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ASSESSMENT OF THE CAUSES OF 2012 FLOODS IN AGULERI AND UMULERI, ANAMBRA EAST LOCAL GOVERNMENT AREA OF ANAMBRA STATE, NIGERIA

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ABSTRACT: *The study assessed the causes of 2012 flood in Aguleri and Umuleri in Anambra East Local Government Area. In doing this, questionnaire was administered randomly to the residents. The data generated were analyzed using frequency/percentage tabulation and Mann-Whitney U-Test statistical techniques. The following hypothesis was tested: (1) there is no significant difference between the causative factors of 2012 floods in the two communities. The results showed that there is no serious variation between the causes of 2012 flood in the two communities. In addition, the result also proved that anthropogenic activities induced the 2012 flood in the community. Consequent upon the findings, the study recommended that there should be flood hazard mapping in order to ascertain areas prone to flooding, so as to reduce the occurrence of flood in the area. It further recommended that the river channels in the area be constantly dredged from time to time so as to increase their capacity for retaining water. Moreover, it recommended that the inhabitants of the area be enlightened on the causes of flood. Finally, it recommended that environmental laws, especially those relating to flood occurrence and management, and land-use be enforced. In addition, areas of future research should be: (1) to ascertain the after-effect (post effect) of flooding on agriculture in the area; and (2) to obtain a flood hazard map for the entire Anambra State, especially the Anambra East Local Government Area, so as to know the areas prone to flooding, and to adopt adequate flood management techniques.*

KEYWORDS*: The Causes of 2012 Floods, Aguleri, Umuleri, Anambra East Local Government Area, Anambra State, Nigeria*

INTRODUCTION

Flooding is one of the major environmental problems facing man within the century. This is especially the case in most wetlands of the world. The reason of this is the general rise in sea level globally, due to global warming as well as the saturated nature of the wetlands in the Riverine areas. Periodic floods occur on many rivers, forming a surrounding region known as flood plain. Rivers overflow for reasons like excess rainfall. In extreme cases flooding may cause a loss of lives. As noted by Adeleye and Rustum (2011) torrential rains made rivers to overflow their banks and caused mud houses to collapse and also washed away livestock. In some places and cases, flooding has damaged bridges and caused overflow of dams, submergence of buildings, displacement of people from their homes, loss of people's valuables. The economy of a place can also be severely affected by flooding. Businesses may lose stock, patronage, data and productivity

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and disruption to utilities and transport. Tourism, farming and livestock can equally be affected. Vital infrastructure may also be damaged or disrupted. Electricity and gas supplies can be interrupted. Road links, railways, canals etc., may be blocked causing disruption to transport network and accessibility severely disrupted for local inhabitants, especially amongst those considered most vulnerable and loss of communications networks (Adeleye and Rustum, 2011).

Although flooding, generally, is a bane to most people, floods can be quite beneficial. Actually, believe it or not, nature benefits more from natural floods than from not having them at all. What makes natural floods a disaster is when flood waters occur in areas populated by humans and in areas of significant human development. Otherwise, when left in its natural state, the benefits of floods outweigh the adverse effects (Bradshaw, Sodhi, Peh, and Brook,2007).However, too much sand deposit will do the opposite. For farmers that maintain their crops along rivers, they should not feel threatened by yearly flooding. This gives their farm lands better soil consistencies and keeps their land fertile resulting to better harvests each year. Instead of preventing the natural flow of river floods, it might be beneficial in the long run to allow the flood waters to encroach into their lands (Hill, 1976). It was how nature intended it to be in the first place. However, there may be limits to how much farmers can tolerate such natural occurrences. One has to increase production to feed the demands of the human populace.

Statement of problem

Flooding is one of the most important environmental problems pervasive in Anambra state. Over 30% of the inhabitants of Anambra state live along the riverine area and survive mainly on fishing and agriculture. The problem of flooding due to sea-level rise and storm surges constitute a significant source of threat to life, property, livelihoods, and infrastructure in the riverine region Ezirim (2010).According to Nwilo (2011), flooding is among the most devastating natural hazards in the state claiming more lives and causing damages to properties and infrastructure than any other natural phenomena. Aguleri has a landmass of 380 sq. km with a total projected population of 18,317 people (NPC, 2006). A reasonable percentage of the landmass of Aguleri was inundated by the 2012 flood, this constitutes about large mass of land area submerged and large numbers ofpeople were made homeless or affected in one form or the other in this community.

