**Understanding Flood Effects, Management Practices, and Challenges in the Effutu Municipality: A Comprehensive Analysis**

**Abstract**

This study aims to comprehensively investigate flood-related issues in the Effutu Municipality, aiming to understand the direct and indirect impacts of floods on residents' lives, identify challenges to flood management, and propose recommendations for enhancing flood resilience and disaster preparedness. This study employs a mixed-method approach to investigate flood-related issues in the Effutu Municipality, combining quantitative data from structured questionnaires with qualitative insights gathered through interviews, focus groups, and observations. The research design targets residents, NADMO personnel, university community members, and those within flood-prone areas. Purposive sampling ensures the representation of relevant expertise and experiences in flood disaster management. Research instruments undergo validation and reliability testing to ensure robustness. Ethical considerations prioritise participant confidentiality and inclusivity. Data analysis reveals significant impacts of floods on citizens' lives, including agricultural losses, property damage, disruptions to education and work, and loss of life. Challenges to flood management include residents' perceptions, limited resources, and institutional constraints. It is recommended that enhanced public awareness and education be provided to residents about the long-term risks of flooding and the importance of proactive measures to mitigate these risks. This would equip residents with the knowledge and skills to prepare for, respond to, and recover from flood events. It is also recommended that Policy Reform and Institutions be Strengthened to reduce flood hazards. Advocate for policy reforms should be based on addressing the underlying drivers of vulnerability to flood hazards, including land-use planning regulations, housing policies, and disaster risk financing mechanisms.

**Keywords:** Flood, Effects, Management, Practices, Challenges

1. **INTRODUCTION**

Each year, flood disasters cause tremendous losses and social disruption worldwide (Glago, (2021). In 2018, several countries and States across the Globe were hit by flood disasters, including Argentina, where there was a severe flood on January 20 2018, whilst Texas in the United States of America also experienced a flood within the same year on October 17 2018. Moreover, the Northern part of Ghana had its share of the flood disaster on September 21, 20018, due to heavy rains, and the spillage of the Bagree dam of Burkina Faso also contributed to the flood. Furthermore, the capital of Ghana (Accra) was flooded on June 19, 2018, due to torrential rains (NADMO, 2018). Finally, Winneba had its share of flood disasters on June 20, when some part of the Municipality was affected due to rains and the accumulation of water from some part of the Eastern region of Ghana into the Ayensu River, a source in Winneba. It is believed that over 250 million people around the Globe are affected by natural disasters each year (www.reliefweb.int/disaster/fl-2018). While many countries are progressing in systematically recording disaster losses, most losses due to extensive disaster events are unaccounted for (UNISDR, 2009).

Flooding has always been an issue of great concern both internationally and locally. In 2018, specifically on October 17, most of Texas' states were flooded after extreme rainfall, to the extent that the authorities of Texas declared a state of emergency. One will ask why a beautiful state like Texas should be hit with a flood because it is believed they have all it takes to manage flood and to direct it to proper use after the rains. However, unfortunately, despite all the policies and programs that have ever been put together by the authorities of Texas State and the expertise available to the people of Texas, they could not control the flood that resulted from the rains till it ended up as a disaster that called for States of Emergency (Hegar, 2018).

Furthermore, because flood disasters have always been an urgent issue that society needs to address, the Africa Union Commission (AUC) has seen the need to develop programmes to curb natural disasters in the subregion. An example of that programme is Building Disaster Resilience to Natural Hazards in the Sub-Saharan African Region, Countries, and Communities.

Ghana, one of the developing nations within sub-Saharan Africa, is constantly hit by floods in some parts of the country, especially its capital, Accra. Accra has experienced periodic floods leading to the death and destruction of properties, which is estimated to be around UD$ 780,500,000 (Dekongmen, Kabo-bah, Domfeh, Sunkari, Dile, Antwi & Gyimah, 2021). One of the most destructive flood disasters that hit Ghana was the June 3, 2015, flood disaster resulting from torrential rains. The government, through its agency responsible for managing floods and other forms of disaster, the National Disaster Management Organization ( NADMO), has put several programs in place to curb the consistent occurrence of floods. However, the policies and programs are not yielding the required result, hence the occurrence of floods every year. Moreover, flooding has persisted and is increasing in frequency despite several programmes and projects designed and implemented by the Ghana government over the years.

Flood disasters substantially inhibit economic development and create more significant difficulties for many of the regions' poor (UNDP/NADMO, 2009). Today, there appears to be significant public concern about the perennial floods that ravage the region and the social and economic consequences. The relevant institutions and partners seem overwhelmed by the adverse effects of dealing with the problem. Effutu Municipality is located on the coastal belt of Ghana and has several rivers, streams, the Atlantic Ocean and several water bodies, making the Municipality very vulnerable to flood disasters. On this note, the researcher wants to research the effects and management practices of flood disaster management in the Effutu Municipality.

The study addresses these research questions: (1) what are the effects of floods on the Effutu Municipality? (2) What are the main challenges to flood management in Efutu Municipality? (3) What are the flood management practices in Effutu Municipality?

