FLOOD VULNERABILITY AND ASSOCIATED RISK MANAGEMENT IN UMUEBU COMMUNITY, UKWUANI LOCAL GOVERNMENT AREA OF DELTA STATE, NIGERIA

By

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A thesis submitted to the department of architecture in partial fulfillment of the requirements for the degree of masters in disaster management.

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Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing a degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

Aghanenu Oghenemudiakevwe

Approval

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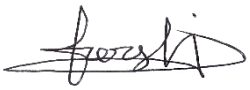

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Abstract

This study evaluated flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State. The study identified the various flood characteristics in Umuebu Community, Ukwuani L.G.A of Delta State; examined the causes of flood vulnerability in Umuebu; discussed the impacts of flood vulnerability on the inhabitants of Umuebu and suggested flood associated risk management strategies in Umuebu Community, Ukwuani L.G.A of Delta State.

The review of past works has proved useful to this research work, as it provided different writers with different views that have been researched and tested. It also revealed the various causes of flood vulnerability as well as the solutions to the problems of flood vulnerability, which made it possible for the researcher to have knowledge of the topic under discussion. 150 questionnaires were administered to respondents in Umuebu community as part of the descriptive survey research design and the stratified random sampling technique used in this study.

The data that used to carry-out this study was obtained from the National Emergency Management Agency (NEMA) and Ministry of agriculture which include data on flood characteristics (types/category, time/duration, causes, effects, and nature of flooding) and flood vulnerability on the livelihood of the people (farm produce, houses, schools, companies, etc) to also include archival climate data (temperature, rainfall) that was obtained from the nearest Nigerian Meteorological Agency (NIMET) Office.

Keywords: Flood; vulnerability; associated risk management; Umuebu; Types of floods; causes of floods

Dedication

I dedicate this to God, my family, and my mother of perpetual help

Ethics Statement

The whole study was conducted with an ethical competence and integrity in terms of conscious decision making and responsibly acting considering legal standards as well as social, economic, and ecological consequences. While conducting field surveys, at first and foremost, consent was taken from each authority to survey the study areas.

All the actions such as taking photographs, talking with the respondents occurred with the permission from the concerned authority. The field survey was conducted with the consent from the appropriate authorities in Umuebu community. One of the major ethical points followed in this study is to maintain the cooperation in data collection procedure and analysis to respect the rights to information and their rights to freedom of speech. The research did not involve any activity for which there was a foreseeable risk or discomfort to the participants. All the respondents were kept anonymous in the research and presented with different identification numbers throughout the data analysis and findings.

Wherever any intellectual property is used for the purpose of this study, they are given proper credits with proper citation. The whole research is conducted with full objectivity starting from determining the research questions to research findings. The overall research design, data analysis, and representation are carried out regardless of any bias and inclination.

Acknowledgement

Special Appreciation goes to Brac University for providing me with a fully funded scholarship to actualize my dream. Once a Brac, always a Brac

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CHAPTER ONE
Introduction

1.1 Background to the Study

Climate change has caused severe floods and persistent droughts in Nigeria (Odey, 2019). He stressed the dangers of climate change once more, citing repercussions like flooding, sea level rise, and desertification, among others. Butler (2010) points out that concern about the harmful effects of climate change and has highlighted the need for developing an enabling environment and enhancing community capacity for adaptation measures to decrease the effects of climate change, which have increased flood vulnerability.

Flooding is a pressing concern everywhere because of its attendant problems that endanger both human survival and the environment particularly in the developing and underdeveloped countries, of which Nigeria is one. It has become a reality, with terrible repercussions. Among the effects of climate change are starvation, drought, landslides, and floods. Serious socio-economic effects follow when the weather becomes more extreme and storms multiply and intensify, malnutrition and illness became frequent occurrences, he continued (Odey, 2019). Despite these numerous effects of climate change, the main barrier is the public perception, lack of awareness and information about it, thus Nigerians need to be made aware about their vulnerability to flooding (Oseji, 2022).

Flooding has been a persistent problem that affects the people of Umuebu. Flooding causes serious disruption to socio-economic activities and can lead to loss of livelihoods in most cases. Flooding has been observed to have a serious damage to infrastructure which eventually results in interruptions to access to clean water, wastewater treatment, energy, transportation, communication, education, and health care are some of the long-term effects. Ajede (2022) notes that loss of livelihoods, diminished buying power and loss of land value in the floodplains can leave affected communities, especially Umuebu, economically vulnerable. He continued by saying that long-lasting trauma can also be caused by floods for both victims and their relatives. According to Brammer (2021), floods could have a detrimental impact on society, the economy, and the environment.

Unusual weather conditions are the most harmful category of climate change consequences on human health. Thornton et al. (2010) added that it will become more difficult and expensive to adapt to climate change unless drastic actions are done, and nations lessen greenhouse gas emissions and boost the removal of these gasses from the environment. The connection between climate change and nutrition has received little attention thus far, and pertinent programs, policies, and projects are mostly unconnected (Osborne, et al., 2013).

There has been a request for routine re-evaluation of climate change in tropical cities in order to be informed and compare the situation in these local communities with those of other cities throughout the world (Oseji, 2022). This is because what seems to be a minor issue at first have now become a major threat to the natural environment and climate of most tropical cities in both developed and developing countries. Studies have shown that in the past, less attention has been directed towards examining flood vulnerability impacts and management. Previous research conducted have only focused on adaptation strategies and control measures. This research work will therefore focus on flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State.

1.2 Statement of the Problem

The direct effect of flooding includes Losing loved ones, which has a profound effect on children especially, being evicted from one's home, losing possessions, and having business and social affairs disrupted all result in ongoing stress. (Bunn and Arthington, 2012). Umuebu Community which is waterlogged areas have been seriously devastated by flood effects. Flood which is a major problem in most communities surrounding Umuebu, have not only displaced residents living within the catchment areas but have caused serious damage to the natural environment of the area (Oseji, 2022). Flooding effect in Umuebu has raised serious concern in recent times among the alarming rate of natural disasters occurring in the area. One of which is the frequent cases of flooding at Umuebu. In September 2012 and 2016 respectively, most residential areas in Umuebu Community were flooded and families displaced of their natural habitats. In September 2018 and 2021 respectively, after heavy downpour, the same flood recurrence rocked the entire Umuebu region leaving hundreds of persons displaced and causing serious damage to life and property (Ajede, 2022).

As observed by Brammer (2021) lack of knowledge on flood vulnerability over the years played negative roles in solving flood problems caused by alteration of the natural climate and climate change. He noted that, even though the people may lack a good understanding of flood vulnerability in tropical cities of the world, which as a result has made them to attribute the changes to such factors as sinful generation, the wrath of God and signs of the end of life, the aftermath effect prevails. Kingsford (2020) also observes that, human induced changes have in recent times altered the natural climate leading to flood issues and other environmental hazards to include erosion menace which affects societies and have shown throughout history a strong extent for adapting to different climates and environmental changes.

Generally, during heavy downpour of rain, most areas in Umuebu are usually flooded. It has been observed that farmers harvest their crops prematurely after flood occurrence since most farmlands are flooded and waterlogged. As observed by Ajede (2022), the September 2019 flood event left a landmark in the entire Umuebu region as most areas within Umuebu Community inclusive were devastated after severe flood events occurred within various parts of Delta State especially areas liable to flood. Even though the government of Delta State provided refugee camps for most displaced persons across the State, the effects of flood vulnerability in Umuebu are enormous. Frequent cases of flooding in Umuebu, have resulted in the destruction of valuable properties such as buildings, household items, farmlands, schools, stores, shops, etc (Ajede, 2022).

It has also been observed that after heavy rainfall most areas and quarters of Umuebu are usually vulnerable to floods that often-paralyzed socio-economic activities in the area and increase cases of malaria from Mosquito and eventually cause serious health problems in these areas (Oseji, 2022). As observed by Oseji (2022), Umuebu is usually flooded and the inhabitants, most traders, find it difficult to continue their normal business since the major roads and streets leading to the markets have been flooded. The Umuebu market is a good example to mention but a few. Despite the Local Government and State Government effort and controlling the flood, the problem remains unabated, and the residents continue to call for studies and make efforts at managing this flood. Upon the foregoing, this study examines the flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State.

1.3 Aim and Objectives

The main aim of this study is to evaluate flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State. The specific objectives include to:

1. Identify the various flood characteristics in Umuebu Community, Ukwuani L.G.A of Delta State.
2. Examine the causes of flood vulnerability in Umuebu.
3. Discuss the impacts of flood vulnerability on the inhabitants of Umuebu.
4. Discuss flood associated risk management strategies in Umuebu Community, Ukwuani L.G.A of Delta State.

1.4 Research Questions

The following questions will be answered in this study.

1. What are the various flood characteristics in Umuebu Community, Ukwuani L.G.A of Delta State?
2. What are the causes of flood vulnerability in Umuebu?
3. What are the impacts of flood vulnerability on the inhabitants of Umuebu?
4. What are the flood associated risk management strategies in Umuebu Community, Ukwuani L.G.A of Delta State?

1.6 Significance of the Study

This study is very necessary, since the Umuebu Community, Ukwuani Local Government Area of Delta State is prone to flooding due to the changing weather conditions, which are a notable effect of flood vulnerability. If this persists for some years, it will no doubt, have adverse effects on the populace. Some of these effects will be ranging from environmental hazards, amongst others. With the knowledge of the impacts of flood vulnerability can have on their populace, they will, no doubt, seek for adaptation measures to mitigate its impacts.

The result of this study will be of utmost benefit to the policy makers and students and the society in general. The result will assist the Ministry of Environment, Delta State in assessing the future

implications of paying little or no attention to climate change in the rural areas, especially those areas that are prone to flooding.

This study also serves as a springboard or launch pad for students and researchers in studying flood vulnerability and global warming from the rural perspective as most studies are concentrated on urban areas which they feel are more prone to the effect of flood vulnerability.

1.7 Study Area

1.7.1 Location and Boundaries

This study was carried out in Umuebu Community. Umuebu is geographically located in Ukwuani Local Government Area in the southern part of Nigeria, in the western part of the Niger Delta, Umuebu shares common boundary with Ugono-Abraka in Ethiope East Local Government Area of Delta State, Abbi in Ndokwa West Local Government Area of Delta State, Amai and Obiaruku both in Ukwuani Local Government Area of Delta State. Ukwuani L.G.A which habours Umuebu shares boundaries with Ndokwa West in the East and West, Ethiope-East in the South and Orhionwhon Local Government area of Edo state in the North. Umuebu is geographically located between Latitudes 5˚51'N and 6˚10'N and Longitudes 5˚10'E and 5˚48'E (Fig. 1) (Atuma & Ojieh, 2013).

Figure 1 Map of Nigeria showing Delta state the study Area

Source: Igiekhume et al, 2021

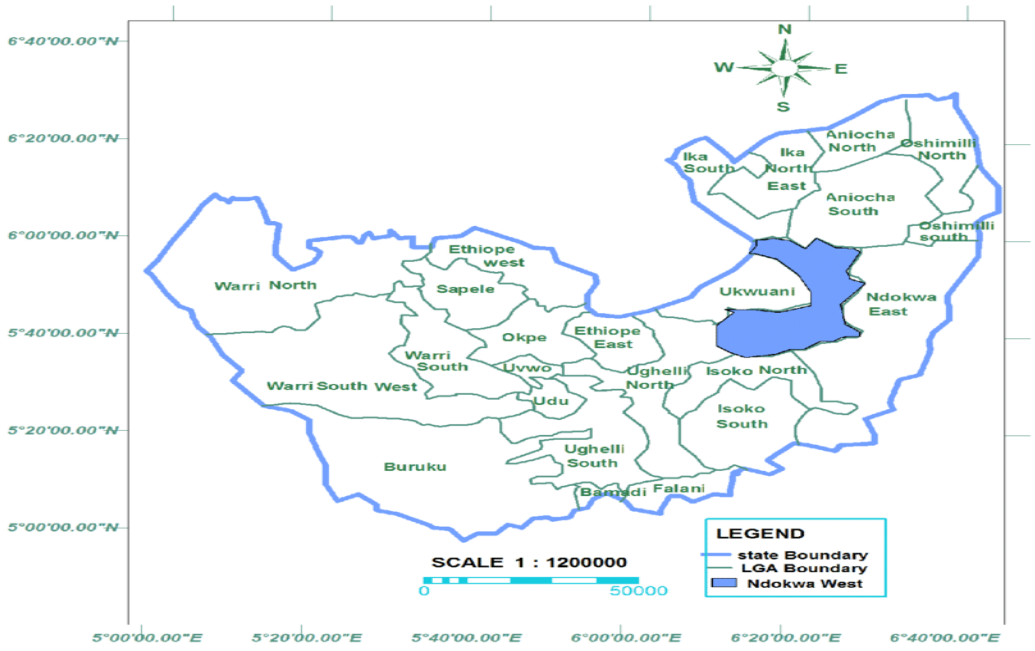

Figure 2 Map of Delta state showing Ndokwa West the study Area

Source: Innocent and Anwuli (2018)

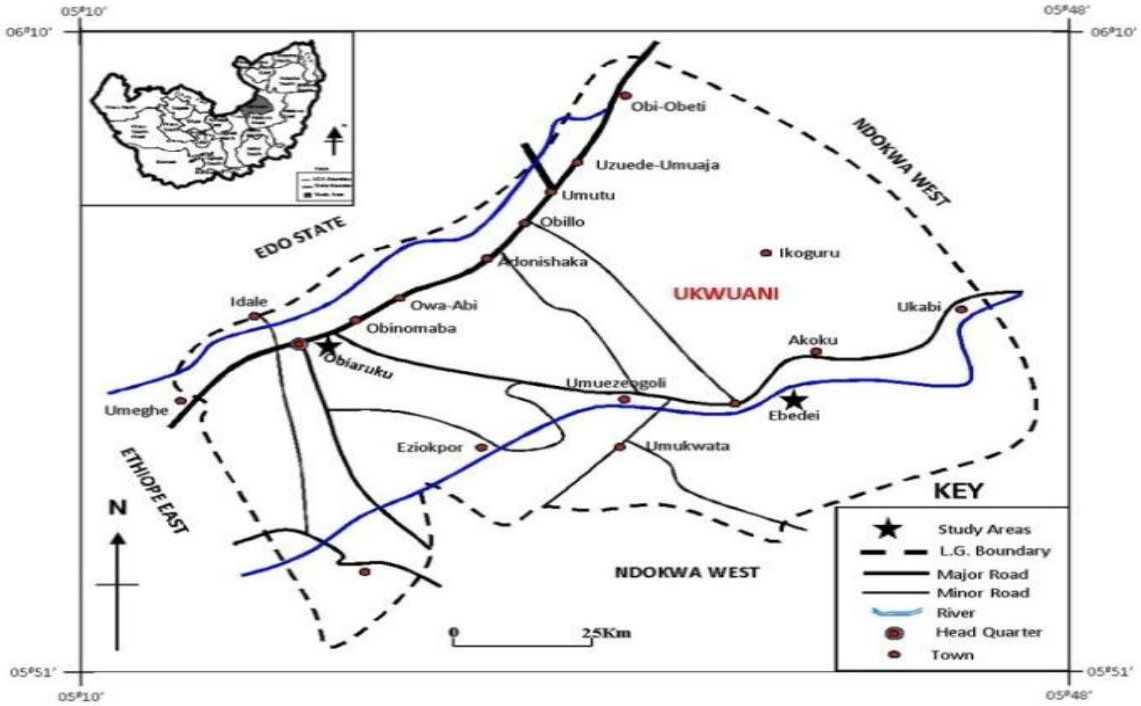

Figure 3 Map of Ukwuani Local Government Area Showing Boundaries, Drainage and Roads

Source: Ministry of Lands, Surveys and Urban Development, Asaba (2004)

The Ukwuani (which Umuebu is part of) comprise one of the major ethnic groups of the Delta State region, the others being the Ibo (Asaba), Itsekiri, Ijaw, Isoko, Ika and Urhobo. Ukwuani Local government area consists of ten clans with Eziokpor as the Head of the Akashede's and Umuebu as the Ancestral home of the Akashede. The area in recent years has been experiencing delay in the onset of rainfall which leads to reduction in the output of farm produce which can lead to food insecurity (Atuma & Ojieh, 2013).

