

***Full Length Research***

# **Impact of Flood and the Need for Preventive and Mitigating Measures in Bayelsa State, Nigeria**

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The purpose of this study was to determine the impact of flood and the need for preventing/mitigating measures in Bayelsa state Nigeria. The study discussed the meaning of flooding, basic background of the Bayelsa State, causes of flooding, types of flooding, the impact of flood, factors determining the impact of flood, and control of flood with emphasis on some countries to provide the desired knowledge needed for the effective management of flood in Bayelsa State. Three research questions were formulated to guide the study and were answered using mean and criterion mean gotten from the items, while six null hypotheses were tested at 0.05 alpha level using independent samples t-test. A cross-sectional survey research design was adopted for this study. A multistage sampling procedure was used to draw the sample. Firstly, purposive sampling technique was adopted to select the Local Government Areas from each senatorial district for the study. Each of the selected LGAs was considered as a stratum. Then simple random sampling technique was used to select three towns from each LGA, and 10% of the total population (240 respondents) formed the sample size. The simple random technique with replacement was used to elicit responses from the participants from the towns in the local government area of the states selected for the study. Self-structured questionnaire titled Impact of Flood and the Preventive and Mitigating Measures Questionnaire (IOFATPAMMQ) with 0.72 reliability was used to elicit information from respondents. Findings among others show that there are severe environmental impacts of flooding in Bayelsa State, there are also severe impacts of health hazards associated with flooding in Bayelsa State. There is significant difference in environmental impact of flooding among urban and rural residents of Bayelsa State. Also, there is significant difference in the health hazards associated with flooding among urban and rural residents of Bayelsa State. It was concluded with few recommendations made based on the preventive/ mitigating measures that can check the impact of flood in Bayelsa State.

**Key Words:** Impact, Flood, Preventive and Mitigating Measures, hazards..

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## INTRODUCTION

Flood is one of the major environmental crises one has to contend within the century (Bariweni, Tawari & Abowei, 2012). This is especially the case in most wetlands of the world (Abowei & Sikoki, 2005). It is the most common of all environmental hazards and it regularly claims over 20,000 lives per year and adversely affects around 75 million people world-wide (Smith, Baeck, Villarini, Bright, & Krajewski, 2013). Across the globe, flood have caused about one third of all deaths, injuries and one third of all damage from natural disasters (Vallarini, Smith, Baeck, & Krajewski, 2011).

### Theoretical Framework

The ecological resilience concept is a more appropriate framework for flood hazards management, for it builds on a more realistic paradigm of multi-equilibrium, focusing pragmatically on persistence in a world of flux (Adger, Hughes, Folke, Carpenter, & Rockstrom, 2005) The ecological resilience concept has become a sophisticated resilience theory, addressing complex human-nature couplings. It is instrumental for addressing flood hazards that arise from the interaction between riverine and urban dynamics. Resilience theory holds that periods of gradual development and sudden changes complements each other (Folke, 2006). It suggests that flooding itself is an agent for resilience because each flood experience creates a chance for cities to adjust internal structures and processes and to build knowledge, leading to diverse coping strategies cumulated over time (Folke, 2006, Smith and Wandel, 2006).

### Concept of Flood

Flood is an overflowing or irruption of a great body of water over land not usually submerged (Oxford English Dictionary). It is an extreme weather event naturally caused by rising global temperature which results in heavy downpour, thermal expansion of the ocean and glacier melt, which in turn results in rise in sea level, thereby causing salt water to inundate coastal lands. Flood occurs when ponds, lakes, riverbeds, soil and vegetation cannot absorb all the water. Water runs off the land in quantities that cannot be carried within stream channels or retained in natural ponds, lakes and manmade reservoirs. About 30% of all precipitation becomes runoff and that amount might be increased by water from melting snow. Flood rises rapidly, with little or no relatively small area, or if, the area was already saturated from previous precipitation (Henry, 2006).

## Causes of Flood

There are different factors that contribute to incidences of flooding and most of them are connected to how areas develop and how land is used and managed (Ramin, 2009). Rainfall duration and amount, poor drainage infrastructure, the sealing of ground surfaces through the construction of buildings, roofs, roads that restrict the natural pathways of rainwater can hinder and change natural rainwater run-off patterns (The World Bank, 2010). Generally, causes of flood could be as a result of Natural Causes or Human Causes. Example of Natural causes are; heavy or torrential rains/rainstorms, oceans storms and tidal waves usually along the coast, highly accelerated snowmelt, tsunamis etc. While the Human causes are; burst water main pipes, dam burst levee failures, dam spills, river flooding and coastal flooding etc. Coastal flooding occurs in the low-lying belt of mangrove and fresh water swamps along the coast. While river flooding occurs in the plains of the larger rivers (Welch, Symons, and Narver, 1977). According to the United States Environmental Protection Agency (2002), unexpected drainage obstructions such as landslides, or debris can cause slow flooding upstream of the obstruction.

### Types of Flood

Flooding is divided into three different types: A-C (Parkinson, 2003): Type "A" flooding is localized and can occur during every rainfall and is usually the result of inadequate drainage of storm water runoff. This type of flooding is detrimental to environmental health and facilitates the spread of water-related diseases. Type "B", flooding is less frequent than Type "A", but can cause greater damage to infrastructure in a larger area. This type of flooding also facilitates the spread of water-related diseases. Type "C", flooding is the most severe, because of large scale inundation that affects a large number of communities. Other types of flooding include: Tidal flooding (where both sea and river defenses may be overtopped or breached by a combination of low-pressure weather system and peak high tides). Fluvial flooding (surface water flooding) which occurs in the floodplains of rivers when the capacity of water courses, is exceeded as a result of rainfall or snow and ice melt within catchment areas further upstream. Flash flooding, can occur in steep catchments and is far more immediate.