**1.1 Theoretical framework of flood management**

In crafting the urban resilience theory to flood, Liao (2012) proposes a flood hazard management approach geared towards adaptation and resilience rather than hard-engineering structural flood control. Before narrowing down on this theory, another goes on to distinguish two broad interpretations of resilience: engineering and ecological resilience (Holling, 1996) and defends the ecological resilience interpretation. Liao (2012) states, " In engineering, resilience is concerned with a disturbance that threatens the functional stability of engineering systems, which are often linked with low probabilities of failures or, in the case of failure, quick recovery to normal levels of functionality". Liao (2012) argues that engineering resilience concerns how well a system recovers (bounces back to full functionality after undergoing stress). Resilience in itself is, according to Aldunce, Beilin, Handmer, and Howden (2014), a concept that has its origins in physics and mathematics but one that has also been applied in describing adaptive capacities of individuals, communities and even larger societies.

They go on to state that community resilience has to go hand in hand with defiling "Community" and, as such, go on to define it as a unit that shares geographic boundaries and that is subject to similar built, social, natural and economic environments that interact in a complex way to affect how the unit functions. Aldunce, Beilin, Handmer, and Howden (2014) explain the concept of community resilience as an integrated unit's capabilities to recover following contact with hazards. This capability is aided by its efficient use of the physical and economic resources.

## 1.2 Effects of flooding

Flood disasters impose the most significant burden on developing countries. The inter-regional distribution is variable, based on income disparities. The per capita burden of catastrophic losses is dramatically higher in developing countries. The effects of flood disaster risk management are often suffered most by the poor, uneducated, very old or very young, the sick, and the oppressed (Comfort et al., 1999). Flood disasters cause significant infrastructure damage, such as disruption to transport, electricity, water supply, and sewage disposal systems. The economic effects of floods are often much more significant, spreading well beyond the flooded area and may last much longer than the flood itself. Flood impact interpretation may positively impact, though most flood assessments emphasise the adverse effects. These effects on humans could be direct/tangible and/or indirect intangible (Smith & Ward, 1998).

## *Direct effects*

Direct or primary effects of floods include damage caused by direct flood waters coming in contact with humans and damageable property. Physical assets such as shelter and infrastructure will be more susceptible to damage as the frequency of flooding increases. Gall. Nguyen and Cutter, (2014). Direct disaster losses refer to the directly quantifiable losses, such as the number of people killed and the damage to buildings, properties, infrastructure and natural resources. Though human lives, livestock, and buildings are lost, capital infrastructure such as roads, culverts/bridges, and drainage systems are often seriously affected (Smith & Ward, 1998).

In most cases, a flood affects many houses, making the families or occupants in those houses or buildings homeless. Sometimes, one’s shop is washed away by the flood, and several properties are affected. These are the effects one can feel because if the flood has washed away one's house, the family will be homeless till they find a new place to stay or repair their damaged house to enable them to live together. The effect will be felt directly because that is where the individual earns a living to care for his/her family.

## *Indirect effects*

Disaster losses include not only the shocking direct impacts that we see on the news, such as the loss of life, housing, and infrastructure, but also indirect impacts, such as the foregone production of goods and services caused by interruptions in utility services, transport, labour supplies, suppliers or markets. Secondary losses include impacts on such macroeconomic variables as economic growth, balance of payments, public spending, and inflation (Smith & Ward, 1998). The indirect effects mainly involve losses that are difficult to assess financially. Floods directly modify the natural environment and undermine low-income people, who depend on local ecosystems for various goods and services (Gall et al., 2014). Indirect effects include declines in output or revenue and impact on the well-being of people, which generally arise from disruption to the flow of goods and services due to a disaster. Changes in local ecosystems entail changes to agricultural systems and practices that form the basic livelihood of low-income people. The loss of an entire harvest reduces livelihood security, the contamination of potable water supplies, unhygienic conditions, and the incidents of infectious diseases like cholera and waterborne diseases are all indirect and are predicted to rise with flooding. Another important indirect impact is that funds targeted for development are reallocated to finance relief and reconstruction efforts, jeopardising long-term development goals, especially in developing countries (Smith & Ward, 1998).

Natural disasters, therefore, impede progress towards social and economic growth, as they wipe out investments made and divert resources from federal, state, and municipal/district assembly budgets and aid agencies to recovery activities (UNISDR, 2004). With the changes in the global perception of risk, a country can be adversely affected if investors demand higher rates of return. Increased investor demand can lead to increased household costs, declines in income, slower economic development, and poor livelihood security.

**1.3 Challenges to Flood Management**

The literature, especially from development agencies, discusses various factors constraining disaster management (Khan, O’Sullivan, Brown, Tracey, Gibson, Généreux, & Schwartz, 2018).

***Human attitudes***

Human beings were naturally to be disaster control ambassadors, but recently, their actions have made it very difficult to manage disasters, especially flood disasters. These days, the sitting of our homes does not matter anymore as a plot of land can be used to put up a small building for residential purposes. One does not care if his/her house is close to a river or water body; in many instances, the authorities try to stop them. However, they refuse and use any means possible to proceed with the project. Finally, when there is a flood disaster, they will be the same people who call for help from the government and other organisations.

***Planning***

Planning under factors that promote flood disaster management can be grouped into four. The first is institutional disaster planning. United Nations Disaster Risk Reduction, UNDRR (2010) defines the general scope of humanitarian actions that the National Society and International Federation will undertake. It is based on the organisation’s institutional mandate, which provides a framework for defining its policies, strategies, standards, norms, and legal remit.