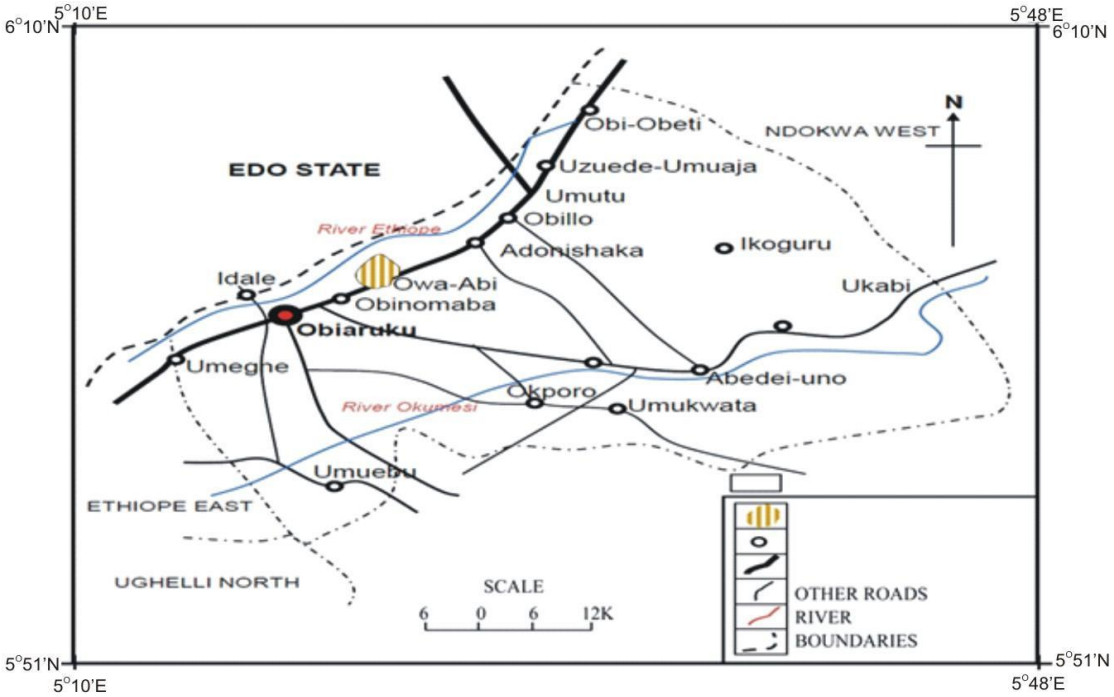

Figure 4 Map of Ukwuani LGA showing the study Area (Umuebu)
Source: Atuma & Ojieh (2013)

1.7.2 Relief and Drainage

Most of the recent unconsolidated quaternary sediments make up the low-lying relief of umuebu. These sediments have both fluvial and marine origin. In the west is Niger and to the Northwestern highlands 'and to the south by the quaternary deposits of the coastal margin. The secondary and tertiary sedimentary rocks have a gentle southerly dip. Under the Benin lowlands is Umuebu (Udo, 1978). There are very few hills that rise above ground surface and the elevation of the land is often less than 50 meters above mean sea level. The topography of Umuebu is Uniform. There is no highlands area, instead, there is a gentle slope from the valley to Okumedhi River till it gets to Kwale where it empties into the Atlantic Ocean.

Umuebu's topography is consistent. There are no highlands in this region; instead, the Okumeshi River flows down a valley and gently slopes until it reaches Kwale, where it falls into the Atlantic Ocean at Pontoon. The Okumeshi River, which flows from Obiaruku through Amai to Ogume in the Ndokwa West L.G.A. of Delta State, drains Umuebu. The river is vulnerable to flooding, especially during the rainy season, due to the valleys' flat terrain, high groundwater table, and severe rainfall (Figs. 1 & 2). Meanders, a floodplain, and marshes are features of the Okumeshi River. The river valley measures roughly 50 meters in width and 6 meters in depth on average. At the source, this velocity is lower (1.85 m/sec). A cross-sectional profile of the river near Obiaruku reveals that the middle course of the water has the highest flow characteristics, while the top and sides have the lowest. The river's swift current and clarity are two of its most distinguishing features.

Since Umuebu is generally a lowland area and only two rivers drain the area, which cut across some communities in Ukwuani L.G.A, during the rainy season, the pore spaces in the soil are easily saturated and most of the communities are not having channels to the rivers, this causes flooding as well as erosion which further cause some loss of nutrients in the soil as a result of leaching and surface runoff in the study area. Loss of nutrients will adversely affect the agricultural productivity of the people. Consequently, Umuebu people are vulnerable to food insecurity in the years to come, as well as low fish output resulting from erosion. There will be shortages in food availability.

Figure (a)

Figure (b)

Figure (a) shows the North side and figure (b) shows the south part of the Okumeshi River.

Source: Field Survey, 2022

1.7.3 Climate

Climate is tropical, with two distinct seasons, wet and dry, and average temperature of 300 degree Celsius. The Umuebu Community has a tropical rainy climate, with a prolonged wet season and relatively constant temperatures throughout the year. There are two types of climates within the tropical environment of Umuebu; Koppen's tropical rainforest climate (AF) and Strahler's wet equatorial climate. Maritime tropical air masses and tropical continental air masses influence the climate, as does the Okumeshi River proximity. The climate is characterized with high rainfall throughout the year, from January through December, though there is usually a break in August, often referred to as August Hiatus. However, November through February have less rain and a slight Harmattan breeze sweeping over the area. The wettest month in this region is September with an average of 401mm, and the driest month December with 17mm. These data indicate that the double maxima rainfall total does not fall below 25mm, throughout most rainy months. The typical range of Relative humidity is 72% in January and February to 94% in July (Nigerian Meteorological Agency, 2013). Despite this, Umuebu has a mean annual relative humidity of 83 percent, making it a generally warm, moist and humid place.

In the local government, the average annual temperature is 30.6^{o}C. March is the warmest month of the year with an average temperature of 28.2^{o}C, while July has the lowest temperature with an average temperature of 25.1oC. The level of rainfall in the area exposes it to flooding which is attributable to the influence of climate change on the area. It is pertinent to note that there has been an increase in the temperature as well as the level of rainfall in the area which results in physiologic discomfort, low rent in flood areas, migration of some animal species, low fish output amongst others. Continual increase in all these will lead to more outbreak of diseases which are climate related as well as food insecurity. This will also affect the level of income of the people. Recent delays in the onset of rainfall have affected plants negatively and if it continues, will make the abovementioned effects more severe.

1.7.4 Vegetation

Umuebu's native vegetation is a swamp forest, which grows in low-lying valleys with flat floors and nearby places that are either constantly or periodically submerged in water. The rain forest has numerous levels of trees and a varied range of floral species. It was a significant supply of wood,

with important species like Antiaris toxicaria, Milicia excelsia, Ceiba pentandria, and Piptadeniastrum africanum producing wood. Other tree species that grow in the region include Irvingia gaboneensis, Pentaklepta macrophylla, and Chrysophyllum albidum (Udo, 1978). As mentioned in the last paragraph, these two species of trees provide income and food supplements to rural residents, despite farming and shifting cultivation, as well as small-scale agriculture, destroying most of the rainforest in the region. (Oseji, 2022). Large tracts of swamp forest can be found in the Ethiope River. The prominent plants in the swamp forest's flora are raffia palms, particularly Raphia hookeri and Raphia vinifera. The Ukwuani Local Government Area's expanding human population puts additional strain on the environment's natural resources, degrading it and making it more susceptible to the effects of climate change. Desertification, which is a notable impact of the people on the natural vegetation, has resulted in loss of habitat of plant and animal species; deforestation has also intensified climate change. Forest soils are moist, but if exposed to the sun without shade provided by trees, they quickly dry out. By releasing water vapor back into the atmosphere, trees contribute to the continuation of the water cycle. Without trees to provide these functions, many areas that were once forested can easily turn into desolate wasteland. When trees are cut down, the forest loses some of its canopy, which keeps heat in at night and filters the sun's rays during the day. A disruption of this system can lead to more dramatic swings in temperature, which can be harmful for both animals and plants. Additionally, trees are essential for absorbing the greenhouse gases that cause global warming. A decrease in forest cover results in a greater release of greenhouse gases, which accelerates and exacerbates global warming. The desertification currently on the increase in the areas will pose more severe problems to the people in the area in the years to come (Ojeh, 2012).

1.7.5 Socio-Economic Activities

There are several human occupations in Umuebu. The primary industry in this area is farming. Farming is practiced by the locals, who frequently cultivate fluted pumpkin, melon, sweet pepper, cassava, yam, and maize. Cassava (manihot esculenta) is one of the principal food crops planted in this area, while perennial crops like as groundnuts (Arachis hypogaea), guinea yams, water yams, plantains, bananas (Musa species), cocoyams, and paw-paws (Carica papaya) are also grown. (FAO, 2018).

The primary method of growing food crops is rotational fallowing. This area also produces maize. Rubber and oil palm are the two most significant revenue crops in this region. The agricultural economy of this region does not heavily rely on livestock farming. The people of Umuebu enjoy fishing, which they do in major rivers and streams. There are nets and other fishing equipment. Catfish and tilapia (Tilapia spp.) make up most of the catch (Clarias spp).

In Umuebu, trees are felled and conveyed by trucks or floated on rivers downstream to sawmills. Not being able to maintain the timber exploitation, the lumbering sector faces a bleak future. Although these felling of trees stands to an extent, as a degradation to the natural environment which can cause the exposure of the topsoil to the direct impact of the sun as well increase the level of erosion in the area. The region stands out as being plagued by unemployment. This suggests a higher sensitivity and lower capacity to cope with the adverse impacts of climate change. All these activities are not coordinated, thereby leading to flood vulnerability, which have adversely affected Umuebu people.

1.8 Scope of the Study

(This study will be restricted to flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State. It will examine some of the factors which contribute to high flood vulnerability especially in rural areas such as the case of Umuebu by determining the causes and effects of flood vulnerability and discussing associated risk management strategies to curb these hazards. Ordinarily, a study of this nature is supposed to stem beyond a geographical area, but owing to time and resources, it will be limited to Umuebu Community in Ukwuani Local Government Area of Delta State.

Figure (a)

figure (b)

The figure (a) and figure (b) show the flood zone area of Umuebu.

Source: Field survey

CHAPTER TWO

Review of Related Literature

This chapter will review related literature on flood vulnerability and associated risk management in the Nigerian context. The study reviews will be carried out in sub-headings.

2.1 Flood Vulnerability: Concept and Definition

This section discusses flood vulnerability as a concept. Mogborukor (2012), noted that any Surface runoff across an urban or rural area that is enough to cause property damage, health concerns, annoyance, and the impediment of socioeconomic activity in the area is considered flooding. He continued by mentioning more sorts of flooding, such as flash floods, splash floods, and flood bonds.

The concept of flood vulnerability was propounded by Fredrick in 1961 in analyzing the nature of land flow and its impact on residential buildings. Flood refers to the inundation of a typically dry area brought on by the rise and overflow of a body of water or by the rise of water to an area that is ordinarily not submerged. (Ayoade, 2004). Floods could be categorized based on where they occur, for example, as coastal floods or urban floods. (Efe and Mogborukor, 2010; Mogborukor, 2012). Urban flood occurs in an urbanized area, such as towns and cities, while coastal flood occurs along riverbanks. (Efe, 2007).

Flood vulnerability results when a risk to the environment has a negative impact on people. Human vulnerability brought on by improper preparation frequently has detrimental effects on the economy, the environment, or other people. Flooding always results in casualties and property destruction, and it frequently leaves behind economic harm, the severity of which is dependent on how severe the disaster was. While occasionally there may be only a few modest losses, there have also been a few disasters that have resulted in significant loss of life and damage to property. The amount of damage caused by flooding also depends on emergency preparedness and the population's or authorities' ability to support or oppose the disaster. The phrase "disasters occur when dangers meet vulnerability" captures this notion. Therefore, flooding won't ever cause a natural disaster in areas that aren't vulnerable. (Ajede, 2022).

A flood is when there is an excessive amount of water, and it covers normally dry areas. A flood is defined by the European Union (EU) Floods Directive as the water covering of territory that is

not ordinarily covered by water. The word can also refer to the tide's inflow when used in the sense of "flowing water." Floods as a topic of research in the hydrology field and are very important for civil engineering, public health, and agriculture. Flooding can happen when a body of water, such as a river or lake, has too much water and overflows, allowing some of the water to escape the area normally contained by the body of water. While the size of the water body will vary with seasonal rainfall and snow melt, it is not a significant flood unless the water covers land used by men, such as a hamlet, village, city, or other inhabited regions, highways, and expanses of farmland (Alexander, *et al.*, 2018).

According to Ajede (2022), Flooding can happen when water from water bodies, such as a river, lake, or ocean, overflows and destroys levees, allowing some of the water to spill outside of its usual boundaries. Flooding can also occur due to rainwater collecting on wet ground. While seasonal variations in precipitation and snowmelt will affect the size of lakes and other bodies of water, these changes in size are unlikely to be significant unless they cause property to flood or domestic animals to drown.

When a river's capacity is exceeded by its flow rate, particularly near bends or meanders in the waterway, floods can also happen. If they are located in the natural floodplains of rivers, homes and businesses are frequently damaged by floods. People have historically lived and worked by rivers because the ground is typically flat and productive and because rivers offer easy transport, access to trade, and industry. By moving away from rivers and other bodies of water, riverine flood damage can be reduced. While some floods take time to form, such as flash floods, others can occur quickly and without any outward signs of rain or wind. Also, floods can be small, impacting an area or community, or affecting entire river basins (Akpan, *et al.*, 2010).

Damaged public infrastructure affects more individuals than people whose homes or businesses were flooded by the storm. Particularly, flooding damage to crucial transportation hubs like rail systems, roads, and seaports may have a significant effect on regional and national economies. Following a flooding incident, the local tourism industry frequently experiences short-term declines. Images of flood-affected places can cause booking cancellations and a large decrease in visitor numbers, even when the damage on tourism infrastructure and the time required to restore to full operational capacity may be small. (Oseji, 2022).

2.2 Flooding Characteristics

One of the environmental issues that have been for humankind since the beginning is flooding. Flooding is a common and old-fashioned phenomenon. Flooding in Umuebu has caused and continues to inflict countless hardships, including the ruination of structures and other property as well as the halting of the region's socioeconomic development.

Floods are crucial to preserving biodiversity and vital ecological services in many natural systems. They connect the river with the surrounding land, replenish groundwater systems, fill wetlands, and improve connection between aquatic ecosystems, and transport sediment and nutrients over the terrain and into the ocean. (Apan, *et al.*, 2010). Floods cause reproductive events, migration, and dispersal in many species. Except for the most extreme floods, these natural systems are resilient. Flooding's positive effects on the environment may also assist the economy by boosting fish productivity, recharging groundwater supplies, and maintaining recreational areas. (Bunn and Arthington, 2012).

According to reports, flooding is a common problem and a threat in Nigeria's south-south geopolitical zone. (Stern, 2017). Environments throughout the world and people from many countries, including Nigeria. Man has abused and neglected the environment, which is the foundation of economic, social, cultural, and human activity. The effects of this ecological misuse include pollution, floods, deforestation, erosion, landslides, global warming, etc. (Stern, 2017).

2.3 Types of Floods

The following are the various types of floods.

Areal: Floods can occur in flat or low-lying areas when snowmelt or rainfall deposit water more quickly than it can percolate through the ground or run off. The surplus builds up, sometimes too dangerous depths. Where the water table is shallow, such as a floodplain, or after intense rain from one or more storms, the surface soil can get saturated, which effectively blocks penetration. Additionally, infiltration through frozen ground, rock, concrete, paving, or roofing is slow to nonexistent. Due to the fact that the velocity of overland flow depends on the surface slope, local depressions without access to a stream channel and flat places like floodplains are where areal flooding first occurs. Areal flooding may occur in endorheic basins when there is more precipitation than evaporation. (Bartsch and Schuphan, 2012).

Riverine (Channel): Even the biggest rivers in the world can flood, as well as the smallest, fleeting streams in humid climates and frequently dry channels in desert climates. Overland flow can cause a muddy flood when sediments are absorbed by runoff and transferred as suspended matter or bed load on tiled areas. Examples of drainage impediments that can cause or exacerbate localized flooding include landslides, ice, debris, and beaver dams. (Bender and Phillips, 2014). Huge rivers with large catchment areas are where slow-rising floods most frequently occur. It's possible that prolonged rain, quick snowmelt, monsoons, or tropical cyclones are to blame for the rise in flow. However, since they may have enormous basins, but limited river channels and rainfall can be highly strong in smaller portions of those basins, large rivers may experience quick flooding episodes in locations with a dry climate.

Flash Flood: In generally dry waterways in desert regions—known as arroyos in the southwest of the United States and by many other names elsewhere—flash floods are the most frequent type of flooding. In that situation, the initial flood water is exhausted as it drenches the sand streambed. As a result, the flood's leading edge moves more slowly than later and higher floods. As a result, as the flood proceeds downstream, the rising limb of the hydrograph rises faster and faster until the flow rate is so high that the depletion caused by wet soil is negligible.

Estuarine and Coastal: Sea tidal surges brought on by wind and low barometric pressure frequently causes flooding in estuaries, and they may be made worse by strong upstream river flow (Ajede, 2022). Storms at sea that cause waves to exceed defenses or, in extreme circumstances, tsunami or tropical cyclones may flood coastal regions. Storm tide, which is referred to as the increase in water level brought on by a storm surge and an astronomical tide, should not be confused with storm surge. When storm surge occurs at the same time as the typical high tide, causing storm tides to occasionally reach 20 feet or higher, this rise in water level can result in severe flooding in coastal communities.

Urban flooding: In Urban areas flooding occurs when rainfall exceeds the capacity of drainage systems, such as storm sewers, and flooding land or property within a developed environment, especially in more densely populated places. Urban flooding is a situation that can occur independently of whether impacted towns are located within defined floodplains or near any body of water, even though it is occasionally caused by occurrences like flash floods or snowmelt. (Ajede, 2021) Aside from the possibility of rivers and lakes overflowing, snowmelt, storm water,

or water from leaking water can connect on private property and in public rights-of-way, seep through building walls and floors, or backup into structures through sewer pipes, toilets, and sinks. Existing paved streets and roads in metropolitan areas can enhance flood effects by accelerating the flow of water. The inhabitants and infrastructure are equally at risk from the flood flow in metropolitan regions. Despite many centuries of flood episodes, urban flood flows have just lately been researched. A recent study examined criteria for safe evacuation of people from areas that have been flooded (Akpan, *et al.*, 2010).

Catastrophic flood: There are a number of factors that contribute to catastrophic riverine floods including landslides, earthquakes, and volcanic eruptions that alter drainage pathways. Lahars and outburst floods are two examples. Undersea earthquakes which are the primary cause of tsunamis, can result in devastating coastal flooding. (Brammer, 2018).