The factors which determine the effect of flooding include: The level of predictability (ie timing, accuracy, communication of warns given before a flood), the rate of onset of the flood (how quickly the water arrives and the speed at which it rises), the speed and depth of the water (this dictates the level of exposure of people and property

to a flood) and the duration of flooding (Dance & Hynes, 1980). The duration of the flood is another important factor in determining the extent of its impact, particularly on individuals and affected communities.

### **Control of Flood**

Flood control refers to all methods used to reduce or prevent the detrimental impact of flood waters. According to Powel (2009) some methods of flood control have been practiced since ancient times. These methods include: Planting vegetation to retain extra water, terracing hillsides to slow flow down hills, construction of flood ways (man-made channels to divert flood water), and construction of levees, dikes, dams, reservoirs or retention ponds to hold extra water during times of flooding. Also flood warning signs can provide a reduction in direct losses through: the timely operation of flood control structures (e.g gates), the installation of flood resilience measures (e.g sand bags, property flood barriers), and the removal of property to somewhere above the flood level or out of the flood plain.

Flooding was considered to be a perennial occurrence in the lower River Niger, but the 2012 turned to be a traumatic experience for the communities in the lower Niger, spanning several communities in central and western senatorial district of Bayelsa State (Samuel, 2012). Bayelsa State is one of the 36 political sub-divisions of Nigeria. It occupies the extreme south of the country and is approximately mid- way east and west along the coast of the Gulf of Guinea, (Yanga, 2006). It is made up of three senatorial districts, comprising of eight Local Government Areas as follows (1) Central Senatorial District, (Yenagoa, Kolokuma/Opokuma and Southern Ijaw Local Government Areas,) (2) East Senatorial District; (Ogbia, Nembe and Brass LGAs,) and (3) West Senatorial District; (Ekeremor and Sagbama LGAs). Its capital is at Yenagoa, (Corporate Nigeria, 2007). Bayelsa State has a population of around 2 million people, (National Population Commission, 2006).

### **Environmental impact of flood**

The impact of flood on the environment cannot be overemphasized. Flood has an enormous impact on the environment. For instance, wild life habitats can be adversely destroyed by flood water. Flood water contaminates or pollutes rivers and boreholes there by making life difficult for inhabitants. When it occurs most people's source of drinking water like bore holes, wells and streams would be submerged and contaminated. Since the people are helpless, they still rely on such contaminated sources of water and the end result is usually some form of disease epidemic.

Farming is completely brought to a stop by the emergence of flood. Not only does it stop farming activities, but crops are destroyed by flood itself and deposits of sediments and silt. This action births a season of famine and hardship on the people. Resumption of agricultural activities for the following farming season is distorted. Reason been that most times the seedlings, tubers and stems of crops preserved for the following farming year are been destroyed by flood.

Flood also destroys river banks and natural levees as rivers over flow their capacity. Deforestation can set in by way of uprooting trees by high velocity water flow. "Most coastal resources, including fish and other forms of marine production, are dependent on the nutrients supplied from the land during floods. The negative effects of floodwaters on coastal marine environments are mainly due to the introduction of excess sediment and nutrients, and pollutants such as chemicals, heavy metals and debris "(Garrett, 2011). These often reduce aquatic habitats, reduce water quality, reduce coastal production, and contaminate coastal food resources.

Transportation system of the people is not left out as roads and bridges are damaged. A typical instance was in the 2012 flood the Imiringi- Elebele bridge linking the Easter Senatorial district of the state was destroyed and the people were means of transportation was cut off. Also, in that 2012, the East-West road, the Amassoma road and the Opokuma- Sabagreia road were cut off by flood. This situation does not only affect movement but also the commercial activities. Services such as schools, churches, markets, hospitals and recreation centers are not spared by flood.

### **Impact of Flood on Humans**

Homes, properties and other possessions are constantly damaged by flood and annually people are rendered homeless, displaced from their homes and communities. One gory situation is when humans struggle for shelter with reptiles putting up with the danger of been bitten by snakes and other wild animals that are also displaced from their habitats. People often drawn in deep waters, get injured and plagued with diseases as a result of flooding. Flood water is often contaminated with sewage, which can lead to illness and affect clean drinking water. Power supply is also disrupted. A peculiar situation in Bayelsa is the shutting down of distribution lines and step-down transformers to avoid risk people been electrocuted. This action also provides blackout to the habitants for as long as the flood last. Businesses are forced to shut down. According to Garrett, (2011), the immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases, as well as

communication links and infrastructure such as power plants, roads and bridges are damaged and disrupted, and some economic activities been brought to a standstill, people forced to leave their homes and normal life is disrupted”.