Umuleri has a landmass of 171.6 sq. km with a total projected population of 21,438 people (NPC, 2006). A large percentage of the landmass of Umuleri was inundated by the 2012 flood, this constitutes land area flooded and people were made refugees and lost their means of livelihood in this community. Unfortunately, most of these areas inundated are places where these towns carryout most of their economic activities like agricultural activities, fishing, industrialization, transportation activities and trading. This is to say, going by how flood plains of the areas are being ravaged, that these economic activities are in serious danger of being badly affected. The implications of this are that the inhabitants of the area and even people from distant places who depend on these activities are in serious danger of losing their means of livelihoods. This definitely will affect their lives.Several other problems where experienced by the people dwelling in the areas affected. These problems include migration of people, destruction of household properties, destruction of farm produce which lead to food scarcity causing hunger to the victims,

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overcrowding, spread of communicable diseases and water-borne diseases, people were attacked by animals washed into their homes, rate of crime and conflict increased as people resort to different social vices to survive. It is to this effect that this study seeks to assess the causes of 2012 floods in Aguleri and Umuleri with a view to proffering solution to the menace.

Aim and objectives

The aim of this study is to ascertain the causes of 2012 floods in the riverine communities of Aguleri and Umuleri. This will be achieved through the following objectives:

1. to seek the opinion of the inhabitants of the areas,
2. to identify the causes of 2012 floods in the area and
3. to determine the mitigation measures applied to remediate the effects in the study area.

Research hypothesis

This work tested the following hypothesis:

Ho: There is no significant difference between the causative factors of 2012 floods in Aguleri and Umuleri.

Study area

The study area is Anambra East Local Area of Anambra State, but specifically, using Aguleri and Umuleri towns as case studies. Anambra state lies within latitude 5º 40′ Nand Longitude 7º 27′ E on the south and latitude 6º 48′ N and longitude 6º 37′ E on the north. (Fig.1). It has a total land area of 4,416sqkm (geological survey Awka, 2000). Anambra state falls within the rainforest climatic region. It has a mean temperature of 33ºC and high annual rainfall ranging from 1, 400mm in the north to 2, 500mm in the south. The state exhibits two seasons – the rainy and dry seasons.

The rainy seasons occurs from March to September, but early rainfall is usually in March with full commencement in April, and stops in the months of October each year, with a few showers in November to herald the dry season and the typical harmattan winds. The dry season lasts for four to five months from November to February. The natural vegetation found in the area is of two kinds, namely Tropical Rainforest and Tropical Savannah. The greater part of the state is mainly the tropical savannah, which in its original form, comprises single stand tall trees with grasses

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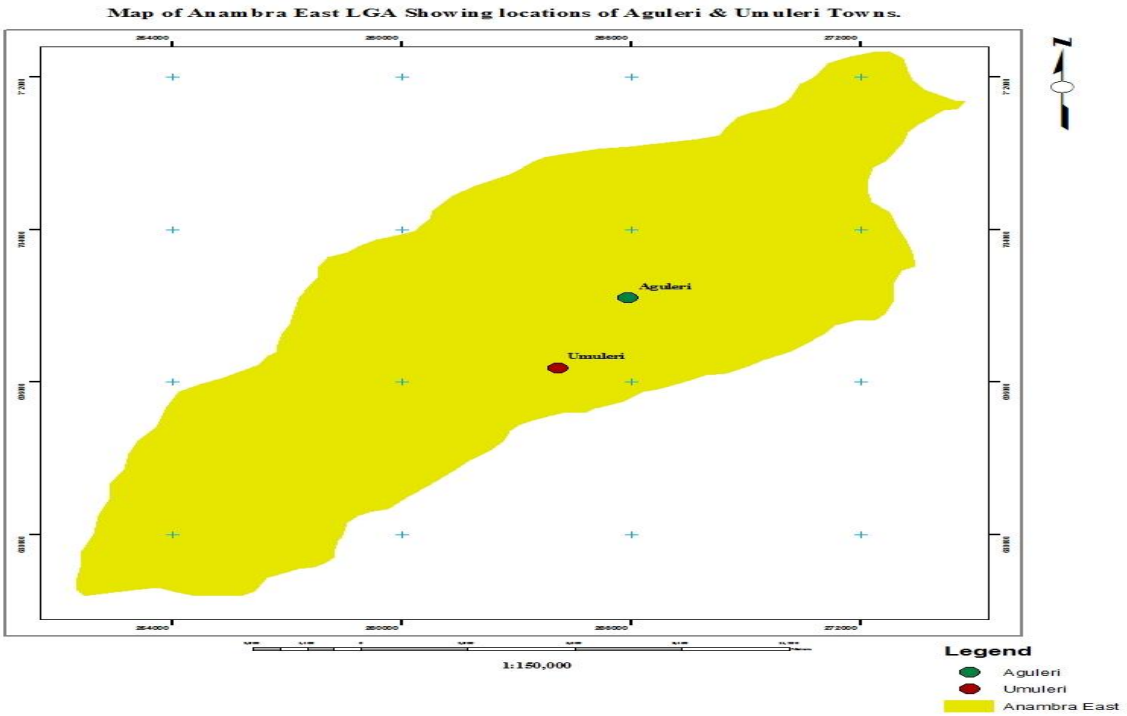