The second is the Disaster Response Plan**.** This involves identifying, strengthening, and organising resources and capacities to reach a level of preparedness for a timely and effective response to a potential disaster. Disaster response planning is preliminary, based on educated assumptions of risks and hazards, and does not address specific disaster scenarios, as in the case of contingency plans. Once a disaster occurs, plans must be monitored, evaluated, and adapted to the situation.

The third is contingency plans. These are based on specific events or known risks at local, national, regional, or even global levels (e.g., earthquakes, floods, or disease outbreaks) and establish operational procedures for response based on anticipated resource requirements and capacity.

The fourth is Standard Operating Procedures(SOP). These are a set of standard procedures that operationalise the disaster response and contingency plans. In other words, SOPs specify how individuals or units will perform their functions under the plan. They also set out what should be done, how it should be done, who is responsible for implementing what, and what resources are available.

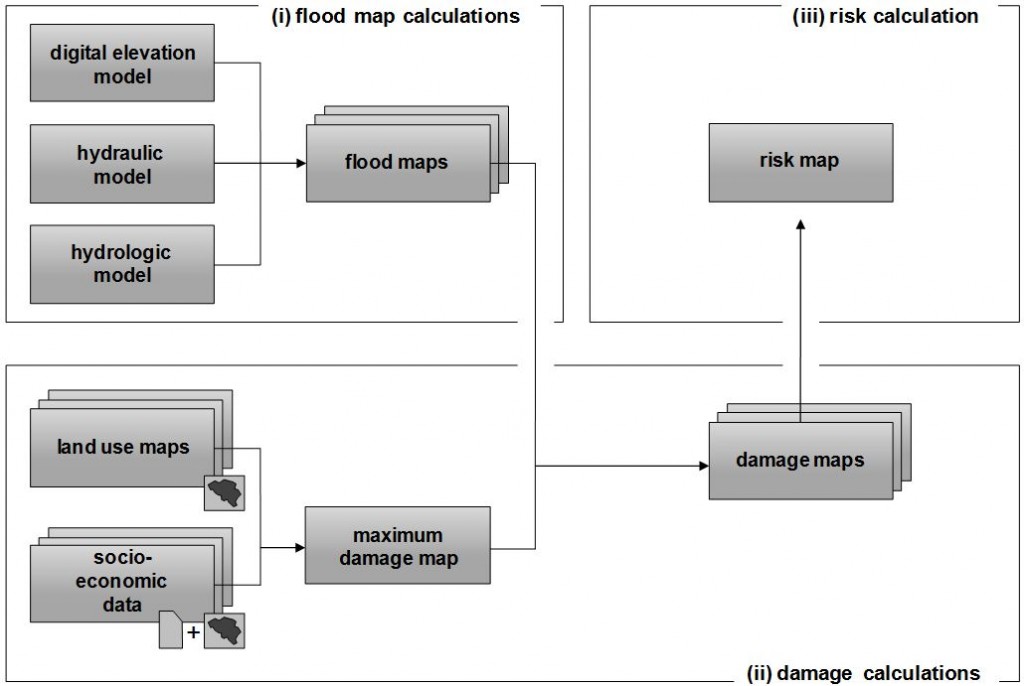
Resources here can be grouped into two categories: human resources and material resources. Human resource problems are related to staffing. Inadequate qualifications are needed for staff or personnel who will help prevent disasters by giving education during the rescuing moment and after the disaster by giving or distributing relief items to the affected people or victims. Material Resources are funding-related.The inadequate funds to purchase disaster relief items that will be used before, during, and after the disaster to help the victims return to normal. In most cases, the agencies responsible for managing disasters complain of their budget being slashed by the government, making it very difficult for them to do what they are expected to do in times of disaster (Loewenstein, 2015).

**1.4 flood Management Practices**

The main thrust of flood disaster management practices is to modify the floods through specific structural measures such as reservoirs, embankments, channel improvement, town protection and river training works. Whichever paradigm is adopted, flood management practices have been an efficient process. The main steps for flood disaster management are briefly discussed below:

***Flood risk calculations***

Kellens, Terpstra, and De Maeyer (2013) presented flood risk calculation methodologies overviews. Until now, the majority of flood risk calculations only consider economic losses. Social cost-benefit analyses are ideal for combining the tangible (economic losses) and intangible elements (social and ecological aspects). Vanneuville, Wolters, Scholz, and Uhel (2016) elucidate the data type needed to calculate flood risks. Flood risk calculation combines the flood maps (i.e., hazard maps) with the land-use maps (i.e., vulnerability maps). Stage-damage curves often define a relation between the water depth (or another flood characteristic) and the expected damage for each land-use category. Many functions have been proposed in the past, either on theoretical grounds or on empirical grounds.

