

Empirical Literature Review on the Menace of Floods on Food Security

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Abstract: Flooding has become one of the most topical natural hazards affecting human livelihoods, especially in the agricultural sector. Its frequency and severity have become a matter of concern to many nations, especially sub-Saharan Africa. This is because the economies of these countries are agriculturally driven which is sensitive to climatic changes. The impact is felt more among subsistence farmers who rely on rain-fed agriculture for their survival. Over the years, the devastating impact of floods occurrence has rendered many households' food insecure with limited coping mechanisms to rely on. Among the households most affected by this phenomenon is smallholder's farmer whose main livelihood is depended on the produce obtained from the farm. As a result of this, subsistence farmers' households are usually food insecure, especially during the lean season. This study explored the various empirical literature which investigates the menace of annual floods on smallholders' food security. The study draws on diverse literature to ascertain the destructive effects of the flood on food production using the northern part of Ghana as a reference point.

Keywords: Flooding, Livelihoods, Subsistence, Food Insecure, Sub-Saharan, Farmers

Introduction

Food production in the world especially in developing countries is vulnerable to changes in climatic conditions. This is due to the dependency rate of crop production on climate-related events more importantly rainfall. This chapter presents a review of literature on the concept of flood and food security. The chapter also looked at the theoretical and conceptual framework underpinning the study.

Defining Concepts

Flood

Flood events are natural and they have existed since time in memorial. Their occurrence in some cases tends to provide fertile alluvial soil for the cultivation of food crops (Okyere and Twum-Baah, 2000). In recent times, the frequency of floods occurrence and their consequences throughout the world are threatening sustainable food production (Aderogba, 2012). This has the potential to cause food security, especially in Sub-Saharan Africa.

What constitutes the definition of a flood has been a subject of debate among scholars (e.g., Baker, 1998). Some writers define floods solely based on natural

phenomena. For instance, Cited in Derbile *et al.* (2016) defined flood as a flow that is larger than the average volume of water along a river channel. Others also associate floods in terms of their implications on human livelihoods, such as food security; for instance, Bakker (2009) associates floods with the destruction of farmlands. However, the (OFDA/CRED, 2010) of the Université Catholique de Louvain in Belgium defined floods as the abnormal rise of water level in a river, stream, lake, reservoir, or coastal areas. In most cases, this rise in water usually comes with its associated problems as farmlands and property are usually destroyed.

The occurrence of floods can be attributed to natural and anthropogenic causes. The natural causes are mainly due to excessive rainfall; snow and ice melt as a result of changes in climatic conditions leading to many rivers overflowing their banks. However, the human activities that contribute to the occurrence of floods include deforestation, inappropriate agricultural practices, and the alteration of drainage patterns through urbanization Derbile *et al.* (2016). Other causes take the form of coastal storm surges, landslides, and dam failures.

The last decade has witnessed a devastating effect of floods on agricultural activities as well as loss of human lives (OFDA/CRED, 2010). Throughout the world, its (flood) impact on crop production is always devastating, especially among developing countries. The inhabitants in these areas (undeveloped countries) are mainly small-scale farmers who depend on rainfall for the cultivation of crops with less adaptive capacity to withstand the adverse effect of any changes in the environment (Wheeler and Von Braun, 2013). Therefore, any changes in the climatic events will affect food production leading to low yield among these smallholder farmers which could threaten their food security.

According to Parker (2005), floods may affect food availability due to the damage it causes to crop production. For example, the Sudanese flood of 1988 resulted in the immediate destruction of farmlands which brought about acute food shortages among households (Parker, 2005). The cause of the flood was the sudden and unexpected rise of water in the white and blue Nile leading to the overflow of its banks. In Khartoum province alone, after the aftermath of the flood, food availability fell to about 60% of the total food storage in the province. This led to chronic food insecurity in that part of the country (Parker, 2005).

In Ghana, flooding usually occurs in the rainy season during the month of May, June, July, August, and the early part of September (Armah *et al.*, 2010). This is the period in which rainfall is usually torrential with most rivers overflowing their banks. The northern part of the country has over the years experienced perennial floods. The main cause of the floods in the area is excessive rainfall resulting in the overflow of the White Volta. The occurrence of the flood also marks the period when the Bagre Dam in Burkina Faso is usually spills off worsening the situation (Forkuo, 2011). The flooding usually occurs on both sides of the river banks, therefore, destroying farmlands belonging to vulnerable communities and exposing them to the risk of food insecurity.

Food (in) Security

Food security has become the most topical and frequently talked about phenomenon in the world particularly in developing countries. It has become popular because it is being confronted with issues of climate change notably floods and drought which are negatively affecting crop production. The interwoven nature of climate change on crop production is so devastating, especially in Sub-Saharan Africa which poses a possible threat of reducing crops yield and consequently brings about food shortage.