Fig 1.2 Map of Anambra East Local Government Area showing Aguleri and Umuleri

Conceptual framework of the research

The problems of flood can best be understood when one understands the concept of hydrologic cycle, which is the concept that describes the fluxes of water between the various reservoirs of the hydrosphere. The hydrologic cycle maintains a mass balance, which means that the total amount of water in the system is fixed and the cycle is in a state of dynamic equilibrium, that the hydrologic cycle is seen as the exchange of water through processes of phase exchange, precipitation, transportation and runoff. Earth's atmosphere is a great solar-powered heat engine that draws up water as vapour and cloud, and discharges water after condensation as rain and for snow. The precipitated water may complete its cycle by following via the rivers, streams and/or percolated down into ground water systems back to the oceans or may be shot-circuited back into the atmosphere by evaporation from the land surface or by transportation from plants. The hydrologic cycle is important is important in moving chemical elements, sculpturing the landscape, weathering rocks, transporting and depositing sediments and providing water resources Hutchinson and Ridgeway (1975).

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The hydrologic cycle concept is illustrated below;

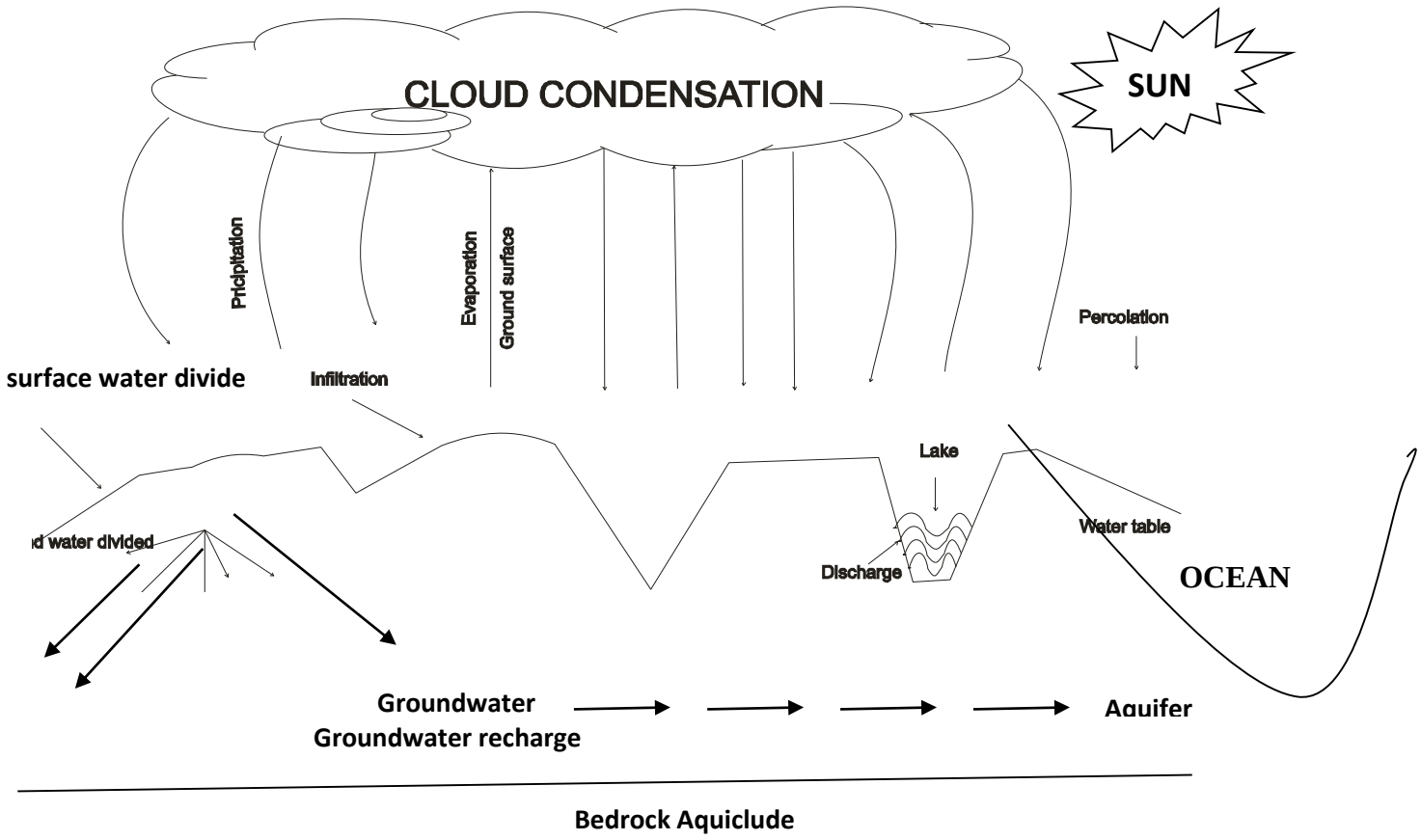

Fig.1.3: The Hydrologic cycle
Source: Egboka et al (1989)

LITERATURE REVIEW

Causes of flood

●climate

Baxter (2001), Hulme (2002), Milley (2002), andWerrity (2002) studied the relationships between flood and climate as a fact/or enhancing flood in Scotland using field observation. Their result revealed that a much larger group will be at risk in the future with climate change likely to result in higher winter rainfall, more intense summer storms and rising sea level. According to Manuta and Lebel (2005), climate change compounds the existing challenges of managing floods. Firstly, the anticipated sea level rises could have a major impact on flood risks in the coastal cities. Secondly, but less