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Assessing the Nature and Causes of Flooding in Ugbor Area, Benin City, Edo State, Nigeria

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Abstract

The nature and causes of flooding in Ugbor area Benson Idahosa University, Benin City Edo state is a major concern of residents as such there is a need to determine the factors responsible for flooding and identify its impact In this study, rainfall data was collected from a secondary source, data was analyzed using descriptive statistics methods such as mean, standard deviation and variance. Also, data was collected using questionnaire from primary source which the data was analyzed and presented. From the rainfall data analysis from 2009 to 2019 (10 years rainfall analysis), it was observed that year 2011 has the highest amount of rainfall (2452.4mm). Results showed that in flood occurrences for the past 10years, Benson Idahosa University road and Ighile street has the highest occurrence of flood (26) while Prince Agbor (20). Also 2017 to 2011 had the highest flood (16.25% and 13.75% respectively), The major cause of flooding is rainfall (36.25%), blockage of drainages (32.5%), building of plains is 12.5% and poor planning/ land use is 18.75%.. Suggestions such as provision of incinerators and trash cans would also reduce the blocking of drainage system and control flooding to a reasonable extent.

1. Introduction

Flood is an overflow of water that submerges land that is usually dry.[1] . They are environmental hazards that occur regularly every year in different parts of the country especially during the rainy season. Flood water overflow expanse of land, submerging the land. Flood occurrence is usually due to the increase in the volume of water within the water body such as rivers and lakes. This causes water to exceed the drainage channel capacity and overflow its bounds. [2]

Urban flooding is a key impact of climatic and meteorological-oriented changes, and is considered a major, immediate and serious environmental problem confronting municipal authorities in developing countries. It is a critical environmental problem and major hazard, which continuously affects the effective functioning of urban ecosystems, especially in the areas of infrastructure and service provision, which are germane to sustainable livelihood [3]. Over the years there had always been one form of crises or another resulting from disasters. Prominent

among these crises is flood disaster. Flood is the overflow on an expanse of water such that it submerges or cover the land while moving with a particular speed. It has the potential of causing great harm to lives, properties and the environment [4].
Flood occurrences are always occuring in rainy or wet season from April to September. Most areas that are more prone to flood in the geographical area under study are Ogbowan Street ,Ogbowan Crescent, Bonisk Crescent, Sam Excellent Atitiekae Avenue,Godwin Abbey way,Abuja quarters and most areas around Benson Idahosa University [5].

In 2004, according to the International Federation of Red Cross and Red Crescent Societies, the ten years between 1993 to 2002 flood disasters affected more people across the world (estimated at 140 million per year on average) compared to all than other natural or technological disasters put together [6].

Studies shows how worsening climatic conditions impact on the livelihoods of six communities living along the Kaduna River basin, and found that women suffered most because of their role in household management. The authors used purposive sampling to select three LGAs, Shiroro, Gbako, and Lavun, in Niger state; then two communities from each LGA were also chosen purposively. Simple random sampling was used to select 200 households, representing 75% of households from each of these communities. [8]

GIS and remote sensing techniques was applied to identify flood-prone areas in Igbokoda town in Ondo state, using Landsat 5, 7 and 8 images for the years 1986, 1999, and 2013, respectively. These images showed a high percentage reduction in vegetation and change in land cover over time, making the town susceptible to flooding. [9]. Other researchers used the same techniques but went further to combine the stream network and the area slope to rank the study locations as high, medium, or low flood-risk zones. It was also found that an increase in runoff without adequate increase in drainage contributes to flooding in the area.[10]. The combination of geospatial techniques and statistical analysis for mapping and modelling of the 2012 flood in Yenagoa, Bayelsa state, finding that 7% of the total land area of Yenagoa LGA was affected. The study identified four types of land uses in Yenagoa, viz., built-up areas, waterbodies, forest cover, and farmland, and found that 50.6% of the flooded land was in built-up areas. [11]. A study shows the relationship between topographic information and rainfall trends in Aba metropolis, Abia state. These researchers found from the vulnerability map that about 72% of Aba metropolis is vulnerable to flooding, except for areas around the Ogbor hill axis, whereas the rainfall trend from Mann-Kendall analysis indicates that rainfall did not significantly increase the flood hazard between the years 2000–2010 in the metropolis. Other key parameters increasing flooding in the area include topography, inadequate drainage, and building on waterways.[12]. Causal factors pivotal to flooding was identified in Surulere, Lagos. They used GIS to generate a digital elevation map. They concluded from factors such as excessive rainfall and duration, urbanisation, and soil impermeability, that Surulere is prone to flooding. [13].