The concept of food security has become so complex and complicated that a single academic discipline cannot explain it (Sarracino, 2010). Because of the complex nature of the concept, various scholars have tried to theorist

and conceptualize the phenomena and bring us closer to the understanding of the direction of food security. However, over the years, several definitions and explanations have been revised and redefined to come out with a working document on food security. Thus, the concept has transcended over time in terms of its development.

Food security has evolved over a considerable period and its root can be traced back to the international development literature and the World Food Crisis of 1972-1974 to present literature. Its definition has seen some significant changes and modifications. After the World Food Crisis; various definitions have emerged over the years (Hoddinott and Yohannes, 2000). A review of the literature revealed that food security has time in memorial focus on food availability, accessibility, utilization, and stability in all dimensions. Notwithstanding the various arguments and counterarguments about the definition of food security, it is stated that scholars now seem to accept the comprehensive definition given on the World Food Summit of 1996 (FAO, 2017).

The World Food Summit defined food security as when people at all times have physical or economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for active and healthy life (FAO, 2017). This definition conceptualizes food security in terms of food availability, food accessibility, and food utilization which were given more preference after the Roman Declaration of 1996 when countries were tasked to ensure food security in individual, household, regional, national, and global levels by making sure that all people at all-time have access to safe, sufficient and nutritious food. The World Food Summit definition laid the foundation for other scholarly definitions to follow. The Food and Agriculture Organization 1986 added a nutritional and safe component to the World Food Summit definition and looked at food security as a situation when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO, 2014). The inclusion of the "safe and nutritious" component shows the importance of food and therefore widens the scope of food security from just availability and access to sufficient food to a more desired food (Pinstrup-Anderson, 2009). However, there are instances when households do not enjoy either one or most of these components of food security due to certain constraints, especially climatic hazards leading to food shortages among households (FAO, 2010).

According to Sanchez and Swaminathan (2005:11), "food insecurity is seen as a "term relating to the condition that exists when people do not have physical and economic access to sufficient, safe, nutritious and culturally acceptable food to meet their dietary needs to

live an active and healthy life". This definition, however, does not clearly explain how all households can have the economic strength to access food given the differential in economic conditions. This is important because most households particularly those in developing countries depend on small-scale farming for their food and income generation. With the rise in temperatures in recent years which could lead to the increase in the occurrence of weather-related hazards like floods, these two important sources of livelihood (food and income generation) will be greatly affected.

In the view of Sanchez and Swaminathan (2005: p11), food insecurity is seen as a "term relating to the condition that exists when people do not have physical and economical access to sufficient, safe, nutritious and culturally acceptable food to meet their dietary needs to live an active and healthy life". To Sanchez and Swaminathan (2005), access to food is closely related to poverty and lack of economic growth: The poor usually do not have adequate means to gain access to food in the required quantities. In all these expressions, gave a contrary view of the various definitions. They explained food insecurity in a very broader concept to include not only lack of access to food but a point in time when the individual feels or entertains some levels of doubt about their future food supply and result in some coping strategies with regards to dietary intake or behaviour change in order ensure food safety. Based on this definition, a household may have sufficient food to consume but the natural and artificial factors hindering crop production may make it entertain some level of anxiety about its future food supply.

Depending on the duration of the situation, food insecurity can be classified as "transitory" or "chronic". The FAO (2008) defined transitory food insecurity as a situation where there is temporal unavailability of food that lasts for a short period. It is caused by several factors most especially climate-related hazards like floods (FAO, 2008). According to Staatz *et al.* (2009), transitory food insecurity is seen as the most devastating household food insecurity even if it happens within a shorter period because it brings hunger and starvation among individual households. Chronic food insecurity on the other hand is when there is insufficient food available for households that last for a long period (FAO, 2008). Chronic food insecurity has a serious repercussion on individual households' well-being (EC, 2006).

Food security is analyzed using certain indicators. These are food availability, accessibility, utilization, and stability cited in Akudugu *et al.* (2012). These components are articulated in the World Bank definition of food security; safe access (accessibility) by all households (vulnerability) at all times (availability) to enough food for a healthy, active life' (utilization). According to in determining the food security of a place,

the components captured in the World Bank definition (availability, accessibility, utilization, and stability) need to be taken into consideration.

Food Availability

In determining food security, the first thing to consider is its availability. Food must be physically available through production, store, and process for people to consume (Demi and Kuwornu 2013). According to Akudugu *et al.* (2012), food availability is defined as the existence of food for household consumption. This means that the amount of food that remains after production is what is available for household consumption. But in assessing food availability, the WFP (2012) reports disagreed with this assertion and reported that making food available to a given population is paramount but not enough to justify the accessibility of households to food. This is because several factors such as poverty, government policies, and institutional/ cultural issues may hinder households' accessibility to food items although the food may be available (Page and Redclif, 2002, Hadley, 2011).

In the last two decades, global food supplies have increased steadily than the corresponding growth in the population leading to a significant rise in food availability among individual households which is reflected in the reduction in the number of undernourished people from about 24 to 14% between the period of 1990 to 2013 (WFP, 2012). This massive reduction in the undernourished people is not reflected uniformly across the globe. According to the WFP (2012) report developing countries have fallen short of this improvement due to their over-reliance on rain-fed agricultural activities which are being grappled with increasing climatic hazards notably floods thereby destroying their crops leading to low yield.