certainly, increases in the frequency or intensity of extreme precipitation events exacerbate risks of disastrous flooding in parts of the world. Thirdly, climate change may alter flood regimes in some basins in other more complex ways, for example, through impacts on melting of glaciers in the uppermost reaches or reduced precipitation in inland continental areas

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Bariweni, Tawari and Abowei (2012) documented that climate change causes flooding because when the climate is warmer it results to: heavy rains, sea level will continue to rise around most shorelines and extreme sea levels will be experienced more frequently including storm surges.
Snoussi, Ouchani, and Niazi,(2008) said that it has been recognized that climate change and sea level rise will impact seriously upon the natural environment and human society in the coastal zones. In Morocco, for example, the coastal zone forms one of the main socio-economic areas of the country with more than 60% of the population inhabiting the coastal cities as well as incorporating 90% of the industry, making them more susceptible to flooding.

● Heavy rainfall

Include flash floods resulting from convective precipitation (intense thunderstorms) or sudden release from an upstream impoundment created behind a dam, landslide, or glacier (Thompson 1964). Floods are commonly caused by a combination of sea tidal surges caused by storm-force winds. A storm surge, from either a tropical cyclone or an extra-tropical cyclone, falls within this category (Rosenberg and Snor 1975).Welch,Symons, and Narver, (1977) studied the causes of flooding in New Brunswick, Canada using field observation and analysis of climate data. He noted that flood can be caused by heavy rainfall, highly accelerated snowmelt, severe winds over water, unusual high tide, tsunamis or failure of dams, levees, retention ponds or other structures that retained the water. Flooding can be exacerbated by increased amounts of impervious surface or by other natural hazards such as wildfires which reduce the supply of vegetation that can absorb rainfall.