From the above literature reviews, it was observed that most of the researchers used different methods and models for analysis like GIS, Geospatial techniques for mapping and modelling of areas. While this research work focuses on using data from the Ministry of works and questionnaires, where the data were analyzed using simple statical techniques method.

2. Materials and Method

2.1 Area of Study

The area of study in this research work is Ugbor Area of Benin City, Edo State in Nigeria, it is a residential and commercial town.

Figure 1: Showing the map of Ugbor Area (source: Goggle Earth)

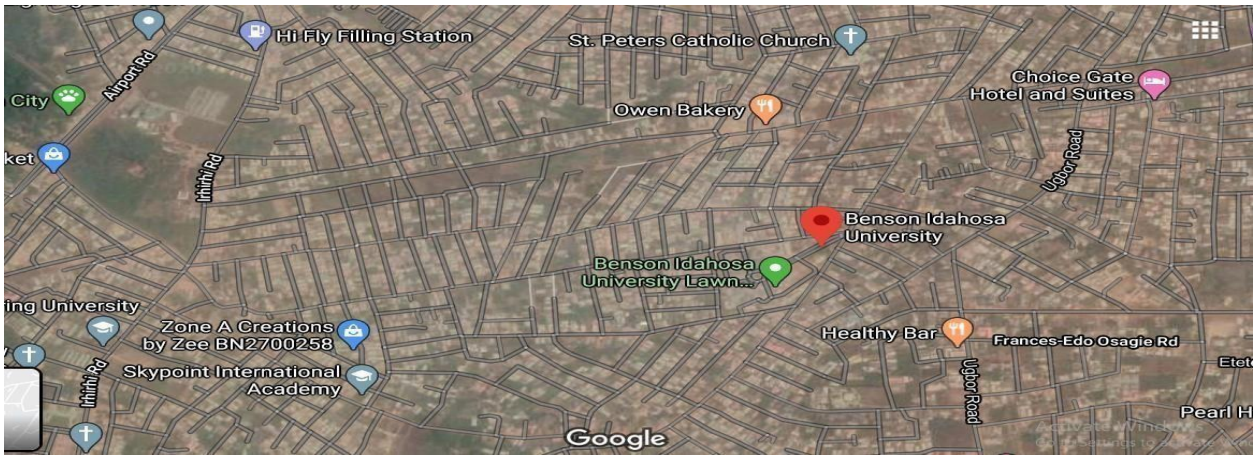

Figure 2: Showing the map of Imagery Ugbor Area (source: Goggle Earth)

2.2 Sampling and Sampling Techniques

The sampling which comprises of ninety respondents that are government workers, traders, farmers, transporters and students living in the area of the study were derived from the above populations. In orders to get this population different work place and people close to those area chosen at random and given questionnaires to respond to the research question raised. The samples were also considered an adequate source [7].

Table 1 Showing the breakdown of respondents

NUMBER OF RESPONDENTS	QUESTIONNAIRES	PERCENTAGE
GOVERNMENT WORKER	15	17%
TRADERS	35	39%
FARMERS	5	5%
TRANSPORTERS	15	17%
STUDENTS	20	22
TOTAL	90	100

To obtain the percentage values from Government workers divided by the total questionnaires multiply by 100, you will get the percentage values for each respondent such as Traders, Farmers, Transporters and Students.

2.3 Data Collection

2.3.1. The Use of Questionnaires

The research was a quasi-experimental descriptive survey, aimed at eliciting opinions of government people and people that are involved in the area of study in its environs within the Ugbor area Benin City, Edo state. The design was used to obtained relevant information on the research work.

2.3.2 Population of the Study

The population comprised of 200 (two hundred) people in the study area. 100 (one hundred) people are government workers while the other 100 (one hundred) people are peoples that lives in the environment/area within the state but 90(ninety) were used for the research.