Food availability does not necessarily portray food security among individual households. In analysing food security (food availability) George (1999) opines that the mere physical presence of food does not guarantee that individual households will have the economic strength to access that food. George (1999) further states that to access the available food, the poverty level should be reduced to enable households to have access to the food items. Akudugu *et al.* (2012) explain that in the northern part of Ghana, food availability through production is hampered by annual floods which are having a devastating effect on crop production. It is important to note that smallholder farmers in this area depend on the produce obtained from the farm for their survival and as well as economic gains (Akudugu *et al.*, 2012). Therefore, limited production as a result of flood damage will worsen the poverty situation among households leading to food insecurity among these smallholder farmers.

Food Accessibility

Food crops may be available at the national or global level but will not guarantee that all individual households will have the purchasing power to access them. Food accessibility is defined as the ability of an individual household to obtain food in sufficient quantity to ensure a healthy life (FAO, 2003). The WFP (2012) explained that when individual households can obtain adequate nutritional food either through production, borrowing, gifts from close associates, and food aid, then it is known as food accessibility. Before 1970, food security was seen as a national policy of food production and global trade but its scope has seen been widened to cover households and individual access to food (Devereux and Maxwell, 2001).

In the view of WFP (2012) two driving forces determine individual access to food. They are; economic and physical factors. The economic factors include determinants such as prices of food, disposable and distribution of income, and livelihood systems in ensuring accessibility to food (FAO, 2013). On the other hand, the physical forces deal with the quality of communication networks and storage facilities in ensuring smooth market flows. However, Benson (2004) argues differently that the ability to access sufficient food by individual household members are being determined by many indicators such as gender, age, and employment status. The overall driving principle is that these factors may hinder food accessibility by individual households. Besides these, the important factor is the ability of the individual to purchase the food by the prevailing market structures (WFP, 2012). According to, poverty and food accessibility are closely related to poor households not being able to obtain the right quantity of food for safe and healthy living. Put it well “Households that are food insecure lack the necessary resources to pay the price for imports and access sufficient supply of food”

In accessing food security in northern Ghana, gender, climate change, ownership, and access to agricultural resources are key factors in determining food accessibility (Akudugu *et al.*, 2012, Anaglo *et al.*, 2014). This is because these factors directly or indirectly hurt crop production leading to scarcity of food.

Food Utilization

The mode in which the body makes use of the nutrient in the food is an essential aspect of ensuring healthy growth. Food utilization is the ability of households to obtain sufficient nutrients and calories in the food consumed to ensure a healthy life (FAO, 2013). To ensure sufficient food utilization, the WFP (2012) provides several factors including safe drinking water, proper storage of food items, and eating nutritionally adequate food.

Effective utilization of food among individuals is dependent on their knowledge about basic issues concerning good health and proper sanitation. According to the FAO (2013) in describing food utilization, two different indicators stand out. One of them describes the anthropometric attribute of undernourishment which is prevalent in children below five years. Signs and symptoms of children under such conditions include stunted growth, underweight babies, and a differential in age and a normal size (FAO, 2013). With knowledge of this indicator, one can be able to analyze the nutritional level of the population of a place. The other indicator deals with numerous variables which look at food quality, hygiene, and health status (FAO, 2013). However, the WFP (2012) also looks at the food utilization measurement using two different indicators. The first one is the diet diversity indicator which calculates the categories of food groups consumed by individual households within the last seven days while the second indicator measures the amount of calories taken from staple food, which is calculated as the percentage of food energy consumed from staples (cereals, roots, and tubers) on total calories intake (WFP, 2012). The relevance of these indicators in food utilization measurement helps us to identify the nutritional level of a given population (IFPRI, 2006).

According to Owusu and Abdulai (2013), food utilization in northern Ghana among households depends on the crops obtained from the farm. This is where many individual households' sources of food supply and consumption come from. Akudugu *et al.* (2012) however opine that although farming is the main source of livelihood in the area the food crop obtained do not always last up to three months resulting in hunger and starvation. This is because area experience monomodal rainfall which last for only four months coupled with the influence of climatic hazards especially annual floods resulting in crop destruction (Akudugu *et al.*, 2012). He further explains that food utilization among individual houses during the lean season usually results in malnutrition and other related diseases.

Food Stability

According to the FAO (2007), the concept of food stability is closely related to the variables that measure accessibility and stability. Food stability or sustainability is a situation where every individual household is guaranteed access to food in sufficient quantities at all times (FAO, 2013). The FAO expanded their definition of not only just excess food but that the individual house should all-time have the economic will to acquire the food, safe and nutritious to enhance the healthy living of each household member (FAO, 2013).