### Health hazards associated with flooding

The health hazards posed by floods may be described in relation to time (e.g. as intermediate, mid-term, and long-term) (Huu Bich, Quang, Thanh Ha, Hanh & Guha-Sapir 2011). Common of the health hazards of flooding normally experienced are drowning, injury, acute asthma, skin rashes and clusters, outbreaks of gastroenteritis, and respiratory infections (Huu Bich, Quang, Thanh Ha, Hanh & Guha-Sapir.,2011), Baxter, Moller, Spencer & Tapsell (2001), McKenzie, Lane, Nichols, Kedge & Iversen (2004)). According to Du, FitzGerald, Clark & Hou (2010), the mid-term health hazard of flooding are infected wounds, complications of injury, poisoning, poor mental health, communicable diseases, and starvation. In the long-term chronic disease, disability, poor mental health, and poverty-related diseases including malnutrition, while the long-term effects of flooding on health may perhaps be even more important than other illnesses or injuries because the psychological problems may continue for long after the water has receded (Du, et al, 2010). Health hazards associated with long period of flooding causes serious health problems for rural dwellers, particularly the elderly and disabled persons living in poor conditions with limited food stocks, unhygienic water sources, and poor sanitation. Epidemic diseases such as dengue fever, diarrhea, among many others also surfaces after floods (Huu Bich et al 2011). One common epidemic that breaks out after every flood in this part of the world is cholera. One of the tragedies recorded in this 2020 is drowning of a Catholic Priest while passing through a foot bridge to his residence. Hunger and starvation are the main issues people will come in terms with for a long time since the flood has become an annual thing and the government at all levels, have not done much to ameliorate the suffering of the people.

### Flood preventive/mitigating measures

Flood events are a part of nature, they have existed and will continue to exist. In Nigeria the middle Belt and the South-South regions of the country, experience annual flooding. This is due to the topography of these regions. They have lived with this flood situation from time immemorial. Therefore, flood prevention is not very feasible, rather steps taken to mitigate against flood will be the best option.

Pre-informing people about imminent flood potentially saves lives. The possibilities of heavy rain rainfall in 2020 that will result in heavy flooding and other social disequilibria in some parts of the country was the pre-warning given by the Nigeria Meteorological Agency, (NIMET) before the emergence of the 2020 flood. Some of the ways in which flooding can be prevented/mitigated are:

- Maintenance of good water/drainage system can offset the effects of flash flood resulting in a safer area.
- Educating/ Instructing people about proper waste disposal and putting the proper container for a litter can help for a cleaner environment and drainage system
- Ensuring that roads have good drainage system that is deep and wide can prevent flooding
- Avoid building on drainages can prevent flooding
- Dredging rivers can prevent flooding
- Avoid putting refuse or solid materials in drains can prevent stagnation as well as water borne diseases
- Putting up building only in the appropriate way and in approved areas can prevent flood occurrence as well as exposure to being bitten by reptiles (e.g snake, crocodile etc)
- Construction of embankments, to protect buildings, constructions, utilities etc can prevent collapse of building, and premature deaths, due to flooding.
- Government should be proactive in flood preparedness to provide support that will help mitigate the effects of flood on the citizenry.

In flood prone areas, preventive measures should be taken to reduce possible adverse effects of floods on aquatic and human habitats. It is necessary to distinguish between different kinds of flooding and the environmental conditions that contribute to the problem. A specific preparedness to alert, rescue and safety measures should be planned and implemented at all levels, including the public, by maintaining regular basic information and continuous ongoing training actions. With appropriate and timely information, preparedness, everyone who may suffer from the consequences of flood events should be able to take; if possible- his/her own precautions and thus seriously limit flood damages.

### Area of Study

Bayelsa State is one of the 36 states of Nigeria. It occupies the extreme south of the country and is approximately mid-way between the eastern and western boundaries of the country with the Republic of Cameroon and Benin respectively. The state is bounded in the north

by Delta State, east by Rivers State and the west and south by the Gulf of Guinea. Bayelsa State is a picturesque (visually charming or having pleasing or interesting qualities) tropical rain forest, with an area of about 21,110 square kilometres. More than three quarters of this area is covered by water, with a moderately low land stretching from Ekeremor to Nembe. The network of many creeks and rivers in the south, all flow into the Atlantic Ocean via the major rivers such as San Bartholomew, Brass, Nun, Sangana among others. The people of Bayelsa State were originally traditionalists. Nevertheless, the concept and acceptance of God as the creator had never been in doubt in any of the sub-religions. This is why every Izon dialect has a specific name for God. The major occupation of Bayelsans (Izon-man) is farming, fishing, canoe- carving and collection of palm products (Yanga, 2006).

Bayelsa State is made up of three senatorial districts, comprising of eight Local Government Areas as follows (1) Central Senatorial District, (Yenagoa, Kolokuma/Opokuma and Southern Ijaw Local Government Areas,), (2) East Senatorial District; (Ogbia, Nembe and Brass LGAs,) and (3) West Senatorial District; (Ekeremor and Sagbama LGAs). Its capital is at Yenagoa, (Corporate Nigeria, 2007). It has a population of around 2 million people, (National Population Commission, 2006).

## **STATEMENT OF THE PROBLEM**

The number of communities that have taken over by flood lately has been a source of grave concern to the natives. Virtually all the communities along the river

banks such as Sagbama, Adagbabiri, Peretorugbene Agbere, ofoni, Ayamasa, Sabagreia, Igbedi, Famgbe, Yenaka, Ogu, Fontorugbene, Agbura, Agudama Ekpetiama, Oporoma, Ndoro, Tombia, Peremabiri, Elemebiri, Asamabiri, Angalabiri, Opokuma, Odi, Kaiama, Besini, Gbarantoru,,Amassoma, Ekeremor kolo creek, Oloibiri,,Otuogidi, OluEbum, among others were submerged (Samuel,2012). According to him, some of these communities, residential and public buildings including schools, banks, churches, town –halls, have been overtaken by flood leaving thousands of families homeless with their means of livelihood destroyed, are now exposed to the outbreak of epidemic looms. The hardest hit segments of the population are not just the fishermen and the conventional formal occupations but the farmers, palm-wine tapers and distillers. The situation is not different in other communities, many homes were affected, forcing them to paddle their canoes to neighbouring communities in search of refuge (Angela, 2010).