2.3.3 Instrument of the Study

Two sets of questionnaires formed the movement of the study. One of the questionnaires, which collected data from the government workers, had thirty (30) items focused on collecting data on the 10 (Ten) research questions. The other questionnaires which collected data from people that lives in the area of study, had twenty (20) items focus on collecting Ten (10) research questions as well.

2.3.4 Method of Data Collection

Data was also collected from published and journals on flood, library research, and articles including oral interviews from Ministry of Environment and Ministry of physical planning and urban development,Benin City Edo State.

Questionnaires were used to draw facts from respondents. The questionnaire was designed in an open ended format to extract statistically reliable information about the land use pattern, causes of flooding, nature of drainage in the study area, Sanitation and sewage disposal, the most flood

prone months, flood risk areas as well as the effects of flood on the people. The flood affected locations were visited and almost all the people that were interviewed in the study area have lived there for about 10 years and more, affirming to the actual existence of flooding in the Area. The interviewed population was able to identify the causes of flooding as well as the problems associated with flooding which includes property damages and others. They gave factors suspected as responsible for several floods in the area measures adopted to stop or check the flood menace in the area. They also noted that these measures were grossly inadequate and most times ineffective.A population density map of the study area was also presented to help relate the occurrence of flooding to human activities or perhaps human concentration. A flood risk map of the study area was also developed to reveal the areas that are prone to flooding.

2.3.5 Method of Sample Selection

Primary data needed for the research was acquired by means of sample survey in the study area. In view of the enormous area liable to flooding, the main zones that make up the study area will be selected and 90(ninety) questionnaires were retrieved among the study population.

2.3.6 Method of Data Analysis

Method of statistical technique that was used in analysising secondary data for the research such as rainfall data was descriptive statistics such as mean, standard deviation and variance.

Mean = $\sum x/n$

Standard Deviation $\sqrt{\sum}(x1-x)2/n$

Variance = $(\text{Standard Deviation})^2$

3. Results and Discussion

3.1 Rainfall analysis of the study area (Ugbor Area, Benin City, Edo State)

Table 2: Rainfall Analysis of the Study Area

S/N	YEAR	ANNUAL RAINFALL (mm)	(X-$\underline{X}$), X=2133.17mm	$(X_1-X)^2$ mm
1	2009	1676.8	-456.37	208273.5769
2	2010	2189.6	56.43	3184.3449
3	2011	2452.4	319.23	101907.7929
4	2012	2256.5	123.33	15210.2889

5	2013	1916.5	-216.67	46945.8889
6	2014	2054.9	-78.27	6126.1929
7	2015	2050.9	-82.27	6768.3529
8	2016	2420.7	287.53	82673.5009
9	2017	2404.6	271.43	73674.2449
10	2018	2132.1	-1.6	2.56
11	2019	1909.9	-223.27	49849.4929
N=11		∑=23464.9mm		∑=594616.2mm

Source: Climatedata.Eu › Climate

Mean = ∑x/n = 23464.9/11 = **2133.17mm**
Standard Deviation = $\sqrt{\sum(x_1-x)/n}$ = 594616.2/ 11 = **62367.47mm**
Variance = (Standard Deviation)2 = (**62367.47**) 2 = **59461.2mm**

To get X-X column = Annual rainfall – Mean value
= 1676.8 – 2133.17 = **-456.37mm**
$(X-X)^2$ = $(-456.37)^2$ = **208273.5769mm**
The same procedure was applied to the other years.

Table 3. Presentation of Data on Flood Occurrences in the Preceding 11 Years

FLOOD	BIU ROAD	IGHILE	PRINCE AGBO	TOTAL	%
YES	26	30	24	80	89%
NO	0	0	10	10	11%
TOTAL	26	30	24	90	100%

From the questionnaires sent to ascertain the flooding occurrence in the areas above, BIU Road (26), Ighile (30), Prince Agbo (24) which represent there are flood occurrence while Prince Agbo only had a value of 10 that represent NO.
To get the Total, all the values were added and the percentage values were gotten by dividing the total values by the total questionnaire.

Table 4. Presentation Of Data On The Year With Highest Duration Of Flood Occurrences.