In analysing food stability, Demi and Kuwornu, (2013) reported that households are considered food secure

when they are not exposed to any form of food insecurity and are not at risk of being food insecure. Demi and Kuwornu (2013) further revealed that a household can have available food for its members but once there is some kind of limitation to the availability and accessibility, it cannot be considered food secure. Akudugu *et al.* (2012) in analysing food security in northern Ghana observed that obtaining food stability in the area is difficult since several factors like drought and floods are prevalent which are affecting food production.

Theoretical and Conceptual Framework

This section discusses the relevant theoretical issues, theories, debates, scholarly works, and measurement dimensions of food insecurity that guided the study. The review of these theories provides a suitable environment for which a conceptual framework was developed which forms the basis upon which the result and discussion were analyzed.

There is no single theory that explains the conceptualization of food insecurity. This is due to the complexity and multidimensional nature which makes it difficult to explain its occurrence as well as provide a suitable mechanism to curtail it (Aden, 2017). The main reason accounting for this lack of a working document in theorizing food security is due to the multidisciplinary fields in which the concept evolves such as sociology, anthropology, climatology, economics, political science, and nutrition coupled with the period of its occurrence as well as the existing conditions in the place ((Devereux, 1993). As a result of this, over the years, several theoretical models have been broadly explained, defined, and redefined to arrive at a suitable means of theorizing food insecurity (Sarracino, 2010). Because of the multifaceted nature of the concept, this study would use two of the theories to explain the food insecurity status as a result of the flood in the research area.

Food Availability Decline Theory

The Food Availability Decline theory states that food insecurity is caused by a sudden reduction in the food supply. The major drivers causing this shortage in food supplies are climate events such as floods (Wisner *et al.*, 2006). Because of the limitations in food supply due to the effect of climatic hazards, prices of food items will increase thereby making it difficult for vulnerable households to meet their needs. According to cited in Yaro (2004), the FAD approach reports that natural forces such as floods, drought, and dry spells could have the potential to cause a decline in food production which is a necessary condition for food insecurity to occur. Besides these, it is also acknowledged that a combination of other factors such as deforestation, overgrazing, pressure on the environment, and a decline in rainfall in dryland areas such as Asia and Sub-Saharan Africa could cause a

decrease in crop production exacerbating the food insecurity situation in these areas. According to drought, flood, and lately climate change are other climatic factors that are responsible for the reduction in crop production which could lead to food insecurity.

Several studies have shown how annual flooding coupled with other hazards like drought, desertification, and dry spells have combined to destabilize agricultural activities in many parts of the globe particularly Sub-Saharan Africa thereby affecting rural livelihoods, particularly food security. Although Africa has made a concerted effort in addressing the climatic hazards, the interplay of annual floods and human-induced activities such as an increase in population growth and civil wars serve as a critical challenge to food security in assessing the 2003 food crises in Africa revealed that four out of the 25 countries that were facing chronic food insecurity were those in the savannah ecological zone. The remaining countries were experiencing conflicts and the effects of climatic influence on the production of crops. It is therefore clear that countries experiencing the double effects of floods and conflicts are more likely to be confronted with food insecurity problems than those that do not (FAO, 2013). opines that, in Ghana, climatic events, poverty, and soil degradation continue to serve as a hindrance to achieving food security in the country. However, studies have revealed that the major factor limiting food production in Ghana and the African continent is climatic hazards such as drought and floods (UN, 2011; Laube *et al.*, 2012).

The northern part of Ghana provides a suitable case at hand for the application of this theory as the area is prone to several extreme weather conditions particularly annual floods which are affecting food production resulting in a decline in food availability. The incident of annual flooding can jeopardize the production of food in the area and put a large number of smallholder farmers at risk of food insecurity since agricultural activities form the backbone of their economic activities (UN 2011). However, the frequency and intensity of annual floods in this part of the country have caused tremendous losses in the crops yield and consequently affected households' food availability as well as their economic income (Molle and Mollinga 2003; Barron *et al.*, 2015; ISDR, 2015; Márza *et al.*, 2015). The problem is not far from being over as it is projected that the incidence of floods is expected to increase as a result of increasing temperatures which would negatively affect crop production leading to low yield (IPCC, 2013).

After it has been established that food availability decline is a major obstacle to realizing food security, there have been several efforts to overcome food availability decline and find alternative measures to ensure food security, especially among smallholder farmers in the

rural area, and improve their resilience capacity (UN, 2011). According to Laube *et al.* (2012), there is a need to increase the production of food and minimize the impact of extreme weather conditions to ensure food availability. Even though it has been recognized by many scholars that food availability decline is a major challenge to food security, the theory has been disputed and criticized by Amartya Sen, who said that food insecurity is a demand failure rather than a supply failure (Aden, 2017). According to Sen (1984), food insecurity is not merely the case of supply decline but something else because some people suffer food insecurity even when there is an availability of food supply.