According to Mike (2012, Oct.10) in a Punch News Paper release, a week-old baby was battling for survival at one of the camps for flood victims in Bayelsa State. The toddler who hail from Agbobi, Biseni in Yenagoa local government area, was born in a pool of water, by a traditional birth attendant at the community. Their homes were submerged, their farm lands washed away and their properties destroyed by the ravaging flood. Adeleye and Rustum (2011) also affirmed that flooding causes contamination of water (water pollution). Clean drinking water becomes scarce. Unhygienic conditions and spread of water-borne diseases result which can have immediate health effects upon people and animals. In extreme cases flooding may cause loss of lives. Torrential rains pushed rivers over their banks, collapsed mud houses and washed away livestock.

Scenes of flood in Bayelsa State. Source: Punch newspaper September, 2012





**Impact of 2012 Flood Between Bayelsa / Rivers State East –West Road**

**SEE PICTURES ON IMPACT OF 2020 FLOOD IN BAYELSA STATE BELOW**







From the 2020 flood pictures seen above, the impact of floods in Bayelsa State is really alarming. According to Richard Davis (27<sup>th</sup> March, 2013), who is the founder of floodist .com resorted that; flood in 2012, the city of Yenagoa and the rest of the state indigenes suffered severe flooding, and it left around 120, 000 people homeless, of which 3,000 of those worst hit, in Yenagoa were housed in a single sports complex. Crops and agriculture, as well as homes were also ruined.

Also according to the National Emergency Management Agency Report by Yakubu (30<sup>th</sup> September, 2018), in an interview with the News Agency of Nigeria (NAN) in Yenagoa; Based on his assessment carried out, on the affected communities, it was discovered that no fewer than 150,000 persons have been displaced by flood in Bayelsa State. Several communities were submerged; markets, schools and churches were under water.

From the fore going; The impact of 2020 flood in Bayelsa state is not an exception. According to Samuel (12th October, 2020). Indigenes of flood-ravaged Adagbabiri community in Sagbama Local Government Area of Bayelsa have called on the State and Federal Government to provide them relief materials. According to community sources, the water level has exceeded that witnessed in 2018 and may reach that of 2012. This is in view of the fact that, most houses in the community including school buildings, health and worship centres,

and town halls have all been flooded with residents vacating their homes. Also, property and items worth several millions of naira have been destroyed. Some community folks had to pack their valuables on elevated platforms to prevent them from being destroyed; while others take refuge in uncompleted structures on high grounds to survive the menace.

Akam (16<sup>th</sup> October, 2020) on 'Daily Post' also reported that a parish priest of St. Joseph Catholic Church, drowned on Thursday being 14<sup>th</sup> October, 2020 at a flooded area of the Kaiama community in Kolokuma-Opokuma Local Government Area of Bayelsa State. Likewise, two school pupils drowned along the good news area of Azikoro town in Yenagoa Local Government Area of the State.

Thus, the **Aim** and **objectives** of this study seeks to determine:

The impact of flood, associate health hazards and the preventive / mitigating measures among residents of Bayelsa State.

## RESEARCH QUESTIONS

The study attempts to answer the following research questions.

1. What are the environmental impacts of flooding in Bayelsa State?
2. What are the health hazards associated with flooding in Bayelsa State?
3. What are the flood preventive/mitigating measures in Bayelsa State?

## HYPOTHESES

The following hypotheses had been postulated and were tested at .05 alpha level.

1. There is no significant difference in environmental impact of flooding among male and female residents of Bayelsa State.
2. There is no significant difference in the health hazards associated with flooding among male and female residents of Bayelsa State.
3. There is no significant difference in flood preventive/mitigating measures among male and female residents of Bayelsa State.
4. There is no significant difference in environmental impact of flooding among urban and rural residents of Bayelsa State.
5. There is no significant difference in health hazards associated with flooding among urban and rural residents of Bayelsa State.
6. There is no significant difference in flooding preventive / mitigating measures among urban and rural residents of Bayelsa State.

## METHODOLOGY

A cross-sectional survey research design was adopted for this study. According to Elendu (2010), cross-sectional survey design is a type of survey design used to generate data from a section of the population, describing events based on their occurrences in their natural setting at a point in time. This design is considered appropriate in gathering data from relatively large number of cases at a time and does not lend itself to experimental manipulation of human subject (Ofo, 2002). Hence the design was applied in this study to generate data from a section of all the Local Government Areas (LGA) of Bayelsa State without the author's biasness.

The population for the study was 2400, comprised of all the people from the randomly selected town from each LGA of Bayelsa State, which is over 2 million people (National Population Commission, 2006).

A multistage sampling procedure was used to draw the sample. Firstly, purposive sampling technique was adopted to select the Local Government Areas from each senatorial district for the study. Each of the selected LGAs was considered as a stratum. Then simple random

sampling technique was used to select three towns from each LGA, and 10% of the total population (240 respondents) formed the sample size. The simple random technique with replacement was used to elicit responses from the participants from the towns in the local government area of the states selected for the study.

The research instrument for this study was a 29 item self-structured questionnaire titled Impact of Flood and the Preventive and Mitigating Measures Questionnaire (IOFATPAMMQ). It consists of section A and B. Section A contained the demographic information ( age, marital status, educational status, religion, gender and location) of the respondents, and Section B contained questions; with four point Modified Likert Scale used with responses of; Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1) for positive questions and Strongly Agree (1), Agree (2), Disagree (3) and Strongly Disagree (4) responses for negative questions. A copy of the questionnaire formed Appendix A.