2.4 Causes of Flooding

Nelson (2021) asserts that severe or excessively extended rainfall, or even both, is the typical global cause of flooding. Flooding can occur along seacoasts because of tropical typhoons and hurricane-related wind-driven storm surges and rain-swollen streams. Additionally, the shorelines of sizable inland lakes may flood. Flooding is also significantly influenced by climate change, which is a problem that affects every country's economic, social, cultural, and physical environments.

Climate change can be caused by natural elements like solar radiation quality and quantity, the earth's astronomical position, or human activities like industrialization, technological development, urbanization, deforestation, burning of fossil fuels, etc. (Ayoade and Akintola, 1980). As was already established, human contact with the environment in the form of industrialization and technology is a significant contributor to floods. Undoubtedly, human activities are becoming more significant as sources of floods. Natural surfaces are being replaced as urbanization grows, which prevents water from easily percolating into the earth. The result is that streams and rivers overflow because a significant percentage of the rainfall, which would otherwise soak into the ground or be collected by plants and delayed before dripping off, is now immediately available.

Twelve (12) causes of flooding include surcharge in water level due to natural or man-made construction of flood path, unforeseen dam failures, improper land use, deforestation of catchment basins, redemption construction site and solid water, insufficient drainage capacity due urbanization and excessive encroachment in floodways was identified by Odrreho (2004) and Nwafor (2006). The issue of urban flooding is a global one, but different management strategies are used depending on the state of the art in technology and the suitability for design considerations.

2.5 Effects of Flooding

The world's ecosystem is likely to alter in the future for a variety of reasons, such as rising global prosperity and the difficulties of feeding a population that could exceed nine billion people by the 2050s. One of the more certain effects of increased flood risks worldwide, especially when temperatures climb by more than 30C, is the potential to produce acid rain.

Effects of flood on the residents may be quite localized, with the foods that are mostly at risk being those that are grown in regions that are experiencing rapid environmental change, agricultural adaptation, or mitigation, people from helpless groups where dietary intakes are already suboptimal (such as those persons with low incomes, and migrant workers) and high nutrient density requirements are elevated (such as during pregnancy, children, and old age) also might be at increased risk. People may start eating food produced with fewer GHG emissions as a form of climate change mitigation. Such adjustments entail less red meat and dairy intake, which would benefit cardiovascular disease rates but could increase the frequency of iron and zinc shortages. In temperate regions, eating more locally grown and in-season food may result in insufficient intakes of fresh fruit and vegetables at different periods of the year.

Developed nations have rules and monitoring systems that may lessen the possible consequences of flooding on locals. It is hypothesized that the systems in place to address nutritional difficulties are less strong, particularly given the likelihood of conflicts between industry and public health. Flooding poses a danger to Umuebu's environmental resources, particularly the land and soil resources. Beautiful greenery naturally deters the threat at Umuebu. Because of the flooding threat, the Umuebu people's primary socioeconomic activity—farming—has been rendered obsolete. The government built a drainage system a few meters away from the main road in an effort to control

the issue. Its purpose is to divert and channel all water going to the erosion sites into the drainage system, which is then dumped into the river. The issue is still the same despite all this effort.

Floods are the most frequent natural calamity damaging the environment in Nigeria, barring fire, according to the Federal Environmental Protection Agency (FEPA). Ninety percent of natural disasters involve flooding. Both natural and artificial factors can create floods. Storms can produce floodwaters that are too high for the environment or for built structures. A difficult lesson was discovered. The removal of wetlands eliminated a natural method for absorbing floodwaters. (Oseji, 2022). Areas that have been significantly altered by human activities typically experience worse flooding consequences. In flooding this is often worsened by increased channel size, dams, levee banks and catchments clearing all contribute to the degradation of hill slopes, rivers, and floodplains by accelerating erosion and the movement of sediment and nutrients. (Oseji, 2022). Nutrients and sediment entering a waterway are necessary for a healthy ecosystem, but excessive amounts can negatively impact downstream waters. Other negative outcomes include habitat loss, the spread of weed species, and pollution (Oseji, 2022).

Numerous coastal resources, such as fish and other marine productions, rely on the nutrients that the land supplies during floods. As a result of the high amount of silt, nutrients and pollutants added to the floodwaters, coastal marine environments are negatively affected. Coastal food supplies, reduce coastal production, harm coastal production, and harm aquatic habitats could be affected by these factors.

2.6 Flood Associated risk Management Strategies

The world's ecosystem is likely to alter in the future for a variety of reasons, such as rising global prosperity and the difficulties of feeding a population that could exceed nine billion people by the 2050s. Increased global flood vulnerability, especially when temperatures climb beyond 30°C, is one of the more certain effects. This could result in the creation of acid rain.

Residents may experience flood damage that is quite localized, and the foods that are most at danger are those that are grown in regions that are experiencing rapid environmental change, agricultural adaptation, or mitigation. People from disadvantaged groups, such as those with low incomes and migratory workers, who already have inadequate dietary intakes and high nutrient

density requirements (such as during pregnancy, children, and old age), may also be more at risk. People may start eating food produced with reduced GHG emissions as a climate change mitigation measure. Such adjustments suggest less red meat and dairy intake, which would benefit cardiovascular disease rates but could increase the frequency of iron and zinc shortages.

Residents of developed countries may be able to limit the effects of floods on residents through monitoring structures and policies. Nutritional challenges are likely to pose a greater challenge due to the lack of robust structures in place to address them, especially because industry and public health may have conflicts. Flooding poses a danger to Umuebu's environmental resources, particularly the land and soil resources. The gorgeous greenery of Delta State's Umuebu Community, Ukwuani L.G.A., naturally controls the threat. Because of the flooding threat, the Umuebu people's primary socioeconomic activity—farming—has been rendered obsolete. The government built a drainage system a few meters away from the main road to control the issue. Its purpose is to divert and channel all water going to the erosion sites into a drainage system, which dumps it into the river. The issue is still the same despite all this effort.

According to the Federal Environmental Protection Agency (FEPA), barring fire, floods are the most frequent natural disaster damaging the Nigerian environment. Ninety percent of natural disasters involve flooding. Both natural and artificial factors can create floods. Storms can produce floodwaters that are too high for the environment or for built structures. A difficult lesson was discovered. The removal of wetlands eliminated a natural method for absorbing floodwaters (Ajede, 2022). Areas that have been significantly altered by human activity typically experience more harmful impacts from flooding. Floods frequently worsen already failing systems. Floods frequently worsen already failing systems. By accelerating erosion and sediment and nutrients movements, increased channel size, dams, levee banks, and catchment clearing all contribute to the degradation of hillslopes, rivers, and floodplains by (Douglas, et al., 2015). Even though the cycling of nutrients and sediments is essential for a healthy system, too much of either can have negative impacts on the water quality downstream. In addition to these negative effects, habitat loss, weed species spread, pollutant discharge, lower fish productivity, loss of wetlands function, and loss of recreational areas are also possible consequences. 2020 (Kingsford).

In many nations around the world, streams that are prone to flooding are often carefully managed. Flood control measures like sandbags and inflatable tubes are frequently used when detention basins, and levees fail to prevent rivers from overflowing their banks. In some parts of Nigeria, coastal fortifications like sea walls, beach nourishment, and barrier islands have been used to combat coastal flooding (Brammer, 2018). To slow down or reverse the natural forces that drive river and stream meandering over a long period of time, erosion control measures can be taken in the riparian zone along rivers and streams. In Nigeria, flood analysts maintain a network of flood control dams over time to lessen the frequency and severity of floods. Flood control dams can be constructed and maintained over time to reduce flood frequency. (Brammer, 2018).

Man -made sewers and storm water infrastructure need to be repaired and expanded as an effective solution. Green infrastructure (also known as sustainable urban drainage systems (SUDS) and porous paving can also reduce impervious surfaces in streets, parking lots, and buildings. Flood-prone areas can be transformed into playgrounds and parks that can withstand sporadic flooding. Ordinances can be passed requiring construction companies to store runoff on site and mandating that structures be elevated, walled off by levees and floodwalls, or built to withstand brief flooding. Additionally, property owners can spend money on their own solutions, such as landscaping changes that divert water away from buildings and the installation of check valves, sump pumps, and rain barrels.

Flood safety Planning involves many engineering and analytical aspects, including:

- observing current and historical flood heights and affected areas,
- studies of the hydrologic, hydraulic, and statistical models,
- mapping flooded regions and flood heights for potential future flooding,
- planning and regulation of long-term land use,
- building structures with flood control or flood resistance through engineering design,
- preparing for emergency responses, forecasting, and monitoring over the medium term, and
- Short-term activities for monitoring, warning, and reaction.

Each subject poses unique but connected problems with various scopes and scales in terms of time, place, and the individuals involved. It has taken at least six millennia for humans to begin gaining

an understanding of and controlling floodplain systems. The Association of State Floodplain Managers is an organization that works to protect the natural and beneficial functions of floodplains in the United States and to advance education, policies, and initiatives that reduce current and future losses, costs, and human suffering brought on by flooding. All of these efforts are made without having a negative impact on the environment. (Oseji, 2022).

2.8 Summary of Literature Review

This focused on flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State. Flooding is a widespread and age long phenomenon. In Umuebu Community, Ukwuani L.G.A of Delta State, Numerous structures have been destroyed, the socioeconomic growth of the region has been halted, and numerous farmlands and agricultural products have been destroyed because of flooding. Despite the flood's deadly effects, the number of farmlands submerged daily is increasing. In the study region, the damage of agriculture, buildings, and enterprises, the displacement of residents, and the loss of valuable property are only a few examples of how flood vulnerability and management have resulted in untold pain and economic despair.

Summarily, the review of past works on flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State with special emphasis on flood adaptation and mitigation techniques. The review of past works has proved useful to this research work, as it provided different writers with different views that have been researched and tested. It also revealed the various causes of flood vulnerability as well as the solutions to the problems of flood vulnerability, which made it possible for the researcher to have knowledge of the topic under discussion.

CHAPTER THREE

Research Methodology

This study focuses on flooding vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State. This chapter describes the procedure adopted in the study. It includes the following subheadings: research design, types and sources of data used, sampling framework, reliability and validity of Instrument, method of data collection and method of data analysis.

3.1 Research Design

This study adopted the descriptive survey research design. This design was suitable for research that gathers first-hand information on the subject's (topic's) setting in the surroundings. The research design used in this research work also includes personal observation and a reconnaissance survey of Umuebu Community for accurate and adequate information for the study.

3.2 Types and Sources of Data

The data used for this study includes data on flood characteristics (types/category, causes, effects, time/duration, and nature of flooding) and flood vulnerability on the people's livelihood. (Farm produce, houses, schools, companies, etc) that was obtained directly from personal field observation, oral interview, participant observation of the inhabitants of Umuebu Community, and group discussion of the topic under discussion. The data obtained from primary and secondary sources are used for this study. The central preliminary data received in this study include a questionnaire, and direct field measurement of flood events, while the secondary sources consist of archival climate data (temperature, rainfall) that was obtained from the nearest NIMET Office.

3.3 Sampling Framework

The stratified random sampling technique in which the researcher created homogeneity out of the heterogeneity by dividing the areas into strata was adopted in this study. To be able to interview a reasonable percentage of the populace, the different areas in Umuebu were subdivided into different groups for an easy conclusion to be drawn out. To select the persons for interview, as the subject of the study in each of the quarters that make up the present day Umuebu Community, the researcher adopted a sample frame by using simple ballot method to pick the sample. The

researcher personally interviewed some residents of Umuebu who reside permanently in the Community. This method, not only permit data analysis on sub-group but made it possible after rewarding the sample to generate more accurate information.

In conducting the simple random sampling, the researcher collected a number of participants (150 in number) using a ballot without replacement to select the participants by writing the names of the areas in Umuebu Community in cards thoroughly shuffled before the desired number of samples was drawn using the Taro Yamane Sampling technique. The researcher administered 150 questionnaires as the sample size of this study since it will not be possible to reach the entire population of Umuebu within this short period of time. The sample size was derived using the Taro Yamane Sampling Technique of 1964 as presented in the table below.

Table 1 Sample size of Questionnaire to be distributed in Umuebu

S/N	Sample Locations	No of Questionnaire to be Administered	Percentage (%)
1	Umuebu Unor	25	16.6
2	Obi	25	16.6
3	Obi-Igba	25	16.6
4	Eke	25	16.6
5	Main Market Axis	25	16.6
6	Obi-Ogwa axis	25	16.6
	Total	**150**	**100**

The researcher adopted the systematic sampling technique in administering twenty-five (25) questionnaires each to the respondents in Umuebu making it a total of 150 questionnaires that was distributed in six (6) locations/areas within Umuebu Community. In addition to the interview and questionnaire administration, the researcher also collected relevant data from sampled populations through direct field measurement of flood events carried out in Umuebu.

3.4 Validity and Reliability of Research Instrument

The data obtained from the primary (fieldwork) and secondary sources (archives) was submitted to the research supervisor for content and face validity and for final validation. The data obtained was criticized constructively and corrections were affected accordingly. For the reliability of the instrument, a total of 20 questionnaires were distributed to a non-targeted population and the test-retest method was applied and the reliability test was placed at 0.78 indicating that the instrument is valid and reliable.

3.5 Method of Data Collection

Data obtained from personal observation and in-depth interviews conducted in Umuebu Community and the archive of Nigerian Meteorological Agency (NIMET) and National Emergency Management Agency (NEMA). This aid the researcher to ensure that all information obtained from both sources (fieldwork and archive) are accurate and reliable. The nature and type of data collected includes:

- Climate data will include:
- Temperature distribution
- Rainfall distribution
- Data on flooding characteristics will include:
- Causes and effects of flooding
- Types/category and nature of flooding
- Time and duration of flooding

Data on flood was directly measured using materials such as measuring tape, wristwatch, rope, etc. In addition, data was obtained from field measurement, data was also obtained from questionnaire administration to the respondents in Umuebu. The questionnaires were administered to 10 (ten) buildings in each area in the study area and to every first household in each quarter to represent the given sampled population. The respondents approached in a friendly manner and after explaining the purpose of the study to them, they willingly agreed to provide relevant information pertaining to the study. About one hundred and fifty (150) questionnaires were distributed in the selected areas (using the face-to-face approach) to examine flood vulnerability and disaster management in Umuebu Community, Ukwuani Local Government Area of Delta State.

3.6 Data Analysis

The data collected from participants' questionnaires was analyzed through the descriptive survey using the multiple regression analysis under the Statistical Package for the Social Sciences (SPSS version 21 software). These statistical techniques have been used by Odey (2019), Ajede (2021), and Oseji (2022), in analysis of flood effects in Nigerian urban cities.

CHAPTER FOUR

Results and Discussion

4.1 Data Presentation and Analysis

This chapter presents and discusses the data obtained from NIMET (rainfall and temperature record, 1958-2021). NEMA (data on flooding characteristics (types, categories, causes, effects, time of occurrence, duration of occurrence and nature of the flood obtained directly from field measurement in Umuebu Community) and the administration of self-structured questionnaires are presented with the aid of tables, percentages and statistical diagrams for easy computation and statistical analysis.

4.1 Climate Characteristics in Umuebu Community, Delta State

The data Information obtained from the archives of NIMET from 1958-2021 were presented and analyzed in Table 2;

Table 2 Temperature and Rainfall Distribution over the Years in the Area

Year	**Mean Temperature (^{0}C)**	**Annual Rainfall (mm)**
1958	26.4	1510
1959	26.5	1820
1960	26.4	2016
1961	26.4	1770
1962	26.3	1967
1963	26.8	1863
1964	26.3	1700
1965	26.4	1884
1966	26.7	1876
1967	26.4	1738
1968	26.6	1779
1969	26.8	2009
1970	26.7	1698
1971	26.1	1659
1972	26.3	1648

1973	26.7	1554
1974	26.1	1595
1975	26.0	1672
1976	26.0	1871
1977	26.6	1553
1978	26.3	1788
1979	26.6	1841
1980	26.6	1914
1981	26.8	1572
1982	26.6	1686
1983	26.8	1402
1984	26.9	1504
1985	26.6	1738
1986	26.5	1574
1987	27.3	1649
1988	26.9	1746
1989	26.7	1531
1990	27.1	1851
1991	26.4	1773
1992	26.4	1542
1993	26.5	1543
1994	26.4	1757
1995	26.7	1984
1996	26.6	1987
1997	26.4	1938

1998	27.1	1606
1999	26.6	1772
2000	26.7	1494
2001	26.9	1720
2002	27.0	1719
2003	27.1	1736
2004	26.9	1736
2005	27.0	1711
2006	27.0	1741
2007	27.0	1708
2008	26.9	1731
2009	27.0	1714
2010	27.2	1727
2011	26.9	1715
2012	26.8	1713
2013	26.9	1716
2014	27.0	1718
2015	27.1	1710
2016	27.4	1705
2017	27.2	1724
2018	27.2	1724
2019	27.4	1835
2020/2021	27.9	1939
Total	**1655.9**	**10777**
Mean (x)	**26.7**	**1729**