Sen (1984) further supported his argument with examples of famine cases in the world such as Ethiopia in 1972-4, Bangladesh in 1974, and Bengal in 1943 where malnutrition was high and many people lost their lives due to hunger and starvation even though, the agricultural sector in those countries were thriving. He then concluded that food insecurity is a matter of access rather than availability. From the argument raised by Sen, it is obvious that food availability at the national level might reflect the same in other places but it cannot be accessed through trade (Aden, 2017). Food availability decline theory, therefore, affect people differently as the poor in society who are mainly small-scale farmers suffer the most during the time of food insecurity than the wealthy ones.

Entitlement to Food Failure

The entitlement to food failure approach was propounded as an alternative model to the failure of the FAD to explain famine and food insecurity among households. The theory was brought to light by Amartya Sen in the 1980s as a counterargument to the Food Availability Decline theory and to provide an alternative way to better explain the food insecurity situation (Aden, 2017). Unlike the FAD which uses food supply as an indicator to determine household food security, the entitlement failure focuses on the demand side. The theory revealed that an increase in food availability alone cannot guarantee access to food security but other important factors such as distribution and individual household ability to access the available food. Sen (1984: p497) defined entitlement as "the set of alternative commodity bundles that a person can command in a society using the totality of the rights and opportunities that he or she faces".

According to Sen (1984), the root causes of famine are not the unavailability of food but the lack of economic power by households to access the available food. Although food availability is an important indicator in determining food security, individual households' ability in accessing food is crucial to the realization of their food security. Therefore, Sen formulated the concept of food

security which households' entitlement enables them to access through the process of demand.

Sen (1984) revealed that household food security is a reflection of their purchasing power through the exchange of their entitlement. He observed that famine occurs when there is a breakdown of people's entitlement. From the perspective of Ghana especially in the northern part of the country, people's entitlement is closely related to the availability of the products they obtained from their farms (Musah *et al.*, 2013a). This is because, agriculture forms the basis of all economic activities in the area and so the destruction of the crops by climatic events is a manifestation of their inability to access food through the interplay of damage (Musah *et al.*, 2013b). According to Sabila (2014) like the FAD theory, Sen's approach was also criticized in many ways. First, it does not provide another alternative for ensuring food security but is rather straight to the point which can lead to hunger, starvation, and even death. As observed by de Waal (1990) people's ability to access food is largely determined by their actions and attitude. This study would therefore apply the two theories in assessing floods' contribution to food insecurity since the study tends to assess smallholder farmers' food availability as well as their ability to access food in the event of food shortage.

Conceptual Frame Work

The impact of floods also the lives and livelihoods of smallholder farmers are very complex to illustrate diagrammatically. Being an essentially agricultural producer (the study area), the main effect of the flood is the destruction of farmlands leading to a decline in food production. This decline in food production is a potential threat to food security as food availability for these households is reduced to the minimum level leading to food insecurity (Fig. 1). The decline in crop production by the flood is also an indication of loss of income for these households since non-agricultural opportunities are very few among these farmers. This reduces their purchasing power thereby contributing to the problem of food shortage and starvation among these households.

A flood is a natural event that forms part of the hydrological cycle of rainfall and another source of water. Flooding occurs when the volume of water increases beyond the carrying capacity of a natural or man-made channel after torrential rainfall or anthropogenic activities. In the northern part of the country, flooding is usually associated with the overflow of river banks after heavy rainfall during the peak of the season. The occurrence of the flood is usually devastating and it is mostly felt in the agricultural sector by destroying food crops which is affecting smallholder farmers' food security status (Fig. 1).

Food production in the northern part of the country is declining over the years. Several reports indicate that both natural and man-made hazards are a major challenge facing small-scale farmers in the area. These hazards especially floods have undermined the tenets of food security in the region. It is reported that food availability among households determines the level of their food security. However, annual floods have significantly affected this aspect of food security through the physical destruction of crops both on-farm and off-farm leading to low yield. From the diagram (Fig. 1), the reduction in crop production as a result of the flood is also affecting the purchasing power of individual households to access food since their economic livelihood depends on the availability of crops obtained from the farm. The absence of food availability and accessibility will affect the food utilization and stability in the region which has the potential to cause malnutrition and it related diseases among individual households. The disconnection of the function of these indicators in crop production is the occurrence of food insecurity (Fig. 1).

Measurement of Food Security

It has been established that the measurement of food security cannot be obtained using a single indicator. Instead, the determination of household food insecurity level can be acquired by different methods based on the severity of the condition causing the food shortage to occur. Ndobo (2013) stated that in measuring national food security, the indicator varies as compared to household food security. In measuring the food security status of a nation, two measures are widely used. These are the measurement of projected food supplies and the measurement of nutritional food supplies (Ndobo, 2013). The first one talks about measuring projected food supplies through the use of Gross Domestic Product (GDP) including produced from farming activities and imports from commercial purposes excluding non-food users over a particular period while the second method explains the difference between the projected food supplies and the actual among of food needed by individual or household in a state who do not have enough food because they have to scarce economic resources (Labadorios *et al.*, 2009).

