have severe negative impact as compared to riverine floods which rise slowly.

Many places across the world have experienced the negative impact of flood events. The following are flood events that have characterize many countries. For examples, UNDRR (2015), reported that, floods are one of fatalities of weather-related events. They acknowledge that, since 1995 after the climate change convention, an estimated 90% of devastating disasters is caused by floods and other natural disasters in which more than 600,000 people lost their lives and over 4 billion people were displaced or injured between 1995 to 2015. For instance, 472 disaster occurred in the United States; China experienced 441disasters, whiles India, Philippines and Indonesia also experienced the following number of disasters, respectively 288, 274, and163. In relation to economic value, about $1.89 trillion was the cost of losses from these disasters during this period (UNDRR, 2015).

2.3.3 Causes of floods

Floods have been seen to be escalating in recent years. This is due to change in the climate associated with increasing urbanization and global warming (Williams, Cook, Smerdon, Cook, Abatzoglou, Bolles, & Livneh, 2020). As posited by Hui, Zhang, Ma, Li, Peng, Li and Wang (2018), increase in the global earth temperature is a significant result from global warming that has caused remarkable changes in the climate. The linkage between floods and global warming can be traced to the warmer air holding excessive moisture (IPCC, 2018). Therefore, any increase in temperature from global warming will significantly cause rainfalls,

which will eventually result in flooding (Kaufmann, Lewandowski, Choryński & Wiering, 2016).

Other factors that are influencing or responsible for the high rate of flood events according to IPCC (2014) include poverty, population growth and urbanisation. Supporting this assertion, Jongman, Ward and Aerts (2012), stated that, increasing flood impacts on societies have been observed to be as a result of the contributory factors such as population density and the growth of an economy. Flood disasters are strongly associated with human activities and climate change. This has contributed to the increase and severity of the frequencies and occurrences of floods as in the way that rainfall is now increasing while the interval of its occurrences decreases (Pistocchi, Calzolari, Malucelli & Ungaro, 2015).

Furthermore, as a result of lack of strategic plans to mitigate the emission resulting from global warming, there will be the likelihood that precipitation will increase by 40% in heavy rains during rainy seasons that will further lead to the development of floods (Zheng, Hui, Xie, Cai & Long, 2019). Floods are mostly caused by human activities (anthropogenic) in hazard prone areas (IPCC, 2014). This assertion is supported by Lu and Xu (2017), in their findings, climate change occurs as a result of global warming caused by the activities of human being. According to Wu, Sun, Sun, Wu and Zhang (2017), this has increased the intensity of extreme weather, likely to increase the risk of floods and economic losses. According to Liu and Shi (2017), it leads to higher rainfall and floods, which are the main factors determining vulnerability.

According to Adzawla and Alhassan (2021), Sustainable Development Goal 2 places emphasis on achieving zero hunger by 2030 globally, but the impact of climate events such as floods is seriously threatening the achievement of this goal. As explained by IPCC (2014), floods have become one of the most negative climate change events in the world. They include urban floods, river floods, flash floods, pluvial floods, coastal floods, glacial lake outburst floods and sewer floods (IPCC, 2012). Such factors that account for the increasing flood risk, have severe negative impact on humanitarian, economic and long-lasting effects on economic growth (Jongman et al., 2014) and as expressed by Feyen, Dankers and Bódis (2012), the more these factors continue to exist in the rate at which they increase, there will be frequent and severe flooding that will emanate from the impact of climate change.

2.3.4 Effects of floods on farming

According to FAO (2015), floods have been named one of the most devastating environmental risks among hydrogeological disasters which have a wide range of negative impacts on environment and human society in general. According to Ching et al. (2013), the situation where water takes over land has become a worrying issue to many societies across the world. The rising sea levels and events of heavy precipitation occurrence are speedily increasing with discharges in some locations across many regions (IPCC, 2014). This assertion is supported by Lu and Xu (2017), that floods tend to have severe negative consequences on human societies.

Many people lose their lives, more are made homeless, and property and infrastructure are severely damaged by floods annually (Parvin, 2016). The occurrence and severity of floods do not directly destroy life and property only but have a long run and wide range of negative impact on economic status of societies (Koks & Tissen, 2016). As said by Prein (2017), it is documented that severe floods which are the product of climate change in years to come will become a severe threat to our unborn children.

Guha-Sapir et al. (2016), assert that the effect of these disasters (floods), on humans is on the increase and is very disastrous and frequent in their nature. According to IPCC (2014), the negative impact includes ecosystems alteration, disruption in food supply chain and supply of water, destruction of settlements and infrastructure, human mortality and morbidity and above all, severe consequences on human mental health and well-being. Activities that depend on the natural resources and the environment such as farming are usually susceptible to flood disasters because some geographical areas are threatened by excess saturation of water.

UNISDR (2017), asserted that the functioning of human society is negatively affected by the destruction of floods. Coastal floods have severe negative effects on a vast number of people and properties including land across the globe (Jongman et al., 2012). For example, Close to 170 million people are annually affected within the global space (Kazakis et al., 2015). According to Thorne (2014), floods are among the most severe and most frequent natural hazards that are confronting the United Kingdom as many areas close to the coast are severely at risk and the impact of it is rising in areas very close to water bodies especially the North Sea in the United Kingdom and thus comprising of vast and low-lying agricultural lands (Gould, Wright, Collison, Ruto, Bosworth & Pearson 2020).

Floods cause a lot of losses within the agricultural sector most often in the farming season where it affects agricultural businesses and livelihoods among farmers in England (Morris & Brewin, 2014). The majority of the people in Bangladesh are subsistence farmers. There are subsistence farmers because floods have taken over the major portion of the farmlands and inundating crops, contributing to low crop production. History indicates that floods are a major and regular occurrence in Bangladesh, mainly because of its low landscape. The country experience floods every year and farmers are identified as the worst affected especially small holder farmers (Ara, 2019).

Furthermore, flash floods and surface waters threaten the livelihoods of people in Germany and riverine floods have been the major issue across the length and breadth of the country, where communities close to big rivers experience great losses due to the impact of severe flooding for the past two and half decades. For example, the cost of severe damage caused by the negative impact of floods in July 2014 was USD 600 million in Münster city and its surrounding areas. The cost of insured damage was also an amount of USD 1.3 billion within the southern part of Germany during the MayJune 2016 floods (Surminski, Roezer, & Golnaraghi, 2020).

Philippines is also one of the countries that is suffering from devastating disasters such as floods, and as explained by Israel and Briones (2012), floods have impacted negatively on agriculture productivity at the national level. According to Pratiwi, Ramadhani, Nurrochmad and Legono (2020), flood affected a total of 94,306 hectares of farm produce in the paddy field in Central Java in Indonesia during the 2014 rainy season reducing total food production in the region. Other four jurisdictions that were also severely affected are Pati with 25,460 ha affected by the floods, Demark also got 13,560 ha of crops destroyed by the flooded, whiles Jepara recorded 13,281 ha of flooding and Kudus also recorded 12,203 ha of food crops damaged by the floods.

The effect of floods has not spared the African continent. In Cameroon for instance, peasant farmers constitute 70-75% of the working population and they produce 80% of food crop (Yengoh et al., 2014), but currently, food production is speedily declining (Epule et al., 2016) because of recent seasonal flooding (IPCC, 2014). Also, other countries like Malawi experience a tremendous decline in crop production (maize) with an annual average of 12% damaged by flood. According to Pauw and van (2010), the annual flood disasters experienced in the country escalates economic losses that lead to a high level of poverty.

Benin and other West African countries faced similar flood effects. 476 ha of farm crops from a total of 1256 ha got damaged as a result of prolonged floods and water logging that led to decrease in crop yield during the 2012 flood disasters in Benin (Bonou et al., 2018). Notwithstanding that, the following season, an estimated amount of $20 million worth of crops got damaged (USAID, 2018). Nigeria for instance had their own share of the negative impact of floods. In Adamawa state for example, an average of 35% of its vegetation cover got affected during the 2012 floods and 56% of state farmlands and food crops got flooded. Aside this, 42% of vegetation cover was inundated while 51% of farmland cover got submerged during the period of the 2014 farming season (Musa et al., 2019). According to Idoko (2016), Dagiri is a community in Abuja, the area farmlands always flooded with food crops usually washed away by floods, which escalated food insecurity issues in the community and eventually had severe negative impact on living standard of the individual, group and the entire community.

In another situation, according to Week and Wizor (2020), out of 790 respondents surveyed, 75.3% attested that food stuffs are scarce after floods, 69.9% said that it is difficult to grow crops after farmlands are wash away, 78.3% agreed that, there is food insecurity when floods come and go, 77.1% said plants are unable to absorb nutrients to grow when they experience floods, while 71.4% attest to the fact that flood leads to massive erosion and wash away soil nutrition. Again, 69.9% of the people agreed that there is chronic and long duration of food shortage within affected communities; other evidence provided prove that 75.6% agreed that food shortage due to floods affects livelihood of residents. 64.7% said that, flood affect household investment. Finally, 60.9% postulated that, losing their source of livelihoods as a result of flood makes it difficult for them to care of their wards.

In Ghana, 23,588 acres of farm crops were submerged in waters across the affected communities (Armah et al., 2010). In addition, Nyamadi et al. (2018) stated that, floods cause food shortage and reduce crop yield in the region. For example, floods damaged crops worth 955,050 tons in 2005 (Dosu, 2011) and in 2007, a total of 70,500 hectares of crops were affected including production losses of 144,000 metric tons in Northern Region (UNOCHA, 2007). Also, 8,760 acres of farms in the Northern Region were destroyed by the 2010 floods (IFRC, 2010), and an estimate of 257,076 tons of food were lost (Arthur & Irene, 2011). To add more, a total of 10,948 acres of farm crops were destroyed in the Savannah Region during the peak of the rainy season, September, 2020 (North Gonja Floods, 2020).

Developing countries suffer from the impact of negative floods and this happens because of inadequate preparedness to limit climate change and its associated events in many sectors. As postulated by IPCC (2014), related cost of flood damage across the world have been increasing for five decades. This occurs as a result of population and assets exposure. Floods have a major negative impact on production of crops and human livelihoods (Visser, Petersen & Ligtvoet, 2014). The magnitude, frequency and spatial distribution of flood disasters have increased across the globe and have greater social, environmental and economic losses (Baldassarre, 2010). For instance, direct and indirect losses resulting from this weather-related event have substantially increased in recent years within regional and the global arena, due to increase in exposure level of the populace and economic assets, which have long run negative economic impact (IPCC, 2014).

2.4. Defining vulnerability

Mavhura, Manyena and Collins (2017), define vulnerability as "the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of an individual, a community, assets or system to the impact of hazards". Nelson, Kokic, Crimp, Martin, Meinke, Howden and Nidumolu (2010), posited that vulnerability is a predisposition of people, geographical location or livelihood systems to disorders which are mostly decided by the exposure to hazards, sensitiveness to disasters and their capacity to be able to adapt. According to the definition of IPCC (2012), vulnerability is "the propensity or predisposition to be adversely affected". IPCC (2014), further define "vulnerability is the level to which a system is susceptible to, or incapable of coping with the adverse effects of climate change, climate variability and extremes".

Looking at vulnerability in relation to adaptive capacity is the loopholes and the weakness to adopted community coping strategy (Rana & Routray, 2018). According to Balica and Wright (2010), "Vulnerability is defined with interaction between exposure, susceptibility and resilience of each community in risk condition". IPCC (2014), further explain that vulnerability is the tendency to suffer effects of hazards, the likelihood to be harmed or the inability to withstand and adapt to shocks. According to Amisigo and Bossa (2019), to assess community socio-economic, physical or environmental factors and its processes by means in which it is susceptible to hazard events is determined by vulnerability. Ghosh and Kar (2018), State that one of the factors determining vulnerability depends largely on the population size,

the economic status, livelihood activities, availability of needed infrastructures and the ability of a community to be able to cope with the impact of hazards.

Vulnerability may be described as the state of being susceptible to harm, or being marginalized or lacking the ability in both the physical, economic and the social systems (Adger, 2006). The concept of vulnerability has been widely recognised lately within the change environment literature (Ford, Pearce, McDowell, Berrang-Ford, Sayles & Belfer, 2018; IPCC, 2014). This is due to the fact that global agricultural production and food security are declining as a result of climate change. Agriculture or let say crop farming according to Wu et al. (2017), is very vulnerable to floods due to wide range of factors, including level of exposure, sensitivity, and lack of adaptation capacity. As stated by Sahana and Sajjad (2018), different methods are used for assessing various dimensions of vulnerability which include spatial, ecological, geographical, social and economic dimensions and as per the definition by IPCC (2014), vulnerability can be calculated as the total effect of exposure, sensitivity and adaptive capacity. Therefore; Vulnerability = ExposureSensitivity-Adaptive Capacity

2.4.1 Exposure

Considering the importance of agricultural farming in the reduction of poverty, economic elevation in rural areas and increasing food security, it still expose to various hazards. According to Pathak, Panta, Bhandari and Paudel (2020), flood vulnerability and its influencing factors. Natural Hazards, 104(3), 2175-2196. (2020), "exposure refers to the susceptibility of a system to flood due to its location inside the sphere of influence." Farmers who crop or practice farming close to river bodies are mostly exposed to severe flood risks.

Exposure is defined as "the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected" (IPCC, 2020). According to Chen, Liang, Liu, Jiang and Xie (2018), farmers who do farming on riparian shrub lands experience fluctuations of crop yield.

Communities close to coastal areas are at risk; for example, the communities living close to the North Sea in United Kingdom are exposed to flood risks because the area comprises low-lying vast lands and there are the activities of farming on the land (Gould et al., 2020). For example, the negative impact of severe flooding impedes food crops production in China. This is because they are directly expose to flood hazards due to farm locations (Chen et al., 2018). Exposure to events of floods and low capacity of adoption is a contributing factor to the high

vulnerability level of many households. Factors influencing the exposure of a community are absence of credit schemes, low migration, high female population, and human perceptions to floods and flood knowledge which influence possible vulnerability (Pathak et al., 2020).

2.4.2 Sensitivity

Sensitivity relates to the negative effects of floods leading to the death of crop plants and human life. For example, many crops are normally sensitive to severe flood leading to massive losses of crop yield due to the negative impact of flood in each farming season. Crops die if the duration and severity of floods exceed the crop capacity to adapt. (Angelika, 2018).

The IPCC (2007), defines sensitivity as "the degree to which a system is affected by flood". According to Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher and Schiller (2003), a system of human environment and condition subject to any form of exposure is the main contributor determining sensitivity. For example, the role of women does not permit majority of them travelling as compared to men due to social and family responsibility at home (Hudson, Pham & Bubeck, 2019). There are high level of dependency such as the aged and children prone to distress from the negative effect of floods. Also, agriculture is one of the essential sensitive professions, therefore, income made from farming has impact on livelihood during flood disasters.

2.4.3 Adaptive capacity

Adaptive capacity according to IPCC (2014), is "the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences". Adaptive capacity enables the resilient level of households or a community. For instance, elderly people in a household are very much experienced and can withstand the increasing risk of floods better than younger ones. Piya, Joshi and Maharjan (2016), stated that, alternative sources of income increase coping capacity and reduce the risk of being affected by floods which as a matter of fact increase adaptive capacity (Piya et al., 2016). According to Fahad, Jing, Khan, Channa, Huong, Shah, Hu and Bilal (2017), low adaptive capacity of farmers influences the vulnerability of crops to floods.

Households can rebound faster from flood disaster with irrigated land as compared to households who depend entirely on rain fed cultivation (Antwi, Boakye-Danquah, Owusu, Loh, Mensah, Boafo, & Apronti, 2015). Aside this, high level of income, livestock holdings, migration for greener pastures, or being a member of social group, high education, available

early warning, better housing, big family, credit facilities, male gender and ethnicity minimize the risk of flood and the failure of food crops. The availability of adaptations and abundance of food increases the ability of farmers to reduce risk of flood. People who depend mainly on agriculture for livelihood are severely affected by climatic change hazards such as floods (Ali, 2013).

2.4.4 Social capital vulnerability

Social vulnerability emanates from three main factors such as built environment which includes, facilities of housing, standard of living, and housing quality. The second is the demographic vulnerability, which comprises the structure of the family, structure of demographic and social groups, gender, and ability to move freely, and finally, socio-economic vulnerability was one of the factors the research emphasized on, which encompasses illiteracy rate and education accessibility, income level and employment structure (Török, 2018). Discussions have been globally held as to the way socioeconomic structure and employment status in a given area can exacerbate both the exposure to hazards and ability to withstand the shocks of natural disasters (Frigerio, Carnelli, Cabinio & De Amicis, 2018).

After a careful analysis in Botswana, factors contributing to social vulnerability include the following; household size, disability, age, illiteracy rate, people without social security, level of employment in the area, structure of the households and high poverty (Dintwa, 2019). Furthermore, Frigerio et al. (2018), postulated that factors determining social vulnerability within a given society in Italy includes the following; age, education, employment and population density. Fatemi et al. (2017), supported the assertion made by Frigerio and others, who hold the view that the main determinants used for the assessment of social vulnerability are as follows; education, gender, socioeconomic status, age, public health condition, employment status, and access to resources such as credit facilities, fertilizers and good seedlings.

In addition, the minority such as the ethnic community, the disabled, or migrants, are also indicators that they are highly socially vulnerable when they are marginalized and living within risky areas (Frigerio et al., 2018). According to Tascón-González (2020), one of the social vulnerability indicators is population density. This is because when population density is high and floods come, evacuation is usually difficult and people get affected by the floods. The time used in evacuation is very important in this case (Frigerio et al., 2018). In the study

by Mavhura et al. (2017), they found that social, economic and political factors as the factors that have an extensive influence on social vulnerability.

2.4.5 Economical capital vulnerability

Economic vulnerability is related to the financial aspect and people's capability to acquire wealth. As stated by Felsenstein and Lichter (2014), income level and individual, group or community wealth are used to determine the vulnerability of a geographical area. According to Olsson, Opondo, Tschakert, Agrawal, Eriksen, Ma and Zakeldeen (2015), poverty is one of the factors contributing massively to climate vulnerability from global to the lower level where the poorest people at these stages are more vulnerable than economically and socially well doing people. As said by IPCC (2014), one of the factors influencing vulnerabilities is change in the total wealth of people and increasing urbanisation as the outcome of economic growth.

For example, flat plains improve good yield in Nepal especially rice, but inadequate flood management hinders the growth of crops and as a result, increase their financial losses in Terai as farming and its activities are close to rivers (Delalay, Ziegler, Shrestha, Wasson, Sudmeier-Rieux, McAdoo & Kochhar, 2018). According to Oo, Van Huylenbroeck and Speelman (2018), lack of access to opportunities of farmer household to non-farm and off-farm income, lack of opportunities to credit, allocation of agricultural loans in the middle of the farming season, high interest rate, increasing debt due to low yield and high farm input prices contribute strongly to economic vulnerability of farmers' households in Myanmar.

According to Ho, Kuwornu and Tsusaka (2022), another example in terms of economic losses to floods, is that farmers are facing a lot of economic challenges, especially during farming seasons. According to the findings of the research, farmers who are economically vulnerable in Vietnam are as follows; aged farmers, female farmers, persons with short experience in farming, persons with small size farm lands and no other economic activities, persons who lack credit facilities extension services and weather information, and persons with inadequate storage facilities, low education, low wealth and persons who live in poor geographical locations. The study revealed that people with the above characteristics are severely exposed to flood disaster and the more they experience floods the more their income level declined.