*[](http://earthzine.org/wp-content/uploads/2011/03/Image-11.jpg)*

**Figure 1: Derivation scheme of flood risk mapping in Flanders (Kellens et al., 2013).**

The Digital Elevation Model (DEM) plays a key role in the flood risk methodology (Ludwig, Ramsey, Wood, Pennaz, Godt, Plant, & Bright, 2018). A Digital Elevation Model (DEM) is a specialised database that represents the relief of a surface between points of known elevation. It is based on laser scanning in rural areas with 1 point per 4 m2 during recording. Photogrammetric interpretation based on stereoscopic aerial photos is used for urban areas, resulting in 1 point per 100 m2. Additional break lines are added to compensate for the lower point density. This high density of elevation points is needed, as the topography is relatively flat in a large part of the territory. The local variations must be in the model to accurately delineate the flooded area. Local embankments or quarries not immediately included in the elevation model create over- or underestimation of the flood zone.

Also, successful flood risk calculation relies on a detailed and uniform land-use map since it determines what is damaged in case of flooding. The Flemish methodology distinguishes various land-use categories (e.g., urban area, industrial area, infrastructure, cropland, pastures). This is further subdivided according to their vulnerability level, which is related to the desired level of detail. A high level of thematic detail is needed where the damages are high or highly varying (e.g., built-up area, industry and infrastructure) and less where the (economic) damages are low (e.g., different types of pastures of nature areas).

The vulnerability of the land-use categories is determined by various socio-economic data (e.g., replacement values). Airborne and space-borne data sets have been found promising concerning spatial distribution and update frequency of land-use data. Recently, cadastral information has been employed to calculate the damage to individual houses and industrial sites, resulting in a higher level of detail (Vanderkimpen, Rocabado, Cools, El-Sammany, & Abdelkhalek, 2010). In this methodology, each country collects socio-economic information differently and applies interpretation keys of land-use information in a (slightly) different way.

***Flood forecasting***

Flood forecasting involves giving prior information regarding the occurrence of floods (Aldunce, Beilin, Handmer, & Howden, 2014). This is essential and extremely useful for taking timely action to prevent the loss of human lives, livestock and movable property. It is usually done through a Flood forecasting network. This centres on daily flood forecasts and warnings throughout the flood season. Flood forecasting involves the following four main activities:

* + - Observation and collection of hydrological and hydro-meteorological data;
    - Transmission of data to forecasting centres;
    - Analysis of data and formulation of forecast; and
    - Dissemination of forecast.

The utility of flood forecasts is dependent on both accuracy and timeliness. The organisations responsible for flood protection, warning and flood-fighting work on the principle that "A Flood Forecast received too late to take the necessary flood fighting measures is of 'No' use." Therefore, forecast bulletins are issued as early warning measures depending upon the urgency and available mode of communication media. For effective forecasting, state governments set up "Central Control Rooms", which receive these forecasts, disseminate the warning to the affected areas, and organise relief and rescue operations. Upon receiving "Fresh Information", a revised forecast is issued if the situation warrants. During high flood stages, the "Control Room" of the forecasting centre works around the clock and keeps flood fighting agencies informed about the latest river position. They work in close collaboration ((Aldunce, Beilin, Handmer, & Howden, 2014).

***Reduction of runoff***

Runoff reduction is a very effective method of flood disaster management ((Aldunce, Beilin, Handmer, & Howden, 2014). Runoff can be reduced by inducing and increasing surface water infiltration into the ground in the catchment area. This can be done by large-scale afforestation, particularly in the catchment area. Afforestation helps in the reduction of runoff in the following ways:

* The canopy of the forest cover intercepts the falling raindrops, and the roots, leaf litter and humus can hold water.
* Together, these encourage infiltration and reduce runoff.
* Runoff reduction helps reduce soil erosion and sediment load in the streams.
* Reduction in stream sediment load reduces siltation and helps maintain the water-accommodating capacity of the rivers.

Runoff can be reduced by artificially inducing infiltration by digging wells along the beds of ephemeral channels. A series of dug wells helps store and channel surface water.

***Reducing flood peaks by volume reduction***

This involves constructing dams and detention basins. The construction of dams and detention basins can reduce the flood peaks. Dams can hold vast quantities of water during the flood period and help reduce flood peak volume of water. Water stored in reservoirs created by constructing dams can flow down the stream under controlled conditions depending upon the accommodating capacity of the river downstream of the dam. These dams have helped in mitigating flood-peak in the downstream reaches. Apart from the dams described above, ponds, tanks, and surface storage structures also check floods and help harvest water for dry seasons. Other detention basins include natural depressions such as marshes in plains and old quarries and mines.

***Reducing flood levels***

Flood levels are reduced in many ways. The following ways are noted within the literature (Linnerooth-Bayer & Amendola, 2003).

* Stream channelisation**:** A close network of canals reduces flood hazard to a great extent because flood water flowing in the river can be diverted to canals. Canals serve as temporary storage and hold water as flood waves move downstream, thus helping to reduce the severity of the flood.
* Channel Improvement**:** Channel improvement involves deepening, widening, straightening, lining, and cleaning vegetation and debris from the river channel.
* These changes in the river channel increase the flood conveyance capacity of the river. Channel improvement is supplemented by bank stabilisation by constructing ripraps, dykes or spurs and planting deep root trees on embankments. In a meandering river, meander loops impede drainage and retard the disposal of flood water. Whenever the river meanders become incredibly sharp, they can be straightened by artificially cutting an individual or a series of bends.
* Flood Diversion**:** Flood diversion diverts the flood water in marshes, lakes, and depressions and spreads it thinly over paddy fields and desert lands (Linnerooth-Bayer& Amendola, 2003).