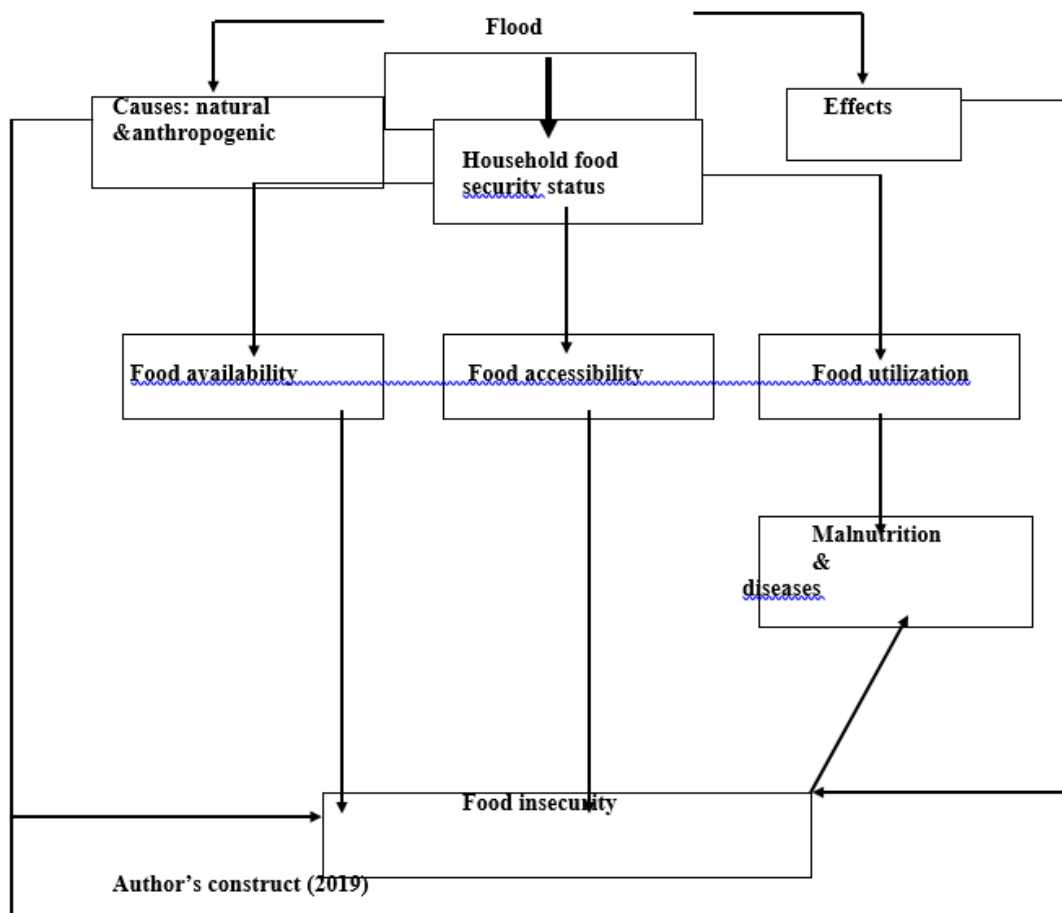


Fig. 1: Conceptual framework of flooding and food security. Source: Author's construct

The need to measure food security at the household level is important because it provides information about how an individual household is affected by the condition of food insecurity and the various coping strategies or mechanisms adopted by these individuals to ensure food security (Qureshi, 2007). According to Faridi and Wadood (2010) measuring food insecurity at the household level is relevant as it ensures that the components of determining food security (availability, accessibility, and utilization) are brought to light.

Throughout history, countries have tried to identify appropriate methods for assessing food security. This is necessary because it enables policymakers to distinguish households that are food secure from those that are facing food insecurity problems and outline the factors that are responsible for causing the problem (Hoddinott and Yohannes 2002). Such information is important because it gives policymakers and other interest groups needed the knowledge to implement policies and programs to assess the changing needs for food security. In discussing food security measurement, several methods exist; however, Hoddinott and Yohannes (2002) identified three broad approaches to measuring food security. These are discussed below.

The Household Food Insecurity Access Scale (HFIAS)

The HFIAS is one of the important indicators used in measuring food security. It involves a continuous process of determining the incidence of household food security in the previous month (Coates *et al.*, 2007). According to Swindale and Bilinsky (2006), the HFIAS operates on the basis that the prevalence of household food insecurity at a point in time can be investigated by quantifying, analysing, and classifying household food insecurity levels. In assessing household food insecurity status, three broad aspects are looked at, which involve, worrying about the likelihood of food insecurity, inadequate quality, and inadequate food supplies Deitchler *et al.* (2011). A study by Mohammadi *et al.* (2011) revealed that the HFIAS ensures that the information obtained is accurate because of its internal consistency, criterion validity, and reliability for analysing household food insecurity.