2.4.6 Environmental capital vulnerability

The environment serves a good purpose in relation to farming activities across the world, especially, in rural communities where farming dominates. On the other hand, the environment in which we live and which we interact with happens to have negative effects on our livelihoods. According to Fahad and Wang (2018), soil fertility is the most important part among farming activities. Farmers become vulnerable when the soil loses its fertility. High temperatures that lead to floods are uncontrollable and precipitation variation are all factors that contribute to farmers' environmental vulnerability. According to Derbile, Chirawurah and Naab (2022), smallholder famers are very vulnerable to environmental climate and non-climate hazards such as flash floods and heavy rains.

Other environmental vulnerability as stated by Ali, Ashfaq, Hassan and Ullah (2019), are market and policy fluctuation which contribute to the high vulnerability level of farmers in various regions. This means that unstable market prices especially the reduction of food prices and increasing prices of farm inputs over which farmers have no control, because they are external factors limit the power of farmers. According to the findings of Nguyen, Seddaiu and Roggero (2019), farmers are environmentally vulnerable due to lack of government subsidies, lack of quality seeds and unstable markets.

Other examples of environmental factors contributing to the vulnerability of farmers according to Sarker, Wu, Alam and Shouse (2020), are inadequate soil fertility, salinity and extreme temperature pressure which are all factors that influence the vulnerability of crop farmers. Lack of accessible market is a factor. Farm size, biological and climate change are also factors that contribute to the high vulnerability of smallholder farmers. People are vulnerable because they don't have much farmlands.

Many rural smallholder farmers have no formal education and knowledge about climate change and its negative impact. For instance, farmers without adequate knowledge on the climate change and variabilities are very vulnerable to environmental changes. Therefore, farmers without climate knowledge are very vulnerable to the environmental changes (Oo et al., 2018).

2.4.7 Physical capital vulnerability

Physical factors play a key role in decreasing farmers' poverty level. This relates to the political systems such as infrastructure, good roads, schools, hospitals, banks and credit

facilities, agricultural facilities for agri-businesses and weather departments. This refers to infrastructure and services that improve farmers' conditions (Pandey, Jha, Alatalo, Archie & Gupta, 2017). According to Bizikova, Nkonya, Minah, Hanisch, Turaga, Speranza and Timmers (2020), support from governments to farmers groups such as farm inputs subsidies, infrastructure such as roads, storage facilities and irrigation systems are the physical assets that help to improve the condition of farmers. On the other hand, the absence of these physical assets exacerbates farmers' vulnerability. Tarolli and Sofia (2016), asserted that human settlement is among the sensitive places to weather extremes and climate fluctuations such as floods.

For example, farmers in Muzaffargarh, province of Pakistan, faced a lot of challenges and where vulnerable as a result of damage roads, cut off electricity, collapsed houses and drainage systems. These facilities that were not in good shape, hindered transportation of goods and services and limited access of rescuers bringing relief items and cut off communications (Jamshed, Rana, Mirza & Birkmann, 2019). When these factors are affected by floods or have not been provided by the state government, farmers become very vulnerable because they do not have access to infrastructures.

Floods are reported to be the largest threat to property and life (Hammond, Chen, Djordjević, Butler & Mark, 2015), usually followed by destruction of agricultural lands. An example is the 2011floods that inundated Queensland in Australia which left many livestock dead, because they were unable to move the animals from their location to upper lands within the expected period (Keoduangsine, Goodwin & Gardner-Stephen, 2014). According to Felsenstein and Lichter (2013), in their findings, when individuals' assets are displaced by flood disasters, their economic and social traditions including conventions and institutions also get destroyed. Explaining further, social vulnerability is associated with physical factors whiles asset vulnerability, irrespective of individual socioeconomic status, severe flooding has negative effects on all assets equally.

According to Kuang, Jin, He, Ning and Wan (2020), smallholder farmers are very exposed and vulnerable because they lack agricultural technologies. Fixed machinery and quality equipment are so expensive that the ordinary farmer has no financial power to be able to buy these assets. Aside this, lack of information on farm innovation technologies is also another factor that contributes to the vulnerability level of farmers. Poor institutions result in inadequate regulations in the market in Khyber Pakhtunkhwa area contributing to their inability

to access farm inputs and the output market, public services and extension services (Ullah, 2015). As reported by Xu, Liang and Huang (2018), rural farmers in developing nations are facing severe economic growth challenges due to physical market distance and poor rural infrastructure.

2.4.8 Human capital vulnerability

Human vulnerability refers to the nature and type of human resource base of a particular farming community. It also refers to availability and non-availability of household labour in agricultural production. It also recognises the knowledge base of individual households in relation to agricultural innovation technology. Awareness of technological advancement is a key player for improve crop production by farmers (Huang, Lu, Wang, Cui & Yang, 2019). What this means is that, lack of skills and technology increases the level of vulnerability to change in climate among many farmers.

According to Huffman (2020), in a changing environment, educated farmers are better in the adoption of new farming technology than persons with little or no education. As reported by Reimers and Klasen (2013), human capital refers to the skill level and the health of people within a given geographical location, which influence the extent of production, adoption of new innovations and use of new inventions. An unhealthy farmer has limitation due to spending time and resources to resolve his health condition. For instance, Loureiro (2009), stated that, the impact of productivity on Norwegian farmers depended on their health status.

Millions of people in the rural areas migrate to urban cities (Qin & Liao, 2016). Migrants are mostly educated and young people within a given community in search for greener pastures, leaving behind the aged and the weak who can only cultivate small pieces of farm lands. This decreases household agricultural manpower productivity (Wang & Benjamin, 2019). It also leads to loss of social memory and when this happens, withstanding shocks or disturbances becomes very difficult and as a result their vulnerability level increases when they return home to this changing climate (Wilson, 2015).

In relation to cropping and weeding, culture enhances group farming among many communities in the rural area, especially the developing countries. Group farming helps an individual to achieve what he or she could not have achieved alone (Rigg, Salamanca & Parnwell, 2012). Migration affects this group decision, because the people are not there to perform this group work, leaving other individuals to suffer with farming practice alone. This

reduces farm sizes and crop yield and as explain by Ge, Long, Zhang and Tu (2018), decrease in agricultural labour contributes to decreasing crop yield. This is usually seen in areas with increasing agriculture development transitioning fron the Indigenous Knowledge Systems.

2.5 Indigenous Knowledge Systems

Indigenous farming systems are the local and traditional farming practices across the world. These practices as acknowledged by Dwivedi (2015), contribute to the improvement of good crop yields, help in the conservation and provide soil fertility, limits the incidence of infections of pests and diseases that affect many food crops and above all, they decrease the negative impacts of climate change and the failure of crops production. Smallholder and medium land size farmers also practice indigenous farming practices, with the application of compost, oil cake and cow dung to increase farmland fertility. Aside this, there are other practices such as the use of wood-ash, decomposed animals and herbs to protect crop from pest and diseases.

The use of age long harvesting before the advent of technology, for instance, crop threshing and seed storage is also part of farming systems, and it is transferred traditionally (Deka & Bhagabati, 2010). According to Singh, Dwivedi, Tiwari, Majumdar, Rani, Singh and Timsina (2014), before the application of fertilizer to improve crop yield, there were already the traditional means of increasing crop yield locally. Singh and friends postulated that, organic manure such as green manure, crop residues and the manure of animal influences high quality of food crops, good yield of productivity and also, it sustains the soil fertility for crop farming.

Many people reside in floodplains, steep slopes, low-lying areas, ravines and are exposed to various kinds of hazards which influence their vulnerability to floods (Harvey et al., 2014). In spite of the high risk involved in crop farming in flood areas, a good crop yield is normally high in these places (Macedo et al., 2019) and it is mainly due to the indigenous farming systems practiced by smallholder farmers in these areas which are mostly intercropping (Dwivedi, 2015). Farming is practice close to flood areas because floods are a contributory factor to soil fertility and pest management (Tran et al., 2021).

Smallholder farmers in African countries are still developing to adopt modern farming practices. Farmers in the continent are still relying on indigenous farming system for crop cultivation and the production of food crops. According to Myeni et al. (2019), some of the indigenous farming systems practiced by rural farmers in Africa are crop rotation, intercropping and mulching. This system of farming practices according to Taremwa et al. (2016), relies only

on local practices and traditional means, which are very cheap in application, and the indigenous crop varieties are mainly used. They also emphasize on the statement of Singh and friends that the application of cow dung and crop residues increases crop production.

According to Rahman, Fosu and Tetteh (2014), the application and use of animal manure provides soil mineral, improves soil fertility and increase soil capacity. All the practices are simple indigenous practices applied to mitigate the impact of climate variability. According to Adesoji (2016) planting different kinds of varieties, adjusting date for planting, shifting cultivation, multiple cropping, mulching, legume and cereal intercropping also form part of indigenous farming systems practiced by the rural farmers in Africa.

Farming systems in Northern Ghana are influenced by climate change stressors such as floods and unpredictable rainfall (Antwi-Agyei & Nyantakyi-Frimpong, 2021). Farming systems practiced according to Johnson, Houssou, Kolavalli and Asante-Addo (2016), is shifting cultivation. According to Tenagyei and Osumanu (2021), in their findings, the people also practice inter-cropping and multi-cropping including the use of animal manure as part of the indigenous farming systems. They also use traditional farming tools for instance hoe and cutlass for weeding and harvesting food stuffs from the farms (FAO, 2015). In addition, row planting and crop rotation are also practiced among the people (Adzawla & Alhassan, 2021). According to Boafo et al. (2016), all these are embedded in their tradition and cultural systems and also form part of their livelihoods (Anang & Yeboah, 2019).

2. 6 Livelihoods

Livelihood is the means by which individuals or groups of people survive. It is defined as the means by which individuals or groups of people strive to earn some living, try to meet their economic needs and daily consumption, to cope with unforeseen circumstances, to take advantage of innovation and opportunities and to select the best valued options (De Haan & Zoomers, 2005). According to Chambers and Conway,
(1992) “livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living”.

Ellis and Allison (2001), also stated that livelihoods comprise the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household. According to UNHCR (2014), people engaging in their livelihood activities is

the way by which knowledge and skills are acquired, building social networking, and getting resources needed to meet basic needs on a continuous basis.

According to Tacoli (2017), rural people have diverse livelihoods as well as the economic activities such as on-farm, non-farm or off-farm livelihoods, mostly outside their place of residence. For example, majority of poor people in the world live within the rural areas especially in the developing countries and mostly depend on agriculture (on-farm) for their livelihood (Anang & Yeboah, 2019). Forests (off-farm) for instance, are another source of livelihoods for many rural people in developing countries (Rasmussen, Watkins & Agrawal, 2017).

According to Sani (2017), trading in the market or buying, selling of goods or providing services and local mining are all non-farming livelihoods that attract many people. Asravor (2020), supported the assertion of Sani (2017) that wage employment such as teaching, banking, security services, extension services or self-businesses such as private sector enterprises, traders, wholesalers and retailers are all livelihoods. Others are petty trading, shea nut collection, casual labour, shea butter extraction, and charcoal making (Abdulai, Adams & Abdulai, 2014). According to the World Bank (2016), migration (nonfarm) to urban areas in search for jobs serves as livelihood means. UNDP (2015), Goal 10 clearly states that migration is one of the ways in which the poor people are able to reduce inequalities.

Wiggins and Hazell's (2011), findings indicate that, off-farm and non-farm activities are economic livelihoods of the people in rural Africa, where 35% of household earnings is generated from non-farm and about 50% in Latin America and Asia. Many households are not able to sustain their livelihoods because of lack of resource, shocks, trends in climate and above all seasonality (World Bank, 2016). It is very critical and crucial for every household to be able to sustain their livelihood against the above shocks, trends and seasonality.

2.7 Livelihood Sustainability

Rural areas livelihoods sustainability has received considerable recognition in the global context, more importantly their strategies in respect to food and the management of water resources (Tran & Tuan, 2020). According to Tran and James (2019), the intensification of agriculture is regarded the major measure in securing food security across the globe. But of late, comprehensive strategies have been outlined to address the issues of livelihood sustainability (Carswell, 2011). Meanwhile, Struik and Kuyper (2017), defined agricultural intensification as the process in which crop yield increase with the absence of environmental

negative impact. According to Barrett, Reardon and Webb (2001), rural farmers sustain their livelihood with three major strategies and they include migration, livelihood diversification and agricultural intensification.

According to Tran et al. (2021), individual farmers or households who are not socially connected have limited livelihood sustainability because people who do not participate in social networking limit their potentials in exchanging ideas as well as learning from others the best methods of farming. Shah, Gong, Khan, Khan, Ali and Naqvi (2021), stated that governments' rural farmer livelihood sustainability police are mostly geared towards on-farming activities instead of focusing on off-farming diversification. They also added that, off-farming diversification reduces food insecurity and manages negative impact of extreme climate change. For example, a study conducted in two districts in Khyber Pakhtunkhwa, a province in Pakistan indicates that, the constraint of livelihood diversification are the uncertainties and risk of climate, limited natural resources, illiteracy rate, inadequate support from government or NGOs, absence of credit facilities, limited infrastructure (markets and roads) and inadequate available labour (Shah et al., 2021).

There are four rural smallholder farmers' livelihood sustainability strategies as outlined by Barrett et al. (2001), income from farms, labour income from other people's farms plus own farm income and the combination of non-farm income, off-farm income and farm income. These are the strategies which households rely on for survival. According to Kuang et al. (2020), in China, farmers in Rugao City apply a crops variety adjustment, agricultural finance, water management, fertilizer application and support from agro-technical as their livelihood strategies. Aryal, Sapkota, Rahut, Krupnik, Shahrin, Jat and Stirling (2020), identify a number of strategies employed by smallholder rural farmers in Bangladesh to be savings, farm modifications, borrowing from friends and family, reducing family food intake, off-farming jobs, seeking relief from NGOs and governmental. For instance, Sani (2017), findings indicate that, in Ethiopia aside farming, households sustain their livelihood in the government sector employment, unskilled wage employment, casual labour as well as the private sector.

Farming in sub-Saharan Africa plays a key role in the economy, because, it is the only activity that is predominantly generating income and food (Steel, Birch-Thomsen, Cottyn, Lazaro, Mainet, Mishili & van Lindert, 2019; OECD/FAO, 2016). It is because the sector largely depends on rains and is therefore vulnerable to climate conditions. According to Nelson et al. (2010), climate change in the region will negatively affect smallholder farmers'

agricultural production, food security and growing economy. Quandt (2021), notes that, farmers in Kenya adopt a variety of strategies such as dry season irrigation farming, burning charcoal for income, change in agricultural practices and temporary labour are used to sustain livelihoods during the negative impact of climate variability. In the Western part of Zimbabwe, communities developed number of livelihood adaptation plan such as social assistance, livelihood and crop diversification, small businesses operation and harvesting water for keeping livestock (Mashizha, 2019).

Ghana's main economic activity is agricultural farming and thus, employs more than 50% of the workforce. They are also rain-fed producers who are negatively affected by climate change (NCEA, 2015). The sector is speedily declining in terms of percentage and the contribution to Gross Domestic Product (GDP) as a result of climate change. For example, agriculture contributed 19% of Ghana's GDP in 2008 and declined to 16.4% in 2012 (Okudzeto, Mariki, Paepe & Sedegah, 2014). This has raised a lot of concern in the minds of many farmers to resort to multiple livelihood strategies. For instance, smallholder farmers in Ghana apply the following livelihood strategies in the face of adverse climate change in order to have sustainable livelihoods; the application of fertiliser, crop rotation and mixed cropping, change of planting date, elevation of farmlands, creation of local dam and management of pest and disease (Fadairo, Williams & Nalwanga, 2020).

In Northern Ghana, farmers resort to multiple strategies to sustain their livelihoods. For instance, farmers livelihood strategies in the Builsa-North district as stated by Kassim et al, (2020) are the application of seasonal migration, early planting, petty trading, rotation of crop and early maturity plants. Nyamadi et al. (2018), supported the assertion that, farmers in Northern Ghana sustain their livelihood through the application of the following; abstaining from farming on waterways, early planning, relying on external assistance and migration for greener pastures.

Another example of livelihood sustainability in the northern sector is knowledge acquisition on early warning systems, application of different farm practices and assets diversification (Afriyie, 2017). As expressed by Antwi-Agyei and Nyantakyi-Frimpong (2021), long-term livelihood sustainability strategies among rural smallholder farmers in northern Ghana are migration, planting resistant crop varieties, dry season irrigation farming and change in planting date, diversification of crops, mixed farming and land management. Meanwhile, the short-term livelihood sustainability among these farmers in the northern regions are as follows;

charcoal burning, selling of assets (non-farm items), non-farm employment, wage labour, selling of livestock and support from social networks (Antwi-Agyei & Nyantakyi-Frimpong, 2021). As stated by Zereyesus, Embaye, Tsiboe and Amanor-Boadu (2017), non-farm job plays a key role in the provision of alternative source for the poor households to overcome the potentials of experiencing food poverty.

As indicated by Christiansen and Todo (2014), the population moving out of agriculture to non-farming activities is a clear indication that the rural non-farming economy is extremely important for rural livelihoods. Studies conducted by Hoang, Pham and Ulubaşoğlu (2014), reveal that income generated from non-farm activities is self-insurance to withstand unforeseen shocks; this is because it generates income to the poor, creates employment and reduction of poverty in most less developed countries (Haggblade, Hazell & Reardon, 2010). Bedemo, Kindie, Kassa and Chaurasia (2014), found out that, households in rural areas diversify their livelihood into non-farm and off-farm activities, so as to minimise the uncertainties and risks which are closely related with farming systems sustain their livelihoods.

According to Scoones (1998), livelihood sustainability can be achieved only through the accessibility of vast range of livelihood resources such as economic, natural, social and human capital in combination with diverse livelihood strategies such as agricultural extensification or intensification, migration and livelihood diversification. It is presumed that, livelihoods of households are fundamentally driven from five essentially types of assets; namely social, natural, physical, human and financial capital (Lienert & Burger, 2015), which are found in the livelihood framework (Ashley & Carney, 1999).

2.8 Conceptual framework

The study adopted the conceptual framework from British Department for International Development (DFID) (Chambers & Conway, 1992) and used it as a tool to examine the structure and processes within the study context. According to Mazibuko (2013), sustainable livelihoods approach contributes to the consideration of a particular phenomenon and identification of patterns. This led to the adoption of people's entitlement theory and the governance systems theory. For example, Sen (1981) argue that people have multitude capabilities, with various kinds of assets and are also supposed to take part in many activities in order to make a living. Whiles, the systems theory emphasis that governance structures and policies are to provide access to these assets that Sen in 1981 acknowledge to be available for people to tap and make a better living.

This tool was use to investigate the living conditions in relation to the targeted population which were the beginning of the Sustainable Livelihoods Approach. The study also used the tool to identify factors that militated against the farmers adapting strategies and the factors that can reduce their vulnerability. The study was able to come up with the means by which they could be supported by their own initiative, government and other stakeholders, such as providing access to asset, good policies, infrastructure and private sector involvement. According to Carney (2000), when people are given access to their assets, they become resilient to influence the structures as well as the processes so as to become responsible for the needs they desire.