USEPA (2002) studied the causes of flooding in United States using data on climate and field observation and noted that flood can be caused by runoff from sustained rainfall or rapid snowmelts exceeding the capacity of a river's channel and there can be caused by heavy rains from monsoons, hurricanes and tropical depressions, foreign winds and warm rain affecting snow pack. According to Nott (2006), the causes of floods can be broadly divided into physical, such as climatological forces, and human influences such as vegetation clearing and urban development. The most common causes of floods are climate related, most notably rainfall.

Powell (2009) stated that floods are caused by severe sea storms, or as a result of another hazard (e.g., Tsunami or hurricane). A storm surge, from either a tropical cyclone or an extra-tropical cyclone, falls within this category.

● Topography and Geology

Uchegbu (2002) stated that river flooding is chiefly manifested through the shape of the watershed, the characteristics of the eventual runoff, the configuration of the terrain within watersheds, the orientation of the rivers, the conditions and properties of soil and rocks, among others.
From the work of Jimoh and Alao (2009), Asa river catchment was found to have a very high precipitation and sediment yields when analyzed yearly for a period of seven years. Jimoh and Alao (2009) further reported that the high amount of sediment yield is directly related to the amount, duration and intensity of rainfall, as well as stream discharge, which often increases the river water level and finally causes flooding in the basin area in Ilorin.

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● Release of water from dams

The continued release of excess water from dams is another reason for flooding. With River Niger overflowing, some dams also overflowed and if not for the steps taken by the authorities, the result would have been more devastating (Nwilo 2013). Olayinka et al, (2012) stated that water from Shiroroand Kainji Dams had to be discharged and that was partly responsible for the flooding in Kogi and other states downstream. He also stated that sudden release of water in Oyan Dam led to the flooded Ogun River Catchment in 2011 and from the Adamawa state end, the opening of a Cameroonian dam (Ladgo dam) caused flooding.

● Human factors

According to Anih (1997), urbanization is a great contributor to flooding. He stated that as urbanization intensifies, natural surfaces are replaced by buildings, paved roads and concrete surfaces which do not allow water to percolate readily into the ground. The consequence according to Anih is that a large proportion of the rainfall which should normally infiltrate into the soil or intercepted by the vegetation, is immediately available for surface runoff which end up in streams and rivers, thus generating excess water for flooding adjacent flood plains. Price and McKenna (2003) and Evans et al (2004) studied flooding in Scotland and using combined methodology of field survey, questionnaire survey and interviews. Their results revealed the further factors that will increase the future flood risk include legacies of drainage systems that have inadequate capacity, poor building construction techniques and flood defenses adapted to a former hydrological regime. These factors combine with the planning 'inertia' of homes and businesses already located on flood plains, low-lying coastal zones and urban areas at risk of flooding.

Adeleye and Rustum (2011) analyzed the causes of the flooding problems encountered to recommend sustainable management solutions to them. Data on climate, drainage, infrastructures and physical planning regulations were collected and extensively analyzed. These were combined with evidence from field inspection and discussion with stakeholders, including relevant government departments, university researchers and selected residents. Their investigation revealed that contrary to popular wisdom, climate change or unusually high rainfall is not the primary cause of flooding problem in Lagos. Rather the increased urbanization, lax planning laws in relation to the city are to blame. Olayinka et al (2012) reported on the recent OdoOna flood in Ibadan. He noted that the flood in the area is attributed to heavy downpour such that water could not be controlled in the channel and the fact that the channel and drainages were blocked.
Bariweni et al (2012) stated that floods can also be caused by accidental damage by workmen to tunnels or pipes.

GAPS IN LITERATURE

Amongst other gaps the few that will be filled by this work includes;

1. None of the works did a study of the Aguleri and Umuleri flood incident of 2012, even when it was a national issue in 2012.
2. There are many causes of flood, none of the works reviewed was able to establish the actual causes of the 2012 flooding in the two communities in Anambra State of Nigeria and compare to

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know whether or not they flooding incidents were caused by same factors or different factors as this is very essential in planning control measures.