Source: NIMET (1958-2021) record

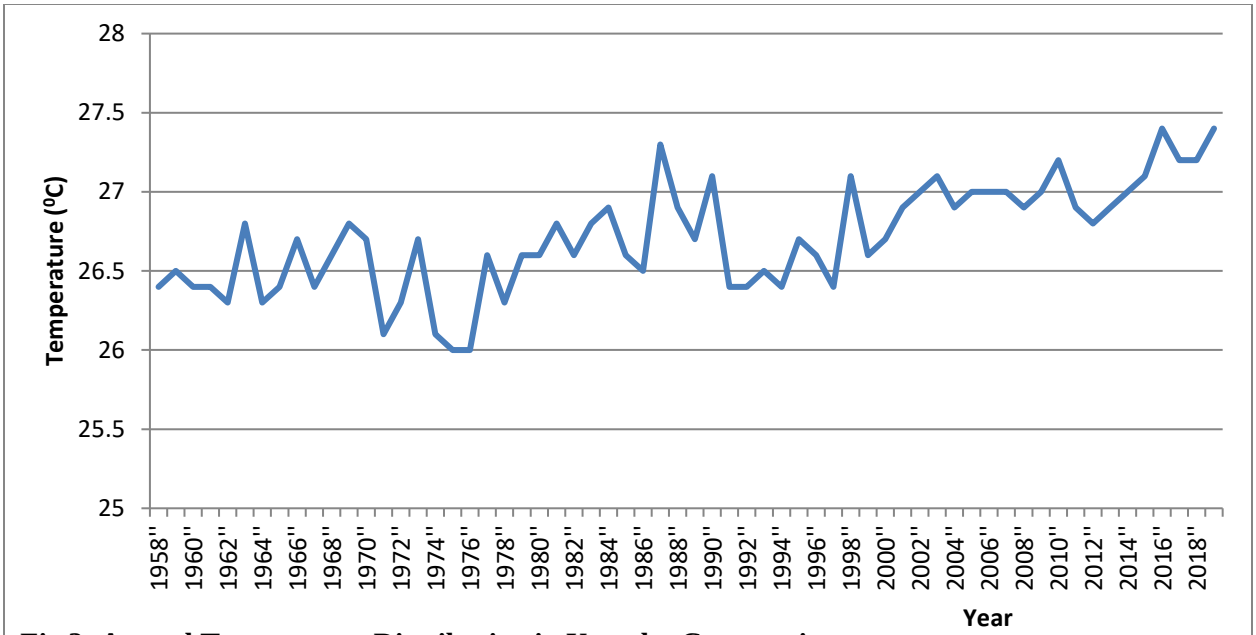

Fig 3: Annual Temperature Distribution in Umuebu Community

Figure 5 Annual Temperature Distribution in Umuebu Community

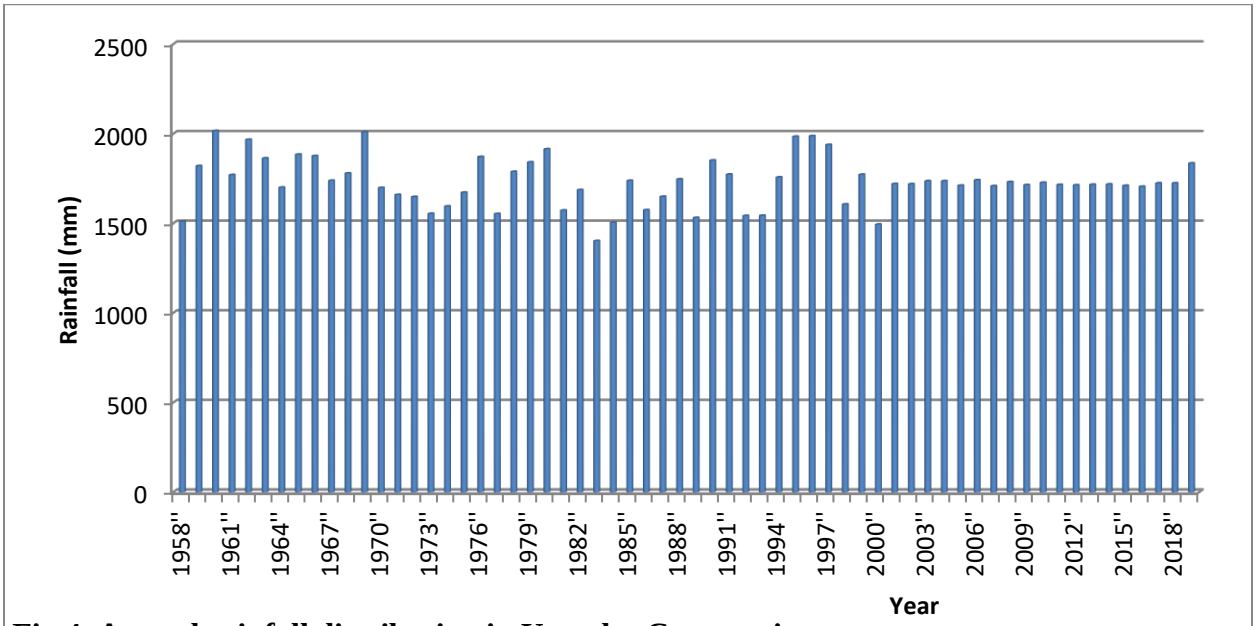

Fig 4: Annual rainfall distribution in Umuebu Community

Figure 6 Annual rainfall distribution in Umuebu Community

Table 2 and Figures 3 & 4 showed the climate characteristics in Umuebu Community, Delta State. Table 2 and Figures 3 & 4 showed that there was an increase in temperature and rainfall distribution in the area from 1958-2021 with a mean annual temperature of 27.2^0C and rainfall distribution of 2046.9mm.

Table 2 and Figures 3 & 4 revealed that in 1958, temperature and rainfall figures were placed at 26^0C and 1510mm respectively. In 1974, the temperature and rainfall figures slightly increased to 26.1^0C and 1595mm respectively. In 1978, temperature increased from 26.1^0C to 26.3^0C while rainfall increased from 1595mm to 1788mm. In 2004 and 2020 respectively, temperature remained the same (27^0C) while rainfall increased to 1736mm and 1835mm respectively. The findings conform with that of Ayoade (2004), Motha and Baier (2015), Anyadike and Efe (2015) and Karl, *et al.*, (2019), who found out that in the past 35years, there has been significant increase in temperature leading to heavy rainfall due to natural and human factors. Their findings also indicated that there is variation in the distribution of temperature and rainfall over the years especially in tropical cities of the world. It could be deduced that this increase in temperature and rainfall could be due to climate change effects and greenhouse gas emissions particularly from industrial stack at the gas plant located in Delta State (Care, 2011). These increases in temperature and rainfall as observed in Table 2 and Figures 3 & 4 could also be due to natural changes in climate.

Table 3 Monthly Temperature and Rainfall Distribution in Umuebu Community (1958-2021)

Month	**Mean Temperature Distribution (^{0}C)**	**Mean Annual Rainfall Distributing (mm)**
Jan	27.6	54.7
Feb	28.6	68.0
Mar	28.1	137.0
Apr	27.9	181.5
May	27.6	216.0
Jun	26.7	232.7
Jul	26.0	216.4
Aug	25.9	214.2
Sept	26.3	253.1
Oct	26.6	276.0
Nov	27.4	133.8
Dec	27.5	63.5
Total	**326.2**	**2046.9**
Mean (x)	**27.2**	**170.6**

Source: NIMET (1958-2021)

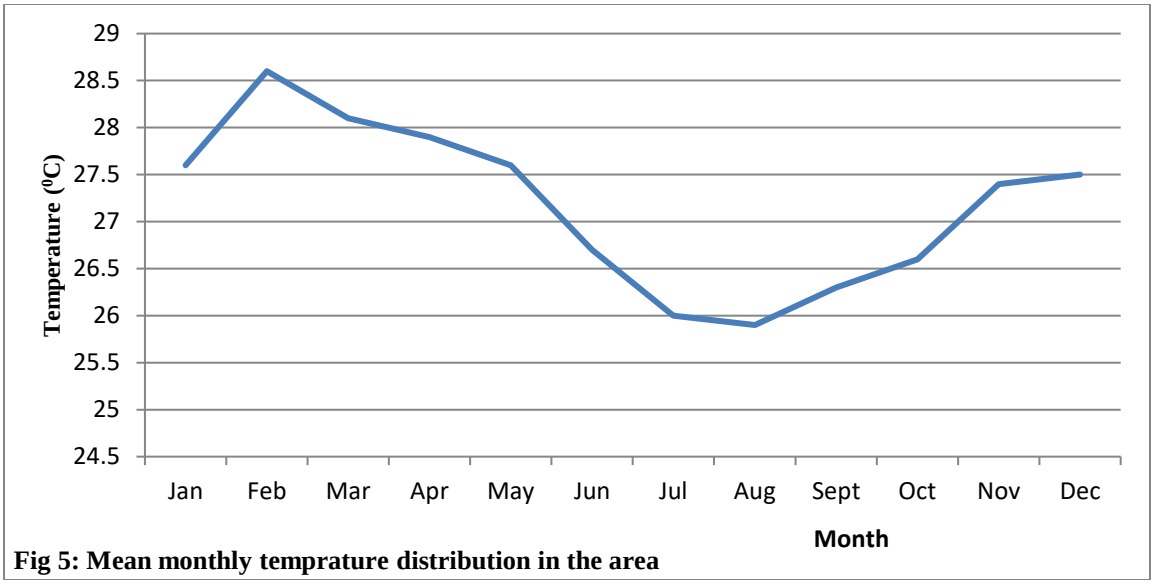

Fig 5: Mean monthly temprature distribution in the area

Figure 7 Mean monthly temperature distribution in the area

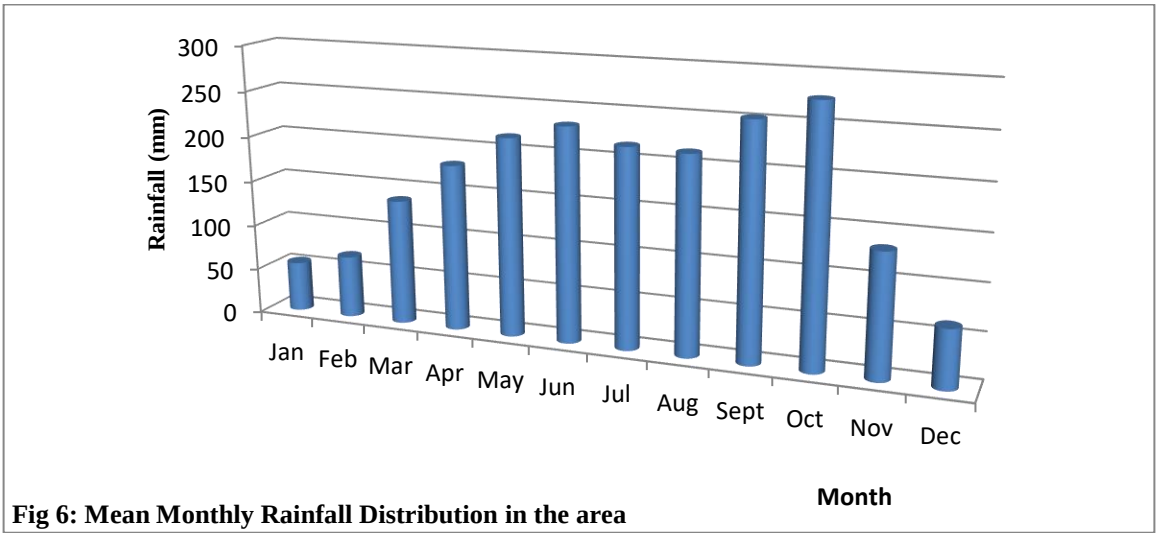

Fig 6: Mean Monthly Rainfall Distribution in the area

Figure 8 Mean Rainfall Distribution in the area

Table 3 and Figures 5 & 6 showed the mean monthly temperature distribution in Umuebu Community, Delta State. It could be deduced that temperature throughout the years (1958-2021) and months (January-December) is not evenly distributed. It was observed that temperature was highest during the months of January and February with mean monthly temperature figures of 27.6^0C and 28.6^0C recorded respectively. This implies that there is an increase in temperature between January and February due to intense heat from the sun and changes in atmospheric weather conditions. Temperature distribution later decreased from 26^0C in July to 25.9^0C in August indicating that temperature is lower during the rainy season (March-September) than the dry season (October-February). A drop in temperature in August (lower than July and September)

signifies August break/August hiatus. There was an increase in temperature in October (26.6^0C) and November (27.4^0C) as the dry season approached, indicating that temperature is highest from October-February. It was also observed that the rise in temperature (with a 0.1^0C increase) and 8.8mm increase in rainfall could be attributed to human/anthropogenic activities within the area especially gas flaring activities in Delta State where huge number of gases is being flared on daily basis leading to intense heat and alteration of the natural climate. This is evidence that the Umuebu Community has experienced significant changes in climate over the years.

4.2 Flood Characteristics in Umuebu Community

Table 4 Flooding characteristics in the area

Quarters	**Mean inundated area (km^2)**	**Mean Length (m)**	**Width (m)**	**Highest Height (ft)**	**Mean Frequency**	**Mean Longest duration lasted per month (days)**
Umuebu Unor	6.60	2.0	2.4	230	1.2	1-8 wks
Obi	5.04	2.2	2.3	210	1.7	4days-4wks
Obi-Igba	6.75	1.5	1.9	250	2.4	1-2wks
Main market axis	5.82	2.1	2.8	200	2.8	1-5days
Obi-Ogwa axis	7.32	2.7	3.7	280	3.8	2wks
Total	**31.53**	**10.5**	**13.1**	**1170**	**11.9**	
Mean	**6.31**	**2.10**	**2.62**	**234**	**2.38**	

Source: Field Survey, 2022

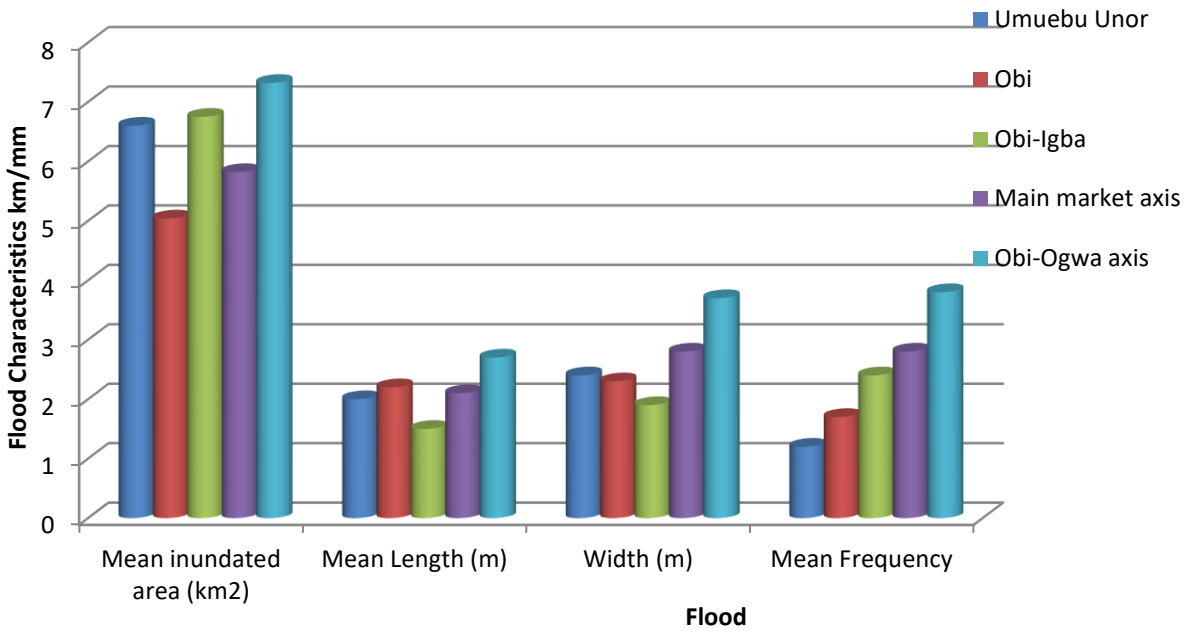

Fig 7: Flooding characteristics in the area

Figure 9 Flooding Characteristics in the area

Table 4. And Fig 7 showed that there are flood cases in the various communities within Umuebu Community. A mean total of 6.31km^2 flood occurred in inundated areas with a mean length of 2.10, width of 2.62, mean frequency of 2.38 and mean highest height of 234 indicating that flooding is a major issue in the area. The various measurements as shown in Table 4 indicate that the Obi-Ogwa axis has the highest flood with a total of 1170m. This is due to gas flaring activities resulting in heavy rainfall, acidic rain and rainstorm which is the main cause of flooding in the area. Rainfall patterns throughout this period as observed in Table 4 could be conventional or orographic rainfall which lasts for days, weeks and sometimes months with extreme weather conditions.

It was observed that areas liable to flood such as the Obi-Ogwa axis are often prone to flood hazards which eventually may lead to loss of lives, valuable properties, and huge sums of money.