In order to ensure the face and content validity of the instrument, the questionnaire was presented to few experts in the field, and whose expert opinions, comments, criticisms and observations were used in preparing the final draft of the questionnaire. To ascertain the reliability of the instrument, test re-test method was used. The questionnaire was administered to twenty (20) persons, outside the study area. The same questionnaire was re-administered after two weeks interval on same respondents. The two sets of data were then correlated using Pearson Product moment correlation to obtain a correlation coefficient. A correlation co-efficient of 0.72 was considered reliable for the study.

Two hundred (240) copies of questionnaire administered to the respondents with the aid of eight trained research assistants being used to ensure proper distribution of questionnaire to the respondents on their various locations (towns) within the eight local government areas of Bayelsa State, for purposes of proper distribution and retrieval of questionnaire, which took about three weeks to round up all the selected towns. The return rate of the instrument was calculated or established, and 80 percent return rate was considered for the study.

The completed copies of questionnaire were collated, coded and analyzed using the Statistical Package for Social Sciences (SPSS) batch version 25. Descriptive statistics of mean was used to answer the research questions. The criterion mean of 2.50 was used in taking decision for research questions. The criterion mean was calculated as follows:

$$\frac{4+3+2+1}{4} = \frac{10}{4} = 2.5$$

For the research questions on Environmental Impact and

Health Hazards of Flood and the Preventive/Mitigating Measures, an item mean or grand mean that equal to or greater than the criterion mean of 2.50 was adjudged as “severe impact of flood”, but any item mean or ground mean that was less than 2.50 was considered as “mild impact of flood. Inferential statistics of independent samples t-test set at 0.05 alpha level was used to test the hypotheses,

## RESULTS

### Research Questions

#### Research Question 1

What are the environmental impacts of flooding in Bayelsa State?

**Table 1:** mean responses of respondents on the environmental impacts of flooding in Bayelsa State

S/N	Item	Mean	Criterion mean (2.50)	Decision
1	Flooding caused buildings, and infrastructure to collapse	3.71	2.50	Severe impact
2	People were left homeless as a result of flooding	3.85	2.50	Severe impact
3	Flooding caused pollution of water rendering it dangerous for human consumption	3.75	2.50	Severe impact
4	Means of livelihood were destroyed as a result of the flooding	3.77	2.50	Severe impact
5	Crops were destroyed because farmlands were submerged in water	3.72	2.50	Severe impact
6	The location of a house near a river can be determinant factor for possible flooding damage	3.61	2.50	Severe impact

Table 1 presents the mean responses of respondents on the environmental impacts of flooding in Bayelsa State. From the table the item mean shows that item 1 is 3.71, item 2 is 3.86, item 3 is 3.75 and item 4 is 3.77 while items 5 and 6 are 3.72 and 3.61. since the item means are all > 2.50 criterion mean indicates severe impacts of flooding on the environment in Bayelsa State.

#### Research Question 2

What are the health hazards associated with flooding in Bayelsa State?

**Table 2:** mean responses of respondents on the health hazards associated with flooding in Bayelsa State

S/N	Item	Mean	Criterion mean(2.50)	Decision
7.	Members were exposed to outbreak of diseases.	3.54	2.50	Severe impact
8.	Members were exposed to snake bites, crocodile and other reptiles.	3.48	2.50	Severe impact
9.	Flooding caused increase in death rate of both humans and animals	3.40	2.50	Severe impact
10.	Flooding caused mass migration of people to higher and safer areas	3.70	2.50	Severe impact
11.	Flooding caused disruption of business and economic activities	3.68	2.50	Severe impact

**Table 2.** Continues

12.	The environment got severely devastated from flooding	3.63	2.50	Severe impact
13.	Flooding changed the features of land areas permanently	3.44	2.50	Severe impact
14.	Flooding expose people to hunger and starvation	3.57	2.50	Severe impact

Table 2 presents the mean responses of respondents on the health hazards associated with flooding in Bayelsa State. Item 7 has a mean of 3.54, item 8 is 3.48, item 9 is 3.40, item 10 is 3.70 and item 11 is 3.68. Also, item 12 is 3.63, item 13 is 3.44 and item 14 is 3.57. Comparing with criterion mean of 2.50 shows that the items are all greater, which indicates severe impact of health hazard associated with flooding in Bayelsa State?

### Research Question 3

What are the flood preventive/mitigating measures in Bayelsa State?

**Table 3:** mean responses of respondents on the flood preventive/mitigating measures in Bayelsa State

S/N	Item	Mean	Criterion mean (2.50)	Decision
15	Finding out if the area suffers often from floods can check degradation of agricultural land, destruction of human /animal lives and properties	3.65	2.50	Preventive/ Mitigating
16	Carrying out an impact assessment study on previous floods in the state can help migrating future flooding	3.63	2.50	Preventive/ Mitigating
17	Removal of illegal structures blocking the water channels to avert the flooding of the areas prone to flood	3.66	2.50	Preventive/ Mitigating
18	Seeking expert advice, and use of appropriate building materials in flood prone areas can prevent degradation of the environment, the spread of infections, soil and water pollution	3.62	2.50	Preventive/ Mitigating
19	Good town planning (good layout) can prevent possible structural problems from flooding	3.67	2.50	Preventive/ mitigating
20	Engineers and Architects should study the areas and build structures that can withstand the challenges in the environment.	3.71	2.50	Preventive/ Mitigating
21	Maintenance of good water/drainage system can offset the effects of flash flood resulting in a safer area.	3.66	2.50	Preventive/ Mitigating
22	Educating/ Instructing people about proper waste disposal and putting the proper container for a litter can help for a cleaner environment and drainage system	3.69	2.50	Preventive/ Mitigating
23	Ensuring that roads have good drainage system that is deep and wide can prevent flooding	3.70	2.50	Preventive/ Mitigating
24	Avoid building on drainages can prevent flooding	3.59	2.50	Preventive/ Mitigating
25	Dredging rivers can prevent flooding	3.58	2.50	Preventive/ Mitigating
26	Avoid putting refuse or solid materials in drains can prevent stagnation as well as water borne diseases	3.61	2.50	Preventive/ Mitigating