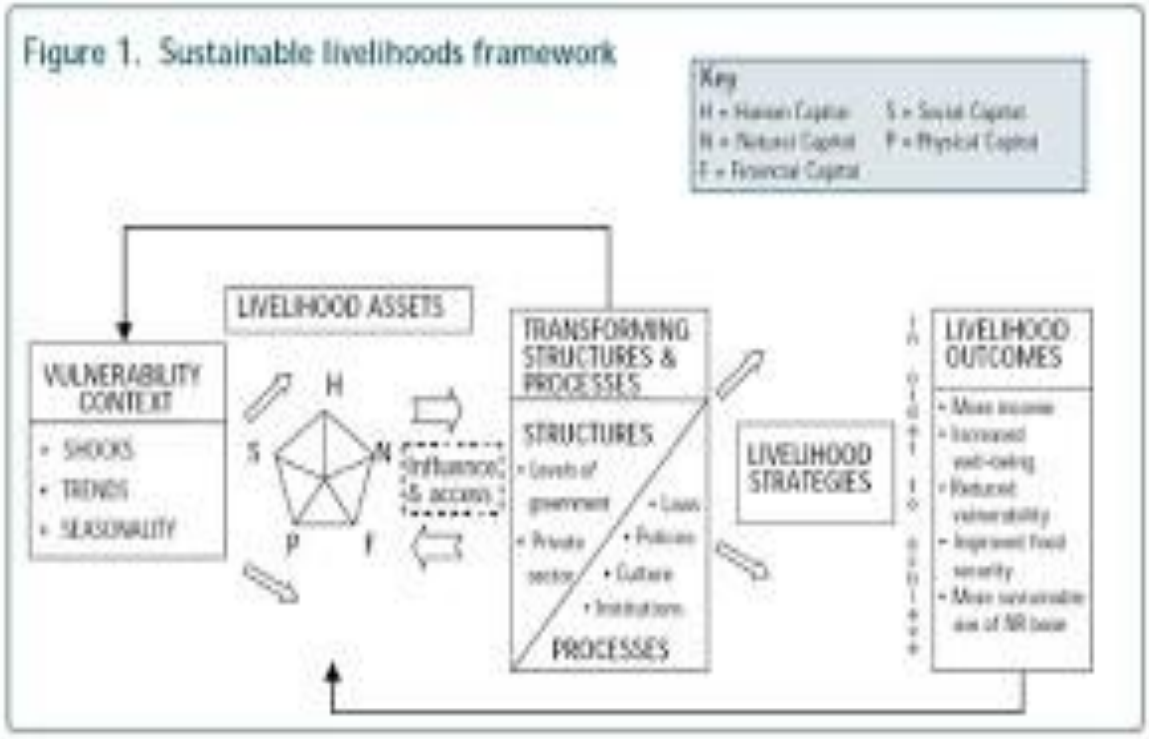

Figure 1. Sustainable livelihoods framework

Source: Ashley & Carney (1999).

African countries including Ghana rely on food systems for their food security which is moulded or controlled by climate change. As expressed by IPCC (2014), food production, availability, accessibility and utilization largely depend on the climate. The severe deficiency of food energy is threatening the life of people and the worse vulnerable are the children. According to FAO (2016), up to 6.2 million people in the Sahel are not food secure and the decreasing nature in crop yields will escalate the problem of food insecurity in the region.

Livelihood framework containing poor disaster management processes in figure 2, is an adopted and modified sustainable livelihood framework used to demonstrate the livelihood outcome of poor or weak governance systems. This is used as a tool to determine the vulnerability of the farmers in the district and how government policies exacerbate their poverty. For instance, the Vulnerability frame contains the trends, shocks as well as seasonality which are caused by climate variability (CV) such as floods. They are the external factors controlling human society and governance system are supposed to work to mitigate the flood disasters because the livelihood assets in the framework are very vulnerable to this variability.

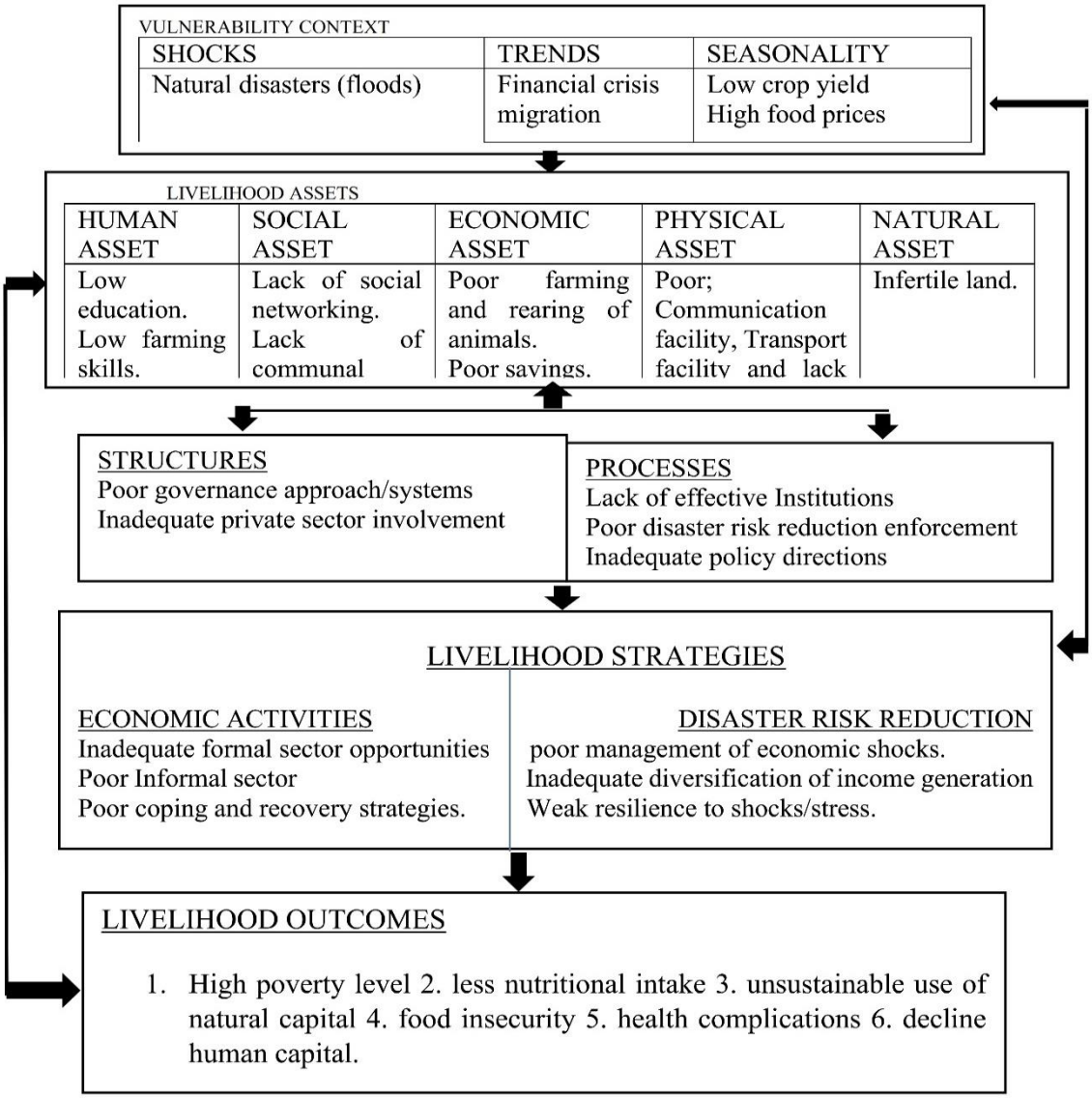

Figure 2. Livelihood framework containing poor disaster management processes.

Source: author (2022)

Poor societies and individuals receive less protection from disasters because of poor infrastructural development and investment in some areas (figure 2). For instance, poor countries receive less protection than rich countries (Hallegatte et al., 2020). Vulnerability can be minimized through disaster risk initiatives which are considered to be the means to poverty reduction (Hallegatte et al., 2020). According to Epule and Bryant (2016), institutional provision, policies, land management and financial support provides enough strategic options for livelihood diversification.

People cannot grow especially the poor when financial institutions are absent (Hallegatte, Vogt-Schilb, Rozenberg, Bangalore & Beaudet, 2020). Instead, growth can be generated through the promotion of DRR programs such as investment that will benefit the people to avoid losses (Hallegatte et al., 2020). According to Bang et al. (2018), government should put in place motivating policies and strategies which will facilitate the improvement of livelihood assets and boost crop production as shown in figure 1.

2.8 Chapter Summary

It is concluded that the entitlement theory places emphasis on food security and food supply and assumes that the laws and regulations enforced in societies are the main cause of food insecurity and scarcity of food and that the solution lies in political interventions, whiles the systems theory explains how various parts of the government system are supposed to work together as a whole to provide services to the communities in order to improve human livelihoods and any breakage of these linked parts will prevent some of the societies from functioning properly. Floods are one of the major disasters which are severely affecting socio-economic livelihoods of peasant farmers across the globe especially in Africa. It is also concluded that increasing human activities and global warming are the main factors influencing flood disasters and the conceptual framework show that good government policies and law can enhance the availability of endowment to be tapped by the society and weak government systems can exacerbate the denial and frustration of the society which will increase the already high poverty level in area affected by the floods.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Methodology is a set of guidelines, methods, process or ways that are used to perform research, which helps or create an avenue for a researcher to re-examine the research process in terms of its basics within the social science context (Ackerly &True, 2020). According to Novikov and Novikov (2013), methodology is a scientific research process outlining the linkage between various stages in a hierarchical form such as the research philosophy, research method, research design and the research technique.

This chapter outlines and describes the nature of the study and how the research was carried out. The chapter deals with the study area and the methodology such as the research paradigm, research design, the population of the study, sampling processes, data collection methods, pre-testing, ethical issues, data processing and data analysis.

3.2 Study Area

The North Gonja District, which is located in the North West of the Savannah Region has a population of 55,265 with sixty-eight communities and twenty-two ethnic groups. Extreme high weather conditions are experienced daily and the annual range is very wide; Cold weather is experienced between December to February at night and early mornings. The mean temperature is 27˚C, humidity is low and the rainy season is from May to October (North Gonja District Assembly (NGDA), 2022). The soil is very fertile and good for agricultural production and economic activities (GSS, 2014).

The governance and political structure is the District Assembly. The assembly has a total of 23 members with the District Chief Executive as the executive head. The White Volta River serves as the main drainage system that collects water from the smaller drainage systems across the district. There is a Waste Management Department, fourteen health facilities five health centres and nine CHPS compounds. There are also two high Schools and other basic schools. A few NGOs are also in the district.

The district also falls under the Wasipe traditional area with the wasipe- Wura as the overlord of the traditional area with his divisional and sub-chiefs. Daboya is the district capital and also serves as the capital of the traditional institution. There is no planned pattern of the

settlements; houses are scattered and most of them are traditional mud type which are connected with walls to form compound houses with a few of them roofed with aluminium sheets. The financial establishment is the Village Savings and Loans Association, formed by the villages. The economic activities are agricultural farming, weaving, charcoal making and shea butter extraction.

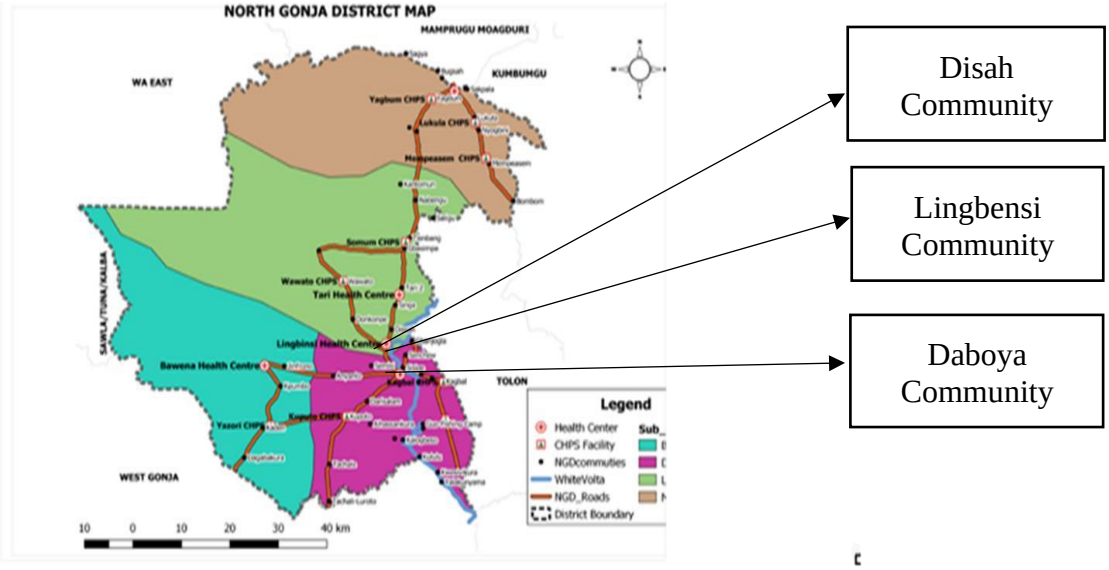

Figure 3. District Map.

Source: NGDA, (2021)

3.3 Design of the study

Research design as postulated by Yin (2011), is a structured process that provides guidelines for researchers to collect as well as analyse and interpret data. According to Sawsan and Raed, (2018), "a research design is a blueprint to guide the research process by laying out how a study will move from the research purpose/questions to the outcomes". On the other hand, Creswell (2008), defines "research design as a plan to conduct research." In the observation of Panneerselvam (2010), a research design is regulated by specified models and as a matter of reality, a well fitted technique must as well be chosen and as a result of that, Sawsan and Raed (2018), stated that, selecting the research design is the critical part of research process.

In view of the research problem, the study adopted a case study design, which involved a study of a case within a geographical setting (Yin, 2009). According to Creswell (2013), it is a qualitative methodology in which the researchers explore a case over time (in this case, the floods that occur periodically), by means of in-depth data collection that involves multiple

information sources (such as interviews, observations, audio visual material, reports and documents) and then reporting the case in a description form according to the case themes. What this means is that, all researchers study problems in their natural environment, interpret and try to make some meanings from phenomena of some people (Denzin & Lincoln, 2011).

The case study was used in order to understand the problem and why the floods periodically destroy their crops as well as the implication of these floods on livelihood sustainability of the peasant farmers in the study area. The approach was very useful to the study because it was used to produce a case report of flood effect on the economic fortunes and livelihood sustainability of the farmers. This began with the study identifying floods which periodically inundate crops as the specific problem within the study district. The case study also presented a comprehensive in-depth knowledge about the effects of the problems.

3.4 Population of the study

The population of the study was drawn from all crop farmers above 35 years of age, with15 years of farming experience, and 20 years of stay in the community, who farm different species of crops along the White Volta River Banks. Others included opinion oeaders namely; women leaders, sub-chiefs, Islamic leaders, Christian leaders, most elderly persons and youth leaders from Daboya, Disah and Lingbinsi. Officials of three government institutions were also interviewd; namely, the District Assembly (District Chief Executive, District Coordinating Director and District Planning Officer),
NADMO (District NADMO Director, Daboya Zonal NADMO Director and Lingbinsi/Disah Zonal NADMO Director) and MoFA (District MoFA Director, Daboya Extension Officer and Lingbinsi/Disah Extension Officer).

3.5 Sampling and sample techniques

The initial visit to the field indicated that crop farmer population in the three communities were 4,702 farmers. Due to this huge number, the study was not able to conduct the research with all the 4,702 farmers. Therefore the study relied on the principle of saturation, which is a method use to discontinue data collection (Glaser & Strauss, 1967). According to Fusch and Ness (2015), failure for a researcher to attain saturation will lead to poor quality of conducted research. Based on this assumption, 6 focus group discussion were conducted, with 2 groups in each of community and 10 farmers in a group. 15 farmers from each community were observed on their farms and 5 farmers each from a community were also observed in their households. 6 opinion leaders were also contacted from each community and 12 key informant

(KIs) from three government institution. A total of 150 respondents were selected from the farmers, opinion leaders and key government officials.

The unit sampled are selected because of their purpose. The study purposively selected three communities namely, Daboya, Lingbinsi and Disah. This was because a report from NADMO reveals that these selected three communities are the communities that are faced with severe negative effects of periodic flooding in the district (North Gonja Floods, 2020). The study also purposively selected the 35 year and above farmers group with the assumption that they have long standing experience, since this periodic flood started about 15 years ago. The observed farmers both on farm and household were purposively sampled because they provided insight into the farming systems, location and practices of farming and household food issues. Three government institution namely; District Assembly, NADMO and Ministry of Food and Agriculture were also purposively sampled. This was because of the experience and in-depth knowledge they have on the subject matter.

Preston (2002), postulated that conducting purposive sampling can produce indepth knowledge and understanding better as compared to empirical generalization. Thorne (2016), also added that purposive sampling is a qualitative sampling approach to inquiry with the aims of identifying study respondents with the same experiences about a phenomenon of the study. This assertion is supported by Creswell (2014), who states that qualitative research is the brain behind purposive selection of respondents.

The snowball technique was an additional technique used in the study. This was used to locate and observe the farmers on their farms and in their households. It was also used to locate farmers who cultivated different species of crops along the river banks. According to Kirchherr and Charles (2018), this technique can also be applied when a sampling frame cannot be constructed. Creswell (2013) stated that snowball "Identifies cases of interest from people who know people who know what cases are information-rich"

First of all, the assemblymen in the three communities were identified and they led to one farmer each who was farming along the river and experiences floods on their farms. They also pointed out some other farmers with the same farming system practices. This process was the same approach used in all the three communities. The study was able to contact all this particular category of farmers and added them to the study.

3.6 Data collection methods

It is very important for the study to employ multiple data collection methods, just as stated by Creswell (2013), that a case research is conducted with multiple data sources, and in relation to this study. It added breadth, richness, complexity, rigor as well as depth to inquiries about the study (Denzin & Lincoln, 2000). Creswell and Poth (2016), suggested that in a study within a particular social context, researchers should be able to examine the perceptions of different participants by gathering multiple kinds of evidence. In view of this suggestion, the study collected both primary and secondary data.

The primary data were collected through in-depth interviews with opinion leaders, key government officials and focus group discussion (FGD). The selected farmers and other farmers were also observed in their farms and at home. Aside the primary data, the study also elicited secondary data from the government officials.

The interview guide for the entire sample population for the study objective were validated and initial testing were conducted for the purpose of clarity and inconsistency of the questions in the guide so as to avoid repeated questions. During the initial testing, the interview guide was refined again as a result of many issues that came up.

3.6.1 Interviews

The study used unstructured interview with open ended questions. This was used to capture information from the respondents from the three communities and the government official in the district.

3.6.1.1 In-depth interviews

The study conducted key stakeholder in-depth interviews that collected vital information and opinions related to policy intervention and flood mitigation from the five government officials namely, the District Chief Executive, District Coordinating Director, District Planning Officer, NADMO Director, District Director of Ministry of Food and Agriculture, Assemblymen, NADMO Zonal Directors and the Extension Officers. The study also conducted separate in-depth interviews in the three communities, and collected information related to effects of floods, local coping strategies and their challenges in flood adaptation using their own local means. This group of people included, women leaders, sub-chiefs, most elderly woman, most elderly person, youth leaders. These two groups (KIs from the three government institutions) and (Opinion Leaders) will be treated separately.

According to Showkat and Parveen (2017), in-depth interviews are conducted to uncover detailed information and experience from study participants and are mostly "face-to-face" and long in duration. According to them, it is also called "one-on-one" which is a strategy to extract detailed evidence or the understanding of a particular concept or subject. According to Guion, Diehl and McDonald (2001), it is a qualitative technique for collecting a variety of data which may include need assessment, strategic planning and in-depth knowledge from a small number of people. Milena, Dainora and Alin (2008), note that it is a technique used to elicit a clear picture of respondents' ideas on a research topic.