YEAR OF FLOOD	BIU ROAD	IGHILE	PRINCE	TOTAL	%
2009	2	2	3	7	8.75%
2010	4	1	1	6	8.75%
2011	2	4	5	7	7.78%
2012	1	3	2	5	7.5%
2013	2	1	1	4	5%
2014	2	2	2	6	7.5%
2015	2	2	1	5	6.25%
2016	1	2	3	6	7.5%
2017	5	3	5	10	11.11%
2018	2	3	4	9	11.25%
2019	3	3	4	16	17.78%
TOTAL	28	28	34	90	100%

To get the values of the percentage in 2009, add up all the values of BIU Road, Ighile, Prince Agbo you will have the total values, therefore the total value divided by the total questionnaire, the percentage value will be obtained respectively. The same thing is applied from 2010 to 2019.

Table 5. Presentation of Data on the Causes of Floods.

CAUSES OF FLOODS	BIU ROAD	IGHILE	PRINCE	TOTAL	%
Heavy Rainfall	10	7	17	34	37.78%
Blockage Of Water Ways	8	15	8	31	34.44%
Building On Flood Plains	4	3	3	10	12.5%
poor Planning/land use	4	6	5	15	18.75%
TOTAL	26	31	33	90	100%

To get the values of the percentage in each cause of flooding, add up all the values of BIU Road, Ighile, Prince Agbo you will have the total values, therefore the total value divided by the total questionnaire, the percentage value will be obtained respectively. The same thing is applied Heavy rainfall, Blockage of water ways, Building on flood plains and Poor planning/land use.

Table 6. Presentation of Data on Whether the Drainages are Dirt Free.

BIU ROAD	IGHILE STR	PRINCE	TOTAL	%
3	5	8	16	17.78%
23	30	21	74	82.22%
26	35	29	90	100%

From the questionnaires sent to ascertain the level of clean drainage system in the areas above, BIU Road (3), Ighile (5), Prince Agbo (8) which represent drainage system is been cleaned in the areas while BIU Road (23), Ighile (30), Prince Agbo (21) represents there is no good cleaned drainage system.
To get the Total, all the values were added and the percentage values were gotten by dividing the total values by the total questionnaire.

3.2 Discussions

In this research, ninety questionnaires were retrieved from the study areas in Biu Road, Ighile Str and Prince Agbo, ninety of these questionnaires constitutes the main data used in this analysis. In the past eleven years, (2009-2019), the causes of flooding has been attributed to many factors ranging from heavy rainfall, blockage of drainage system, building on flood liable plains etc. the questionnaire sample survey also reveal that among the perception of what causes floods, heavy rainfall is the highest with 36.25%. Rainfall affects most parts of Ugbor Area Biu Benin City. The effect is mostly felt in Ighile Str and Prince Agbo where improper waste disposal combine to worsen flood situation.

Flooding in Ugbor Area Biu Benin City is also influenced by the flat and table land nature of the area, with high water table due to its proximity to the Atlantic Ocean, areas like sapele road have poorly constructed drainages. These areas have high population which makes it susceptible to flooding.

Interviews reveal that one of the major causes of flooding in Ugbor Area Biu Benin City is over-population. As the population of GRA Benin City continually increase, the carrying capacity of the area is exceeded. The result of this change is improper waste disposal as experienced in the study area. The major loss that is experienced from flood occurrence is the destruction of property and destruction of houses. Psychological fear is the major inconvenience associated in flood occurrences. Increasing population causes development to gradually expand thus urbanization processes begin to increase due to the increased human activity associated with population growth. The result of these changes is an unprecedented change in land use. Population growth and urbanization has led to land use changes as the populace continuously struggle for survival. However, to combat these flood menace, dwellers suggest that the best control measures is creation of drainage system (61.25%), proper land use planning and flood insurance for affected victim which may be in form of compensations. Other control measures include raised foundation (5%) in Biu Road and use of Sand bag (3.75%) in Ighile Str. Suggestions such as provision of incinerators, and trash cans would also reduce the blocking of drainage system and control flooding to a reasonable extent.