Table 5 Distribution of flooded areas in Umuebu Community

Zone	Areas	Length (m)	Width (m)	Flooded portion	Depth (cm)	Periodicity	Category
A	Obi	577	2.92	1540.7	85	4 days-4wks	Single event
B	Obi-Igba	456	1.9	842.4	119	2wks	Pondage
C	Umuebu Unor	296	2.2	625.8	74	1-2wks	Single event
D	Main market axis	688.4	1.9	1308.3	104	1-5wks	Flash
E	Obi-Ogwa axis	535	2.2	1182	91	1-4wks	Flash/pondage
F	Obi-Ogo axis	435.9	2.4	1050.5	90	1-8wks	Single event
G	Farm road	272	2.5	640.9	95	1-2wks	Flash
H	Palace road	349.2	2.1	796.1	83	1-4wks	Pondage

Source: Field Survey, 2022

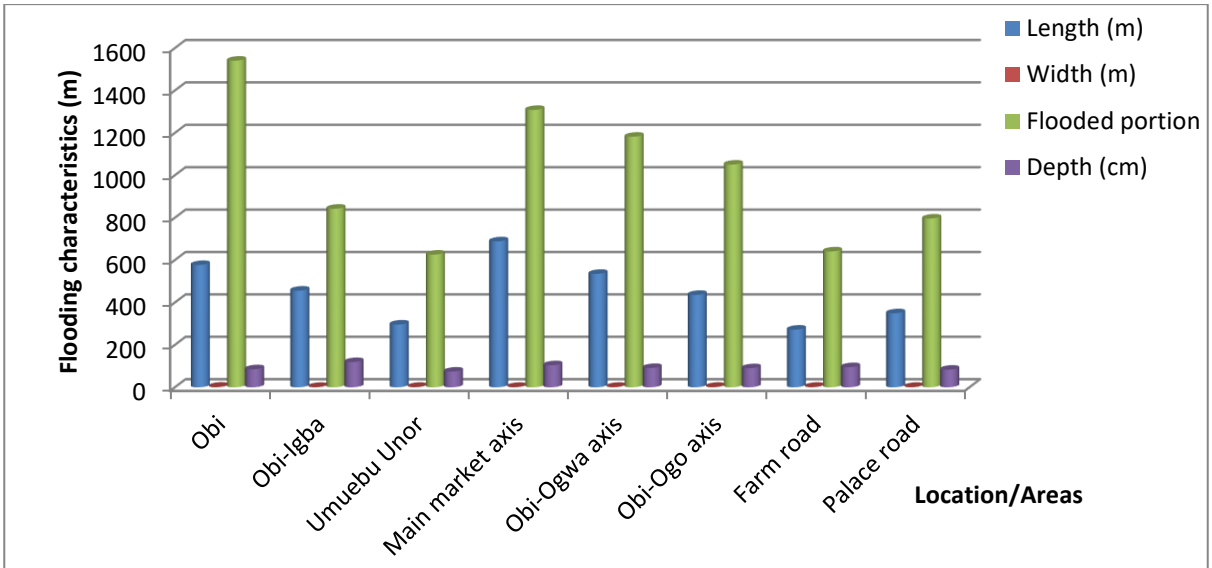

Fig 8: Flooding characteristics in the area

Figure 10 flooding characteristics in the area

Table 5 and Fig 8 showed the flooding characteristics in Umuebu Community measured for the year 2021. It could be observed that flood events in Obi took a different dimension as compared to other areas. It was observed that Obi measured flood length (577m), width (2.92m), flooded portion (1540.7) and depth of 85cm lasting for 4days to 4weeks. Single events and pondage floods dominate the area.

Table 5 and Fig 8 also show that there is variation in flood distribution in Obi-Igba. It was observed that a single event dominating Obi-Igba measured flood length (456m), width (1.9m), flooded portion (842.4) and depth of 119cm lasting for 2weeks. Table 5 and Fig 8 above also show that flood events in Umuebu Unor have the flash and single event flood lasting for 2weeks. It recorded flood length (296m), width (2.2m), flooded portion (625.8) and depth of 74cm indicating that the region is characterized by conventional flood.

Table 5 and Fig 8 also shows that flood events in Obi have the single event flood lasting for 5weeks. It recorded flood length (688.4m), width (1.9m), flooded portion (1308.5) and depth of 104cm indicating that the region is characterized by heavy rainfall and storm due to the fact that it is close to the coast. Table 5 and Fig 8 above also show that flood events in the Obi-Ogwa axis have the flash and single event flood lasting for 4weeks. It recorded flood length (535m), width (2.2m), flooded portion (1182) and depth of 91cm indicating that the region has a good drainage system which reduces flooding effects.

Table 5 and Fig 8 shows that flood events in the Obi-Ogo axis recorded flood length (435.9m), width (2.4m), flooded portion (1050.5) and depth of 90cm. This implies that the Obi-Ogo axis area experiences heavy rainfall and extreme weather conditions. The category of flood is flash and single event flood which lasts for 2-8weeks.

From Table 5 and Fig 8 flood events in Farm Road areas recorded flood length (272m), width (2.5m), flooded portion (640.9) and depth of 95cm. This means that Farm Road experiences heavy rainfall due to its closeness to the coast. The heavy rainfall often leads to severe flood hazard which affects agricultural activities in Umuebu Community thereby leading to premature harvest of farm produce. The category of flood is flash and single event flood which lasts for 1-2weeks.

From Table, 5 flood events in Palace Road recorded flood length (349.2m), width (2.1m), flooded portion (769.1) and depth of 83cm. This implies that the Palace Road area experiences heavy

rainfall and extreme weather conditions. The category of flood is single event and pondage flood which lasts for 1-4weeks.

It could be deduced that the various quarters in Umuebu Community experiences heavy rainfall which often leads to flooding of riverbanks and surrounding areas which in turn flood houses, farmlands and leads to loss of lives and valuable properties.

Table 6 Annual Distribution of Flooded Area (m2) in Umuebu Community (2005-2021)

Year	Obi	Obi-Igba	Umuebu Unor	Eke	Obi-Ogwa axis	Obi-Ogo axis	Farm road	Palace road	Mean
2005	786	796	1541	858	1309	1198	780	1060	1038
2006	698	513	1490	796	1288	1170	638	1042	951
2007	698	600	1500	840	1300	1179	638	1042	975
2008	735	610	1529	848	1310	1181	645	1050	989
2009	758	515	1538	850	1321	1189	650	1053	985
2010	768	627	1521	838	1306	1183	662	1050	994
2011	731	637	1543	852	1332	1191	668	1058	1002
2012	772	658	1597	863	1347	1198	672	1060	1021
2013	728	661	1621	868	1351	1199	675	1063	1021
2014	802	737	1633	871	1357	1128	679	1059	1033
2015	832	746	1640	879	1362	1127	680	1067	1042
2016 - 2021	839	782	1654	881	1373	1136	688	1073	1053

Source: NEMA, Obiaruku Branch (2005-2021 record)

Table 6 showed the annual mean distribution of flooded areas in Umuebu Community. It could be deduced that 2005 recorded 1038, 2006 recorded 951, 2007 recorded 975, 2008 recorded 989, 2009 recorded 985, 2010 recorded 994, 2011 recorded 1002, 2012 recorded 1021, 2013 recorded 1021, 2014 recorded 1033, 2015 recorded 1042 and 2016-2021 recorded 1053. It could also be observed in Table 4.5 that 2016-2021 has the highest record of flooding events in Umuebu Community while 2006 recorded the least which indicates that flooding increases over time with the alteration of the natural climate and weather modification which often disrupts agricultural activities in the area leading to premature harvest and loss of farm produce during harsh climate, heavy rainfall, and flooding events.

Table 7 Flood prone areas in the area

Areas	**Frequency**	**Percentage (%)**
Marshy areas	25	17
Areas that have poor drainage system	50	33
Remote villages	27	18
Major streets	33	22
Others	15	10
Total	**150**	**100**

Source: Field Survey, 2022

From Table 7, 17% of the respondents said mostly marshy areas are prone to flood, 33% said areas that have poor drainage system, 18% said flood occurs mostly in remote villages, 22% said flood occurs mostly in major streets and 10% mentioned other flood prone areas in Umuebu Community. This implies that flooding is high in areas that have poor drainage systems and major streets.

Table 8 Level of flood severity in the area

Severity	**Frequency**	**Percentage (%)**
Very Severe	105	70
Severe	45	30
No Severe	50	33
Total	**150**	**100**

Source: Field Survey, 2022

From Table 8, 70% of the respondents supported the view that flood is very severe in Umuebu Community especially in the core city, 30% said it is severe and 33% of the respondents' said flood is not severe. This means that flood occurs mostly in Umuebu Community.

Table 9 Nature of flooding in the area

Nature	**Frequency**	**Percentage (%)**
No flood	38	25
Low flood	23	15
Moderate	41	27
High flood	50	33
Total	**150**	**100**

Source: Field Survey, 2022

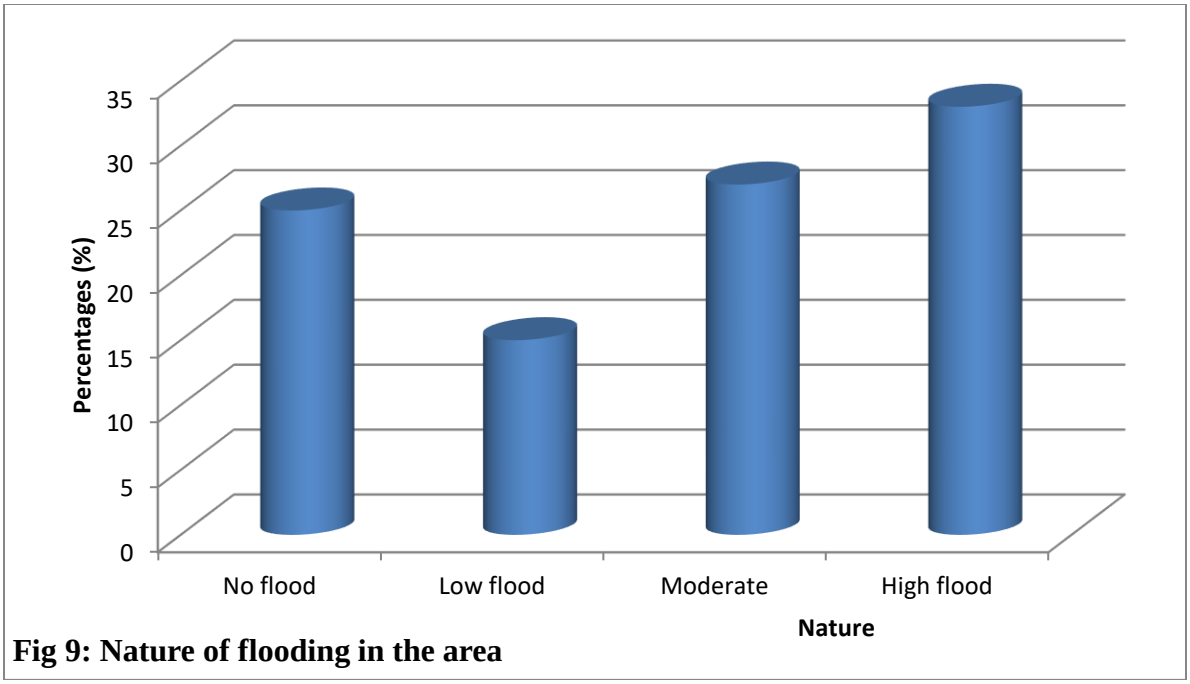

Fig 9: Nature of flooding in the area

Figure 11 Nature of flooding in the area

From Table 9 and Fig 9, 25% of the respondents said there is no flood in the area, 15% said there is low flood, 27% said the flood is moderate and 33% said the nature of flood is high. This implies that flooding is high in the study areas.

Table 10 Seasonality of flood occurrence in Umuebu Community

Response	**Frequency**	**Percentage (%)**
Wet season	108	72
Dry season	2	1
August break	40	27
Total	**150**	**100**

Source: Field Survey, 2022

From Table 10, 72% of the respondents agreed that the flooding in the area occurs in wet season, 1% said dry season and 27% said august break. This means that flooding in the area is a seasonal occurrence. Flooding is common in the rainy season.

Table 11 Nature of flooding in Umuebu Community

S/N	Nature of flood	High flood	%	Moderate	%	Low flood	%	No flood	%
a.	Coastal areas	98	65	12	8	32	21	8	5
b.	Riverbanks	38	25	44	29	35	23	36	24
c.	Marshy areas	59	39	28	19	33	22	33	22
d.	Flood plains	58	39	35	25	26	17	31	21
e.	Flood prone zones	47	31	47	31	27	18	29	19
f.	Areas liable to flood	74	49	28	19	26	17	22	15

Source: Field Survey, 2022

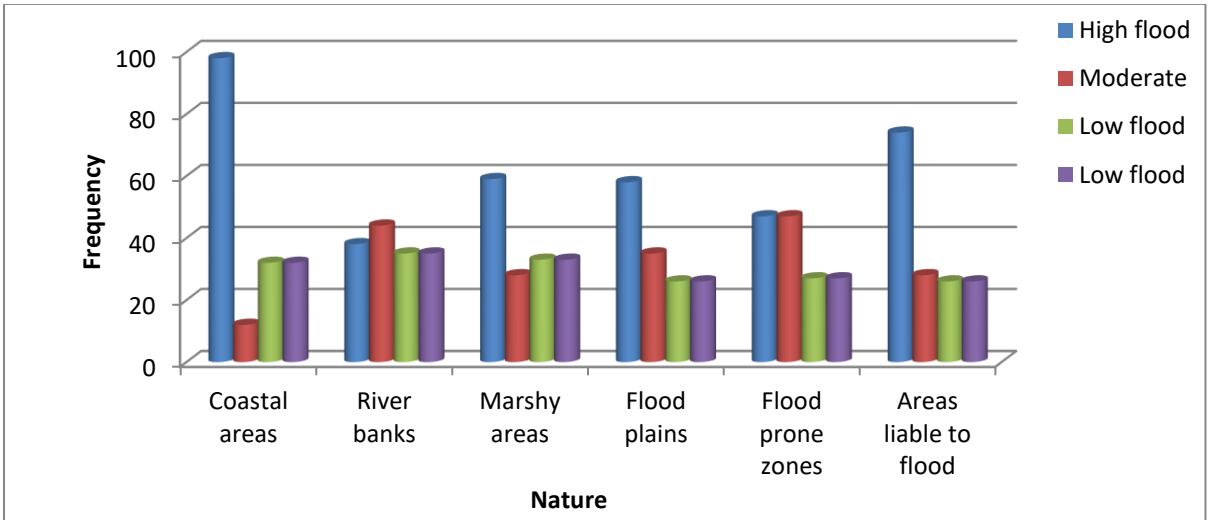

Fig 10: Nature of flooding in the area

Figure 12 Nature of Flooding in the area

Table 11 and Fig 10 showed the nature of flooding in Umuebu Community. Item (a) reveals that there is high flood in coastal areas with 65% of the respondents affirming this view, 12% said moderate, 8% said low flood and 5% said no flood.

Item (b) shows that 25% of the respondents said there is high flood in riverbanks, 29% said moderate, 235 said low flood and 24% said no flood occurs in riverbanks. This implies that flooding is very high along the riverbanks especially surrounding settlements.

Item (c) shows that 39% of the respondents indicated that flooding is very high (39%) is in marshy areas, 19% said moderate, 22% said low flood and 22% said no flood occurs in marshy areas.

Item (d) shows that 39% of the respondents indicated that flooding is very high in flood plain zones, 25% said moderate, 17% said low flood and 21% said no flood. This implies that flood hazard is more severe in flood plains.

Item (e) shows that 31% of the respondents indicated that flood hazard is very high in flood prone areas, 31% said moderate, 18% said low flood and 19% said no flood. This implies that flood hazard is more severe in flood prone areas.

Item (f) shows that 49% of the respondents said flood hazards are very high in areas liable to flood, 19% said flood is moderate, 17% said there is low flood and 15% said no flood occurs in such zones. This implies that severe flooding occurs in areas liable to flooding.

4.3 Demographic Characteristics of Respondents

Table 12 Location of Residence

Location	**Frequency**	**Percentage (%)**
Urban area	68	45
Rural area	39	26
Neighborhood Villages	44	29
Total	**150**	**100**

Source: Field Survey, 2022

From Table 12, 45% of the respondents live in the urban areas of Umuebu Community, 26% live in the rural areas, and 29% live in the neighborhood villages. This implies that most of the inhabitants are urban dwellers.

Table 13 Sex of Respondents

Sex	**Frequency**	**Percentage (%)**
Male	72	48
Female	78	52
Total	**150**	**100**

Source: Field Survey, 2022

From Table 13, 48% of the respondents are male while 52% are female. This implies that there are more males than females in Umuebu Community.

Table 14 Age of Respondents

Age	**Frequency**	**Percentage (%)**
Below 18yrs	0	0
19-25yrs	27	18
26-35yrs	21	14
36-45yrs	35	23
46-65yrs	42	28
65yrs and above	25	17
Total	**150**	**100**

Source: Field Survey, 2022

From Table 14, none of the respondents fall below 18yrs, 18% are between the age of 19-25yrs, 14% are 26-35yrs of age, 23% are 36-45yrs of age, 28% are 46-65yrs of age, and 17% are 65yrs and above. This implies that the majority of the respondents are adults.

Table 15 Marital Status

Marital Status	**Frequency**	**Percentage (%)**
Single	50	33
Married	69	46
Divorced	18	12
Widow	13	9
Total	**150**	**100**

Source: Field Survey, 2022

From Table 15, 33% of the respondents are married. This is because married occupy about 33% of the total respondents. Meanwhile, 46% are single, 12% have divorces and 9% are widows. This implies that most of the respondents are married.

Table 16 Occupational Skill

Occupation	**Frequency**	**Percentage (%)**
Skilled	87	58
Unskilled	63	42
Total	**150**	**100**

Source: Field Survey, 2022

From Table 16, 58% of the respondents are skilled workers while 42% are unskilled. This means that most of the respondents are skilled workers.

Table 17 Educational Level

Level	**Frequency**	**Percentage (%)**
No formal education	24	16
Primary education	40	27
Secondary education	45	30
Higher/tertiary education	41	27
Total	**150**	**100**

Source: Field Survey, 2022

From Table 17, 16% of the respondents have no formal education, 27% have primary education, 30% have secondary education, and 27% have higher education. This implies that most of the respondents are educated literates who can read and write.

4.4 Causes of flood in the area

Table 18 Experience of Flood Problem

Experience	**Frequency**	**Percentages (%)**
Less than a year	16	11
2 years	15	10
3 years	11	7
4 years	49	33
5eyars 7 above	59	39
Total	**150**	**100**

Source: Field Survey, 2022

Table 18 shows that 11% of the respondents have been experiencing flood problems for less than a year, 10% have been experiencing flood problems for 2years, 7% said for 3years, 33% said for 4years and 39% said for 5years. This implies that the majority of the respondents have been experiencing flood problems for more than 5years. This means that the flood problem has been consistent in Umuebu Community.