3.6.2 Focus group discussions

The study conducted Focus Group Discussions in the three communities. The FGDs collected and captured information on effects of floods on farming systems, the local means of coping and adapting with the floods and the challenges they face in floods adaptation using their own local means. Each of the communities was divided into two (2) zones, namely; the northern zone and the southern zone. Ten (10) farmers were drawn for each zone in a community for the focus group discussion.

This were group of people who come together to discuss so as to identify their perceptions, their thoughts as well as their impressions in relation to the specific issue under investigations (Kairuz, Crump & O'Brien, 2007). According to Milena et al. (2008), focus group discussions generate information that is valuable, especially with smaller number of participants who represent one interest which is usually ignored by quantitative researchers. According to Morgan (1996), focus group discussion is a technique used for the collection of qualitative data through interaction with a particular group of respondents. It reveals layers of understanding which are not tapped by other data collection methods (Doody, Slevin & Taggart, 2013).

One of the uniqueness of this technique is its ability to produce information based on interaction of a group of people with the same interests (Green, Draper & Dowler, 2003). It is a technique that includes the use of group interviews where respondents are purposively selected. In a focus group discussion, participants are selected on the basis that they have better ideas to contribute to the subject. Participants in the group are usually within a particular range of age, with the same characteristics and are very comfortable to voice out their views to the researcher and among themselves (Richardson & Rabiee, 2001).

3.6.3 Secondary data source

Secondary data were also sources to back up some of the responses provided by both respondents. This were documents and reports which were very relevant to the issues of flood disasters and other related matters. This information were gathered from the NADMO office, some of which were collected from MoFA office, the District Planner, the extension officers and NADMO Zonal Directors.

3.6.4 Observations

In the same vein, the study observed 45 farmers on their farms and obtain vital information about farming close to the White Volta River. This gave the study an opportunity to have an experience and look at some of the major crops that are farmed, farmlands along the river banks, their indigenous farming practices and places which have been named by both the officials and farmers as always flooded with water during the peak of the raining season. Aside this, the study also conducted some household observation on 15 individual farmers in the communities. Information were obtain on the food they eat, number of times they eat and quantity of food stuff still left in their stores as well as their social relation with each other.

According to Creswell and Poth (2016), observation is one of the multiple choice for gathering evidence or information from the study area. Dewalt and Dewalt (2002) explain that, observing participants help many researchers to have the knowledge of the activities of the participants who are being studied in their own environment by means of participating and observing these activities. It allows researchers to examine nonverbal expression, the way they interact and communicate among them (Schmuck, 1997).

3.7 Ethical Consideration

In a social science and academic research, a researcher is expected to meet a tolerable ethical standard. For instance, being honest, capable, and transparent as well as following the guidelines in relation to the study subjects. According to Smith (2003), a range of ethical requirements are outlined for a researcher to adhere to and to act professionally. They include seeking the consent of participants and protecting their privacy. Information should be confidential and should not link to the provider.

Five established rules have been outlined to isolate ethical uncertainty, they are; a researcher should inform participants the experience involved so that willingly they can participate, subjects should be informed that they can freely withdraw their participation if

they so desire, remove all barriers that will prevent subjects from participating in a research, behaviours and responses of research participant must be kept confidential and finally, after participating in a research work, initial findings should be presented to the participants (American Psychology Association, 2010). Creswell (2013), added that a researcher needs to building trust, create credibility in the targeted area and also convince respondents to participate in the discussion.

This research met all the above stated ethical requirement issues. The assemblymen from each community led me to visit the sub-chiefs in their respective communities. They also went ahead to ask for permission for the study to be conducted in the communities with the acceptance from the participants. With the acceptance of the chiefs, the participants were encouraged and were providing information very relevant to the research. As per the rules, initial findings were given to the assemblymen for a crosscheck with members and corrections and inputs were made where necessary.

3.8 Data analyses

The study conducted the analysis using qualitative approach, descriptive summaries were properly examined and well discussed, and logical qualitative and comparative method of analysis was done. According to Thorne (1997), comparative analysis is the process of taking one interview or statement and relating it to others very similar or others that are different so as to draw the relationship between those various data. First of all, logical analysis was adopted to bring together the data that needed synthesising, which comprised filtration of preconceptions, separating biases and personal opinions, expectations and cross-checking, stereotypes, triangulating data sources as well as validating and or invalidating was also done. This was used to categorize the data according their patterns of relationship and their similarities, which eventually produced a logical flow of the analysis. The study interpreted the data by combining statement and facts as well as the observation and secondary data. The data consistencies as well as its inconsistencies were both analysed to provide an understanding. The Data was finally presented with some tables and pictorial evidence which then allowed for written descriptions for the presentation of data that provided meaningful interpretation.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the analysis of the implication of floods on livelihood sustainability of the rural farmers in North Gonja District. It is presented according to the structure of the objective in chapter one and begins with the discussions and documentation of effects of floods on farming systems; factors influencing floods and affecting crop production; effects of floods on farming systems; crops most vulnerable to floods; effects of floods on farmers and floods and household food security. This is followed by the second objective, which assesses the coping mechanisms used by farmers to sustain their livelihoods in times of floods; immediate steps taken to cope with flood disasters and farmers' adaptive strategies. The third objective looks at the challenges farmers face in adaptation strategies in the presence of floods; factors influencing farmers' vulnerability to flood disasters; factors influencing farmers' inability to adapt to flood disasters and finally. Policies/bylaws in place to mitigate the effects of floods on farming systems; government policies on flood disasters; government pro-poor policies and challenges NADMO and MoFA face in disaster risk reduction.

The study was conducted in three communities namely; Daboya, Lingbensi and Disah. The respondents included farmers above 35 year of age with 15 years of farming experience and farming along the river banks with different crops; they are also farmers with 20 years of stay in the communities in addition to some key opinion leaders as well as the District Planning Officer, the District Chief Executive, NADMO and MoFA Directors, Zonal NADMO Directors and Extension Officers who both have in-depth knowledge about the floods in the district.

4.2 The Effects of Floods on Farming Systems

4.2.1 Type of flood experienced in the district

During the interview and the discussion, all the 9 out of the 12 government official (KIs) representing 75%, all the 60 FGD participants and 13 out of the 18 opinion leaders representing 72.2% were of the view that the floods that periodically occur on their farms are fluvial in nature. The FGD indicated that the water in the White Volta River spill out from the river basin usually in the middle of the rainy season. This information validates the findings presented by Cook et al. (2018), they analyse that fluvial floods are waters that overflow the bank of rivers or dams due to rising water level with less carriage capacity as a result of heavy rains that cause

many rivers to exceed their carriage capacity (Nace, 2017). A 53 year-old man from Daboya community indicated said;

> *During the rainy season flood are not experience in the area, but at the peak of it and where there are heavy rains or whenever the river is full to its capacity, it begins to flow over into the crops that we have farmed close to the river (Field survey, 2022).*

In an interview session with the NADMO Director, he also reveal that;

> *The fluvial floods are experienced periodically in the district as a result of the rising water level from the river. Mostly, the river flows to the lands when the river if full and cannot take more of the water, it remains on the floor of crop farms, whiles others drops from the river to this same places (Field survey, 2022).*

This draws the research attention to the concept of river drainage density propounded by Horton, (1945) who postulated that the total channel length and river density as well as the water resistance from the ground surface influence the discharge of water in the river system. Whiles the Russian writer documented that fluvial floods are the overflow of water on lands that are covered with grassy vegetation along the river plains (Kropotkin, 1876). Fluvial floods are largely exacerbated by the geometry of the local area, the surface water slopes towards the coast where movement slows leading to rising depth of the water (Chow, 1959). This implies that vegetation and crops found in floodplains gets flooded as the depth of the water increases with slow movement as experienced in North Gonja District.

4.2.2 Factors influencing floods and affecting crop production

The key informants provided a vital accounts on the factors that influences periodic floods that leads to crop production loses. All the 12 KIs representing 100% and 15 out of the 18 Opinion Leaders representing 83.3% gave an accounts that change in the rainfall patterns in the region, Bagre Dam spillage, Ground water absorption and flat topography of the area were the major causes of the floods. The interview with the

MoFA Director, he disclose that climate change is influencing major rains in the northern part of the country that contributes to the floods experienced in the district. A study conducted by Williams et al. (2020), confirms that climate change escalates rainfalls in many areas. Based on this account, the studies on climate change also suggests that dwindling rainfall, shorter rainfall periods and long dry season are among the major factors that cause floods in the

northern part of Ghana (Anab, Abazaami & Achanso, 2022). Hence, the table 1 below contains number of factors influencing floods and affecting crop productions in the district.

Table 1. Factors influencing floods and affecting crop productions

No.	Factors	Explanation of Influencing Factors
1	Climate change	1. Deforestation 2. Bush burning 3. over grazing
2	Bagre Dam spillage	The spillage of the Bagre Dam from Burkina Faso through the White Volta River.
3	Ground water absorption	The ground is usually saturated with water during the peak of the rainy season and can no longer absorb water.
5	Flat topography	The topography of the district is low-lying in nature.

(Source: field survey, 2022)

In the light for Sendai Framework for Disaster Risk Reduction Management, the management is a process. One of the step in this process is for managers to identify and understand the characteristics of hazards confronting various societies as the base line for effective management of various disasters (UNISDR, 2015). In advancing, all the KIs identified deforestation, bush burning and over grazing as among the factors that are influencing floods in the district. In an interaction with the Opinion Leaders, it was reveal that some community members were into charcoal burning, which led to deforestation in the area. People whose livelihood depended on hunting, burn bushes for their hunting activities, whiles the herdsmen in the study area also over graze the grass that are supposed to control the climate. Surprisingly, Anab et al. (2022), also note that deforestation, bush burning and over grazing lead to rise in temperature, because the forest and grass serve as cover to minimize the speed at which the climate is changing. District MoFA Director reveal that;

> *The long hours of heavy rainfall experienced in the region is the caused by the recent climate change, which severely flood the communities and the farming areas (Field survey, 2022).*

During the discussions and the interviews, 9 out of the 12 KIs representing 75%, 12 out of the 18 Opinion Leaders representing 66.7% and 54 out of the 60 FGD Farmers representing 90% admitted that the spillage of the Bagre Dam from Burkina Faso were the major factor above all that causes flood disasters. This aggressive admission by the respondents justifies the findings in the report presented by AAP & UNDP (2013). In their report, they indicate that spilled water from the Bagre Dam through the White Volta River is the main factor that causes the floods in communities where this river cuts through in the regions. Studies conducted by

Pistocchi et al. (2015) added that flood causing havoc across the globe are strongly associated with both human activities (manmade disasters) and climate change (natural disasters).

In a private session with the NADMO Director, it was revealed that the Bagre Dam is annually spilled during the peak of every rainy season and this Dam was a manmade, but the cause of the spillage largely depend on the climate variability in that part of Burkina Faso. The Officer at the District Planning Unit also indicated that the spillage of the Dam is more of a routine exercise by the official of Burkina Faso and usually spilled when the time comes and it can no longer hold excess water that flows into its reservoir. A study conducted by Chrysogonus, et al., (2022), found that the Bagre Dam is spilled when the water exceeds 235 meters of the Dam.

The responses of the Zonal Officials and the Assemblymen was obvious that the flow of the water usually exceeds the carriage capacity of the White Volta River, causing it to overflow its banks into many communities and farmlands from the Upper East Region to the coastal regions of the country. During the interview, the District NADMO Director, further explain;

> *Previously, the spillage of water from the Bagre Dam had no negative effects on crop farming and its associated activities in the district, but in recent years, the volume of spilled water and the rate at which it moves, washes away the crops that are yet to be harvested (Field survey, 2022).*

The MoFA Director also added;

> *The spillage of water coupled with the heavy rains exacerbated the already compounded water saturation issues on crop farms. These come together to cause the White Volta River to stretch out to far distance from its banks, usually submerging vast areas of farmlands (Field survey, 2022).*

The revelation from the two KIs (NADMO and MoFA Directors) conforms to the findings in the studies conducted by Musah, et al. (2013), they attested that the spillage of water from the Bagre Dam from neighboring Burkina Faso coupled with the August/September heavy rains causes floods on communities and farmlands located along the White Volta River. This implies that the Dam is spilled during the period in which northern Ghana experiences heavy or torrential rains.

The data gathered indicated 6 out of the 18 opinion leaders representing 33.3%, 3 out of the 12 KIs representing 25%, whiles 6 out of the 60 FGD farmers representing10% disclose

that the flooding in the communities is not only caused by the heavy rains, but rather the volume and rate at which the water is spilled from the Bagre Dam during the peak of the rainy season. It was observed that the White Volta River had already gotten to its full level during the middle of the rainy season when the Bagre Dam had not yet been spilled and that speaks how the water will spread out when the Dam is spilled. During the interview with the NADMO Director, he confirmed that global warming has exacerbated the issues of change in the climate which has brought about these heavy rains, compelling the officials from Burkina Faso to spill water from the dam in huge volumes. In his opinion (NADMO Director);

> *Heavy rains in the district alone cannot cause the major flooding that is being experience by the rural poor, but when the spillage of the dam is coupled with the torrential rains within the region and that of the Upper East and North East as well as Northern Region it causes saturation and overflow off the river (Field survey, 2022).*

From the total of 12 KIs, 8 of them representing 66.7%, 37 of the 60 FGD farmers representing 61.7% and 12 of the 18 opinion leaders representing 66.7% disclosed that the absorption of water in the ground is usually very slow, allowing huge quantity of water to run off causing floods and disasters. Whiles the remain 4 of the KIs representing 33.3%, 23 of the FGD Farmers representing 38.3 and 6 of the Opinion Leaders representing 33.3% indicated that dry the nature of the soil during the dry season should be able to absorb into the ground.

From the above claim from both sides, a total of 12 KIs, 8 of them representing 66.7%, 37 of the 60 FGD Farmers representing 61.7% and 12 of the 18 opinion leaders representing 66.7% affirm that the flat topography of the district rather influence the occurrences of the periodic floods in the study area. As shown in Table 1, the KIs indicated that the district is a low-lying area and as a result of that, the ground takes more water and faster than area that slopes. This makes the ground to get full of water and as such the ground cannot absorb more water from the river basin and when White Volta River is full to the extent that it can no longer contain the water, the water easily spreads out to other areas. A study conducted by Di Baldassarre, Montanari, Lins, Koutsoyiannis, Brandimarte and Blöschl (2013), asserted that flat topographical areas are usually threatened by floods.

A theory propounded by Ives and Messerli and popularized by Erik Eckholm (1976), in a book titled Losing Ground, assumes that environmental degradation and the elevation of runoff water during the peak of the rainy season influences flood disaster on the downstream. This implies that communities and farmlands located in are most likely to be experiencing flood

disaster as in the case of the North Gonja District. Spalding, McIvor, Tonneijck, Tol and van Eijk (2014), added that restoration and management of forest reserves protect the environment from flood disaster whiles Colven, (2017) insisted that, poor planning of drainage systems are part of factors that influence the occurrence of floods in many areas.

4.2.3 Indigenous Farming System Practices

In the FGD, all the 60 farmers disclose that the major indigenous farming practices included the land in which they farm, the animals they rear at home and crop farming. They indicated that farming is practiced using hoes and cutlasses as their implements and the application of cow dung, local seed varieties and the methods of farming are mixed cropping and crop rotation. During the interview with the opinion leaders, 12 of them representing 66.7% added that some community members practice mix farming as well. A 48 year-old man from Disah community indicated that;

Majority of us in this community have been practicing only crop farmers, only small number of the people in the community's rear animals at home, except that some Fulani herdsmen living closer to the community sometimes practice mix farming. This was because they live with their animals at the same time practice farming as well (Field Survey, 2022).

Out of the 60 FGD farmers, 12 of them representing 20% indicated that they use hoes and cutlasses to prepare their farms, whiles 48 of them representing 80% disclosed that they have access to tractors and that they employ the services of tractors for their crop farming. It was also observed that majority of the farmers in their farms were seen using locally made farm implements such as the hoes and cutlasses mentioned. In addition, all the 53 FGD farmers representing 88.3% disclose that locally prepared variety of seeds from the previous farming season are used for the current planting and then cutlasses and hoes are used to dig holes for sowing of the seeds, whiles the remaining 7 of the FGD farmers representing 11.7% uses either of the advance methods. 13 of the opinion leaders representing 72.2% affirm that majority of the farmers use locally prepared material and equipment's.

In the discussion, 46 farmers out of the 60 FGD Farmers representing 76.7% of the farmers disclose they are into small scale farming with the main purpose being to feed the household. They indicated that surpluses of this small scale farm produce are then sold to provide other food as well as non-food items. Aside this, 14 of them representing 23.3% are into large scale commercial farming. Traditionally, the 18 opinion members in the three communities named a number of crops grown in their communities. They mentioned grains

such as maize, soya beans, groundnuts, early and late millet, rice, Bambara beans and tubers like yaw, sweat potato and variety of vegetables are also grown.

The mode of farming practiced are that, crops are usually spread all over the parcel of land with diverse environmental features and how they are locally managed influences major crop cultivation. During the discussion in the respective communities, all the 60 FGD Farmers and the 18 Opinion Leaders disclose that Farm households practised more than a single farming system. They indicated that Females practice compound system as compared to the other farming systems, the reason being is that it is close to the house and they can easily go in to cook and aside that lack of resources to practice bush farming. A 57 year woman from Disash community said;

> *We the women practice mix cropping at the compound and the crops we mostly cultivate are sorghum, few maize, few early and late millet and much of vegetables on the same parcel of farmland. But not all the women practice the same farming on the compound farms, they may choose either of them but certainly not one crop species is cultivated within this farming system (Field survey, 2022).*

During the discussion, 47 out of 60 FGD Farmers representing 78.3% disclose that they have their farms located by the riverine areas. This farming system has majority of farming practices because greater portions of the forest is part of the game reserve and has a larger space leaving little space for crops farming, whiles the remaining 13 of the FGD Farmers representing 21.7% indicated that they practice bush farming system and have their farms located in the bush. In the FG discussion, farmers disclose how sowing is done according to gender practices. The men dig the hole with the use of dibber while the female partners place some of the seeds in small calabash or container and then put the require number of seeds in the holes created by the men and then places small soil on the hole to cover the seeds. It is also indicated that some of the men further request for communal labour to their farms that are located along the river side, either for sowing, weeding or harvesting.

The Opinion Leaders from the three communities indicated that family members (children, wife or wives, adopted family members) serve as farm labour, which form part of their farming systems. The members of the household form the labour, who are given instructions by the head of the house to weed, clear the grass and prepare the land for sowing. According to the FGD, it was reveal that the family labour also sow and take care of the crops till they are harvested and brought to the house. The 12 out of the 18 Opinion leaders presenting 66.7% and the 3 Assemblymen in the communities disclose that they sacrificing their gods

before and after harvesting. Performing sacrifices forms part of their farming systems practice in the study area. Whiles 6 (religious leaders) of Opinion Leaders representing 33.3% contested the assertion made by other Opinion Leaders and indicated that this system of practices is not more valid. But the 68 year old sub-chief in Lingbinsi reveal that;

> *The elders in the communities sacrifice to their great grandfathers who they inherited the farmland from before their children can preparing farms for cultivation. In the harvesting period, every household perform sacrifices to their forefather before they can start eating the harvested food (Field survey, 2022).*

4.2.4 Effects of Flood on Farming Systems

Notwithstanding the important role farming systems play, discovering the various components of farming systems that are severely affected by the floods is very essential to study. This is because floods have severe negative effects on people than other hazards (Tramblay, Villarini & Zhang, 2020). All the 60 FGD Farmers who represent 100% in their various respective group discussion affirm that all farming systems except that of rearing of animals in the study communities, crops and farmlands are exposed and very vulnerable to the floods. They disclose that the most affect farming system is the crops in the riverine farming system, as a result of that it is not more considered a reliable source of gaining sustainable livelihood due to its unpredictable yield for the past ten years.