4. Conclusion

The Ugbor Area Biu Benin City is consistently experiencing fast growth and expansion as well development of new areas both in the core of the city and its periphery especially in BIU axis: The increase in built up areas of the city, implies increase in the surface cores of urban landscape, leading to reduction in the infiltration capacity of the soil, thereby generating higher magnitude of runoff as compared with the pre-urbanization period. Increasing population has further worsened the scenario in Ugbor Area Biu Benin City, considering the fact that higher number of this population is traders, producing waste which will fill up the drainage ways.

Apart from population intensity and urbanization, other causes of floods in Ugbor Area Biu Benin City includes; intense rainfall, building in flood prone areas, poor planning and maintenance of available drainage facilities, including government reluctance to implement the world bank`s proposals for flood control in the country and Edo state in particular.

4.1 Recommendation

There is need for reinforcement of the practical application of flood risk map, the town planner should endeavor to constantly use these maps as guide to help them in site inspection and plan

approval for construction of new buildings. These flood risk maps will help to determine areas which should be avoided in location of building for specific land use purposes that the flood risk areas can conveniently serve without many losses

Land use planning and development control are inevitable tools for controlling urban development. In a swiftly urbanizing area like Ugbor Area Biu Benin City, proper land use policies, regulations, building and development bye-laws are very necessary to check the excesses of developers and to monitor the nature of urban development. Flood forecasting has to be well developed with standard modern technique of predicting the occurrence of flood. This will also be supplemented by the construction of flood frequency curves to determine the occurrence frequency of floods in certain areas. Warning of flood plain occupant before flood occurrence will help reduce the flood damages and loses as emergency action to guide against the destructive effect of flood may be highly efficient.

Government agencies, authorities, planners, environmentalists, practitioners of the built environment international organization and individuals must work in synergy to evolve a comprehensive approach that would emphasize more on the means of reducing flood damages over a long time. This process would rely on both indigenous and advanced techniq ues to abating flood problems in the country and Ugbor Area Benin City in particular.

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Appendix

A questionnaire on assessing the nature and causes of flooding in ugbor area, Benin city, Edo state, Nigeria.

Instruction: Please tick (√) where applicable in the space provided below.

1. What is your occupation? A. civil servant ☐ B. Trader ☐ C. Transporter ☐ D. Farmer ☐ E. student ☐

2. How long have you been living here in your area (Ugbor)?
   A. 10 years ago. ☐ B. 5 years ago. ☐ C. A year ago. ☐

3. Have you experienced any flood incident in the last 11 years?
   A. Yes. ☐ B. No. ☐

4. If yes, please give us the date(s)
   ……..

5. Could you tell us the most likely cause of flood in your area?
   A. Heavy Rainfall ☐
   B. Blockage of natural and artificial water ways ☐
   C. Building on flood liable plains ☐
   D. Improper planning and poor land use ☐
   E. Other reasons, please specify
   ……

6. Have you encountered loss that could be attributed to flood hazards like;
   A. Destruction of property ☐
   B. Destruction of houses ☐
   C. Loss of life ☐

7. Have you suffered such ☐ related inconveniences such as;
   A. Relocation of ☐ property
   B. Abandonment of Houses
   C. Psychological fear that you may have flood hazards ☐

8. Do you think you have adequate drainages around your house?
   A. Yes. ☐ B. No. ☐

9. Do you consider the provided drainage free from filth or refuse?
   A. Yes. ☐ B. No. ☐

10. How often do you clean the provide drainage system? A. very often. ☐ B. Rarely. ☐ C. Never.

11. Does Government have any flood control Measure in your Area? A. yes ☐ B. No. ☐

12. If Yes, Please specify;

A. Channeling of Streams ☐

B. Creation of Drainage Network ☐

C. Desilting of Drainage Network ☐

13. Do you have enough information on floods problems in your area?

A. Yes. ☐ B. No. ☐

14. If yes, what is the source?

A. Nigerian Meteorological Agency ☐ B. The media ☐ C. Others ☐

15. What measure do you consider necessary for reducing flood hazard?

A. Creation of drainage system ☐ B. Raised Foundations ☐

C. Sand bags to keep flood away ☐

D. Proper Land use Planning ☐

E. Flood Insurance ☐

F. Others ☐