Table 19 Duration it takes the water to drain off after heavy rainfall

Duration	**Frequency**	**Percentages (%)**
One week	69	46
Two weeks	11	7
Three weeks	8	5
Four weeks and above	62	41
Total	**150**	**100**

Source: Field Survey, 2022

Table 19 shows that 46% of the respondents were of the view that it takes a week for the water to drain off after heavy rainfall, 7% said 2 weeks, 5% said 3 weeks and 41% said 4 weeks and above. This means that it takes 1-5weeks for the water to drain off after heavy rainfall.

Table 20 Human activities responsible for flood hazards in the area

Activities	**Frequency**	**Percentages (%)**
Road construction	29	19
Building construction	30	20
Poor drainage system	31	21
Sand excavation	24	16
Agricultural activities/overgrazing	18	12
Others	8	5
Total	**150**	**100**

Source: Field Survey, 2022

Table 20 shows that 19% of the respondents indicated that road construction is solely respondents for flood hazard in Umuebu Community, 20% said building construction, 21% said poor drainage system, 16% said sand excavation, 12% said agricultural activities and overgrazing often give rise to flood hazards. Meanwhile, 5% of the respondents mentioned other human activities responsible for flood hazards in the area. This implies that flood hazards are mostly caused by ma's anthropogenic activities.

Table 21 Factors responsible for Flooding Menace in the Area

Factors	**Frequency**	**Percentage (%)**
Road construction	21	14
Building/house	24	16
Poor drainage system	60	40
Street excavation	23	15
Sea level rise	15	10
Others	7	5
Total	**150**	**100**

Source: Field Survey, 2022

From Table 21, 14% of the respondents said road construction is the major factor affecting flooding menace in the area, 16% said building/house, 40% poor drainage system, 15% said street excavation, 10% said sea level rise and 5% mentioned another factor.

Table 22 Incidences of loss of lives and properties due to flooding in the area

Response	**Frequency**	**Percentages (%)**
Yes	118	79
No	32	21
Total	**150**	**100**

Source: Field Survey, 2022

Table 22 shows that 79% of the respondents agreed that there are incidences of loss of lives and valuable properties due to flood hazards in the area. The respondents who agreed indicated that about 18 people died during the 2012 flood hazard while valuable properties worth millions of naira were lost due to flood hazards in Umuebu Community with thousands of households being displaced from their homes and natural habitats respectively.

Table 23 Causes of Flood Hazards in the area

		Rank									
S/N	**Causes of flood**	**1**	**%**	**2**	**%**	**3**	**%**	**4**	**%**	**5**	**%**
1	Dumping of refuse in drains & drainage paths	3	3	9	8	38	35	18	17	41	38
2	Impervious urban surface	28	26	33	30	28	26	12	11	8	7
3	Microclimate characteristics/climate change	17	16	20	18	58	53	11	11	3	3
4	Building along waterways	3	3	1	1	33	30	45	41	27	25
5	Spiritual/anger of the god	77	71	15	14	8	7	0	0	9	8
6	Inadequate storm drains	31	28	5	5	39	36	1	1	33	30
7	Low topography	3	3	4	4	40	37	30	28	32	29
8	Government policy	3	3	11	10	52	48	20	18	17	16
9	Rapid population increase	34	31	7	6	10	9	37	34	21	19
10	Absence of drainage	6	6	39	36	12	11	44	40	8	7
11	Poor heading to predictions	1	1	9	8	61	56	7	6	31	28
12	Land reclamation	17	16	0	0	46	42	2	2	44	40
13	Noncompliance with regulations	2	2	2	2	30	28	39	36	31	28
14	Type of soil	15	14	17	16	58	53	3	3	16	15
15	Others	17	16	5	5	47	43	32	29	8	7

Source: Field Survey, 2022

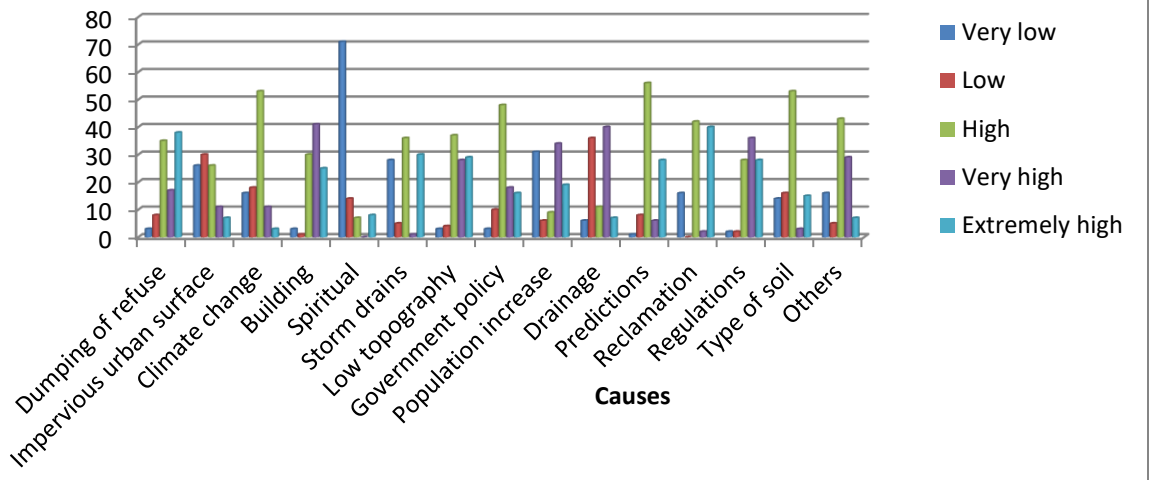

Fig 11: Causes of Flood in the area

Figure 13 Causes of Flood in the area

Table 23 and Fig 11 showed the various causes of flood hazard in the area. It could be deduced from the table above that dumping of refuse in drain and drainage paths as a major cause of flood in the area is high since high constitutes 35% of the total proportion. Impervious urban surface causes flood at a low (30%) rate. Microclimate characteristics/climate change causes floods at a high (53%) rate. Building along waterways also causes flood at a very high (41%) rate while spiritual/anger of the god does not cause flooding. Inadequate storm drains cause floods at a high (36%) rate. Low topography (37%) and government policy (48%) causes floods at a high rate. Rapid population increase and absence of drainage causes floods at a very high rate and poor heeding to predictions causes floods at a high rate. Land reclamation causes flood at a high (42%) rate, noncompliance with regulations causes flood at a very high (36%) rate, type of soil causes flood at a high (53%) rate and others (43%) causes flood at a high rate.

This implies that dumping of refuse in drains/drainage paths, impervious urban surface, microclimate characteristics/climate change, building along waterways, inadequate storm drains, low topography, lack of government policy, rapid population increase, and absence of drainage, poor heeding to predictions, land reclamation, noncompliance with emulations and type of soil are the major causes of flooding in the area.

Table 24 Lack of proper drainage network resulting to flood

Response	Frequency	Percentage (%)
Yes	74	49
No	77	51
Total	**150**	**100**

Source: Field Survey, 2022

From Table 24, 49% of the respondents agreed that flooding resulted due to lack of a good drainage system in the area while 51% of the respondents disagreed with this view. They attributed flooding to natural processes other than drainage morphology. This means that flooding is not majorly caused by lack of drainage system.

4.5 Socio-economic Impact Flood in the area

Table 25 Socio-economic activities in the area

Activities	Frequency	Percentage (%)
Farming	37	25
Trading	26	17
Transport	21	14
Commercial activities	20	13
Industrial activities	46	31
Total	**150**	**100**

Source: Field Survey, 2022

Table 25 reveals that 25% of the respondents indicated that farming is the major socio-economic activities in the area, 17% said trading, 14% said transport, 13% said commercial activities and 31% said industrial activities is the major socio-economic activities in the area. This implies that most people in Umuebu Community are commercial traders who rely on trading activities for their source of livelihood. The recent flood cases in the area have been observed to have a direct effect on the socio-economic activities of the people.

Table 26 Flood disrupt socio-economic activities in the area

Response	**Frequency**	**Percentage (%)**
Yes		82
No		28
Total	**150**	**100**

Source: Field Survey, 2022

From Table 26, 82% of the respondents agreed that floods disrupt socio-economic activities in the area while 28% disagreed. This implies that floods disrupt socio-economic activities in the area.

Table 27 Level of flood vulnerability in the area

Level	**Frequency**	**Percentage (%)**
Very High	24	16
High	35	24
Moderate	60	41
Low	30	20
Very Low	0	0
Total	**150**	**100**

Source: Field Survey, 2022

From Table 27, 16% of the respondents indicated that flood vulnerability in the area is very high, 24% said it is high, 41% said it is moderate, and 20% said it is low with no respondents saying it is very low. This means that the effect of flooding in the area is moderate.

Table 28 Level of flooding effect in the area

Level	**Frequency**	**Percentage (%)**
Very Severe	74	49
Severe	39	26
Mild	32	21
Not Severe	5	3
Total	**150**	**100**

Source: Field Survey, 2022

From Table 28, 49% of the respondents were of the view that the level of effect of flooding in the area is very severe, 26% said it is severe, 21% said it is mild, and 3% said it is not severe. This means that the effect of flooding in the area is moderate.

Table 29 : Level of flooding effect in Umuebu Community

S/N	Options	Very Severe	%	Severe	%	Moderate	%	Low	%	Not Severe	%
a.	Loss of farm produce	38	25	75	50	10	7	25	17	2	1
b.	Destruction of valuable properties	52	35	31	21	25	17	18	12	24	16
c.	Damage of farmlands	98	65	32	21	12	8	5	3	3	2
d.	Exposure of building foundation	44	29	38	25	35	23	25	17	8	5
e.	Destruction of landscape	24	16	18	12	52	35	31	21	25	17
f.	Disruption of business and transportation activities	59	39	28	19	27	18	23	15	13	8

Source: Field Survey, 2022

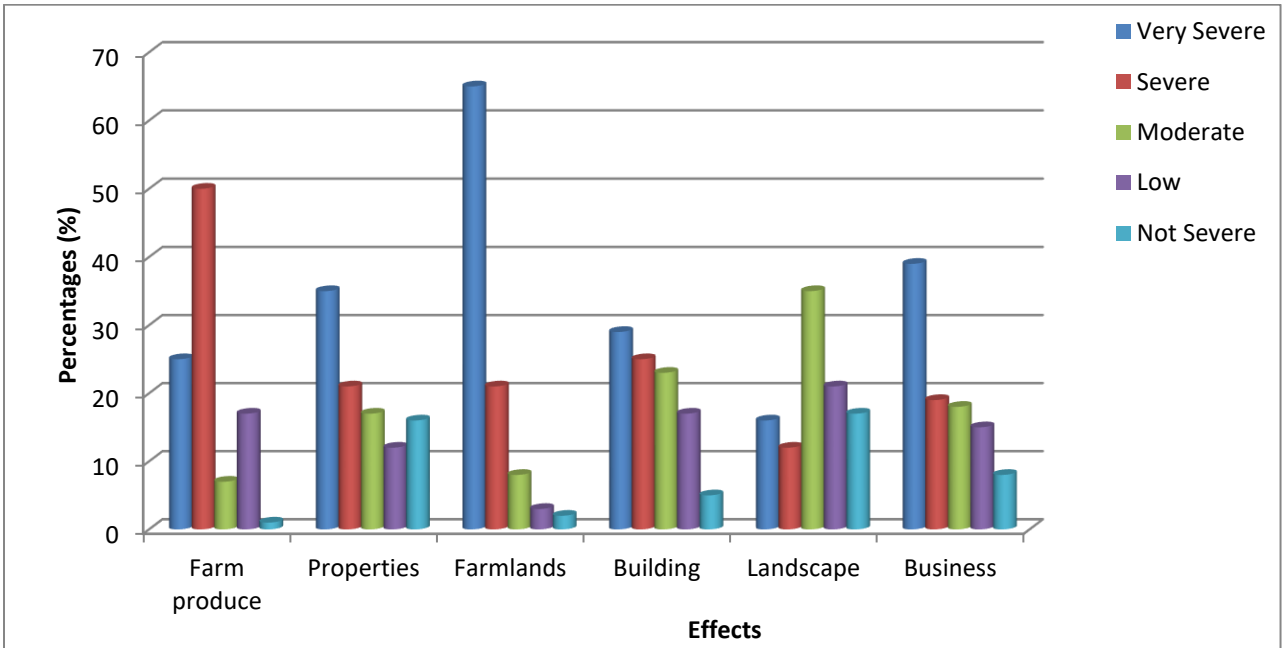

Fig 12: Level of flooding effect in the area

Figure 14 Level of Flooding effects in the area

Table 29 and Fig 12 shows the level of flooding effect in Umuebu Community. Item (a) shows that 25% of the respondents said that flooding to a very severe level has resulted to loss of farm produce, 21% said severe, 17% said moderate, 12% said low and 16% said not severe. This implies that flooding has a very severe effect on farm produce.

Item (b) shows that 35% of the respondents indicated that said the effect of flooding on destruction of valuable properties in the area is very severe, 21% said severe, 17% said moderate, 12% said low and 16% said not severe. This implies that flooding has a very severe effect on the destruction of valuable properties.

Item (c) shows that 65% of the respondents indicated that the effect of flooding on damage of farmlands is very severe, 21% said severe, 8% said moderate, 3% said low and 2% said not severe. This means that flooding has led to the damage of farmlands.

Item (d) shows that 29% of the respondents indicated that the effect of flooding on exposure of building foundation is very severe, 25% said severe, 23% said moderate, 17% said low and 5% said not severe. This shows that flooding exposes building foundations which often leads to the collapse of buildings in Umuebu Community.

Item (e) shows that 16% of the respondents indicated that the effect of flooding on the destruction of landscape is very severe, 12% said severe, 35% said moderate, 21% said low and 17% said not severe. This implies that flood hazard has led to the destruction of landscape.

Item (f) shows that 39% of the respondents indicated that the effect of flooding on the disruption of business and transportation activities is very severe, 19% said severe, 18% said moderate, 15% said low and 8% said not severe. This implies that flood hazard has led to the disruption of business and transportation activities.

Table 30 Causes and effects of Flood in Umuebu Community

S/N	Causes	No of time	Effects	No of time
1	Dumping of refuse in drains & drainage paths	63	Traffic congestion	97
2	Impervious urban surface	55	Damage to landed property	67
3	Microclimatic characteristics	78	Lateness to school & work	78
4	Building along waterways	58	Slow down business activities	68
5	Spiritual/anger of the god	25	Cars & vehicles veering off the road	60
6	Inadequate storm drains	75	Blocking clogging of drains	15
7	Topography of the area	50	Turbid water unsuited for domestic use	96
8	Government policy	60	Pre-mature harvest of crop yield	11
9	Rapid population increase	30		28

Source: NEMA, Obiaruku Branch (2005-2021 record)

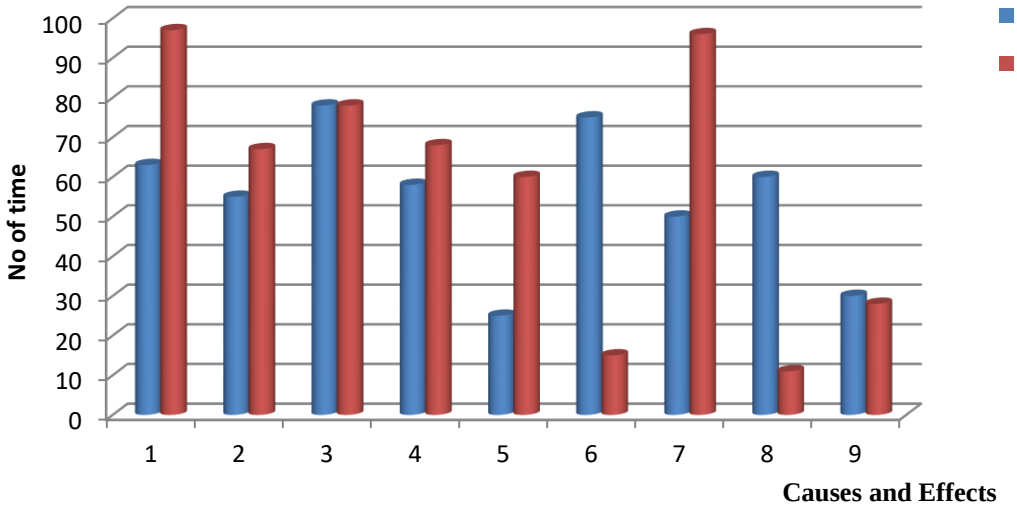

Fig 13: Causes and effects of flooding in the area

Figure 15 Causes and effects of flooding in the area

Table 30 and Fig 13 showed the causes and effects of flooding in Umuebu Community. From the table above it could be observed that dumping of refuse in drains, drainage paths and major roads/streets causes traffic congestion, impervious urban surfaces often result in damage of landed

properties such as buildings, churches, shops, schools, and workshops. Alteration of the natural climate could lead to weather modification which causes changes in weather leading to heavy rainfall which often deprive school students and workers from going to school early, building along waterways could cause serious flooding which may slow down business thereby affecting the socio-economic activities of the people.

It could also be observed from the table above that spiritual /anger of the gods, inadequate storm drains, topography of the area, government policy and rapid population increase often result to slow down of business activities, cars/vehicles veering off the road, despoiling of valued land, blocking clogging of drains, turbid water unsuited for domestic use and ore-mature harvest of crop yield.