Household Dietary Diversity (HDD)

The Household Dietary Diversity Score (HDDS) includes all the different kinds of food or food groups that a household consumed over a given period (Hoddinott and Yohannes, 2002). Arguing differently, Maxwell (1991) defined this indicator as to the total measure of all kinds of food groups eaten in the previous 24 h by all members of a particular household at home in addition to those that are prepared at home but eaten out size. In preparing a questionnaire for the HDDs, the questions are designed based on the different food groups which are categorized

according to the food that is eaten at home concerning their nutritional level (Swindale and Bilinsky, (2006). According to Ndobo (2013), the reference period ranges from one to three days or it can extend to one week. Within this period, the HDDS is used to determine whether a household can consume a variety of food or not. A rise in dietary diversity shows an increased chance of a household becoming food secure (FAO, 2007). The rationale behind this is that a household is more likely to have both economic and physical access when on average; it consumes six or several various food groups (Swindale, 2007).

According to, the application of the HDDS is relevant and effective when utilized at the end of natural hazards like flooding to identify households that are affected by the floods and likely to suffer food insecurity. However, this indicator has been criticized by several scholars for its ineffectiveness. For instance, Hoddinott and Yohannes (2002) explains that it is not suitable to investigate individual households regarding the frequency of food consumed and as a result, an inadequate diet cannot be determined. For its, effective utilization, Swindale, (2007) contends that the method is suitable for investigating households that consume the most common crops such as cereals. Despite its lapses, the HDDS is suitable for assessing household food security as it revealed the extent of a balanced diet consumed at the household level (Kingu, 2015).

Household Coping Strategies Index (CSI)

The Household Coping Strategies Index deals with the measurement of food security in individual households in which a group of questions is asked to find out how they manage to cope with the limited availability of food. The index is determined by assessing individual household behaviour such as the things they do when they do not have enough food (Maxwell, 1991). The strategies are usually made known by someone responsible for preparing or consuming the food. According to Maxwell (1991), the coping strategies observed by these individual households are usually associated with food practice in the short term. The CSI has been used by many researchers to determine household food insecurity status in many parts of the globe. For instance, Maxwell (1991) revealed that the most widely used coping strategies by the individual household during the time of food insecurity are; eating food that is less preferred, limiting portion size, borrowing food or money to buy food, and skipping meals.

Food Security Challenges in the World

The need to maintain global food security for some time now has seen significant development. During the introduction of the concept in 1970, the whole world was going through a food crisis which was also worsened by

the Cold War. As a result of such circumstances, food security was seen as a political concern in which nations wanted to maintain their dignity by relying on their own to the detriment of the global market. Despite the collaborative effort of multinational organizations like FAO, WFP, UN, and IFAD in ensuring food security in the world, household food insecurity continues to increase across the globe. According to FAO (2017), the number of malnourished people in the world has increased from 777 million people in 2015 to 815 million people in 2016. This means that after several years of concerted efforts to end hunger and starvation in the world, the problem is still lingering among households. Several reasons accounted for this situation and a key among them is climate events such as floods. According to Yaro (2013), the influence of climate events especially the occurrence of floods is among several natural hazards which are negatively affecting individual households who depend on the environment for their source of livelihood. The effects of floods on crop production range from the local to the global levels and its impact can lead to short, medium, and long terms consequences on household food security (Wisner *et al.*, 2006).

Research has shown that floods have led to a reduction in crop yield in any part of the globe and it is estimated to further bring about a drastic decrease in crop production especially cereals shortly. For example, in 2003, extreme temperatures were recorded during the summer season, which brought about a reduction in food production in Europe resulting in cereals and vegetables being the most affected. Cereal production fell to about 30 percent in France and Italy (Ciais *et al.*, 2005; Battisti and Naylor, 2009). Smallholder farmers whose source of livelihood depends on agriculture are always the most affected by the occurrence of this hazard.

Again, the impact of the flood is recognized through the destruction of crops resulting in insufficient crop yield and also the untimely submergence of crops on the farms leading to limited availability of food among households can result in food insecurity. The limited availability of food can also have a negative consequence on the general development and health status of the individual (Alam, 2016).

In Sub-Saharan Africa, floods have drastically reduced crop production and have left many countries in dire need of food aid. This is because, in Africa, the cultivation of crops is climate dependent and so the variations in the climatic variables are negatively affecting food production in the region (Alam, 2016). further noted that many Africans are not able to acquire sufficient and quality meals for their household members and this have affected their nutritional as well as health status.

Food Security in Ghana

Ghana's quest to achieve sustainable food security and reduction of poverty has been confronted with the problem of a decline in crop production due to natural

hazards (Devereux, 2007; Challinor *et al.*, 2007). This can be seen from the perspective of increasing extreme weather events like floods leading to loss of crop production and rising prices of foodstuff. The country has improved significantly on the national level concerning food stability among households. However, this achievement is not a true manifestation of what is on the ground in all the regions of the country (Namaa, 2017). The three regions of the north have experienced intermittent food insecurity for some time now due to unfavourable weather conditions such as flood, drought, and desertification which are hindering crop production (UN, 2011).