A secondary data sourced from NADMO and MoFA indicated that cultivated crops in the riverine farming are the worst affected in the district. For instance, they were some pictorial evidence sourced from the NADMO office that supported the responses of the farmers in relation to crops farming along the river being the worse affected farming system in the three communities. This pictorial evidences below (Figure 4, 5 and 6) were part of the secondary data provided by NADMO to justify their displeasure on the nature of floods.

Figure 4. Crops partly submerge by the flood water in Lingbensi Community (September, 2021).

Source: District NADMO Office.

The pictorial evidence in figure 4 suggests that among all the livelihood activities found in the study area, crop farming is the worst affected just as the revelation made by the discussants. This confirmation is in line with the entitlement theory, which indicated that not only policies can cause entitlement failures but other factors as well such as floods. On the other hand, the confirmation contradict the assumption of the system theory, where government institutions are to implement conducive policies to minimize the negative effects of the floods in the study area. This is because government can negotiation with the spillage country on how these waters can be spilled, as it is seriously attested that floods in general have more negative effects on crop farming than any other farming system (Morris & Brewin, 2014; Ara, 2019). The systems can still provide alternative for livelihood support to the farmers in the study communities. The MoFA Director admitted that;

> *Monitoring crop production in 15 years have proven that the quantity of grain which was harvested on a piece of land is not the same quantity people are harvesting when crops are inundated. The quantity and quality of grain that is currently produced have drastically decline due to imminent flood disasters. He further indicated that over 2,000 acres of farm crops are lost to the flood disasters annually (Field survey, 2022).*

The secondary data sourced from NADMO further provided another pictorial evidence that shows how maize crops were inundated by the floods. In an interaction with the NADMO District directors, the study sourced a secondary data from the office that captures the following statistics, 2,588 acres of crops were lost to the floods in 2020 and 2,152 acres also got damaged

by the floods in 2021. The pictorial evidence provided prove that crops were severely affected by the floods.

Figure 5. Farmer harvesting maize in 2022 flood water

(Source: field survey. 2022)

This evidence in figure 5 shows that maize being harvested in flood water implies that majority of the maize are mostly rotten before they are harvested. This goes to also indicate that food security is severely under threat within the study district. A study conducted by Nyamadi et al. (2018), prove that the effect of flood on farming systems leads to decline in crop yield that translate into shortage of food. Another study conducted by Derbile et al. (2022), affirm that floods negatively affects farming systems that contribute significaly to the decline in the production of food crops in the Northern regions. A 56 year old from Lingbinsi community disclose that;

> *Two decades ago, his father could harvest maize as much as three times of a room in this community but ten years today, his harvest has been declining year after year. This has made his living very difficult for the father including them the children. Although we are aware of other factors causing this reduction in crop production, floods are the major factor that we have identify to be the cause of our unfortunate reduction in crop farming in our communities (Field survey, 2022).*

Studies conducted in the Northern Ghana indicated that food crops worth 955,050 tons were damaged in the 2005 flood disaster (Dosu, 2011) and 70,500 hectares of crops were affected including production losses of 144,000 metric tons (UNOCHA, 2007). Another studies

reveal that crop farming in the northern sector of the country have been severely affected by floods for the past ten years which led to the damage of 8,760 acres of farms in the Northern Region during the 2010 floods, with an estimation of 257,076 tons of crop losses (Arthur & Irene, 2011). They further attested that with anticipation and depending on the type of crops cultivated in a particular location, many farmers do lose every crop in the farm, as shown in figure 6.

Figure 6. Maize crops washed away by the floods in Daboya Community (August, 2018). Source: District NADMO Office (2022).

The MoFA Director admitted as follows;

> *Statistics have been gathered for the period of more than 15 years today, it acknowledged that floods come and damage life and property in the district and the office is still observing the same phenomenon and continue to observe the trend and it is observe that they either wash away, submerge or inundate property, especially crops (Field survey, 2022).*

Whiles all the farmers agreed on the crops being the most affected farming system, there were also divided opinions on the next affected farming system, but at the end, 53 of FGD Farmers representing 88.3% disclose that farmlands are the second most affected farming system in the study area. In an interaction with the two KIs from NADMO and MoFA directorate reveal that floods degrade the farmlands and cause soil erosion on lands that are close to the White Volta River. As the water is moving away and begin to subside, the top soil is usually carried along with the movement water to the coastal areas as seen in the pictorial evidence above (Figure 6). In a further interview with the Opinion Leaders from the formal institution depicted this claims and further alluded that not all the area that are flooded experience land degradation or erosion. Jongman et al's. (2012) and Ara's, (2019), studies confirm that floods have the ability to takeover major portion of farmlands.

In addition, 7 of FGD farmers representing 21.7% indicated that rearing of animals are part of their indigenous farming systems and the least affected farming system. In a further discussion with the focus groups, it was alluded that animal farming was one of the systems mostly affected by the floods but not as much as the crops and farmlands. The content in table 2 shows how the systems are being affected by the floods with animal farming being the least, which means that the discussants have identified that animal rearing is not much affected by the floods. This was due to the fact that animals are reared at safe places not affected by floods, usually located nears houses or in the homes. The study also observe that animals are pent around the houses and some are kept in the houses, a far distance away from the river side.

Drawing from the above analysis, floods have severe negative effects on farmers and the society, just as stated in FAO (2015) report, which indicated that floods have negative effects on the environment and human society in general. Based on annual statistics, more than 60 million individual personal property as well as their economic fortune are lost due to the incidence of flood disasters (WCD, 2000). This coincided with the discussants submissions. The FGD also disclose that the effects of floods on crop production have replication effects on their lives.

The interaction with the FGD in their respective communities, 54 of the FGD Farmers representing 90% reveal that they experience poverty rise as a result of low income generated from the farming due to the negative effects of the flood disasters. In explaining, 16 opinion leaders representing 88.9% disclose that when the crops are damaged by the floods, they are unable to get much harvest and this reduces their income from farming. The situation is similar to studies conducted by Nyamadi et al. (2018), where they found that the effect of flood on farming systems leads to decline in crop yield, which eventually translate to poverty and shortage of food.

Another study conducted by Derbile et al. (2022) in Northern Ghana also acknowledged that floods negatively affects farming systems and contribute to the decline in the production of food crops in the region. All the KIs also revealed that floods have exacerbated the already bad poverty situation and have eventually succeeded in reducing the purchasing power of the affected farmers in the study communities. During an interview, a 53 year woman from Lingbinsi said;

> *The effects of floods on farm crop reduces the income expected from the farm. I used my little savings to cultivate the crops, whiles other people in the communities borrow*

money from family and friends and are expected to recoup monies spent on the crop farming. This capital used for the crop farming are lost whenever the flood destroys our farm crops. The little capital remaining is so meagre that it can't be used for other activities. This makes it very difficult for us to be able to purchase complementary items; For instance, gran maize and buy cooking ingredients (Field survey, 2022).

Secondly, 58 of the FGD Farmers representing 96.7% indicated that they lose their next planting seedlings, just as earlier stated of locally prepared variety of seedlings are part of their indigenous system practices. The 16 of the Opinion Leaders representing 88.9% affirm that after every harvest, seedlings are selected from the harvested crop, dried, stored and are used for the next planting season. This explains why farmers in the study area find it difficult to come by seedlings when farm crops are destroyed by the floods. It was further reveal that when the seedlings are damaged or washed away by the floods just in figure 6, it becomes very difficult for the farmers to plant much in the following season. 64 year old Opinion Leaders who was interviewed said;

When the flood destroys the crops, it destroys all the seeds expected as well. The seeds are prepared from harvested crops and when farmers harvest poor grains that are not worth to use for planting again, it becomes very difficult for them to be able to acquire seeds for the next planting season (Field survey, 2022).

A 72 year old man from Daboya community added that;

My farm got flooded a year ago and the seeds I use to collect from my farm could not yield any better result when it was used for plant this year, because they did not geminate as usual. I was so lucky that planting season had not gone far, so a friend assisted me with his left-over seedlings and that was what I used to plant this season (Field survey, 2022).

The data gathered reveal that 17 of the FGD Farmers representing 28.3% usually contract the services of some organizations who are into farming business for farming assistance. This was confirm by all the Opinion Leaders in the three communities. They indicated that contract the services of these institutions for supply of fertilizer, agro-chemicals and sometimes plough and pay back after harvesting the produce. They either pay back with farm produce or with income generated from the farm. Secondary data sourced from the MoFA Office indicated that, the office has have some sought of intervention in many of similar cases due to the fact that farmers are not able to pay back this contract amount for reason they all

know to be the negative effects of the flood disasters. In an interview with 67 year opinion leader from Daboya community and he said;

> *I was once locked up in the police cells before, because I took some fertilizers from one NGO and promised to pay back with some of my farm produce during the 2020 farming season. Unfortunately, floods came and destroyed all the crops and I didn't get the farm produce nor their money to pay them back (Field survey, 2022).*

The data gathered from 23 FGD Farmers out of the 60 farmers representing 38.3% indicated that they have experienced shock after floods have taken over their crops in their farms. They attested that the major effects of the flood disasters on their well-being, is the problem associated with health issues. As outlined in the literature of Jonkman and Kelman, (2005), cited in Jha, (2012), farmers get depressed, traumatized or get heart attacks after flood disasters. This validated the IPCC (2014) report, which explains that flood disasters have severe negative effects on human mental health and well-being of many societies.

The KIs in their respective jurisdiction, all of them disclose that some of the farmers in the district get admitted into the clinic or Daboya health centre when they receive bad information about the flood on their farms. They reveal that farmers who lose their crops to the flood disasters get depressed, traumatized and eventually get sick and admitted in the CHPS Compound. This revelation extended the research to the health centres of the three communities. This was to find out the reality about people who are brought there due to the effects of floods on their crop farms. A 27 years old nurse Lingbinsi disclose that said;

> *In 2020 and 2021, the clinic recorded 11 and 8 cases respectfully during the flood disasters and all the farmers brought to this clinic were depressed and traumatize as a result of the effects of floods on their crops in the farms. The centre eventually referred 7 of them to Daboya hospital for further diagnoses and treatment (Field survey, 2022).*

The farmers in their respective group discussion, 56 of the FGD Farmers representing 93.3% indicated that their savings are very low and not encouraging as compared to the previous years when there were no flood disasters and food crops were well harvested. All the Opinion Leaders attested that majority of the farmers who crop around the riverine systems faces a lot of low level of income savings due to the fact that, no crop has can be harvested and no produce can be sold as generated income from the farming. Their responses were in line with the study conducted by Afriyie et al. (2018), they found that flood disasters have negative

effect on the financial savings of peasant farmers. A 69 year old man from Lingbinsi reveal that;

> *I wasn't able to save much money in 2021 due to the negative effects of the 2020 flood disaster that came and destroy most of my farm crops. The fact that I was not able to harvest much farm produce to sale for cash and had no any other livelihood source aside the farming, which has also turned out to be fruitless, I was left with nothing in me (Field survey, 2022).*

4.2.5 Crops most vulnerable to floods

Floods affect a lot of crops in the study communities as a result of sensitivity exposure and inadequate resilience to the floods exacerbate their level of vulnerability as indicated by Amah and his co-writers (Amah et al., 2010). Not to withstand that, all the opinion leader reveal that there was variation of vulnerability of farm crops to the floods. This was in line with data gathered from the FGD which indicated that maize, groundnut and soya beans were the mostly affected crops. They indicated that they are the crops that are mostly cultivated within the riverine farming system, because of its high performance due to the nature of the soil and the high demand in the commodity market.

The data gathered from the FGD reveal 28 of FGD Farmers representing 46.7% indicate that they farm maize than other crops among their farming practices, whiles 20 of the FGD Farmers representing 33.3% indicated of farming more soya beans than other crops cultivated in the area and 12 of FGD Farmers representing 20% also indicated of farming more groundnut than the other crops, but in general, 57 of FGD Farmers representing 95% attested that maize crops are the worse affected crops among all the crops that cultivated in their farms. 16 of the Opinion Leaders representing 88.9% confirm the statement of the farmer and indicated that majority of the crops around the riverine systems are maize crops. The NADMO Director disclose that the flood disaster reports that are received from the Zonal Directors are mostly related to maize damaged by the flooded waters. The NADMO Zonal Director in charge of Lingbinsi/Disa community during an interview disclose that;

> *After the flood, the next activities that I undertake is flood disaster assessment. My reveal that majority of the farms that are affected during the assessment are the maize farms. Although other crops are also affected, the major one is the maize (Field survey, 2022).*

A 46 year old woman in the FGD from Lingbinsi community also said;

> *I cultivate maize, rice, groundnut and beans. Among these crops, maize cropping are my biggest problem because of how floods are destroying it in the farm. Any time my farm is saturated with water, i sees my maize crops change to yellow color, meaning that the crop have been affected by the saturated water (Field survey, 2022).*

4.2.6 Flood and household food security

The implication of floods on food security and livelihood sustainability is very paramount to this study. From all indications, floods have a major effect on food in the three study communities. According to the study conducted by Sanchez et al. (2005), reveal that people who are affected by the floods would not have economic and physical access to adequate, nutritious and safe, as well as traditionally accepted food that will enhance dietary needs in order to live healthy lives. This findings is not far from the situation in the study communities. The 15 farmers who were observe at the household disclose that negative impact of floods have affected food security among the various households who experience flood disasters.

Observing their food security and the food intake at the household level, it was observe that people eat their meal but yet they still will take more food because the food eaten wasn't enough for them in one particular farmer's house that the observation took place. This same observation was similar to that of the other farmers in all the 15 houses observe in the three communities. The study also observe that their local silos were almost empty at the beginning of the rainy season. From the observation, some of the people may not get food to survive during the peak of the rains. In addition to this observable revelation, although the researcher wasn't a dietitian, but the food some of the houses were eating was enough to tell that the food wasn't nutritious and safe, just as stated by (Sanchez, Shah & Velthuizen, 2005). A 48 year old woman in Disah community stated that;

> *I have experienced the negative impact of flood disaster before. Since that time, the quantity of food previously cooked in the pot has drastically reduced. There are no enough food stuff in the house to cook for my children to eat before going to school. We also eat maize prepared food only instead of changing diet periodically (Field survey, 2022).*

The ability to transform the livelihood assets in figure 1 into very positive outcome, where people can have access to sufficient food to eat is hindered by the inability of the policy makers to provide this access, leading to inadequate food and resources. According to the entitlement theory, this are entitlement failures resulting from government systems and or choice of entitlement. The 9 out of the 15 representing 60% alluded that household food insecurity is the result of shortage of food at the household level whiles 6 others representing 40% too blame it on high dependency of flood victims and low supply of food in the market. This is rather opposite with the emphasis placed by the Sustainable Development Goal 1 and 2, which states that increase food security and end hunger A 63 year old man from Daboya disclose that;

> *The effects of the floods in our community have caused a number of people to experience low crop yield that led to inadequate food intake in our homes. Sometimes I and the family cook only yam to eat without soup or stew. Other family members also sometimes come to the house for food to eat (Field survey, 2022).*

Another 45 year old woman also said;

> *Not that some of us do not have food at home; we have enough to eat with only the immediate family members. But the instance where food gets short, is the situation where victims of the flood disasters depend on the same food that has been stored at home (Field survey, 2022).*

The interview with the Opinion Leaders indicated that 15 of them representing 83.3% made similar statements of how farmers who are affected by the floods struggle to survive. They indicated that farmers who are hard hit by the floods start experiencing hunger and lack dietary diversification for a period of seven months. It was revealed during the interview that for majority of the people, food shortage begins in the month of June to the month of October. In an interview with the NADMO Zonal Directors for Lingbinsi/Disah communities, it was established that families experience food crises during the next planting season when government and NGOs are unable to support the people with relief. According to the entitlement theory, institutions are supposed to link people to their livelihood assets, such as market places and good roads where food items can be brought to the market. In the instances where systems are not jointly working together, their failures create barriers and hinder people from getting through to obtain the desired livelihood (Sen, 1981). The Opinion Leaders affirm

that when the people are not supported immediately after the floods, food crisis is experienced earlier than the stated period. The MoFA Director said;

> *After the floods have damaged the crops and gone, the farmers are still left with a little produce in the farms and some of them still have left over food in their stores to manage. They are able to manage this food stuff until June, when most of them start to experience food shortage in their respective homes. It has been observed that people begin to look for alternative food sources during this period, but there are no alternatives in this situation (Field survey, 2022).*

The 7 observed farmers representing 46.7% established that the little food from the farms as well as the remittances they receive from families and friends takes care of them for a period between five to six months after the October/November harvest. This implies that the people actually experience food shortage and inadequate dietary diversification during the period of May/June. They explained that those of them who have no place to turn during these disasters, begin to experience food shortage immediately after the floods have receded.

A study conducted by Blackmore, Rivera, Waters, Iannotti and Lesorogol (2021), stated that people experience food shortage at the beginning of the planting season when rains have started to come or immediately after the harvesting season. The opinion leaders made similar points during the interview. They stated that the period people experience food shortage at homes is the planting season but the hunger crisis begins immediately after the floods are over. It was explained that this is the instance when farmers have not been able to even harvest a grain in their farms.

The data gathered from the 16 opinion leaders representing 88.9% reveal that the supply of food in the market has drastically declined due to a number of factors such as declining crop production as a result of the effects of floods on crops and poor road network from the hinter land where floods do not affect to the central market places. 13 of the Observed Farmers representing 86.7% confirmed that the floods in the district have been the reason behind the food shortage in the local market. The data gathered from the 16 opinion leaders disclose that poor roads affect the movement of farm produce from one place to the other.

The three assemblymen were interviewed in relation to food security in the communities during food disasters. The three of them indicated that the implication of the flood situation in the communities is the low supply and high prices of food stuff in the local market. Whereas the 16 opinion leaders also added that the demand of farm produce is low, because

the prices of such product in the local market are extremely high. This revelation is in consonance with entitlement theory, which states that some of the failures of the entitlement bundles are as a result of poverty. A 65 year-old man from in Daboya said;

> *The flood disasters that occur in our communities and farmlands destroy majority of the farm produce and the little that is spared in the farms is used for home consumption. It wasn't like this 10 to 15 years ago, when we harvested more crops in the farm and sell some for other needs. Food prices are high because there are not much food stuffs in the local market due to the poor road factor (Field survey, 2022).*

A 40 year-old man from Lingbinsi community said;

> *The manner in which the floods destroy our crops in the farms, we do not have enough food in the house for consumption and going to the market to purchase these food stuffs has been headache to many of us in the community because of its high prices due to inadequate supply of food commodity in our local market (Field survey, 2022).*

4.3 Coping mechanisms used by farmers to sustain their livelihoods in times of floods

4.3.1 Indigenous coping mechanism

The data gathered from FGD and the Farmers reveal that some of the farmers who are unable to adapt immediately employ the indigenous coping strategies to cope with the flood disaster that affected their crops. The data indicates that 5 farmers representing 8.3% out of the 60 FGD and 4 out of the 18 opinion leaders representing 22.2% cope with the flood disasters by lending their farmlands to other people who wants to farm. From the group discussions, it was revealed that the person who borrows the land for crop farming pays back with some of the farm produce. It was indicated that after the crops are matured and harvested, the produce is divided into three equal parts and the land owner takes one part whiles the lender takes the remaining two parts. In an interaction with the three Assemblymen in the three communities, they affirm that they use this method to cope when they have no any alternative. A 71 year-old opinion leader in Lingbinsi community said;

> *I have not been farming for the past five years, yet still, I eat well with my family. This is because I gave my farmland to one man who farm maize on the*

land for this years and he brings me enough farm produce that usually take care of us for a year and even sometimes I sell some for other purposes. This person is not being affected by the floods because of his scientific means of farming (Field survey, 2022).