***Protection against inundation (Construction of embankments)***

In the 1940s, building embankments was considered the only way of controlling floods. It is still considered one of the most effective devices against the inundation of inhabited areas and agricultural land. Construction of embankments has been taken up at a large scale in India, where more than 44,451km of embankments have been constructed (Aldunce, Beilin, Handmer, & Howden, 2014).

***Emergency relief response and recovery***

Response occurs when the hazard is about to happen or is happening and involves real-time disaster response (assessment, coordination, and relief). Rehabilitation focuses on recovery, taking into account long-term planning objectives (Pelling, 2003). This framework has been applied in many different contexts, i.e., the landslides and tsunamis on the east coast of Canada (Liverman, Batterson, and Ryan, 2001). It is very clear that access to public infrastructure comprises a significant component of the wealth of the poorest households. Therefore, the annual direct damage to rural infrastructure due to natural disasters, such as roads, bridges, irrigation, electrification, and schools, is said to cost billions of dollars around the Globe, pushing the poor further down the poverty drainpipe (UNDP, 2004). The links between poverty and disaster vulnerability make disaster management an important part of development planning, particularly in developing economies where poverty levels are starting. While these elements are critical for effective disaster risk reduction, they are not always designed to bring about long-term development concurrently.

***Institutional frameworks for flood management***

Governments worldwide located within flood-prone zones often develop policies and strategies to reduce the occurrence of flooding and lower the effects on populations living in the flood plains. In many countries, rivers prone to floods are often carefully managed (Dunne & Leopold, 1978), using structural measures such as levees, bunds, reservoirs, and weirs to prevent rivers from bursting their banks. When these defences fail, emergency rescue measures reduce the effect on the people.

Disaster risks can be minimised, and losses can be substantially reduced by enabling local bodies such as unions and municipalities to undertake planned interventions. Most governments have national disaster and emergency policies, with special ministries, departments, and agencies responsible for disaster preparedness and response. For example, in Vietnam, the Department of Dyke Management, Flood and Storm Control, the Hydro-meteorological Service, and the Red Cross are in charge of planning and implementation of appropriate mitigation (development) strategies to significantly reduce the drudgery and cost of rescue, relief, resettlement and reconstruction (Huu, 2011).

Disaster risk reduction in Ghana has its main institutional home within the National Disaster Management Organization (NADMO), established in 1996 under a National Security Council under the NADMO Act (Act 927, 1996) in the Ministry of the Interior. The organisational framework indicates that NADMO is responsible for assisting the Government of Ghana in observing and investigating the establishment and implementation of the annual flood preparedness solutions and plans for all disaster types and phases. NADMO functions under a National Secretariat in Accra with 10 Regional Secretariats, 170 District/Municipal Secretariats and 900 Zonal offices. Since its inception, NADMO has contributed considerably to managing disasters nationwide despite a constant struggle to obtain resources and maintain response capacity on the ground.

The National Disaster Management Committee (NDMC) has administrative oversight responsibilities for NADMO and reports to the National Security Council, which is NADMO's Governing Council. Seven hazard-specific technical committees of governmental and non-governmental experts have been established to advise the NDMC on specific issues. Confronted with various natural hazards and prompted by the recent floods in the north, the Government of Ghana initiated actions on several fronts to develop strategies and strengthen institutional capacity in disaster risk management. A draft of the National Disaster Management Plan (NDMP) has recently been prepared to revise the 1997 NDMP and amend the Act (UNDP/NADMO, 2009).

***Adaptation measures***

Adaptation measures are connected with the concept of resilience. Adaptation is not about returning to some prior state because all social and natural systems evolve and, in some senses, co-evolve with each other over time (Tomkins & Adger, 2004). Adaptation refers to the actions people take in response to, or in anticipation of, projected or actual changes in climate to reduce adverse impacts or take advantage of the opportunities posed by climate change. Paton, Millar and Johnson (2001) recognise the importance of the nature of social relationships as a factor that can enhance resilience. Although the lessons from these studies are context-specific, they establish some broad criteria by which to assess the adaptive capacity of communities. The nature of the relationships between community members is critical, as are access to and participation in the broader decision-making processes (Adger, 2003).

Social resilience often describes the capacity for positive adaption despite adversity (Luther, Cecchetti and Becker, 2000). In climate change, social resilience is the ability of groups or communities to adapt to external social, political, or environmental stresses and disturbances (Adger, 2000). resilient, societies must generally demonstrate the ability to safeguard against disturbance, self-organise, learn, and adapt (Trosper, 2002). Social resilience in this context appears to be promoted through at least two distinct forms of cross-scale interaction: Network and community relations of individuals and groups operating to cope with variability and change in everyday decision-making and broader networks of individuals or groups who may be able to influence the decisions that are being made at the local scale.

These approaches offered pathways for vulnerable communities to engage in developing response policies and ensure that there is room for change in those policies. These principles are relevant to climate change situations in which there is much uncertainty and disagreement about managing the potential consequences of climate change issues. However, there is a need to take anticipatory adaptive action. Networks can be explored regarding the access to power and the representation they provide participants (Cox, 1998). For instance, networks of engagement, the support they offer to participants in vulnerable positions (networks of dependence) and the expansion of their engagement are critical to enhancing resilience in communities affected or likely to be affected by climate change.