Ghana has experienced chronic and transitory food insecurity in the past years in which many of them were weather induced-causes (Namaa, 2017). Apart from the 2008 global food crisis, the country was affected by a drought in 1983 which is considered the worst natural disaster to ever occur in the country. According to Demi and Kuwornu (2013), people resorted to eating all kinds of foodstuff to survive since there was an acute shortage of traditional Ghanaian food. Recent projections about the country's food stability point toward a negative direction. The WFP (2012) and revealed that about 1.2 million Ghanaians representing 5% of the total population do not have access to adequate nutritious food and need food aid. Demi and Kuwornu (2013) further stated that these households make up about 55 percent of people who are in small-scale farming. The factor responsible for this fall in food production among these households is climate variability resulting in extreme weather events such as drought and flood which is affecting crops yield (Schlenker and Lobell, 2010). Arguing differentially, Bakker (2009) again attributed this to household poverty, high literacy rate, and an over-reliance on the agricultural sector with little resources to access food at the national level.

Previous and present governments have over the years tried to improve the agricultural sector by formulating policies and programs aimed at enhancing food security in the country. For instance, around the 1970s, the Acheampong government introduced a policy in the agricultural sector known as "Operation Feed Your Self". This policy was aimed at putting in place measures and strategies like subsidizing fertilizer to enable people to go into farming to improve crop production (Demi and Kuwornu, 2013; Namaa, 2017). However, these policies were not successful as a result of challenges from natural hazards. These challenges range from weather-related hazards to man-induced ones which affected the program and retarded crops production in the country Demi and Kuwornu (2013) further noted that items meant for the agricultural purpose were distributed to party supporters and sympathizers thereby worsening the plight of smallholders' famers with regards to their food security.

Food Security and Households' Coping Strategies

The need to ensure food security within households is not a recent event. Throughout the history of human civilization, the fear of households becoming food insecure was a major concern for leaders as identified in the Bible during the time the Israelites were in captivity in Egypt. As years pass by, efforts have been made by stakeholders in both developed and developing countries in ensuring a stable and safe food supply for their people (Tour, 2016). According to the and FAOSTAT (2009), there has been a significant increase in food production over the century, allowing for a massive decrease in the number of people in the world who do not have sufficient food to eat and are starving although there has been a doubling of the total population in the world. Despite these gains, achieving food security is still a major challenge and concern for world leaders, particularly in developing countries where the issue of climatic hazards notably floods are having a massive effect on crop production coupled with a high level of poverty. The FAO (2007) has observed that one out of every seven people still suffers starvation and lack of insufficient nutritious and energy food leading to malnutrition.

According to Maxwell *et al.* (1991), coping strategies are defined as how households adapt during the event of a food shortage or when food security is under threat as a result of natural hazards and the people who are tasked with the responsibility of preparing and serving meal are asked a series of questions concerning how households are responding to the food shortage. Coping strategies are important measures in ensuring food security during the event of food shortage in that it helps minimize the impact of the negative hazard on the lives of the people once it occurs (Rose, 2008). Coping strategies adopted by households during food crises differ depending on the nature of the event and the available resources at their disposal. According to cited in Bedeke (2012), various strategies adopted by the individual household during the period of food shortage include selling their assets, engaging in part-time work, seeking assistance from acquaintances, and venturing into income generating activities, and engaging in food for work activities. In some instances, others also get food relief items from NGOs and the government.

Mjonono *et al.* (2009) opine that other coping strategies include consuming less expensive food, borrowing food from friends and relatives, searching and gathering wild food, selling one-possession such as livestock or poultry, harvesting immature crops for consumption, consuming seedlings stored for the next season, sending household members to eat elsewhere; limiting the quantity of meal served at mealtime, restricting adult consumption in favour of small children; reducing the number of meals eaten in a day; skipping one or two of the three square meals and begging from neighbours or friends.

Studies have shown that households' increased reliance on coping strategies as an alternative source of being food secure is an indication of lower food availability which could result in transitory or chronic food insecurity Maxwell *et al.* (1991) further revealed that the weighted sum of coping strategies can be used to calculate the different strategies used by households to ensure food security where "often" is counted as a 4, "sometimes" is counted as a 3, "rarely" is counted as a 2, and "never" is counted as a 1. In this case, the higher the sum, the more food insecure the household is. Different scores are ascribed to the levels of household food security because coping strategies are not the same for all people and so some families are extremely food insecure and may skip the three-square meals than others who may change their eating preferences from quality food to less quality.

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Author's contributions

John Aloba Atubiga: The manuscript was written by the designed the study and sub-segmentally wrote the report the AJA did the proof reading of the final document.

Eric Donkor: Did the proof reading of the first draft and also the final draft.

Ethical Considerations

Ethical considerations in research play a significance role in research regardless of the data collected (Saunders *et al.*, 2012). This study considered ethical issues which were inclusive of confidentiality, anonymity and safety. The document was checked for plagiarism and all cited works are reflected in the reference list. In addition, the research does not involve data fabrication.

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