The data gathered also indicated that 55 FGD representing 91.7% indicated that farmers who are affected by the floods and are facing food crises exchange their animals for food stuffs. They also revealed that some of them usually sell their animals (livestock) to get money in order to be able to buy themselves the necessities to complement their food. In the interview with the assemblymen, it was made clear that many farmers in the communities also rear sheep, goats, cattle and fowls. A 63 year man from Disah community said;

During the 2020 flood disaster, my crops got destroyed by the floods and I was short of food stuff in the house. Although food prices in the market went higher, I was able to sell two goats and some of my guinea fowls to buy grains and pay off some of my debts (Field survey, 2022).

The data gathered from the interview with the opinion leaders and the extension officers reveal that there were other means aside the indigenous farming systems used to copy with the floods. The data gathered from the interaction with discussants indicated that family members who are the income generators explore for available small-scale activities that generate income. It was clearly established that poor and low-income household families were involved in these types of jobs. According a literature reviewed, these types of jobs do not generate enough income to take care of families in distress (Mirza et al., 2011). Other studies have also revealed that farmers who face crises during flood disasters have two major coping strategies such as migration and the diversification of livelihood (Scones, 2009),

Other studies have illustrated that farmers have many coping strategies such as labor, borrowing grains, selling assets, dry season irrigation farming, savings, sale of livestock and borrowing money while others also pledge their farmland for food (Watts, 1983). Farmers in the study area employ more than one coping mechanism in addition to the indigenous coping strategies. 8 of the FGD participants representing 13.3% indicated that they tap into their hard earned savings in order to cope with the negative impact of the floods. It was revealed that alternatively, some farmers who are well abreast with the floods in the study area also have some saving so that they can use such monies when the need arises. The data also revealed that some of the farmers rear animals as their alternative livelihood. A 46 year-old woman in Disah Community said;

I rear goats, sheep and fowls in my house. Anytime I have a financial problem, I sell some to solve my problems. The last time my farm was affected by the floods, the animal rearing served as alternative source of livelihood to my family and myself (Field survey, 2022).

The data also revealed that when things are not working in the right direction, some farmers borrow grains and money from others in order to be able to cope with the floods. 4 out the 60 FGD farmers representing 6.7% borrow grains and money from other people in and outside the communities, so that they can survive till the next farming season. Secondary data gathered from the NADMO Office indicated that not all the farmers are affected by the flood. Some are not affected at all and some experience minor effects from the flood. Data gathered from the respondents also indicated that many affected victims borrow grains and some are provided by their kin, family members or friends who were not affected by the floods. A 69 year old man from Daboya community said;

The 2021 flood came and affected my crops. I would not have been able to feed my family if I hadn't gotten help from my kinsmen or friends; even with that I still then I borrowed some grains from other people, with a promise of paying back their borrowed grains (Field survey, 2022).

The data that was further gathered from all the opinion leaders indicated that some of the affected people do paid work in order to cope with the crises they are faced with after the flood disasters. 9 out of 60 FGD Farmers representing 15% also indicated that they engage in charcoal burning whiles others are hired as laborers to carry charcoal into trucks for money. Secondary data from the Assembly indicated that many people in the district burn charcoal for a living and others are also working with them for money. The data explains that other people work in the farms of other farmers for food as their coping strategy, especially during the harvesting season. The opinion leaders gave similar explanations when they were interviewed. They indicated that children of farmers who face food crisis or the young farmers themselves immediately apply other strategies to cope with the flood disasters.

It was also confirmed that many farmers in their communities also weave thatch as their activities to cope with the floods. 5 out of the 60 FGD Farmers representing 8.3% weave thatch and others process shea butter as their coping strategies to manage the effects of the floods. They indicated that thatch weaving is a very lucrative job in the two communities. It provides money to the farmers in the two communities as an alternative source of livelihood. The data

also indicate that majority of the women in the two communities also gather shea nuts and process into shea butter. This shea butter processing serves as an alternative source of livelihood for many women in the area.

The interview with the extension officers, NADMO Zonal Directors, the opinion leaders and FGD provided similar statements. They indicated that some of the farmers especially those residing in Daboya community have devised alternative livelihoods in order to avoid or cope with the shocks of the perennial floods that have devastating consequences on their live, their families and friends. 7 out of the 60 FGD participants representing 11.7% undertake smock weaving and petty trading to cope with the flood disasters that have come to stay. The MoFA Director said;

> *Majority of the people in Daboya who used to farm, especially the youth have left farming to the smock weaving activity. The smock business generates a lot of income to the smock weavers in the community (Field survey, 2022).*

A 46 year man from Daboya Community also said;

> *All my farmlands are in the flood prone areas and I have always been experiencing food crises due to the floods but I have other opportunities elsewhere that I can rely on for the survival of my family and myself. This got me into the smock business in Daboya. Instead of farming, I now weave smock for sale and I now make better gains from the business (Field survey, 2022).*

According to Blackmore et al. (2021), decline in crop production influences people especially the youth to migrate to search for jobs so that they can bring money home. 6 out of the 60 FGD Farmers representing 10% either migrate or their family members to the southern sector of the country, where there are many jobs such as small-scale mining, working as laborers in cocoa farms etc. A study conducted by Mirza (2011), shows that lack of employment opportunity affects farmers in many communities. In an interview with the District Planning Officer, it was revealed that majority of the youth are speedily leaving the district because there are no jobs aside the farming activities. A 46 year respondent from Lingbinsi Community said;

> *My three children left farming and travelled to Accra three years ago to look for jobs, because farming is no more attractive to them and there is also no job opportunity in this community. Well, they have all gotten some jobs and are doing very well. One of them is even putting up a building in the district capital (Field survey, 2022).*

Another coping strategy observed during the visit was the reduction in food consumption among the flood victims in the study community, which was in line with the explanations of the three assemblymen. 8 out of the 60 FGD farmers representing 13.3% said they reduce the quantity of food consumed and the rate at which they eat their meals. It was clear when the study was being conducted that majority of the farmers who were affected by the flood disasters experience food shortage, thereby cope by reducing the quantity of food they eat every day. A 70 year-old man from Disah Community said;

> *In the 2021 flood disaster, I was among the farmers whose farm crops were severely affected. I couldn't harvest much during the season and that led to food shortage in the house. The only way for us as a family to cope with the food shortage was to reduce the number of times, we the grownup in the house ate and also the quantity of food we ate was also reduced till date (Field survey, 2022).*

It was also revealed that majority of the poor farmers in the study area cope with the remittance they receive from family, friends both inside and outside the community. The 5 of FGD farmers representing 8.37% admitted that they have their friends, families and neighbors, both inside and outside also supporting them with remittances. This implies that social networking in the communities is very strong although the support provided by these groups of people is not sufficient. The respondents indicated that it is due to the fact that majority of the people do not have enough money to support one another adequately, but notwithstanding that, affected farmers are able to still cope with the remittances they receive from people. It was also established that these monies received are able to support some of them until the next farming season. A 59 year-old woman from Daboya Community said;

> *I have a daughter who works as a head porter in Accra and she occasionally sends money to me. I use these monies sent to me by my daughter to buy food stuff with when my crops got damaged by the flood disaster. Just like the 2007, 2012, 2018 and 2020 flood disasters that severely affected a lot of my farms in this community (Field survey, 2022).*

Another 47 year old man from Disah community also said;

> *I have a son who is a teacher in Tamale; he knows how I survive with the family through farming. When my farms were taken over by the flood waters, every month he sends me money so that the family and I can survive (Field survey, 2022).*

4.3.2 Indigenous adaptation strategy

All the 60 FGD farmers and the 18 opinion leaders in the three communities disclose that all the farmers in the study area practice the following indigenous adaptation strategies either on their farms in the riverine farming system areas or the bush farming system areas. Aside that, only a few adapt by undertaking joint farming. These were 6 FGD farmers out of the 60 farmers representing 10% share responsibility on the same parcel of farmland with another person and farm produce are also shared equally among the two parties. They further disclose that the former provides the land as well as the human resource (family labor) and the latter provides fertilizer, agro-chemicals, seeds and does the plouging. According to the data gathered, the two parties take care of the farm till the crops are harvested and shared into two equal parts.

The interview also indicated that 56 of the FGD Farmers representing 93.3% disclose that they adapt to the flood by rotating the crop farming which sometimes help them to harvest some of the farm produce and 16 Opinion leaders representing 88.9% confirm that majority of the farmers adapt with the floods using indigenous farming systems such as crop rotation which is based on the account of the flood occurrences in their farmlands and the heavy rains which are monitored through the indigenous means of knowing floods. This is then use to determine the type of crops to be grown on the river side in a particular crop season. A 57 year old FGD reveal that;

> *I learnt a lot from my father when he was alive. Therefore I have many way of knowing whether the rain will come plenty or not. This influences my choice of crop to be cultivated along the river banks (Field survey, 2022).*

According to all FGD and all opinion leaders, use of family labor is among the systems practiced in the three communities. They disclosed that family members are employed to prepare the farmlands, sow, weed and harvest the final produce and carry them to the house for storing. It was revealed that adapting to the floods largely depends on a large size of the family labor in a household. A large household influences how crops are produced and harvested before the floods occur, especially in the riverine areas. Communal labor is also organized in the three communities for farmers who require it.

In the same circle, all the farmers, opinion leaders and extension officers provided similar statement in relation to farming implements. They disclosed that the farmers use locally made hoes and cutlasses for weeding on their farms are employed throughout the life cycle of

the cropping season. They further disclosed that they are groomed with this implement, which are very easy and cost effective to use them in the field. A 65 year-old FGD participant from Daboya disclose that;

I once bought weedicide (selector for maize crops) and sprayed on my crops by the river side. Although the weeds died, the crops were very weak and it almost took two weeks before they started getting stronger and even grow well, but the delay in the process made the crops to get caught by the floods. That influence my decision to adopt to the use of hoes and cutlasses (Field survey, 2022).

The data gathered from FGD and opinion leaders indicated that 47 of the FGD farmers representing 78.3% disclosed that their major adaptation technique is the creation of beds on the farmland or heaping sand around the stem of the crop and 16 of the opinion leaders representing 88.9% confirmed that majority of the farmers in the various communities adapt by way of heaping sand around the crop stem. The 47 FGD farmers also revealed that the sowing is done on top of the bed, where saturated water cannot affect the crops. In an observation during the time of visiting the farmers on their farms, majority of the farms observed were created in beds and the crops were planted on top of the beds just as in Figure 6.

The study observe some farming activities during the on-farming observation and the observation shows that the crops that are grown on top of the beds were crops that did not need or like much water around the stem. Majority of those crops were maize. On the interaction with the farmers on their farms, 39 out of the 45 Observed Farmers representing 86.7% explain that the practices help crops that are not water resistant to grow well, especially maize. They indicated that the aim of creating farm beds is to assist the water to pass when the volume is low, but in the instance where the volume of the water exceeds the height of the bed, then they become inundated. At this point one may or may not have harvest at all, especially if the flood water last longer. A 72 year old opinion leader Lingbinsi Community said;

> *I have plenty children and grandchildren, they are all grown and live in the community with me in my two houses. They use hoes to create beds in the farmland and crops are then grown on the beds where water cannot inundate the crops. On less in the instance where the volume and height of the water the created beds (Field survey, 2022).*

The data gathered indicated that 27 of the observed farmers representing 60% respondents that they apply cow dug and do mulching below the stem and just above the roots of the crops. They

indicated that this farming system are part of their practices and are employ to adapt with the flood. According to 27 them, this practices aid the crops to grow faster and well during the season and are most applied by the farmers who do not have money for fertilizer application, use this method to save and facilitate the growth of crop. They also added that cow dug are the local manure that science have adopted and substitute it with modern fertilizer. A 63 year-old farmer from Disah community said;

> *I have no money to buy fertilizer to apply on my crops during the farming season. But I have animals such as cattle, goats and sheep's at home, I collect their waste as manure for my farm and I spread this waste on the farmland before the lands are cultivated. This helps the crops to grow well and faster and when am lucky and floods are moderate, I harvest a lot maize with this indigenous means of adaptation (Field survey, 2022).*

According to Combest-Friedman et al. (2012), people who reside within flood zones are aware of the risk involved because they have much knowledge about the rising rainfall and the severity of the floods. The farmers and the opinion leaders in this study, then disclose that they have developed a range of adaptation strategies aside the indigenous strategies, to combat the negative effects of the periodic flooding. A study conducted in Ghana has reveal that farmers have adopted livestock and crop diversification as well as the use of fertilizers and migration to other places for greener pastures as their adaptive strategies (Nelson, 2010).

The responses received from the FGD and interaction with the opinion leaders affirm that farmers in the study area have adopted varied adaptation strategies to mitigate the negative effects of flood disasters aside the indigenous adaptation strategies. The results indicated 8 out of the 60 FGD farmers representing 13.3% adapt to early farming and early harvesting strategies to deal with the flood disasters. Documents reviewed from the MoFA Office explain that these strategies employed by the farmers were to prevent crops from being destroyed, since the incidence of flood disasters has been unpredictable for the past 15 years and occurs at the period end of August or in September. A 63 year old man in Daboya community emphatically said;

> *I plant very early so that I can harvest my farm produce early in order to avoid the flood washing away or destroying my crops in the farm. Although planting early has its own peculiar problems, it is still better for me (Field survey, 2022).*

Another adaptive strategy of the farmers is the use of local variety seedlings. 33 Out of 60 FGD farmers representing 55% still uses the local variety seedlings to combat the effects of the floods. The opinion leaders indicated that these local prepared seeds are not chemically prepared seeds and therefore very strong enough to withstand the shock of the floods. The FGD insisted that the scientific or agro-seeds are time bound and may expired during the time of growth. This can easily weaken the crops and allow it to be destroyed by the floods.

Another adaptive strategy of the farmers is planting flood tolerant crops and hybrid seedlings to withstand the test of the floods. 17 of the FGD farmers representing 28.3% adapt to the floods by the use of flood tolerant seedlings and hybrid seedlings as well as the use of aro-chemicals. According FGD they were taught by the extension officers to plant flood tolerant crops and use hybrid seedlings and also apply chemicals to avoid food crises. This implies that MoFA as government institution is working in line with the systems theory, which states that systems of government should work together as a whole to provide services to the communities (Bertalanffy, 1950) and allocate resources such as extension officers to farmers (Adams, Hester, Bradley, Meyers & Keating, 2014). These farmers attested that crops that are very resistant to the floods are performing very well, and leads to the improvement of farmers' livelihoods (Bertalanffy, 1950). A 39 year old man from Daboya community said;

> *The extension officer in our place educated us to buy some seed and the crops that can be grown on the water ways. I bought this seed and also started to cultivate rice on my farm where most of the time floods occur and I never experience much losses like the previous years (Field survey, 2022).*

Another 47 year-old man from Daboya Community said;

> *When I started the application of fertilizer and insecticides 6 years back on my crops, they grow faster than the years I wasn't using these chemical for farming and I also started to plant three month duration maize seedlings in combination with the agro-chemicals. I harvest early before the flooding period (Field survey, 2022).*

The data also revealed that some of the farmers in the study area have diversified to the formal and informal sector employment. The District MoFA Director indicated that some of the farmers in the area especially the youth have gained formal and informal sector employment. 2 out of the 60 FGD farmers affirm that they and some of their children are learning hair dressing, dress making etc. others are also working as mechanics, teachers and nurses, both in and outside the district. This implies that farmers with formal education who

are facing difficult with the experiences of the floods have decided to look elsewhere in the formal and informal sector for available jobs. It also implies that livelihood diversification has also reduced the farmer ratio in the district. A 38 year old man from Disah Community said;

> *I live in Disah and farming in the community was my livelihood activity, which I practiced since my childhood, but due to the nature of the persistent floods in the community as well as its farming areas, I left and went back to teacher training college 5 years ago and today I am a fully trained teacher, far better than farming with many problems (Field survey, 2022).*

4.4 Challenges farmers face in adapting to floods

The objectives of all farmers in the study area are to increase income and secure food security as well as obtain a better livelihood through the resources available to them and the policies that will enhance their ability to withstand the shocks of flood disaster that disrupt their basic needs. This calls for the research to delve deep into the issues that are influencing the farmers' inability to be able to adapt to strategies in order to cope with the floods. Information was received and data were also gathered to reveal the factors that limit farmers' ability in relation to the floods that occur in the study area.

4.4.1 Factors Influencing Farmers Vulnerability to Flood Disasters

The farmers in their respective group discussion including those observed were of the view that indigenous farming systems plays an important role in the sustenance of their livelihood, but the recent development of floods in the area has pronounce their farming systems worthless production and declining crop yield. The information gathered from the FGD revealed 42 out of the 60 FGD farmers representing 70% have no inadequate farm lands on the higher grounds across the study area, which is one of the factors influencing farmers' vulnerability to flood disasters. The data indicates that there is pressure on the farm lands on the higher grounds due to population growth which has drastically limited the land per farmer.

This is not surprising because Shannon et al. (2013), explain that the acceleration in population growth and change in land use patterns have increased human vulnerability to flood disasters. The opinion leaders revealed that there is no enough land for crop farming in the district due to increasing family size and static farmlands. According to the interview with the assemblymen, extension officers and the zonal NADMO directors indicated that people are

compelled to farm close to water bodies because they don't have access to adequate farmlands on the higher grounds. A 61 year old FGD from Disah Community said;

> *My father had a lot of farm lands especially on the high ground, but after he passed on, these parcels of farm lands were shared among all the children. This has reduced the land holding per household head among our family. Many of us are compelled to farm close to the river side because we do not have lands elsewhere (Field survey, 2022).*

The assemblyman for Lingbinsi Community also said;

> *One of the factors that is making us the community farmers very vulnerable to flood disasters is inadequate farm lands on the high grounds. Majority of the farm lands in the communities are mostly low-lying lands with only a few of them found on the high grounds. Majority of us farm on these low lands and lands lying close to water bodies especially the main river areas (Field survey, 2022).*

The data indicates that all the 60 FGD farmers representing 100% indicated that their poverty level is another factor that causes the people to be vulnerable to the negative effect of floods. Ghosh and Kar, (2018) explain that the identification of vulnerability depends on the economic status of the people, their livelihood activities as well as the availability of needed infrastructures. The in-depth interview conducted with the district planning officer and MoFA Director revealed that some of the farmers are vulnerable to flood disasters because they are poor and lack the needed resources to be able to cope with the negative impact of the floods. The respondent also revealed that farmers who are poor are unable to harvest the crops early and as a result risk to be affected by the floods. This indicates that the poverty level of farmers exacerbates the level of vulnerability to flood disasters.

The interview with the three assemblymen and the two extension officers indicates that lack of formal education is another factor that exacerbate the vulnerability level of farmers to the flood disasters. The informant indicated that majority of the farmers in the study area have no formal and do not have scientific knowledge about farming. Therefore, farmers without formal education have limited ideas about modern application of farming in the communities. The information that was receive from the Director of NADMO in the district implies that farmers with no formal education find it very difficult to adapt to Disaster Risk Reduction strategies. The Director of MoFA also said;

The education and advice provided by the extension officers to farmers in the district has not yet yielded any results due to the fact that majority of the farmers do not understand much about the education provided to them by the officers, due to lack of formal education (Field survey, 2022).