Adaptation is not about returning to some prior state because all social and natural systems evolve and, in some sense, co-evolve with each other over time. Adaptive co-management may promote the expansion of networks and thus enhance social resilience in responding to climate change (Lee, 1999). However, their networks enable individuals to engage in the wider decision environment that will affect their longer-term resilience (Tompkins et al., 2004). The existence and usefulness of these networks are determined by institutional and social factors (Trosper, 2002).

At the community level, reducing the barriers to communication through sharing information and feedback that provides positive reinforcement is an important element in consolidating networks of dependence. At the institutional level, integrated institutional structures may be better able to support the inclusion of climate stakeholders in decision-making processes to ensure that an audience can address their needs as widely as possible. The wider community is being drawn on for assistance and advice. The adaptive management processes are informed by iterative learning about the ecosystem's earlier management successes and failures and increased threats of climate change and disasters. Present-day resilience, which in turn increased the ability to respond to the threats of long-term climate change today, resulted from time-tested adaptation strategies. According to Lee (1999), this type of adaptive management can be used to pursue more excellent ecological stability and more flexible institutions for resource management.

***Risk assessment/analysis***

This is a methodology for determining the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods, and the environment on which they depend. The process of conducting a risk assessment is based on a review of both the technical features of hazards, such as their location, intensity, frequency, and probability, and the analysis of the physical, social, economic, and environmental dimensions of vulnerability and exposure while taking particular account of the coping capabilities related to the risk scenarios (WHO/EHA, 2002).

The level of loss a society or community considers acceptable given existing social, economic, political, cultural, technical and environmental conditions is termed acceptable risk. In engineering terms, acceptable risk is used to assess structural and non-structural measures undertaken to reduce possible damage at a level which does not harm people and property, according to codes, among other issues based on a known probability of vulnerability (WHO.EHA, 2002).

**2. Methodology**

This study utilised a mixed-method approach, incorporating quantitative and qualitative data collection methods. Quantitative data involved structured information, while qualitative data comprised open-ended insights gathered through interviews, focus groups, and observations. A mixed-method research design was adopted to comprehensively explore respondents' insights on flood-related issues in the Effutu Municipality. The population encompassed residents of the Effutu Municipality, including NADMO personnel, university community members, and residents within the catchment area from Klimovic to Kojo Beedu. The accessible population comprised 250 individuals. Purposive sampling was employed to select individuals with relevant expertise or experience in flood disaster management. This included individuals affected by floods and those with significant work experience in the field. Additionally, key institutions involved in disaster planning and management were included in the sample.

Data collection methods comprised the administration of structured questionnaires, unstructured interviews, and field observations. Closed-ended questionnaires with Likert scales were utilised, supplemented by unstructured interviews to gather nuanced information. Field observations involved systematic assessments of flood-prone areas during the rainy season. Content validity was ensured through expert review, while reliability was established through the test-retest method and pilot study. Steps were taken to ensure clarity, coherence, and consistency of the research tools.

Ethical considerations included maintaining participant confidentiality, ensuring transparency, and being accountable to residents and local authorities. Measures were taken to promote inclusiveness and minimise participant selection and data collection bias. Qualitative data from interviews were analysed using content analysis, categorising responses into themes and sub-themes for comparison. Quantitative data were analysed using descriptive statistics, such as frequencies and percentages, facilitated by software tools like Microsoft Excel.

**3. RESULTS AND DISCUSSION**

**3.1 Effect of Flood in Effutu Municipality**

This section examines the effect of floods in the Effutu municipality and presents people's views on the direct and indirect effects on citizens' lives.

*The flood takes over our farms, and all plants die off. When it happens this way, we cannot visit the farms and harvest the produce. Seedlings and nursery beds go to waste, and as a result, all money(loans) from the banks for farming go to waste, and we have to pay the banks from our pockets or sell our personal belongings to save ourselves from disgrace.*  (**Interview with a tomato farmer)**

*Whenever we encounter flood issues in Effutu, the victims lose numerous properties. These include household items, office equipment, money and other valuable items.* (**Interview with District Assembly Official**)

*Floods affect our lives badly, so our children must stay home for weeks before returning to school. It takes weeks for us to gather ourselves before going back to work. Depending on the intensity of the flood, some families lose the lives of siblings.* (**Interview with a resident within Winneba Township**)

**3.2 Challenges of Flood Management**

This section also evaluates the main challenges to flood management in Effutu Municipality**.** The study examines why people who suffer flood disasters continue to live in the same place, the most important reason why flood victims remain in flood-prone areas, the main reasons preventing people from leaving flood-prone areas, and the main challenges facing flood disaster management in Effutu.

**3.2.1 Reasons Preventing People from Leaving Flood Prone Areas**

This section examines why victims of flood disasters continue to live in the same place. Answers were sought from the following: flood victims assume that flooding is a temporal experience; victims assume flooding will not occur again; lack of political will to evict; and they have no alternative place to relocate. The results are shown in Table 1 below.