METHODOLOGY

Survey design was used to derive information used for the study. Questionnaire method was employed in collecting information on the causes of flooding in Aguleri and Umuleri, the effects of flood on social and economic activities, and impacts of flood on the residents of Aguleri and Umuleri. This methodology was chosen because the data needed for study assessed the population sample size affected by the flood. The population of Aguleri and Umuleri was collected from the national population commission and projected to 2013 and the sample size was determined using YaroYamine's formula.

Population Projection and Sample Size Determination

Population projection $Pn = P_o (1+r)^n$

Where Pn = Projected Population

P_o = Base year population

r = estimated annual growth rate of the entire population obtained from the National population commission

n = time lapse (in years)

Aguleri

$Pn = 9,160 (1 + 0.032)^{22}$

$Pn = 9,160 \times (1.032)^{22}$

$Pn = 18,317$

Umuleri

$Pn = 10,721 (1 + 0.032)^{22}$

$Pn = 10,721 \times (1.032)^{22}$

$Pn = 21,438$

1) The sample size determination using YaroYamine's Formula

$$S = \frac{N}{1 + N(e)^2}$$

Where:

S = Sample size

e = Margin of error assumed (0.05)

1 = theoretical constant

N = No of populations

No of population for Aguleri – 18,317

No of population for Umuleri – 24,438

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Source (NPC, 2006)

Sample size for both communities

$$S = \frac{N}{1 + N(e)^2}$$

$$S = \frac{39755}{1+39755(0.05)^2} \quad S = \frac{39755}{100.3875} \quad S = 396.02$$

Table 1: Sample Size Distribution of Questionnaire

Communities	Number of questionnaires distributed	Number of questionnaires returned	Percentage returned rate (%)
Aguleri	200	185	50.8
Umuleri	200	179	49.2
Total	400	364	100.0

Source: Author's Computation from Field work (2013)

From the table above, the number of questionnaire distributed and the percentage returned is shown.

RESULTS AND DISCUSSIONS

The discussions were approached from two ways: firstly, the discussions of the causes of 2012 flood in Aguleri and Umuleri and the various environmental effects of the 2012 flood as shown in the tables 2, 3, 4, 5, 6, 7 below, and discussions based on the statistical analyses made.

Table 2: Percentage Response on Causes of 2012 Floods in Aguleri and Umuleri

S/N	**1ssues raised**	**SD**		**D**		**U**		**A**		**SA**	
		F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
1.	Damage of pipe-borne water	64	17.6	140	38.5	85	23.4	42	11.5	33	9.9
2.	Drainage failure	54	14.9	62	17.0	115	31.6	75	20.6	58	15.9

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3.	Heavy rainfall	18	4.9	37	10.2	47	12.9	206	56.6	56	15.4
4.	Increase in development	29	8.0	43	11.8	78	21.4	128	35.2	86	23.6
5.	Blockage of flood channels through erection of structures	22	6.0	34	9.3	76	20.9	167	45.9	65	17.9
6.	Overgrazing and agricultural activities	32	8.8	45	12.4	53	14.6	148	40.6	86	23.6
7.	Over population	28	7.7	44	12.1	92	25.3	125	34.3	75	20.6
8.	Bush burning	36	9.9	52	14.3	43	11.8	137	37.6	96	26.4

Source: Author's Computation from Field work (2013)

From the table above, there was a concurrence of the fact stated in the frequency/percentage tables of each of the communities. The respondents generally agreed that heavy rainfall, increase in development as a result of over population, blockage of drainage channels through erection of structures with the following percentages 72%, 58.8%, 54.9%, 63.8% respectively.Also, the communities agreed on bush burning being a cause with percentage of 64% as a causative factor of 2012 flood as the land was rendered bare by the burning. Rainfall intensity increased over the years causing flood events in different areas and Aguleri and Umuleri experienced it in 2012.Furthermore, both communities were of divergent opinion of drainage failure and damage of pipe – borne water as a causative factor of the 2012 flood in the towns.