Table 31 Effects of flood on the inhabitants of Umuebu Community

	Properties affected						
Zone	**Areas**	**Houses**	**Shops**	**Workshops**	**Schools**	**Churches**	**Estimated cost (₦)**
A	Obi	97	18	37	2	11	22.4m
B	Obi-Igba	47	30	21	0	68	16.5m
C	Umuebu Unor	18	12	16	0	6	20.7m
D	Eke	96	28	37	6	8	31.7m
E	Obi-Ogwa axis	51	20	26	5	5	18.9m
F	Obi-Ogo axis	144	59	43	0	6	51.14
G	Farm road	116	53	20	0	7	23.2m
H	Palace road	56	54	19	2	8	1.7m

Source: NIMET Office (2005-2021 records)

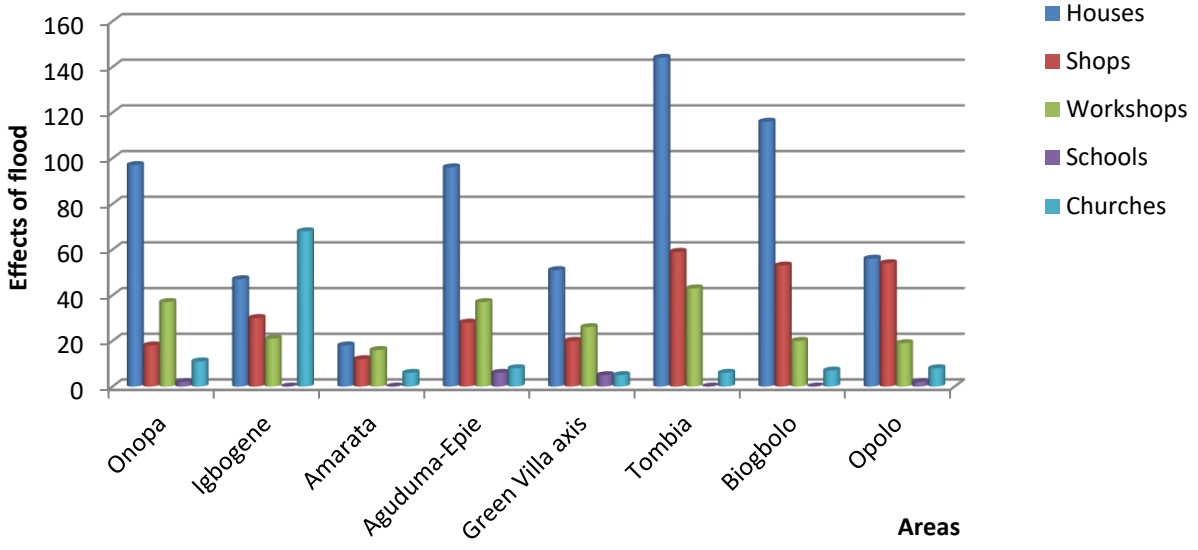

Fig 14: Effects of flood in Yenagoa

Figure 16 Effects of flood in Yenagoa

Table 31 and Fig 14 showed the effects of flood on the inhabitants of Umuebu Community. It could be observed that about 97 houses, 18 shops, 37 workshops, 2 schools and 11 churches were prone to flood hazards in Obi losing approximately 22.4million naira. This is an indication that severe flood damage was recorded in Obi.

Table 31 and Fig 14 also shows that about 47 houses, 30 shops, 21 workshops, and 68 churches were prone to flood hazards in Obi-Igba quarters. The region also lost 16.5million naira during flood hazards especially in 2012.

Table 31 also shows that about 18 houses, 12 shops, 16 workshops, and 6 churches were prone to flood hazards in Umuebu Unor losing approximately 20.7million naira. This is an indication that severe flood damage was recorded in Umuebu Unor.

Table 31 and figure 4.9 also shows that about 96 houses, 28 shops, 37 workshops, 6 schools and 8 churches were prone to flood hazards in Eke losing approximately 31.7million naira. This is an indication that severe flood damage was recorded in Eke.

Table 31 also shows that about 51 houses, 20 shops, 26 workshops, 5 schools and 5 churches were prone to flood hazards in the Obi-Ogwa axis losing approximately 18.9million naira.

Table 31 also shows that about 144 houses, 59 shops, 43 workshops, and 6 churches were prone to flood hazards in the Obi-Ogo axis losing approximately 51.14million naira. This is an indication that severe flood damage was recorded in the Obi-Ogo axis.

Table 31 also shows that about 116 houses, 53 shops, 20 workshops, and 7 churches were prone to flood hazards in Eke quarter. An estimated cost of 23.2million naira including crop yield and farm produce was lost during flood hazards in Eke quarter indicating flooding has a negative effect on agricultural activities.

The table also shows that about 56 houses, 54 shops, 19 workshops, 2 schools, and 8 churches were prone to flood hazards in Palace Road. An estimated cost of 1.7million naira including agricultural crop produce and livestock was lost during flood hazards in Palace Road indicating flooding has a negative effect on agricultural activities.

Table 32 Market activities breakdown during flood

Response	**Frequency**	**Percentage (%)**
Yes	36	24
No	114	76
Total	**150**	**100**

Source: Field Survey, 2022

From Table 32, 24% of them agreed that market activities breakdown during flood cases while 76% said nothing of such occurs during flooding. This means that flooding does not disrupt market activities and other businesses. The respondents who agreed that market activities are affected during flood cases said that the proportion of flood damages in the area ranges from large to small proportions.

Table 33 Proportion of Market Activities Breakdown during Flood

Proportion	**Frequency**	**Percentage (%)**
Small proportion	45	30
Moderate proportion	46	31
Large proportion	59	39
Total	**150**	**100**

Source: Field Survey, 2022

Table 33 shows that 30% of the respondents indicated that there are small proportions of market activities which breakdown during flooding, 31% said moderate proportion, and 39% said large proportion of market activities breakdown during flood events. This implies that flooding destroys a large proportion of market activities in Umuebu Community.

Table 34 Flooding has restricted the Movement of People and Vehicles in the Area

Response	**Frequency**	**Percentage (%)**
Yes	72	48
No	78	52
Total	**150**	**100**

Source: Field Survey, 2022

From Table 34, 48% of the respondents agreed that flooding has restricted the movement of people and vehicles in the area while 52% of the respondents did not agree. This implies that the majority of the respondents were affected by flooding induced effects.

Table 35 Ways in which Flooding has affected Socio-economic activities in the Area

Response	**Frequency**	**Percentage (%)**
Closure of business	45	30
Low business transaction	46	31
Hike in transportation	21	14
Low mobility	24	16
Low patronage	14	
Total	**150**	**100**

Source: Field Survey, 2022

From Table 35, a total of 30% of the respondents' said flooding has led to closure of business, 31% said low business transaction, 14% said hike in transportation, 16% said low mobility and 9% said low patronage. This implies that flooding affects the inhabitants of Umuebu Community mostly in the business sector.

Table 36 Occurrence of flood significantly dependent on rainfall, poor drainage, and erosion

Response	**Frequency**	**Percentage (%)**
Yes	119	79
No	31	21
Total	**150**	**100**

Source: Field Survey, 2022

From Table 36, 79% of the respondents agreed that flooding results in the damage of valuable properties and possibly the loss of life, while 21% disagreed with this view. This means that flooding usually leads to property damage.

Table 37 Livelihood of Umuebu Community significantly vulnerable to flooding

Response	**Frequency**	**Percentage (%)**
Yes	114	76
No	36	24
Total	**150**	**100**

Source: Field Survey, 2022

From Table 37, 76% of them agreed that the livelihood of Umuebu Community people is significantly vulnerable to flooding while 24% of the respondents did not agree to this view. This means that flooding affects the livelihood of Umuebu Community residents.

Table 38 Flooding effect on socio-economic activities in the area

Response	**Frequency**	**Percentage (%)**
Yes	123	82
No	27	18
Total	**150**	**100**

Source: Field Survey, 2022

From Table 39, 82% of the respondents agreed that flooding affects the socio-economic activities of the people while 28% disagreed. This implies that flooding affects the socio-economic activities of the people.

Table 39 Socio-economic Effects of flooding in the area

Effects	**Frequency**	**Percentage (%)**
Destruction of urban properties	18	12
Destruction of landscape	42	28
Damage of socio-economic activities	62	41
Exposure of building foundation	28	19
Others	0	0
Total	**150**	**100**

Source: Field Survey, 2022

From Table 39, 12% of the respondents said that destruction of urban properties is the most severe effect of flooding in the area, 28% said destruction of landscape, 41% said damage to socio-economic activities, 39% said exposure of building foundation and none of the respondents mentioned other effects. This implies that the most severe effect of flooding could be seen in the socio-economic activities of the people.

Table 40: Incidence of flooding results in the loss of lives and properties in the area

Response	**Frequency**	**Percentage (%)**
Yes	118	79
No	32	21
Total	**150**	**100**

Source: Field Survey, 2022

From Table 40, 79% of the respondents agreed that flooding results in the damage of valuable properties and possibly the loss of life, while 21% disagreed with this view. This means that flooding usually leads to loss of lives and property damage.

Table 41 Estimated number of properties destroyed/estimated cost

S/N	**Areas/roads**	**Mean Properties Affected**	**Estimated mean cost (₦) million**
1	Umuebu Unor	26	2.2
2	Obi	35	1.7
3	Obi-Igba	110	2.5
5	Eke	77	1.5
6	Obi-Ogwa axis	18	1.9
	Total	**226**	**9.8**
	Mean	**53.2**	**1.96**

Source: Field Survey, 2022

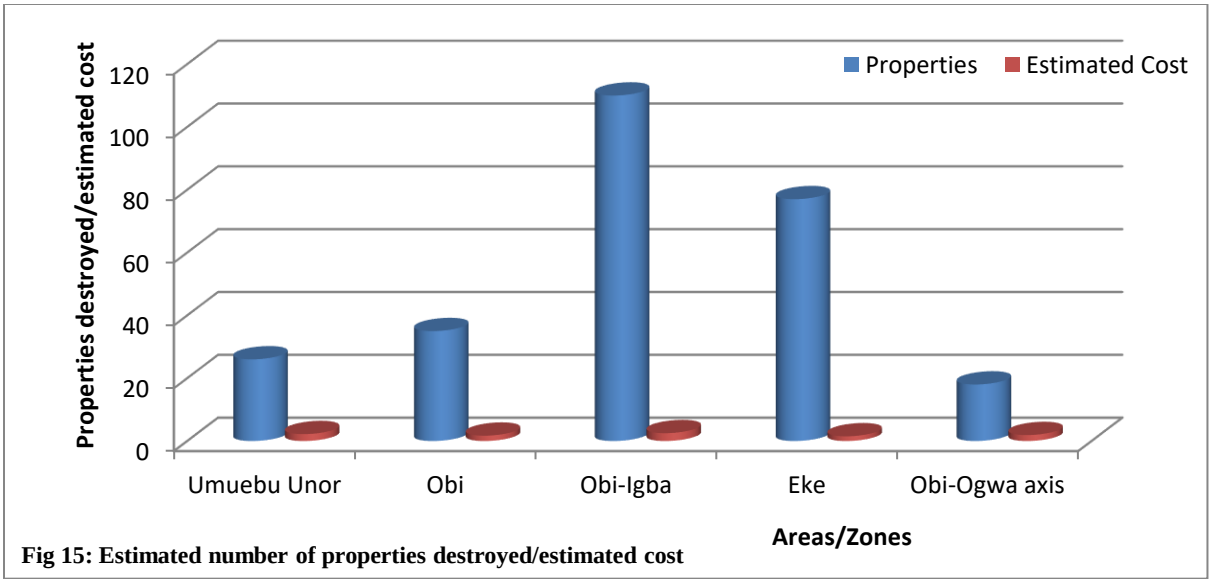

Fig 15: Estimated number of properties destroyed/estimated cost

Figure 17 Estimated number of properties destroyed/estimated cost

Table 41 and Fig 15 shows the estimated number of properties destroyed by flood hazard and estimated cost of affected properties. From the table above, about 26 properties worth 2.2.m were destroyed in Obi-Igba, 35 properties worth 1.7m destroyed in Obi, 110 properties worth 2.5m were destroyed in Obi-Ogwa axis, 77 properties worth 1.5m were destroyed in Eke and 18 properties worth 1.9m were destroyed by flood in Umuebu Unor. A total of 226 properties worth 9.8m were affected and destroyed by flood hazard. These properties range from buildings, roads, marketplaces, schools, shops, etc to community services and environmental facilities. This is evidence that flooding has a serious effect on landed properties in Umuebu Community.

4.6 Flood Adaptation and Mitigation Strategies in Umuebu Community

Table 42 Flood Problem in the area

Response	**Frequency**	**Percentage (%)**
Yes	113	75
No	37	25
Total	**150**	**100**

Source: Field Survey, 2022

From Table 42, 75% of the respondents said that flood problems exist in their area while 25% did not agree that floods exist in the area. This means that flooding occurs in the area. Some of the respondents who agreed that flood occurs in their area said they have been experiencing flood for more than 2-4years now.

Table 43 Flooding Problem can be solved

Response	**Frequency**	**Percentage (%)**
Yes	121	81
No	29	19
Total	**150**	**100**

Source: Field Survey, 2022

From Table 43, 81% of the respondents agreed that flooding problems can be solved while 19% disagreed with this view. This means that flooding problems can be solved.

Table 44

Table 44: Measures to curb Flooding Problems

Measures	**Frequency**	**Percentage (%)**
Construction of good drainage network	59	39
Clearing of waterway for easy runoff	31	21
Sand filling of liable flood area	42	28
Clearing of block culvert	18	12
Total	**150**	**100**

Source: Field Survey, 2022

From Table 44, 39% of the respondents said construction of a good drainage network, clearing of waterway for easy runoff (21%), sand filling of liable flood areas (28%) and clearing of block culvert (12%) are the remedies to solve flooding problems.

Table 45: Successful Flood Methods

Response	**Frequency**	**Percentage (%)**
Yes	74	49
No	76	51
Total	**150**	**100**

Source: Field Survey, 2022

From Table 45, 49% of the respondents said the measures adopted are successful while 51% of the respondents said the measures are not successful. This implies that the measures are successful.

Table 46 Contribution of Private Individuals in Curbing the Problems of Flooding in the Area

Response	**Frequency**	**Percentage (%)**
Yes	38	25
No	112	75
Total	**150**	**100**

Source: Field Survey, 2022

From Table 46, 25% of the respondents agreed that the individual has contributed immensely to solving the problems of flooding while 75% of the respondents did not agree.

Table 47 Compensation the affected Communities has received from the Government as a result of loss of lives and properties

Compensation	**Frequency**	**Percentage (%)**
Cash gift	42	28
Building of houses of victims	25	17
Donations of building materials	53	35
Rehabilitation of damaged roads and markets structures	24	16
Provision of temporary settlement to IDPs	6	4
Total	**150**	**100**

Source: Field Survey, 2022

From Table 47, 28% of the respondents said they receive cash gifts from the government, 17% said building of houses of victims,35% said donation of building materials, 16% rehabilitation of damaged roads, and market structures, and 4% said provision of temporary settlement to IDPs. This means that to some extent the government has played a key role in handling flooding problems.

Table 48: Flood Management Measures Adopted over the years

		Areas/Roads						
S/N	**Flood management**	**Obi-Igba**	**Obi**	**Obi-Ogwa axis**	**Eke**	**Umuebu Unor**	**Total**	**%**
1	Environmental sanitation/clearing of drainages	5	3	6	1	1	16	14.7
2	Proper waste disposal methods	3	1	4	1	3	12	11.0
3	Reduction in gas flaring activities	5	0	12	8	4	29	26.6
4	EIA programme	7	4	5	1	0	17	15.6
5	Proper enlightenment/awareness programme	8	3	9	1	1	22	20.2
6	Others	3	1	4	2	3	13	11.9
	Total						109	100

Source: Field Survey, 2022

Table 48 shows that about 14.7% of the respondents in Obi-Igba, Obi, Obi-Ogwa axis, Eke and Umuebu Unor indicated that environmental sanitation and clearing of drainages are the best flood management measures adopted over the years. About 11.0% said proper waste disposal methods, 26.6% said reduction in gas flaring activities, 15.6% said Environmental Impact Assessment programme, 20.2% said flooding can be managed and controlled through proper enlightenment/awareness programme and 11.9% mentioned other flood management measures adopted in the area over the years. This implies that suggestions on the reduction in gas flaring activities in Obi-Ogwa axis and its environs are the best control measures to flood hazard issues as shown in Fig 16.

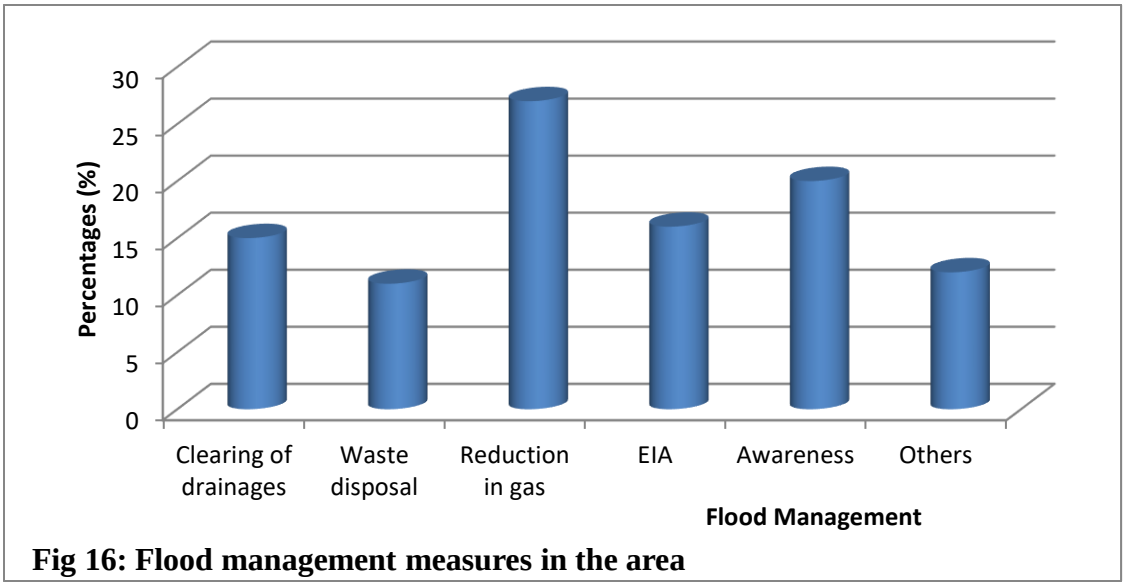

Fig 16: Flood management measures in the area

Figure 18 Flood management measures in the area

4.8 Discussion of Findings

The findings of this study are discussed as follows.