A 61 year old man from Disah Community also said;

It is very difficult to know what is good and bad from the look, especially inputs that have written instructions on them and how they are to be applied, because I have never been to class one not to talk of knowing how to read. Majority of us apply agro-chemicals very wrongly; that is why most of us do not want to apply some of the chemicals, even if they are good product for crop farming (Field survey, 2022).

4.4.2 Factors Influencing Farmers Inability to Adapt to Flood Disasters

The FGD, observed farmers and the opinion leaders disclose that their inability to adequately respond to periodic floods in the areas are as a result of the high volume of the spillage from Bagre Dam as against lack of resources. All the 60 FGD farmers representing 100% disclose that this waters that comes as a result of the spillage from the Dam, comes in huge volumes that management of the crops in this case becomes very difficult. The assemblymen who are also part of the communities alluded that this waters were supposed to be coming in with intervals, but looking at the water volume, it is predict that the may open at one time. Majority of the observed farmers in their farms disclose that the water can be manage if the volume of spillage is low. 47 year old man from Lingbinsi community reveal that;

In the 2020 flood disaster, immediately I heard of the floods, I went to the farm in the morning to see whether my family and I can start harvesting the maize, as a matter of fact, we were able to harvest some in the morning and also carried the produce home. So when we came back in the after because the distance to home, the water had already gotten to the waist level, which was then impossible for a human to go in this water because reptile and harmful animals (Field survey, 2022).

According to the entitlement theory, lack of institutions (transforming structures) and unfavourable policies (Processes) creates barriers (Sen, 1981), which prevent people from accessing various assets and the strategies involved to achieve a positive livelihood (DFID, 2000). Other information gathered from the opinion leaders attest that majority of the farmers in the study area lack adequate resources that can influence their adaptation and coping

strategies to the high volume of water spilled which usually couples with heavy rains between August and September.

A DFID (2000) document explain that human beings need a wide range of resources (within the five livelihood capitals) in order to achieve a better livelihood outcome. Whiles people whose livelihoods are threatened by disasters are supposed to be the first persons to respond and take necessary actions that are sustainable and cost effective (WMO, 2008), the people in the study area lack various resources that were supposed to be available to provide necessary guideline for sustainable livelihood (Hallegatte et al, 2020). This implies that farmers with limited access to resources are very vulnerable to stressors.

4.4.2.1 Lack of human resources

The data gathered also shows that family size also accounts for the farmers' inability to adapt strategies and coping mechanisms to be able to withstand the influence of the floods. 48 out of the 60 FGD farmers representing 80% and 7 out of the 18 opinion leaders representing 38.9% attested that majority of the farmers household have small number of family labor and no formal education that they can use in their position to fight against the persistent flooding in their respective communities. The literature indicates that human capital comprising the number of people, their level of education, acquired skills and knowledge as well as life expectancy rate combine together provides various kinds of livelihood strategies for people to achieve their livelihood objectives (DFID, 1999).

In the FGD, the farmers indicated that household with small family labor are always facing problems during flood. They illustrated that looking at the family sizes, a family labor cannot harvest 10 acres of crops within three day. According to the data gathered, large size families have other alternative and adaptive strategies at their disposal to combat the flood. The opinion leaders indicated that families with small size members have limited choices to make in terms of flood adaptation and livelihood sustainability. A 41 year old man from Disah community said;

> *I have one wife and two children and my brother has eight children and two wives in our house. Some of his children have travelled down south to work and they send money to their father at home whiles my children, who cannot travel but live with me struggle with the farming activities alone. This has made me very vulnerable to the flood disasters (Field survey, 2022).*

The farmers also disclose that majority of them were not educated by their parents and they don't also have required knowledge to adjust to the climate change crisis that has drawn global attention and how to mitigate flood disasters in their communities. It also implies that for majority of the farmers alternative choices are very limited aside the farming activities. The chief from Lingbinsi community said;

> *I have no formal education because my father did not send me to school. My only problem is how to get food for my family and also generate some income from my farm produce. But my children alone are usually not able to harvest the farm produce before the water starts entering the farms. We are usually confused with the training provided to us by the extension officer in the village, because some of majority of us are not educated. I practice farming the way my late father thought me when I was very young (Field survey, 2022).*

4.4.2.2 Technology and indigenous farming systems

Lack of technical knowledge was also identified as a factor that influences the farmers to continue practicing the indigenous method of farming in the study communities. During the FGD, 47 out of the 60 farmers representing 78.3% and 14 out of the 18 opinion leaders representing 77.8% affirm that they still practice the age-old farming systems in the communities. It also emerged that 13 of the remain 60 FGD representing 21.7% and 4 out of the opinion leaders also representing 22.2% apply modern technological and advance farming methods to adapt and cope with the flood disaster in the area. This revelation implies that majority of the farmers are vulnerable to flood disasters as a result of old farming practices such as the use of hoes, hand weeding and cutlasses and harvesting using family labor instead of modern technology such as combine harvesters and weedicides. A 65 year old man from Lingbinsi community explained that;

> *During the farming season, my family and I use hoes and cutlasses to weed the entire farms. Although we are able to finish weeding the farms, we still delay in its completion and in a few weeks we return to the farms to weed again (Field survey, 2022).*

Majority of the farmers use cutlasses, hoes as farm implements during crop season. In the FGD, 57 of the FGD farmers representing 95% disclose that the flooding occurs when major farms crops are still not ready for harvesting. The data gathered from their responses indicated that the indigenous farming practices makes it difficult for them to meet the deadline for crop planting, as majority of them use local made implements such as cutlasses and hoes for the

entire farming season. The 14 of the opinion leaders representing 77.8% explained that some of the farmers in the communities use several days to weed their crops. On the contrary, the few farmers who apply weedicides and other chemicals have the opportunity to cope with the imminent flood that devastate crop than the local means of farming. A 53 year old educated elite from Daboya who is also an opinion leader said;

> *I cultivate my crops using agro-chemicals throughout the farming season and at the harvesting period, I contract the services of harvesters and am able to harvest my farm produce earlier than other farmers whose farms are located around my farm (Field survey, 2022).*

4.4.2.3 Inadequate infrastructure development

Infrastructure in this instance refers to roads, market places, health and storage facilities which can support the development of rural agriculture. Lack of infrastructure is among major factors that influence the farmers' ability to respond to flood disasters in the study area. In relation to the infrastructural development, all the 60 FGD farmers and all the 18 opinion leaders were of the view that their inability to adequately prepare effectively to respond to flood disaster in the study area were associated with lack of infrastructure such as roads, market places, health and storage facilities.

The farmers assumed that the bad roads and lack of market structures and health facilities that could have enhance movement of produce from the farms to prevent flood damages, market places where farm equipment and agro-chemicals can be sold to farmers and health centers that farmers could get treated when they are ill, were the factors limiting their adaptive and coping mechanisms to the flood disaster in their community farms. A 48 year old woman in the FGD from Disah community repeated and said;

> *There are no accessible roads that lead to the farmlands, no market in the community for us to get other farming implement that are very essential for crop production to buy in the community (Field survey, 2022).*

Another 52 year old man in the same group and from the same community also said;

> *The problems that the woman narrated were correct but she didn't add one important infrastructure that is also lacking in the community. Farmers get sick or injured in the farms and the community has also no health center, people have to travel all the way to Lingbinsi or Daboya for health care (Field survey, 2022).*

Also farmers' lives are severely threatened during this period of flooding. 57 out of the 60 FGD farmers representing 95% drawn the attention of the study to the fact that when the flood is arriving towards the communities, it drives reptiles such as pythons and other snakes and dangerous animals in to the farms. According to them, this species of animals can injure or kill a farmer. All the opinion leaders indicated that it is a high risk for a farmer to enter into the farms at this particular period. They reveal the majority of the farmers have had unexpected encounters with reptiles in their farms during the process of flooding. Whiles the data gathered also revealed that, Disah community has no health facility that farmers who are having challenges with their health could immediately seek for medical care.

Lack of storage facilities in this farming communities is another major factor that influences the farmers to store their farm produce in the farmsteads located close floods are imminent. 53 of the FGD farmers representing 88.3% indicated that their farms are located within the flood prone zone without proper storage facility to store harvested farm produce. They indicated that due poor roads, they are compel to live the first harvested farm produce such as groundnuts which are usually affected by spillage of the Bagre Dam. 16 of the opinion leaders representing 88.9% reveals that, although they are storage facilities in every home, these facilities are small to contain the harvest of every farmers' total produce from the farms. They alleged that the food that is brought home is for the household consumption.

According to the FGD, communities have no public silos or warehouses that could enable them to store their harvested crop back home for storage. This implies that the government policy of building warehouses across the farming communities has not been implemented in these areas. This means that government has poor or week policy implementation on the one village one warehouse policy in the study communities. All the 18 Opinion Leaders indicated that if there were warehouses in the communities, they could have save more farm produce and reduce food insecurity among the farmers.

Inadequate finance is one of the major challenges smallholder farmers' face in adapting or coping with climate change such as the floods (IPCC, 2007 cited in
Mudombi, 2011). Whether the farmers' economic situation is measured according to their economic assets, the available capital resource to them or the means by which they can obtain finances, are both factors determining the capacity of farmers. The data gathered from 46 FGD farmers representing 76.7% indicates that they are lacking of credit facilities such as savings and loans institutions that can provide them with farm loans to increase their income level,

neither do they have capital resources or enough economic assets. During the interview, all the opinion leaders responded that they are unable to respond adequately to floods because they do not have access to loan facilities in the area to support their farming activities. Meanwhile, all these factors, according to DFID (1999), it denote the cash flow which people depend on to cope with climate variability's. A 72 year old opinion leader from Lingbinsi community said;

> *Farming in this community largely depends on the amount of capital in hand. Due to the large scale of farming, farmers need financial assistance to be able to cope with flooding in the community and yet still, we the farmers do not have institutions that we can borrow money from for our farming activities and then pay back later (Field survey, 2022).*

A 65 year old FGD participant from Daboya said that:

> *Floods affect my farm crops as a result of my inability to buy improved seeds, fertilizers, weedicides and hire tractors to plough my farm due to increase in prices. High prices of goods and services and inadequate capital to purchase these goods and services exacerbate my inability to transport my harvest from the farm to the house (Field survey, 2022).*

The revelation above validate the statement by Mudombi (2011), that financial constraints exacerbate farmers' vulnerability. Other literature suggest that it is very important farmers are given financial support for them to be able to adapt and cope with climate stressors (Ngigi, 2009). The theory of entitlement assumes that farmers' financial endowment bundles depend largely on the laws, political, socio-economic characteristics of a particular area in question (Sen, 1981). This implies that laws, policies or regulations of government are the barriers denying the farmers access to financial services that leads to farmers' inability to adapt and cope with the floods.

District Assembly Planning Officer said;

> *There are a lot of institution that are yet to be established in the district and one of such institutions is the banking and micro finance sector. This is because the district is still young and growing, but the slow nature of development in the district does not attract the development of private financial institutions (Field survey, 2022).*

4.4.2.4 Inadequate early warning information

Timely early warning information is essentially needed by the people at risk to adequately respond to flood disasters in the study area. The available time needed by the farmers depends on the type of disaster occurring within a given period (Macherera & Chimbari, 2016). Flood information is very critical for the preparation and management of flood disasters. The FGD reveal that there are both local and scientific method of communicating and knowing floods in the study communities.

Table 2. Local means of communicating and knowing floods

Indicators	Description	Impact on flood mitigation
Frogs croaking	The croaking of frogs means that there is going to come precipitation and heavy thunderstorms within the period.	Low
Butterfly swarms around the farming areas	This indicates that there is going to come some draught, immediately after these few days of draught, there is going to follow up with heavy and continuous rains in the remaining period.	Low
Ants carrying their eggs	This signals that the ground that the ants are living in is getting saturated with water, forcing them to relocate with their eggs since eggs need warmer condition to hatch.	Low
Cloudy skies	When the clouds form between north and east, accompanied by with slit heat, it indicates that there are going to be heavy rains with windstorms	Average
Wind direction	The direction of the wind from the south to the north signifies that there are going to come heavy rains in the area.	Low

(Source: field survey, 2022)

In the interview session with the opinion leaders in their respective communities, all of them indicated that they have local means of forecast rains and knowing the floods. They indicated that heavy rains and floods are predicted by the croaking of frogs as shown in Table 2 but this is also presented as ineffective. The table also indicates that butterfly swarms observed close to crops, and ants carrying their eggs from one place to another and where the clouds are formed as well as the wind direction were identified by the discussants as the local means of forecasting floods. It was also well established that the local means of knowing the floods are transferred from their forefathers from generation to generation. A 67 year old man from the FGD and also from Disah Community said;

Ants are very sensitive to water; once you observe them moving away with their eggs it indicates that the ground is saturated. This means that more rains will cause runoff or floods. Others such as the wind direction, croaking as well as the cloudy skies mentioned by other people indicate that there will be heavy and prolonged rains that are likely to cause floods in the area (Field survey, 2022).

The above prediction is in line with a study conducted in one communities in South Africa by Oageng (2012). It revealed that indigenous knowledge system has been develop to identify and make meaning into weather related issues. According to the literature, seasonal change in the weather, observing stars and the lunar cycle as well as the cloud formation and wind direction were both identified as the means to determine the rains in the community. The responses of majority of the respondents also reveal that these means of forecasting and knowing floods are no more accurate due to climate fluctuation. A 53 year old man in the FGD said;

> *Many years ago, we could detect heavy rains and floods through our local means, but in recent years, we are unable to accurately predict the weather and its related activities. I can confidently tell you that I don't understand the weather again, because the moment I don't expect heat I experience heat likewise the cold (Field survey, 2022).*

During the one-on-one interaction with the assemblymen and the MoFA Director, important issues came up concerning local means of communicating and also knowing of disaster in the study area. They both gave similar statements. They stated that due to climate change, weather related activities are now unpredictable. They also indicated that as a result of unpredictable climate, local means of communicating and knowing flood disasters are no longer reliable in the face of the current crisis of the climate change.

The FGD and opinion leaders admitted that there are government officials who provide them with climate related early warning information, which is made to enhance decision making of farmers (UISDR, 2015). Information also gathered indicated that there are public address systems in the communities to provide information to the general public. But 47 of the FGD farmers representing 78.3% revealed receive untimely dissemination of this information from the government as well as the media. This implies that farmers have limited time to put in place strategies to avoid the effects of the floods. The interview with the district director of MoFA and his NADMO counterpart indicated that the delay in weather related information sharing is as a result of inadequate resources. Meanwhile, the systems theory was developed

for stakeholders to identify issues and put in place measures to solve those problems encountered by communities (Lich et al., 2017). In an interview, the NADMO Director said;

> *We manage disasters in the district and one part of our mandate is to provide to the general public timely weather-related information, so that they can prepare for any event. We are unable to provide timely information because the office has only limited resources (Field survey, 2022).*

The 72 year old man from the FGD in Disah community said;

> *We the members of this community do not have access to early flood warning information from the government officials. Due to this, we lose a lot of assets to the flood disasters (Field survey, 2022).*

The two extension officers also indicated that both the radio and that of the telecommunication networks are very poor both at home and in the farms. 53 of the FGD farmers representing 88.3% and 15 of the opinion leaders representing 83.3% disclose that they do not have good telecom network. They indicated that in Lingbinsi and Disah community, they have to stand at a particular point especially in Disah community before they can advance a call or receive one from another. They indicated that people are faced with challenges of radio communication, making and receiving calls due to poor network. This portion of the analysis reflect the poor or weak governance systems in Figure 2. This implies that farmers are not able to receive adequate flood information in their homes, especially in their farmsteads. It also implies that government needs to provide all necessary resources that will deliver information to the people because the farmers in the study area are entitled to the information needed for adequate flood preparedness (Tiwari, 2007). A 72 year old FGD from Lingbinsi community said;

> *In my farm, I don't have radio or phone communication network. Unless they send someone from the house to come and inform me about the floods, I don't have any means of information. This made me to lose a lot of my farm crops to the flood water in 2021 (Field survey, 2022).*

4.5 Policies/bylaws in place to mitigate the effects of floods on farming systems in North Gonja District

4.5.1 Government policies on flood disasters

Ghana being a member of the United Nations and part in the formulation of the Sendai Framework for Disaster Risk Reduction, NADMO has constitutional Act, 2016 (Act 927), which provides the organization the mandate and authority to manage disasters through mitigation or prevention at the National, Regional and Local level. The data gathered from the District Assembly indicated that NADMO has operationalized disaster mitigation and prevention activities in the district. A study conducted by Nelson (2012), indicated that Flood mitigation policies can be looked at in two different ways; that is the engineering and the regulatory dimension of flood control.

In the interview with the KIs in their respective jurisdiction, all the 12 KIs attest that there are in place the district disaster risk reduction programs across the district, but are poorly managed. Meanwhile, a study by Awange and Kiema (2018), indicated that initiating disaster prevention and undertaking activities to mitigate floods is essential to cope or avoid the effects of floods. Secondary data from the NADMO Office indicated that the organization has regulatory activities such as pre-disaster, emergency disaster and post-emergency disaster activities in the district.

The above statement is in line with the Sendai Framework, which emphasises that governments should strengthen the governance of DRR in order to manage all kinds of disasters in their respective countries (UNISDR, 2015). In spite of the above declaration, information gathered from the informant in the District Assembly revealed that disaster management through the regulatory process is under performed in the district. The NADMO Director said;

> *The districts are the local levels in the NADMO Organogram and our mandate is to provide pre-disaster information, sensitization and create the awareness of the general public especially areas that are vulnerable and at risk. Secondly, we also have the mandate to save life and property during disasters by evacuation, relocation, provision of shelters, Medicare, food and water for immediate survival. Thirdly, the organization assists victims of disaster to reconstruct or to rebuild their lost livelihoods. This is how the office operate in collaboration with other institutions both Government, International or Local NGOs and Community Base Organizations in the district but this processes are poorly managed (Field survey, 2022).*

The interview with the KIs in the District Assembly indicated that 9 out of the 12 KIs representing 75% disclose that there are bylaws that are meant to mitigate the negative effects of flood disasters and regulate all activities that may be threatened by hazards in the district. They also indicated that the District Assembly has implemented some bylaws that are in line with the National Disaster Management laws such as the bylaws against human activities close to the White Volta River, bush and charcoal burning, deforestation as well as sand mining that is capable of causing major floods in the district.

In an interview with the District Planning Officer, he confirmed that these bylaws are in place to regulate the incidence of disasters. He further revealed that they are not effectively implemented in the district. For instance the charcoal and bush burning, cutting down trees for fire wood and farming activities along the river banks still persist. During the interview, NADMO Director said;

> *One of the activities we the NADMO staff undertake is to regulate, and create the awareness of the dangers associated with bush burning, cutting down trees and farming close to the river, but people still carry on these activities. This is because they depend on these natural resources for their livelihood and there are no alternatives in the communities (Field survey, 2022).*

All the 12 KIs also reveal that NADMO is not the only government institution in the district that is providing services relating to climate and food security; MoFA also provides support and services relating to climate or various kinds of disasters to the farmers. The discussants also confirmed that some of the farmers have received training from some extension officers in their communities. The data gathered from Opinion Leaders also reveal that farmers in the communities have been given training on preferable farming. The District MoFA director said;

> *The District Office has provided farmers with extension services such as education on the variety of seedlings, type of crops to be planted and how to identify hazards and adjust time of planting in the risk areas (Field survey, 2022).*

4.5.2 Government policies

The transforming structures and the processes in the sustainable livelihood framework links to adaptation, which eventually shapes human livelihood strategies as shown in Figure 1. It is alluded that it helps in mitigating the negative impact of shocks on food security resulting

from climate variability (Bang, Miles & Gordon, 2018). Secondary data sourced from the MoFA Office indicated that as part of government's responsibility, flagship policies have been initiated to provide poor farmers access to sustainable livelihood. The information above implies that government has initiated the sustainable livelihood program as part of its responsibility to eliminate poverty (SDG Goal 1) and end hunger (SDG Goal 2) by 2030.