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DISCUSSIONS ON STATISTICAL ANALYSES

In order to further the findings made, the data generated were subjected to statistical analyses to test the hypothesis earlier postulated as:

Hypothesis 1

Ho: **There is no significant difference between the causative factors of 2012 floods in Aguleri and Umuleri.**

In doing this, the Mann-Whitney U-test was used to test the hypotheses postulated. Mann – Whitney test for causes, the p – value is 0.758 which is greater than 0.05, we accept the null hypothesis and conclude that there is no significant difference in the causes of the 2012 floods in Aguleri and Umuleri. From the above, it was concluded that the communities agreed that the following factors Drainage failure, heavy rainfall, increase in development, blockage of flood channels, overgrazing and agricultural activities, bush burning, were the major causes of the 2012 floods. This is as a result of similarity in location and conditions.

CONCLUSION

From the work done, the following conclusions are drawn

- That anthropogenic activity like construction on flood plains, deforestation, bush burning, drainage failure, over grazing and agricultural activities, over population and urbanization trigger and aggravate flood activities in both Aguleri and Umuleri towns in Nigeria.
- That flood has impacted on both social and economic activities in Aguleri and Umuleri in a number of ways including displacement of families, migration of people, poor health condition, traffic congestion, impairment of communication, loss of farmlands, loss of income, loss of household and structural properties, increase in the price of goods and services, destruction of social infrastructure.
- That there are not much significant differences between causes of 2012 flood in Aguleri and Umuleri.
- That there are not much significant differences between the social, health, personal, post and economic effects of 2012 flood in Aguleri and Umuleri.
- That flood is a manifestation of climate change, reducing greenhouse gas emission is essential to avoiding the worst parts of climate change, because mitigating alone is not enough. It is instructive to note that adaptation planning can limit the damage caused by climate change, as well as the long-term costs of responding to climate-induced flooding that are expected to increase rapidly in level in the decades to come. Adapting to the impacts of climate change is vital if we are to manage the risks of flooding. We can't ignore the consequences which is why we need to start adapting now.

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RECOMMENDATIONS

●Flood Hazard Mapping: To reduce and manage properly the adverse consequences of flood in the country, there should be immediate Flood Hazard Mapping of the affected areas using best practiced modern technologies.
●Regular removal of constrictions along the river channels and water channel maintenance plan.
●Dredging is recommended along river channels in some areas to widen it up and give the channel the ability to contain excess water.
●Construction of more dams in the country could also go a long way as a control measure. The federal government needs to act quickly to provide a permanent solution to flood problem. The plan to construct buffer dams between the Nigerian and Cameroonian borders as the solution should now be put in place.
●Capacity building to integrate climate change and its impacts into urban development planning involving local communities, raising public awareness and education on climate change and enabling representation at international meetings.
●Enforcement of extant city and building regulations, Authorities responsible for town planning should be more alert to their duties if meaningful and long-lasting solutions are to be found. Development control agencies and other governmental departments responsible for allocation of land for building purposes should ensure that such structures are not erected on water ways or areas that are prone to floods. Those who violate such regulations should be appropriately sanctioned no matter how highly placed to deter others from doing the same.
●Enlightenment campaigns are important to put an end to the habit of dumping refuse in drainages. Relevant government agencies in collaboration with non-governmental organizations should educate people both in rural and urban areas about the dangers inherent in blocking water ways. Community leaders and association, including the media should be involved in this sensitization campaign. More of such education should be done at primary and secondary schools. The National Orientation Agency (NOA) has a vital role to play in facilitating the success of the programme.
●Changes in water and land-use management policies: Devising land-tenure markets, appropriate town planning, and encouraging use of water ways for higher values such as transportation.
●The authorities in areas where people have been displaced by flooding should endeavor to ameliorate their suffering. Adequate relief materials should be provided to enhance the well-being of particularly children exposed to the harsh weather conditions in open camps. If need be, efforts should be made to resettle them elsewhere. Relief should not be limited to providing mattresses and blankets and food items, as the National Emergency Management Agency (NEMA) does when disasters strike, but should encompass measures to ensure that such occurrences have minimal impacts on people and the environment.
●There is a great need for agro forestry and green belt development in flood prone areas that is agricultural practices such as the planting of trees to retain extra water.
●Environment policy reforms, changes in urban and housing design, removal of laws that can inadvertently increase flood vulnerability.
●Appropriate infrastructure investments, build-up of unblocked drainage patterns, flood defenses, increasing investment; improved health care through flood shelters and assistance shelters as part of community emergency preparedness programs.

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