**Table 3.** Continues

27	Putting up building only in the appropriate way and in approved areas can prevent flood occurrence as well as exposure to being bitten by reptiles (e.g. snake, crocodile etc.)	3.52	2.50	Preventive/ Mitigating
28	Construction of embankments, to protect buildings, constructions, utilities etc. can prevent collapse of building, and premature deaths, due to flooding.	3.54	2.50	Preventive/ Mitigating
29	Government should be prepared for the flood and do all it can to help mitigate the effects of flood, so that the public is not unduly affected	3.69	2.50	Preventive/ Mitigating

Table 3 presents the mean responses of respondents on flood preventive/mitigating measures in Bayelsa State. The mean values of the various items as responded by the respondents are: item 15 (3.65), item 16 (3.63), item 17 (3.66), item 18 (3.62), item 19 (3.67), item 20 (3.71). others are: item 21 (3.66), item 22 (3.69), item 23 (3.70), item 24 (3.59), item 25 (3.58), item 26 (3.61), item 27 (3.52) and item 28 (3.54) while item 29 (3.69). From the table all item means are > 2.50 criterion mean which only indicates that the measures outlined in the item statements will surely mitigate/prevent flooding in Bayelsa State.

**Hypothesis**

**Hypothesis 1**

There is no significant difference in environmental impact of flooding among male and female residents of Bayelsa State.

**Table 4:** t-test of equality of means on environmental impact of flooding among male and female residents of Bayelsa State

**Independent Samples Test**

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	D	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.193	.276	-.885	236	.377	-.22628	.25558	-.72966	.27709
Equal variances not assumed			-.900	238.409	.369	-.22628	.25141	-.72155	.26898

Table 4 presents the t-test of equality of means on environmental impact of Flooding among male and female residents of Bayelsa State. The t-test is -.885, degree of freedom is 236 and sig. 2-tailed (P=.377) > 0.05 alpha level.

Since P (.377) is greater than 0.05 alpha level, the null hypothesis is upheld. That is, there is no significant difference in environmental impact of flooding among male and female residents of Bayelsa State.

## Hypothesis 2

There is no significant difference in the health hazards associated with flooding among male and female residents of Bayelsa State.

**Table 5:** t-test of equality of means of health hazards associated with flooding among male and female residents of Bayelsa State

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	6.601	.011	.730	237	.466	.33249	.45522	-.56430	1.22927
Equal variances not assumed			.717	206.273	.474	.33249	.46394	-.58218	1.24715

Table 5 presents the t-test of equality of means of health hazards associated with flooding among male and female residents of Bayelsa State. The t-test is .730, degree of freedom is 237 and sig. 2-tailed ( $P=.466$ ) > 0.05 alpha level. Since  $P (.466)$  is greater than 0.05 alpha level, the null hypothesis is upheld. That is, there is no significant difference in the health hazards associated with flooding among male and female residents of Bayelsa State.

## Hypothesis 3

There is no significant difference in flood preventive/ mitigating measures among male and female residents of Bayelsa State.

**Table 6:** t-test of equality of means of flood preventive/ mitigating measures among male and female residents of Bayelsa State

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.612	.435	.243	236	.808	.16851	.69358	-1.19788	1.53490
Equal variances not assumed			.241	216.797	.810	.16851	.70031	-1.21178	1.54880

Table 6 presents the t-test of equality of means of flood preventive/mitigating measures among male and female residents of Bayelsa State. The t-test is .243, degree of freedom is 236 and sig. 2-tailed (P=.808) > 0.05 alpha level. Since P (.808) is greater than 0.05 alpha level, the null hypothesis is upheld. That is, there is no significant difference in flood preventive/ mitigating measures among male and female residents of Bayelsa State.

**Hypothesis 4**

There is no significant difference in environmental impact of flooding among urban and rural residents of Bayelsa State.

**Table 7:** t-test of equality of means on environmental impact of flooding among Urban and Rural residents of Bayelsa State

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Interval Difference Lower	Confidence of the Upper
Equal variances assumed	10.366	.001	-3.231	236	.001	-.83018	.25696	-1.33641	-.32394
Equal variances not assumed			-3.171	202.787	.002	-.83018	.26178	-1.34633	-.31402

Table 7 presents the t-test of equality of means on environmental impact of flooding among urban and rural residents of Bayelsa State. In the, t-test is  $-3.231$ , degree of freedom is 236 and sig. 2-tailed (P=.001) < 0.05 alpha level.

Since P (.001) is less than 0.05 alpha level, the null hypothesis is rejected. That is, there is significant difference in environmental impact of flooding among urban and rural residents of Bayelsa State.

**Hypothesis 5**

There is no significant difference in health hazards associated with flooding among urban and rural residents of Bayelsa State.