The data gathered from all the KIs reveal that some of these policies that are workable in the communities are Planting for Food and Jobs, Rearing for Export, One Village One Dam and Production for Export and Rural Development. They have also reveal that only a pocket of farmers have the opportunity to be part of these government flagship programs. The data gathered from them has also revealed that these policies have little impact on livelihood sustainability because, all the people in the study area are predominantly farmers and only a pocket of people are part of this program. This implies that the district is faced with weak or poor governance policies as indicated in figure 2. The District MoFA Director said;

> *Government has introduced some pro-poor policies in the district to cushion people who are faced with food challenges, but these policies are also not adequate to support the people to overcome stressors, due to the fact that majority of the people who are faced with food crises are not benefiting from the policies. Although some people are benefiting from the program, they are only few across the district (Field survey, 2022).*

According to the systems theory, transforming structures and processes are supposed to work as a whole in order to provide effective policies through its structure from the national to the local level, which will empower the people to be able to command the resources available in their possession to generate a sustainable livelihood (Bertalanffy, 1950). However, the entitlement theory emphasizes that access must be provided to people who are entitle to resources in order to address their economic difficulties (Sen, 1981). In view of this, the policies initiated by the government are not in the right direction with systems and entitlement theory because not all the people have access to the policy interventions that are initiated in the district, meanwhile, they are entitled to these endowment bundles. The District Planning Officer said;

> *This poor implementation of policies are the failures and lack of planning at the central government level. A policy like One Village One Dam needed broader consultation. Other policies have also failed due to inadequate financial support from the central government (Field survey, 2022).*

4.5.3 Factors influencing NADMO and MoFA operations

The two directors both reveal that one of difficulties they encounter during the release of this waters from the Bagre Dam, is the volume or the magnitude of the water.
They disclose that no matter what type of farming systems the farmer's apply does not favor the crops in the field because the volumes of the water are release simultaneously without intervals, as a result of that the water increases within thirty to an hour. They indicated that crops are still damaged even with the application of modern technology and scientific base agriculture. The Zonal NADMO Director for Lingbinsi/Disa communities indicated in an interview that sometimes farmer will be sleeping in their farmstead and before they realize, they are already surrounded by the water. In the office, the NADMO Director said;

> *Due to the huge water factor, the first step we take is to evacuate all farmers from their farms. We are also able to bring some of their produce to a safe place, that is, the period the water is still containable. Aside that the height of the water off river can be as deep as two electricity poles because there are some electricity poles somehow close to the river and this are usually submerge in the water. This are use to determine how the level of the water (Field survey, 2022).*

The data gathered from all the KIs reveal also that NADMO has funding challenges and lacks logistics such as communication equipment, instrument for measuring river water levels, cars and motors for monitoring and awareness creation. The officials indicated that funds for the implementation of disaster risk reduction programs, communications gadgets and transport for sending information to zonal directors and for monitoring and assessment in the flood zone were the challenges impeding the smooth operations of the district NADMO office. The director of NADMO explained that;

> *Funds are no more coming and the office has no car or motor bike to monitor and assess progress of awareness creation and sensitization across the district. These issues are limiting progress of operations and ensuring right implementation of programs by the zonal director (Field survey, 2022).*

According to both NADMO and MoFA Directors, their outfits have inadequate staff. Secondary data sourced from the NADMO office indicated that the district has only 7 staff and that includes the director manning the whole district with 62 communities. The officials of NADMO stressed that the district is too large for only 5 zonal directors who are responsible for

the management of disasters for 12 zones and two district office staff for the coordination of activities. Aside that, the secondary data from the MoFA directorate also indicated that there are skilled staff in the district with fewer extension officers who are responsible for extension services in the district. This statement implies that information, education and sensitization are lacking in the district. The Director of NADMO said;

> *Staff who have been recruited and transferred to the district are few but the district has been split into 12 zones with a deficit of about 7 zonal staff. The district office is also supposed to have at least 5 staff who will coordinate the activities of the zonal directors. This has become one of the biggest challenges in the district disaster management (Field survey, 2022).*

The District Director of MoFA also said;

> *All my staff both in the office and those in the field have the knowledge and skills in delivering their duties as agricultural officers. But the only problem with the implementation of our mandate as agricultural officers is the small size of staff in the office. This makes it very difficult to reach majority of farmers in the various communities (Field survey, 2022).*

The Director of NADMO indicated that the NADMO staff in the district have no basic disaster management knowledge. This information was confirmed during the interaction with district NADMO officials. It is indicated that since they were employed as staff of NADMO none has been trained in relation to disaster management and majority of them are also holding basic and pre-tertiary education certificates. In the interview, the NADMO Director said;

> *Unskilled staff in the office here is my major problem because all the staff under my watch have not had a single disaster management training. This makes information dissemination to people very difficult during pre-disaster management. It is also difficult for the staff to be able to facilitate disaster risk reduction activities in the district (Field survey, 2022).*

These challenges confronting NADMO operations in the district imply that farmers in the district are not getting information in relation to the floods that have come to stay with them. 10 KIs representing 83.3% disclose that farmers will continue to be exposed to the floods so long as disaster risk reduction programs are not being executed adequately in the district. This has gone to confirm the statement of the discussants in the analysis above. The discussants

indicated that operations of the district NADMO as well as the zonal directors are not visible in the study communities.

The data also indicated that both NADMO and MoFA are making all efforts with their limited resources to manage and improve food security in the district. Infrastructure such as roads, clinics and market warehouse that can enhance the farmers ability to avoid the impact of flood disasters on the farming systems cannot be accessed. From the interviews with all the KIs and the observation so far made, road infrastructure has not reached the farmlands, but there is a major road from Damongo that passes through the district capital to Disah community that is also not asphalted and is still under construction. Roads leading to the farmlands have not been constructed yet. This means the strategy to mitigate or prevent flood disasters through the creation of adequate infrastructure has been neglected. The District NADMO Director further said;

> *We are facing difficulty in reaching most of the communities in the district, because the roads leading to such communities are in a deplorable state and some of the communities have only bush roads. During disasters, injured persons are usually transported to the district capital for treatment because there are no health centers in most of the communities (Field survey, 2022).*

The Director of MoFA also said;

> *Many a time farmers will want to adopt new farming practices, but due to lack of market for farmers to access some farm inputs, majority of them stick to the old ways of practicing farming. This is due to the distance from their communities to the nearest and available market (Field survey, 2022).*

Another problem that was also observed during the data collection was the late arrival and small quantity of relief support from the central government, which cannot support post disaster livelihood reconstruction (Tenga &Algabayboa, 2016). According to the data gathered, it was revealed that NADMO is a decentralized institution but its funds are allocated from the central government. This corroborates the findings of Chrysogonus, et al. (2022), which stated that relief items come mostly from the central government and also arrive very late.

CHAPTER FIVE

SUMMARIES, CONCLUSION AND RECOMMENDATIONS

4.1 Introduction

The study set out to explore the effects of persistent floods in the study area as well as the local means of adopting to floods and their implications on sustainable livelihood of the peasant farmers. In exploring this problem, I was guided by the assumption that when given access and resources, farmers will be able to prevent or mitigate the effects of the floods that have been occurring annually. In view of this, specific research objectives were set to investigate this phenomenon. These include investigating the effects of floods on farming systems in the North Gonja District, the coping mechanisms used by farmers to sustain their livelihoods in times of floods, the policies in place to mitigate the effects of floods on farming systems as well as the challenges farmers face in adapting strategies in the presence of floods. To achieve these objectives the study developed the conceptual framework for sustainable livelihood approach adopted from Ashley and Carney (1999). The reviewed literature and the conceptual framework of the study established that human beings need various forms of capital to be able to achieve a better livelihood outcome through effective management of transforming structures and processes which can enhance access to livelihood endowment from the local level to the international space, be it private or public. The study eventually employed the qualitative approach in the collection of data and analysis.

The study findings from the analysis are summarized in the following section.

5.2 Summaries of key findings

Following the first objective, which mandated the study to assess the effects of floods on farming, farmers dependency on normal rains for crop production were the major livelihood activity and source of living. The floods in the study area were noted to be the result of the Bagre Dam spillage, climate change, a flat topography and low absorption of ground water. There was evidence that rearing of animals, crop farming, mixed cropping, family labor and sowing were done according to gender practices; the men use dibbers to create holes on the ground and the women place the right amount of seeds in the hole and cover it with some soil. They use locally made tools and a variety of seeds, cow dung and mulching for growth. However, the study found that crops especially maize, was the worst affected farming followed by groundnuts and soya beans. This led to low income generation, loss of seedlings and low income savings. Legal action was sometimes taken against some farmers who couldn’t pay

back loans, whiles some of them who couldn't also withstand the shocks suffer depression, trauma and heart attacks. There were many reported cases of inadequate dietary diversification and huger, due to shortage and low supply of food in the market places which eventually led to high prices of food.

In relation to the second objective, which examined the indigenous coping mechanisms, some farmers were lending farmland for food every season. Others were also exchanging livestock for food or selling them for other needs. The study found that there were other coping mechanisms which farmers were engaging in, like small-scale activities such as charcoal burning, causal labour, petty trading and selling assets, thatch and smock weaving, borrowing grains and money. Others migrate while some depended on remittance from family members, friends. A few farmers adapted by providing land, family labor and local implements whiles others provide financial resources for ploughing, agro-chemicals and the produce was shared equally. Farmers sought to rotate and grow water resistant crops in riverine areas based on local means of forecasting floods. The study also found that they expanded their family size to be able to adapt to the floods because they could harvest crops faster after receiving early warning signals. Others too have maintained the use of hoes and cutlasses to weed inside their crops instead of using weedicide because weedicide weakens crops in the process and delays crop growth rate. Crops were seen growing on farm beds and some crops were also seen with heaps of sand below the stem to prevent saturation or inundation. Some of the farmers adapted early farming and harvesting and the use of agro-products. The study also found some of the farmers adapted by seeking formal and informal sector employment.

The challenges majority of the farmers face that make them vulnerable to flood disasters were found to be inadequate farmland on the higher grounds, poverty and lack of scientific knowledge about farming. The huge volumes of water released from the Bagre Dam were overwhelming farmers' coping and adaptation strategies. Also small family sizes and lack of formal education, the use of local implements such as hoe and cutlass, poor infrastructure such as roads, market places for the sale and purchases of agriculture inputs and equipment and lack of health centres for ill or injured farmers to seek health care were the factors militating against their adaptation. The study again found that the late arrival of early warning flood information and failure of local means of forecasting floods and poor communication network in the study area were the factors militating against farmers' adaptation strategies to flood disasters in the district.

The study found that there is a disaster risk reduction policy which is implemented by

NADMO. The management of disasters through the regulatory processes to stop the activities that leads to climate change in the district were under performing. The Assembly had implemented bylaws to regulate activities that influences climate change, but yet still these activities such as bush and charcoal burning, logging and sand mining still persist in the district. MoFA was also noticed to be providing climate related services through its extension officers. Furthermore, the study found that government flagship policies were only benefiting a pocket of people in the district. The District Assembly bylaws were meant to enforce law and flood mitigation were also not effectively enforced. The volume of water released coupled with the rains overwhelmed the NADMO and MoFA operational systems in the district. Whiles Farmers' adaptation failures were because NADMO and MoFA are severely under staffed and lacked logistics, funds inflows from the central government were delayed. The analysis indicated that extension officer to farmer ratio and NADMO Zonal Director to community ratio are too low to address adaptation and the provision of timely early flood warning information as well as enforcing the district bylaws to regulate the activities of farmers around areas that are threatened by the floods.

5.3 Conclusions

The study concludes that the livelihood of the people depends on rain-fed agriculture, which is usually and severely interrupted by the negative effects of periodic floods, caused by human activities and climate related issues. It is also concluded that floods have severe negative implication on household food security, human health and economic fortunes of the farmers in the district and that with effective and a wide range of policies put in place, such as mandatory application of hybrid and short duration seeds and improved afforestation, food security issues could improve in the district.

From the summaries, the study concluded that majority of farmers in the study area have no means of coping with the floods that have become a nightmare. The coping mechanisms employed by the few are also sustainable for only a short period. Aside that, only a few of the farmers have adapted strategies to mitigate the negative effects of the floods on crops. The alternative strategies that could have provided fruitful solutions to the farmers are also limited. Therefore, the desire for adoption by the majority of the farmers with wide range of alternative will increase their capacity to mitigate flood disasters and eliminate poverty.

The study again concluded that, farmers are vulnerable because of their inability to acquire farmlands on the higher grounds as well as poverty, and lack of formal education also

exacerbated their vulnerability. It is further concluded that the huge spillage of water from the Bagre Dam in Burkina Faso overwhelms adaptive strategies irrespective of indigenous or modern farming systems employed. Inadequate infrastructural development and late arrival of early warning information limits the ability of farmers to adapt to the floods. Therefore, spillage of the water at intervals, adequate infrastructure and timely flood information will assistance farmers and provide them with enough opportunity to adequately prepare for the floods.

Finally, the study has concluded that, the coordination and decentralization of government institutions and organizations from the national to local level is weak and ineffective because the policies and planning of the central government are poorly implemented in the district. The district disaster management bylaws are also not being effectively enforced. It is also concluded that, the huge volume of water spilled from the Bagre Dam hinders emergency disaster operations, as NADMO and MoFA are challenged with resources for their operational duties.

5.4 Recommendation

From the conclusion, I advance the following recommendations for effective policy intervention:

The study found that the floods have negative implication on human livelihood and sustain food security. In order to sustain food security and human livelihood in the district, farmers will need to change their attitude towards the activities that will exacerbate climate change related issues such as bush burning, deforestation and sand mining. There should be a uniform approach where farmers should also adopt a particular variety of crop that can take at most three months to mature and grow such crops at the riverine areas.

Farmer based NGOs in the district should channel their efforts towards promoting community based initiatives on flood mitigation measures to enable community capability and resilience to be able to cope in the long term with the floods. There should be price management of agricultural inputs to encourage more farmers to adopt the appropriate farming practices in the communities. Government through the District Assembly should also create alternative opportunities such as jobs etc. in the communities for easy access to sustainable livelihood alternative.

Since there are no adequate farmlands on the higher grounds for the farmers to permanently re-locate and since both the indigenous and modern farming systems are also being affected by the periodic floods resulting from the spillage of the Bagre Dam, Government

of Ghana and Government of Burkina Faso should have a stakeholder discussion and review how the water can be spilled if possible before the Dam gets to its maximum capacity, so that the water can be spilled in smaller quantities. This new development should come along with transformational development such as roads and market structures in various communities and building of standard health centers etc. which can influence farmers' ability to overcome the stressors.

The weak and ineffective policy and planning supervision has led to poor implementation of some government flagship policies such as One Village One Dam and Planting for Food and Jobs among others. These initiatives of course are very good policies but they should be geared towards the bottom-up approach. NADMO should be fully decentralized so that they can generate their own funds at the regional and district levels. Whiles doing so, they should also resource NADMO and MoFA with adequate skilled labor and proper equipment such as speed boats that can be in the water whiles providing information whiles monitoring the rising level of the water. Institutional collaboration between NGOs, NADMO and the District Assembly on flood mitigation must be encouraged to effectively manage floods. Finally, government should eliminate the intermittent communication network interruptions and widen the scope of the communication space for easy access of timely early warning information.

5.5 Contribution to knowledge

The study was conducted to investigate implication of floods on livelihood sustainability. The study noted a number of issues which militated against the coping, adaptation and the alternative strategies of farmers. These were access to resources and food entitlement and these were the result of failure of institutions and weak policies. This is unique because it looked at the feelings and worries of the farmers.

The conceptual framework adopted in the study was able to prove that institutional failures and weak government policies were the contributory factors to food insecurity issues in the district.

5.6 Limitations of the study

A number of challenges were encountered in the process of conducting the study. It was not easy to convince respondents to take part in the study willingly. The scope of the study was limited to observe the trend of the phenomenon as well as the deplorable roads and the period in which the study commenced and I had limited access to some of the respondents who had already left home to stay in their farmsteads during the farming season.

The study was also designed to obtain only qualitative results, which did not provide a balanced check on the outcome of the findings. The sampling method did not also reflect the microcosm of the population in the study area. The procedure for the analysis was only limited to qualitative analysis instead of a combination of multiple methods.

5.7 Suggestions for further studies

Further studies are needed into institutional behavior towards DRR, particularly infrastructural development and the enforcement of bylaws. In respect of information dissemination, the quality of early warning information through the media and the effectiveness of early warning systems especially, the urgency and timeliness of the information should also be thoroughly investigated.

There is also the need to investigate this phenomenon through the employment of a combination of both qualitative and quantitative approaches to produce balanced results that could complement one another.

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APPENDICES

APPENDIX 1: Interview Guide

Main Question: the effects of floods on farming systems.

1. Floods are the major problem associated with crop farming.
   (a) Name the type of flood you experience in the district?
   (b) How does the floods occur in the district?
   (c) How long does it stay when it occur?
2. What are the factors that are influencing the flood that destroy crops in the district?
   (a) Explain the way in which these factors causes the floods?
   (b). When do the floods occurs in the district?
   (c). Where do the floods occurs during this period?
   (d) How does it occur in the district?
3. Explain the effects of floods on farming systems?
   (a) Name the farming systems found in the district?
   (b) Which of them is most affected by the floods?
      I. label them according to degree of affect (high, moderate and low affect).
   (d). What are the effects of floods on the most affected farming system?
   (e). What are the effect of the most affected farming system on the farmer?
4. Mention the crops that are most vulnerable to floods?
   (a). Why are these crops vulnerable to the flood?
5. How does the floods affect household food security?
   (a). what are the implication of food insecurity on household members?

Main Question: coping mechanisms use by farmers to sustain their livelihoods in times of floods.

1. What steps do you take to cope with the flood disasters?
   (a). explain to me how you are able to apply these coping mechanisms after the floods?
   (b). How sustainable is your coping mechanisms?
2. Explain the strategies you have adopted to avoid the flood disaster on your crops?
   (a). explain to me how you are able to apply your adaptive strategies to avoid flood disasters?
   (b). How sustainable is your adaptive strategies?
   (c). What are the impact of your adaptive strategies?

Main Question: challenges farmers face in adapting to flood disasters.

1. What are the factors that influences vulnerability to flood disasters?
   What exacerbate the factors that influences your vulnerability?
   What are the impact of the factors that influence vulnerability?
2. What are the factors that influences farmer's inability to adapt to flood disasters?
   What are the effects of the factors that influence farmer's inability to adapt to flood disasters?
   What are the local means of forecasting?

Main Question: policies/bylaws in place to mitigate the effects of floods on farming systems.

1. What are the government policies to mitigate flood disasters?
   How are these policies implemented in the district?
   What are the impact of these policies on the well-being of farmers?
   Who are responsible for the implementation of these policies?
2. What are the government pro-poor policies in the district?
   How effective are these policies on sustainable livelihood of the people?
   Explain how these policies are implemented in the district?
   Explain how bad or good the policies are in terms of coverage in the district?
3. What are the factors militating against the operations of NADMO and MoFA?
   Why do you say it is militating against your operations?
   Why are you not have any alternative to these militant?