**Table 1: Why do people who suffer floods continue to live in the same place?**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **strongly agree** | **agree** | **not sure** | **disagree** | **strongly disagree** |
|  | **(%)** | **(%)** | **(%)** | **(%)** | **(%)** |
| Flood victims assume that flooding is a temporal experience | 147  (58.8) | 107  (42.8) | 3  (1.2) | 0  (.0) | 0  (.0) |
| Victims assume flooding will not occur again | 170  (68.0) | 77  (30.8) | 0  (%) | 1  (.4) | 3  (1.2) |
| Lack of political will to evict | 130  (52.0) | 101  (40.4) | 19  (7.6) | 0  (.0) | 0  (.0) |
| They have no alternative place to relocate | 89  (35.6) | 91  (36.4) | 49  (19.6) | 13  (5.2) | 8  (3.2) |
|  |  |  |  |  |  |

Table 1 above shows that most participants either agreed or strongly agreed with all the indicators concerning why flood victims continue to live in flood-prone areas.

This was more pronounced concerning where victims assume that flooding is a temporal experience. On that score, only three participants were not sure; 147 strongly agreed, and 107 agreed. The majority of participants’ responses followed a similar trend. The responses related to the suggestion that victims assume flooding will not occur again also received similar responses, with 170 strongly agreeing and 77 agreeing. One person disagreed, while three strongly disagreed. Interestingly, the lack of political will to evict people from flood-prone areas also received very high responses, as 130 strongly agreed and 101 agreed to this as why people continue to live in flood-prone areas. Only 19 participants indicated they were not sure. Whereas this corroborates the earlier responses concerning the causes of flood disasters within the Municipality, the results raise some issues with what may be described as a temporality syndrome.

This is because most people indicated flood victims usually think it is a temporal experience, given that the research explored views on the primary reason why victims continue to live in flood-prone areas. This agrees with the study that floods are shocks which do not occur throughout the year. People only adjust or relocate temporarily because they believe the floods will recede quickly (Smith & Ward, 1998). 4.5.2 Most important reason why flood victims remain in flood-prone areas. Participants in the study were asked to rank the following based on their knowledge of why flood victims remain in flood-prone areas. This section focuses on the following: flood victims assume that flooding is a temporal experience; they assume flooding will not occur again; they lack the political will to evict, and they have no alternative place to relocate.

**Table 2: The most important reason why flood victims remain in flood-prone areas**

|  |  |  |
| --- | --- | --- |
| **Item** | **Frequency** | **Percentage** |
| Flood victims assume that flooding is a temporal experience | 106 | 42.4 |
| They assume flooding will not occur again | 38 | 15.2 |
| Lack of political will to evict | 86 | 34.4 |
| They have no alternative place to relocate | 20 | 8 |
| **Total** | **250** | **100** |

Table 2 showed that 42.4%, representing 106 participants, believed that the possible reason why flood disaster victims continue to reside at the exact location is that they think of floods as a temporal experience. This is followed by a lack of political will to evict people residing in flood-prone areas, accounting for 86 (34.4%) participants. Responses relating to the fact that flood victims assume that flooding may not occur again accounted for 38 (15.2%) of participants. Only 20 (8%) indicated that flood victims continued to stay where they were despite flooding because they had nowhere to go. Thus, it is likely that 57% of the participants refer to the temporality effect or syndrome as the main reason. In this case, it can be argued that the temporality effects or syndrome and the lack of political will are responsible for why flood victims continue to be where they were flooded.

**3.2.2 Main Challenges Facing Flood Management in Effutu**

This section examines the main challenges facing flood disaster management in Effutu. It touches on the following: human resources, financial resources, logistics and equipment, and perceptions about flooding. The outcome is depicted in Table 3.

**Table 3: Main challenges facing flood management in Effutu**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **strongly agree** | **agree** | **not sure** | **disagree** | **strongly disagree** |
|  | **(%)** | **(%)** | **(%)** | **(%)** | **(%)** |
| Human resource | 53  (21.2) | 147  (58.8) | 41  (16.4) | 3  (1.2) | 3  (1.2) |
| Financial resource | 55  (22.0) | 22  (8.8) | 170  (68.0) | 1  (.4) | 3  (1.2) |
| Logistic and equipment | 130  (52.0) | 101  (40.4) | 0  (.0) | 11  (4.4) | 8  (3.2) |
| Perceptions about flooding | 91  (36.4) | 89  (35.6) | 49  (19.6) | 13  (5.2) | 8  (3.2) |

Table 3 showed that the majority (170 out of 250 participants) were unsure that financial resources accounted for the challenges that affected flood disaster management in Effutu. However, 200 participants agreed that human resource issues affect flood disaster management. Two hundred thirty-one agreed that logistics is a constraint, while 180 agreed that flooding is a significant obstacle to flood disaster management. This suggests that many participants thought the lack of financial resources did not necessarily constrain flood disaster management. They instead thought it was related to policy implementation issues. The main challenge identified that did not identify financial resources as accounting for flood disaster management is Effutu. Most participants agreed that human resource issues affect flood disaster management. Logistics was identified as the primary constraint. Flood perceptions were identified as a significant obstacle to flood disaster management. This suggests that many participants thought the lack of financial resources did not necessarily constrain flood disaster management. They instead thought it was related to policy implementation issues.

**3.3 Flood Management Practices**

This section also examines the flood-coping management practices in Effutu Municipality and the management practices of flooding in the Municipality. It includes (3.3.1) Management strategies to reduce flooding and (3.3.2) Rehabilitation strategies against flooding. Interviews, observations, and questionnaires were used to derive the outcome from the sub-themes. It is organised based on the questions that were explored during the fieldwork. The findings are organised in frequency tables and supported with interview descriptions and observations.