**Table 8:** t-test of equality of means of health hazards associated with flooding among urban and rural residents of Bayelsa State

	Levene's Test for Equality of Variances		Independent Samples Test						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Equal variances assumed	12.320	.129	-.959	236	.039	-.43662	.45534	-1.33366	.46043
Equal variances not assumed			-.952	222.869	.042	-.43662	.45868	-1.34053	.46729

Table 8 presents the t-test of equality of means of health hazards associated with flooding among urban and rural residents of Bayelsa State. The t-test is  $-.959$ , degree of freedom is 236 and sig. 2-tailed ( $P=.039$ )  $< 0.05$  alpha level. Since  $P (.039)$  is less than 0.05 alpha level, the null hypothesis is rejected. That is, there is significant difference in the health hazards associated with flooding among urban and rural residents of Bayelsa State.

### Hypothesis 6

There is no significant difference in flooding preventive/mitigating measures among urban and rural residents of Bayelsa State.

**Table 9:** t-test of equality of means of flood preventive/ mitigating measures among urban and rural residents of Bayelsa State

	Independent Samples Test								
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	9.378	.002	-1.519	236	.130	-1.04590	.68833	-2.40196	.31017
Equal variances not assumed			-1.476	181.551	.142	-1.04590	.70838	-2.44361	.35182

Table 9 presents the t-test of equality of means of flood preventive/mitigating measures among urban and rural residents of Bayelsa State. The t-test is  $-1.519$ , degree of freedom is 236 and sig. 2-tailed ( $P=.130$ )  $> 0.05$  alpha level. Since  $P (.130)$  is greater than 0.05 alpha level, the null hypothesis is upheld. That is, there is no significant difference in flood preventive/mitigating measures among urban and rural residents of Bayelsa State.

### FINDINGS

1. There are severe environmental impacts of flooding in Bayelsa State.
2. There are severe impacts of health hazards associated with flooding in Bayelsa State.
3. there is no significant difference in environmental impact of flooding among male and female residents of Bayelsa State.
4. there is no significant difference in the health hazards associated with flooding among male and female residents of Bayelsa State.
5. there is no significant difference in flood preventive/ mitigating measures among male and female residents of Bayelsa State.
6. there is significant difference in environmental impact of flooding among urban and rural residents of Bayelsa State.
7. there is significant difference in the health hazards associated with flooding among urban and rural residents of Bayelsa State.

8. there is no significant difference in flood preventive/mitigating measures among urban and rural residents of Bayelsa State

### DISCUSSIONS OF FINDINGS

#### Severe environmental impacts of flooding in Bayelsa State

Hypothesis one reveals that's there is no significant difference in environmental impact of flooding among male and female residents in Bayelsa State. Analysis of the responses to research question one also shows that: There are severe environmental impacts of flooding in Bayelsa State.

The findings reveal the fact as natural as flooding is, it affects both male and female alike and in the same manner. The way a male resident will be displaced from his residence as a result of flood is the same way a female resident will be displaced. Other negative impact



synonymous with mankind, affects all gender in same manner. The findings of hypothesis four that compared the means responses of urban and rural residents showed statistical significance. This means both residences feel the impact of flooding differently. The experiences in the past and even in the 2020 flood the rural environment recorded places with massive flooding as compared to the Yenagoa the state capital that is adjudged an urban area. Two-third of the settlements in Bayelsa state are rural settlements. 95% of all these settlements are affected by the 2020 flood in the state. Houses, health centers, rural markets, farms all submerged. The few deaths recorded as a result of the flood are from the rural communities. Notwithstanding, the report of Chanthy & Samchan (2014) submitted to the Action Aid Cambodia indicated in their finding that women take up employment in agricultural and informal sectors that are often worst affected by flood disasters which brings about high rate of unemployment among women after flood disasters. The study investigated how floods affect women differently from men, the most significant problems women face during and after flood disaster.

### **Severe impacts of health hazards associated with flooding in Bayelsa State.**

Hypothesis 2 reveals that there is no significant difference of health hazards associated with flooding among male and female residence of Bayelsa State. Flooding comes with enormous health challenges and this challenge affects both male and female alike. According to the World Health Organization "flooding increases the transmission of communicable diseases such as water-borne diseases, like typhoid fever, cholera, leptospirosis, hepatitis A etc., and also vector borne diseases; such as malaria, yellow fever, and west Nile fever. Both males and females are exposed and at risk to contracting these diseases. The findings of hypothesis 5 reveals that there is significant difference in the health hazards associated with flooding among urban and rural residents of Bayelsa State. The experience of the past and the current flood situation in Bayelsa State shows that the rural areas are more adversely affected. While few homes are affected by the flood in the urban areas, 95% of the communities in the rural areas are submerged by the 2020 flood and other previous floods. This explains the fact that health hazards associated with flood, no doubt will affect the rural residence than the urban residences. During the flood, health facilities that usually provide health services are submerged, so access to health service is almost zero in the rural areas. According to the WHO, risk of increase of disease infection is significantly high if people are displaced from their home. In the case of Bayelsa State this exactly

plays out. People are totally displaced from their homes in the rural areas and forced to settle in make-shift apartments with hundreds of people whose health history is not known. Besides such considerations are not even important since the basic and pressing need at the point in time is shelter. Using contaminated water sources, increases the risk of been infected with water-borne diseases.

Floods also increase the spread of vector-borne diseases through the increase in the number of vector habitats around human habitats. Stagnant water caused by heavy rainfall or river overflow can act as breeding sites for mosquitoes, thereby exposing humans to the risk of been infected with diseases like malaria and dengue.

Common of the health hazards of flooding normally experienced are drowning, injury, acute asthma, skin rashes and clusters, outbreaks of gastroenteritis, and respiratory infections (Huu Bich, Quang, Thanh Ha, Hanh & Guha-Sapir (2011), Baxter, Moller, Spencer & Tapsell (2001). One of the tragedies recorded in this 2020 is drowning of a Catholic Priest while passing through a foot bridge to his residence.