4.8.1 Flood Characteristics in Umuebu Community

The result of the findings showed that there are flood cases in the various communities within Umuebu Community. A mean total of 6.31km^2 flood occurred in inundated areas with a mean length of 2.10, width of 2.62, mean frequency of 2.38 and mean highest height of 234 indicating that flooding is a major issue in the area. From Table 2, it could be deduced that the various quarters in Umuebu Community experiences heavy rainfall which often leads to flooding of riverbanks and surrounding areas which in turn flood houses, farmlands and leads to loss of lives and valuable properties. Flooding is high in areas that have poor drainage systems and major streets. The various measurements indicate that the Obi-Ogwa axis has the highest flood with a total of 1170m. This is due to gas flaring activities resulting in heavy rainfall, acidic rain and rainstorm which is the main cause of flooding in the area. Rainfall patterns throughout this period could be conventional or orographic rainfall which lasts for days, weeks and sometimes months with extreme weather conditions.

4.8.2 Causes of Flood in the Area

The result of the findings showed that most of the respondents have been experiencing flood problems for more than 5years. This means that the flood problem has been consistent in Umuebu Community. It was observed that dumping of refuse in drains/drainage paths, impervious urban surface, microclimate characteristics/climate change, building along waterways, inadequate storm drains, low topography, lack of government policy, rapid population increase, absence of drainage, poor heeding to predictions, land reclamation, noncompliance with emulations and type of soil are the major causes of flooding in the area.

4.8.3 Socio-Economic Impact Flood in Umuebu Community

The result of the findings revealed that most people in Umuebu Community are commercial traders who rely on trading activities for their source of livelihood. The recent flood cases in the area have been observed to have a direct effect on the socio-economic activities of the people since 82% of the respondents agreed that flood disrupt socio-economic activities in the area while 28% disagreed. The findings also showed that loss of farm produce, destruction of valuable properties, damage of farmlands, exposure of building foundation, destruction of landscape, and disruption of business and transportation activities are the socio-economic impact of flood in Umuebu Community Local Government Area of Delta State.

The result obtained also showed that dumping of refuse in drains, drainage paths and major roads/streets causes traffic congestion, impervious urban surfaces often result in damage of landed properties such as buildings, churches, shops, schools, and workshops. Alteration of the natural climate could lead to weather modification which causes changes in weather leading to heavy rainfall which often deprive school students and workers from going to school early, building along waterways could cause serious flooding which may slow down business thereby affecting the socio-economic activities of the people. Also, spiritual /anger of the gods, inadequate storm drains, topography of the area, government policy and rapid population increase often result to slow down of business activities, cars/vehicles veering off the road, despoiling of valued land, blocking clogging of drains, turbid water unsuited for domestic use and ore-mature harvest of crop yield.

4.8.4 Flood Adaptation and Mitigation Strategies in Umuebu Community

The result of the findings showed that construction of good drainage network, clearing of waterway for easy runoff, sand filling of liable flood area and clearing of block culvert are the remedies to solve flooding problems since 49% of the respondents said the measures adopted are successful while 51% of the respondents said the measures are not successful. A total of 28% of the respondents said they receive cash gifts from the government, 17% said building of houses of victims,35% said donation of building materials, 16% rehabilitation of damaged roads, and market structures, and 4% said provision of temporary settlement to IDPs.

The result also showed that most of the people in Obi-Igba, Obi, Obi-Ogwa axis, Main market axis and Umuebu Unor indicated that environmental sanitation and clearing of drainages are the best flood management measures adopted over the years. Others suggested proper waste disposal methods, reduction in gas flaring activities, Environmental Impact Assessment programme, flooding can be managed and controlled through proper enlightenment/awareness programme and other flood management measures adopted in the area over the years.

The results obtained from the findings shows that the livelihood of the people is significantly vulnerable to flooding. This is in line with the findings of Ejoh (2021) who noted that loss of livelihoods, reduction in purchasing power and loss of land value in the floodplains can leave communities, especially most communities in Umuebu Community, economically vulnerable.

The results also highlighted that the occurrence of flood is significantly dependent on rainfall, poor drainage, erosion, etc. This corroborates with the findings of Odili (2021) who found that the impact of flooding can have social, economic, and environmental consequences. Douglas, et al., (2015). They observed that flood negative and positive consequences vary vastly depending on its location and as well as their threat to natural and constructed environments

CHAPTER FIVE

Summary of Findings, Recommendations and Conclusion

5.1 Summary of Findings

In order to reduce flood problems by utilizing management methods put in place throughout time, this study assessed flood vulnerability and associated risk management in Umuebu Community, Ukwuani Local Government Area of Delta State. The issues that made this investigation necessary were carefully outlined throughout the paper. Flooding has been identified as one of the environmental issues that have plagued humans since the beginning of time. Flooding is a common and ancient occurrence. Flooding in the Umuebu Community has resulted in enormous hardship, including the destruction of structures, a halt to the region's socioeconomic progress, and several farmlands and agricultural products. A growing number of farmlands are being flooded every day as the flood's fatal effects continue.

The idea of environmental impact assessment (EIA) and sustainable agriculture was chosen for the study because these approaches aim to produce food while also protecting the environment, which is something that every country and farmer must consider before engaging in any practices. The Umuebu Community and its surroundings, particularly the urban and rural areas, may be affected by this. According to the reviewed literature, flood threats have caused immeasurable pain and economic depression in the research area by destroying farmland, buildings, and businesses, uprooting residents, and losing valuable properties, among other things.

Data for this study were obtained from NEMA, Obiaruku Branch, and questionnaire administration in Umuebu Community. We analyzed data obtained from primary and secondary sources with the aid of statistical diagrams. The following are the findings:

The study revealed that marshy (Obi-Igba, Obi, Obi-Ogwa axis, Main market axis and Umuebu Unor) areas that have poor drainage systems, remote villages, and major streets are prone to flooding in the area.

The study revealed that the level of flood vulnerability in the area is very high, and the level of flood effect is on the high side leading to loss of farm produce, destruction of valuable properties, damage of farmlands, exposure of building foundation, destruction of landscape, and disruption of business and transportation activities.

The study revealed that dumping of refuse in drains & drainage paths, impervious urban surface, microclimate characteristics/climate change, building along waterways, spiritual/anger of the god, inadequate storm drains, low topography, government policy, rapid population increase, absence of drainage, poor heading to predictions, land reclamation, noncompliance with regulations, and type of soil are the major causes of flood in the area. The findings showed that the occurrence of flood is significantly dependent on rainfall, poor drainage, erosion, etc.

The study revealed that road construction, building construction, poor drainage system, sand excavation, and agricultural activities/overgrazing are the human factors responsible for flooding in the area. The study also showed that the livelihood of the people is significantly vulnerable to flooding.

The study revealed that closure of business, low business transactions, hike in Transportation, low mobility, and low Patronage are the various ways in which flooding has affected Umuebu people. The findings also showed that destruction of urban properties, destruction of landscape, damage of socio-economic activities and exposure of building foundations are the major effects of flooding in the area.

The study revealed that the adaptation and mitigation strategies to flood vulnerability problems in the different quarters (Obi-Igba, Obi, Obi-Ogwa axis, Main market axis and Umuebu Unor) of Umuebu region include environmental sanitation and clearing of drainages proper waste disposal methods, reduction in gas flaring activities, Environmental Impact Assessment programme, proper enlightenment/awareness programmes as the best control measures to flood hazard issues.

5.2 Conclusion

The study concluded that there is a significant effect of flood on the socio-economic life of Umuebu people. The study established the fact that the occurrence of flood is significantly depended on rainfall, poor drainage, erosion, etc

5.3 Recommendations

The study recommended/suggested as follows:

Environmental education on flood vulnerability and associated risk management should be carried out in the entire Umuebu.

To avoid recurrent floods, drainage systems should be cleaned by adequate environmental sanitation.

5.4 Contribution to Knowledge

The finding shows that flooding has significant effects on Umuebu people confined to the flood pulse concept by Junk (1989). This makes it relevant to hydrology.

The study was able to curb flood problems using management measures adopted over the years. This management techniques adopted highlighted the fact that flooding problems can be solved if drainages are cleared and if proper waste disposal and management techniques are adopted in disposing solid waste and building construction are properly planned in Umuebu Community. This makes it vital to environmental management. The findings showed that there is a significant difference in the level of flood effect in the community in the study area, which was further backed up by a flood hazard model as postulated by Heiler (1995) which helps to control flood hazards in the community.

The study has been able to orient farmers on the possible ways to control flood hazards especially in farmlands and the mitigation techniques adopted in preventing loss of crop yield and agricultural produce in the area. It has created a new horizon for future research and exposed researchers who wish to delve into similar study on the adverse impact of flooding on agricultural productivity since most farmland in Nigeria is susceptible to flood hazard thereby leading to premature harvest and loss of farmlands.

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APPENDIX

Questionnaire

Department Of Disaster Management

Brac University, Mohakhali Dhaka, Bangladesh.

Research Questionnaire

Dear Respondent,

The researcher is a final year student of the above-named department and institution. The researcher is currently undertaking research work on the **"Flood vulnerability and disaster management in Umuebu Community, Ukwuani Local Government Area of Delta State".**

This research work is basically meant for academic purpose and to fulfill the requirement for the award of Master of Science (M.Sc.) Degree in Disaster management.

This questionnaire is to aid the researcher gather meaningful and useful information for the completion of the research work. All information provided is strictly for academic purpose as earlier pointed out and will be treated with utmost confidence. Please feel free to partake in the exercise as it will not take more than 5minutes of your time.

Thank you for your time and patience

Yours Faithfully,

Researcher

Instruction: Please tick (√) the option that best corresponds with your opinion and comment briefly where necessary.

Section A: Personal information of the respondent

1. Location of Residence: (a) Urban area [ ] (b) Rural area [ ] (c) Neighboring villages (environs) [ ]
2. Sex: (a) Male [ ] (b)Female
3. Age: (a) Below 18yrs [ ] (b) 19-25yrs [ ] (c) 26-35yrs [ ] (d) 36-45yrs [ ] (e) 46-65yrs [ ] (f) 65yrs and above [ ]
4. Marital Status: (a) Single [ ] (b) Married [ ] (c) Divorced [ ] (d) Widow [ ]
5. Occupational skill: (a) Skilled [ ] (b) Unskilled [ ]
6. Educational level: (a) No formal Edu. [ ] (b) Primary Edu. [ ] (c) Secondary Edu [ ] (d) Higher/Tertiary Edu [ ]

Section B: Flood Characteristics in Umuebu Community

7. Where do you think are the flood prone areas in Umuebu? (a) Marshy areas [ ] (b) Areas that have poor drainage system [ ] (c) Remote villages [ ] (d) Major streets [ ] (e) Others…….
8. Which of the following areas is the flooding most severe? (a) Villages [ ] (b) Town [ ] (c) Hamlet [ ]
9. Indicate the nature of flooding in your area. (a) No Flood [ ] (b) Low flood [ ] (c) Moderate [ ] (d) High Flood [ ].
10. Is flooding in your area a seasonal occurrence? (a) Yes [ ] (b) No [ ]
11. Please indicate the nature of flooding in your area

		Rating/Scale			
S/N	Nature of flood	High flood	Moderate	Low flood	No flood
a.	Coastal areas				
b.	Riverbanks				
c.	Marshy areas				
d.	Flood plains				

e.	Flood prone zones				
f.	Areas liable to flood				

12. How long have you been experiencing flood problem: (a) less than a year [ ] (b) 2years [ ] (c) 3years [ ] (d) 4years [ ] (e) 5years and above [ ]
13. How long does it take for the water to drain off after heavy rainfall? (a) 1 week [ ] (b) 2weeks [ ] (c) 3week [ ] (d) 4 weeks and above [ ]
14. Which of the following human activities is responsible for flood hazards in your area? (a) Road construction [ ] (b) Building construction [ ] (c) Poor drainage system [ ] (d) Sand excavation [ ] (e) Agricultural activities/Overgrazing [ ] (f) Others (specify): ……
15. Which of the following human factors of flooding is responsible for flooding menace in Umuebu? (a) Road construction [ ] (b) Building/House [ ] (c) Poor drainage system [ ] (d) Street excavation [ ] (e) Overgrazing [ ] (f) Others (specify):_____
16. Does the flood often cause any form of damage to properties? (a) Yes [ ] (b) No [ ]
17. What do you think are the cause(s) of food hazards?

		Rank				
S/N	Causes of flood	1	2	3	4	5
1	Dumping of refuse in drains & drainage paths					
2	Impervious urban surface					
3	Microclimate characteristics/climate change					
4	Building along waterways					
5	Spiritual/anger of the god					
6	Inadequate storm drains					
7	Low topography					
8	Government policy					
9	Rapid population increase					
10	Absence of drainage					
11	Poor heading to predictions					
12	Land reclamation					
13	Noncompliance with regulations					
14	Type of soil					
15	Others					

1. Do you think flooding is because of lack of proper drainage network? (a) Yes [ ] (b) No [ ]

Section D: Socio-economic impact flood in the area

2. What are the socio-economic activities in the area? (a) Farming [ ] (b) Trading [ ] (c) Transport [ ] (d) Commercial activities [ ] (e) Industrial activities [ ] (f) Others (specify)……
3. Section C: Causes of flood in the area
4. ……..
5. Does flood disrupt the socio-economic activities in the area? (a) Yes [ ] (b) No [ ]
6. What is the level of flood vulnerability in the area? (a) Very High [ ] (b) High [ ] (c) Moderate [ ] (d) Low [ ] (e) Very Low [ ]
7. What is the level of flooding effect in the area? (a) Very Severe [ ] (b) Severe [ ] (c) Mild [ ] (d) Not severe [ ]
8. What is the level of flooding effect in the area?

		Effect Rating				
S/N	Options	Very Severe	Severe	Moderate	Low	Not Severe
a.	Loss of farm produce					
b.	Destruction of valuable properties					
c.	Damage of farmlands					
d.	Exposure of building foundation					
e.	Destruction of landscape					
f.	Disruption of business and transportation activities					

9. Do market activities often break down in this flood affected area? (a)Yes [ ] (b) No [ ]
10. If yes, what proportion of market activities breakdown in the flood? (a) Small proportion [ ] (b) Moderate proportion [ ] (c) Large proportion [ ]
11. Has the flooding restricted movement of people and vehicles in your area? (a) Yes [ ] (b) No [ ]
12. How has flooding affected your movement? (a) Closure of business [ ] (b) Low business transaction [ ] (c) Hike in Transportation [ ] (d) Low mobility [ ] (e) Low Patronage [ ]
13. Is the occurrence of flood significantly dependent on rainfall, poor drainage, erosion, etc? (a) Yes [ ] (b) No [ ]
14. Is the livelihood of Umuebu significantly vulnerable to flooding? (a) Yes [ ] (b) No [ ]
15. Do you think flooding affects the socio-economic activities of the area? (a) Yes [ ] (b) No [ ]
16. If yes, what are the effects? (a) Destruction of urban properties [ ] (b) Destruction of landscape [ ] (c) Damage of socio-economic activities [ ] (d) Exposure of building foundation [ ] others (specify): ……
17. Are the incidences of loss of lives and properties due to flooding in your lost lives and properties due to flooding in your area? (a) Yes [ ] (b) No [ ]
18. If yes, how many lives and how many properties were lost?
    a. _____
    b. _____

Section E: Flood adaptation and mitigation strategies in Umuebu Community

18. Is there a flood problem in this area? (a) Yes [ ] (b) No [ ]
19. If yes, do you think that the problem of flooding can be controlled? (a) Yes [ ] (b) No [ ]
20. Do you think that flooding menace can be solved? (a) Yes [ ] (b) No [ ]
21. If yes, what measure has been taken or should be taken to curb the flood? (a) Construction of good drainage network [ ] (b) Clearing flood area [ ] (d) Clearing of block culvert [ ] (a) Provision of temporary camp for displaced citizens [ ]
22. Are these methods successful? (a) Yes [ ] (b) No [ ]
23. Has any individual contributed in any form in curbing/solving the problem of flooding in your locality? (a) Yes [ ] (b) No [ ]

24. Has the government played any active role in handling environmental issues such as flooding? (a) Yes [ ] (b) No [ ]
25. Which of these forms of compensation has your community received from the government as a result of loss of lives and properties? (a) Cash gift [ ] (b) Building of houses of victims [ ] (c) Donation of building materials [ ] (d) Rehabilitation of damaged roads and market structures [ ] (e) Provision of temporary settlement to IDPS [ ]
26. What do you really want the government to do to check the problem of flooding and its effects on residents of Umuebu?

i. _____

ii. _____

iii. _____

iv. _____