**3.3.2 Management Strategies to Reduce Flooding in Effutu Municipal**

This section dealt with the views on the following: flood diversion into existing water into marshes and lagoons; training people in flood resilience; construction of embankments; construction of dams and deepening of existing streams; early warning systems; cleaning of choked gutters and drains; mapping places where culvert need to be constructed; and construction of canals. Table 4 shows the outcome of the questionnaire administered.

**Table 4: Management Strategies to Reduce Flooding**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Strongly agree (%)** | **Agree (%)** | **Not sure (%)** | **Disagree (%)** | **Strongly disagree (%)** |
| Flood diversion into existing marshes and lagoons | 91  (36.4) | 89  (35.6) | 49  (19.6) | 13  (5.2) | 8  (3.2) |
| Training people in flood resilience | 98  (39.2) | 78  (31.2) | 55  (22.0) | 8  (3.2) | 11  (4.4) |
| Construction of embankments | 112  (44.8) | 46  (18.4) | 45  (18.0) | 44  (17.6) | 3  (1.2) |
| Construction of dams and deepening of existing streams | 147  (58.8) | 53  (21.2) | 41  (16.4) | 3  (1.2) | 3  (1.2) |
| Early warning systems | 170  (68.0) | 77  (30.8) | 0  (.0) | 1  (.4) | 3  (1.2) |
| Cleaning of chocked gutters and drains | 130  (52) | 101  (40.4) | 0  (.0) | 11  (4.4) | 8  (3.2) |
| Mapping places where culverts need to be constructed | 103  (41.2) | 88  (35.2) | 44  (17.6) | 0  (.0) | 15  (.6) |
| Construction of canals | 96  (38.4) | 86  (34.4) | 44  (17.6) | 11  (4.4) | 13  (5.2) |

*Source: Researcher’s Fieldwork, 2019*

Table 4 shows Views concerning the management strategies that could be adopted to manage flood disasters in Effutu Municipality. The areas that received the most support were early warning systems, where 247 participants agreed that this could effectively manage flood disasters. This was followed by cleaning the chocked gutters, to which 231 participants agreed. Regarding mapping places where a culvert could be constructed, 191 participants agreed.

**3.3.2 Rehabilitation Strategies against Flooding**

This sub-theme surveys the questionnaire outcomes of respondents regarding emergency relief response, development of flood recovery plan, construction of shelters for flood victims, provision of relief items, and financial support to flood victims in the Effutu Municipality. The outcome is shown in Table 5.

**Table 5: Rehabilitation Strategies against Flooding**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Strongly agree (%)** | **Agree (%)** | **Not sure (%)** | **Disagree (%)** | | **Strongly disagree (%)** |
|  |  |  |  |  |  | |
| Emergency relief response | 147  (58.8) | 53  (21.2) | 41  (16.4) | 3  (1.2) | 3  (1.2) | |
| Development of a flood recovery plan | 225  (90) | 22  (8.8) | 0  (.0) | 1  (.4) | 3  (1.2) | |
| Construction of shelters for flood victims | 130  (52) | 101  (40.4) | 0  (.0) | 11  (4.4) | 8  (3.2) | |
| Provision of relief items | 91  (36.4) | 89  (35.6) | 49  (19.6) | 13  (5.2) | 8  (3.2) | |
| Financial support to flood victims | 111  (44.4) | 117  (46.8) | 18  (7.2) | 1  (.4) | 3  (1.2) | |

*Source: Researcher’s Fieldwork, 2019*

Table 5 shows rehabilitation measures that can be taken against flood disaster effects. The data showed that 200 participants agreed. Of the total, 247 agreed to develop a flood disaster recovery plan. Two hundred thirty-one participants supported the construction of shelters for flood victims, 180 participants supported the provision of relief items, and 228 participants supported financial support for flood victims.

**4. Conclusions and Recommendations**

The study indicates that profound impacts, such as agricultural losses, property damage, disruptions to education and work, and tragic loss of life, underscore the urgent need for effective flood management strategies to mitigate the devastating consequences experienced by residents. The study also concluded that key challenges to flood management in Effutu Municipality to inhabit flood-prone areas were identified due to perceptions that flooding is temporary or lacks alternative housing options. Significant obstacles to effective flood disaster management include limited human and logistical resources, financial constraints, and misaligned perceptions about flooding risks. It is recommended that enhanced public awareness and education be provided to residents about the long-term risks of flooding and the importance of proactive measures to mitigate these risks. This would equip residents with the knowledge and skills to prepare for, respond to, and recover from flood events. It is also recommended that Policy Reform and Institutions be Strengthened to reduce flood hazards. Advocate for policy reforms should be based on addressing the underlying drivers of vulnerability to flood hazards, including land-use planning regulations, housing policies, and disaster risk financing mechanisms. Strengthening institutional capacities at the local and national levels should improve coordination, communication, and collaboration among relevant stakeholders involved in flood management and disaster response efforts.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT) and text-to-image generators have been used during the writing or editing of this manuscript.

**COMPETING INTERESTS**

The authors have declared that no competing interests exist.

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