### **Flood preventive/ mitigating measures among male and female residents of Bayelsa State**

Finding hypothesis 3 reveals no significance in the flood preventive/mitigating measures among male and female residents and also no statistical significance among urban and rural residents of Bayelsa State. Responses to research question three reveals that the following are preventive/mitigating measures that can serve as recommendations, will alleviate suffering of residents from flooding in the Bayelsa State.

- Finding out if the area suffers often from floods can check degradation of agricultural land, destruction of human /animal lives and properties
- Carrying out an impact assessment study on previous floods in the state can help migrating future flooding
- Removal of illegal structures blocking the water channels to avert the flooding of the areas prone to flood
- Seeking expert advice, and use of appropriate building materials in flood prone areas can prevent degradation of the environment, the spread of infections, soil and water pollution
- Good town planning (good layout) can prevent possible structural problems from flooding
- Maintenance of good water/drainage system can offset the effects of flash flood resulting in a safer area.
- Educating/ Instructing people about proper waste

disposal and putting the proper container for a litter can help for a cleaner environment and drainage system

- Ensuring that roads have good drainage system that is deep and wide can prevent flooding
- Avoid building on drainages can prevent flooding
- Dredging rivers can prevent flooding
- Avoid putting refuse or solid materials in drains can prevent stagnation as well as water borne diseases
- Construction of embankments, to protect buildings, constructions, utilities etc. can prevent collapse of building, and premature deaths, due to flooding.
- Government should be prepared for the flood and do all it can to help mitigate the effects of flood, so that the public is not unduly affected

## CONCLUSION

From the forgoing; if individuals and the government in particular can abide to the preventive / mitigating measures highlighted above, the impact of flood would be reduced to minimal and likewise the morbidity and mortality rate from flood would be checked to a considerable level in Bayelsa State.

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**APPENDIX A****Questionnaire on Impact of Flood, and the Need for Preventive and Mitigating Measures in Bayelsa State.**

This questionnaire is mainly aimed at eliciting relevant information on the Impact of flood, associated health hazards and preventive/mitigating measures among residents of Bayelsa State.

It is purely an academic exercise and respondents are expected to answer the questions to the best of their knowledge. Information given herein shall be treated confidentially, and do not write your name on any part of this questionnaire. Your co-operation is highly solicited in this regard.

Yours Sincerely,

Dr (Mrs) Ikemike Dolfina .O

**Section A: Demographic Data**

**Instruction:** Please respond to the items or statements as they apply to you by ticking (√) in the appropriate box below:

1. Age group: Less than 40years  40 – 49 year  50 years and above
2. Marital Status: Sing  Married  Divorced  Widow/widower
3. Religion: Christianity  Islam  Others
4. Location: Urban  Rural
5. Gender : Male  Female

**Section B:**

**Instruction:** Please respond to the items or statements as they apply to you by ticking (√) on any of the options provided :

**Instruction: Please respond to the statements as they apply to you by ticking (√) on any of the options provided :**

**Environmental Impact of Flooding**

S/N	Environmental Impact of flooding	SA	A	D	SD
1	Flooding caused buildings, and infrastructure to collapse				
2	People were left homeless as a result of flooding				
3	Flooding caused pollution of water rendering it dangerous for human consumption				
4	Means of livelihood were destroyed as a result of the flooding				
5	Crops were destroyed because farmlands were submerged in water				
6	The location of a house near a river can be determinant factor for possible flooding damage				
	<b>Health Hazards of Flooding</b>				
7	Members were exposed to outbreak of diseases.				
8	Members were exposed to snake bites, crocodile and other reptiles.				
9	Flooding caused increase in death rate of both humans and animals				
10	Flooding caused mass migration of people to higher and safer areas				
11	Flooding caused disruption of business and economic activities				
12	The environment got severely devastated from flooding				
13	Flooding changed the features of land areas permanently				
14	Flooding expose people to hunger and starvation				

<b>S/N</b>	<b>Mitigating Measures of Flooding on the Environment</b>	<b>SA</b>	<b>A</b>	<b>D</b>	<b>SD</b>
15	Finding out if the area suffers often from floods can check degradation of agricultural land, destruction of human /animal lives and properties				
16	Carrying out an impact assessment study on previous floods in the state can help migrating future flooding				
17	Removal of illegal structures blocking the water channels to avert the flooding of the areas prone to flood				
18	Seeking expert advice, and use of appropriate building materials in flood prone areas can prevent degradation of the environment, the spread of infections, soil and water pollution				
19	Good town planning (good layout) can prevent possible structural problems from flooding				
20	Engineers and Architects should study the areas and build structures that can withstand the challenges in the environment.				
21	Maintenance of good water/drainage system can offset the effects of flash flood resulting in a safer area.				
22	Educating/ Instructing people about proper waste disposal and putting the proper container for a litter can help for a cleaner environment and drainage system				
23	Ensuring that roads have good drainage system that is deep and wide can prevent flooding				
24	Avoid building on drainages can prevent flooding				
25	Dredging rivers can prevent flooding				
	<b>Preventive /Mitigating Measures of Health Hazards of Flooding</b>				
26	Avoid putting refuse or solid materials in drains can prevent stagnation as well as water borne diseases				
27	Putting up building only in the appropriate way and in approved areas can prevent flood occurrence as well as exposure to being bitten by reptiles (e.g snake, crocodile etc)				
28	Construction of embankments, to protect buildings, constructions, utilities etc can prevent collapse of building, and premature deaths, due to flooding.				
29	Government should be prepared for the flood and do all it can to help mitigate the effects of flood, so that the public is not unduly affected				