

ASSESSMENT ON THE EFFECT OF POOR DRAINAGE NETWORK ON FLASH FLOODING IN BUKURU METROPOLIS OF JOS SOUTH LOCAL GOVERNMENT AREA PLATEAU STATE, NIGERIA

Adamu Peter Francis^{1*}, Mrs. Alice Peter Bootyin²

^{*1-2} Department of Environmental Health Technology, Federal College of Veterinary and Medical Laboratory Technology Vom Plateau State, Nigeria.

Corresponding Author Adamu Peter Francis

Department of Environmental Health Technology, Federal College of Veterinary and Medical Laboratory Technology Vom Plateau State, Nigeria.

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Abstract: The research work was carried out in Bukuru Metropolis Jos South Local Government Area of Plateau state, Nigeria. This study focuses on assessing the effect of poor drainage networks on flash flooding in Bukuru, Plateau State, Nigeria. Data were collected through questionnaires distributed to 200 respondents in the study area, with a response rate of 91%. So the finding reveal that 112 respondent which represent (56%) strongly agreed that they have knowledge on drainage system, 110 respondent represent (55%) strongly agreed that there is no intensity and frequency of floods, 69 respondent represent (34.5%) strongly agreed that there are means of assessing and evaluating network distribution in Bukuru, 102 represent (51%) strongly agreed that poor drainage system have impact on residents, 160 respondent represent (80%) says that they previous years that flood has occur in Bukuru was between July to October, 97 respondent represent (48.5%) strongly agreed that resident have shown their attitudes towards drainage systems, 64 respondent represent (32%) believes that the Volume of flood in Bukuru is Moderate, 30 respondent represent (30%) believes that the factors that contribute to the previous flood that has occur in Bukuru was because of Dumping of waste on channels, 50 respondent represent (25%) believes that what actually causes inadequate network in Bukuru Metropolis is non-conformity to land used planning, 78 respondent represent (39%) believes that the quality of drainage network in Bukuru Metropolis are very narrow, 85 respondent represent (42.5%) of the Residents strongly agreed that poor drainage systems adversely affect their lives and properties, 77 respondent represent (38.5%) strongly agreed that poor drainage network serve as a breeding place for mosquito, 100 respondent represent (50%) strongly agreed that the previous flooding that has occur in Bukuru has actually affect the activities of people, 112 respondent represent (56%) strongly agreed that poor drainage network actually have health implication and 90 respondent represent (45%) indicate that none of the above year mention that they have experience flooding in Bukuru metropolis of plateau State, Nigeria.

Keywords: Assessment, effect, water drainage, flash flooding, urbanization Consequence, Critical Evaluation, Inadequate.

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Introduction

Poor drainage systems remain a substantial challenge to urban environments in Nigeria, especially in urban and rural settlements where the nonappearance of well-designed drainages to evacuate storm water is commonplace. Urbanization, driven by social, economic, and political changes, has led to the speedy growth of towns and cities. This growth often surpasses the ability of governments to provide adequate infrastructure, including effective drainage systems. Urbanization, while a force for economic growth and modernization, also exacerbates environmental and health issues due to inadequate planning and

infrastructure development. Duru and Nnaji (2008) defined urbanization as the increase in the population of cities in proportion to the region's rural population. Urbanization is the outcome of social, economic and political developments that lead to concentration and growth of large cities, changes in land use and transformation from rural to metropolitan pattern of organization and governance.

Rapid growth of towns and cities has been common feature of the developing world (Aderamo, 2008)

Drainage systems are critical for managing wastewater and stormwater, ensuring proper disposal and preventing flooding. Instrument like ditches, pipes and channels encompassed drainage water system, should be able to manage by maintaining drainage system effectively which actually lead to advance water quality and assimilate environmental and communal benefit of water management (Folorunsho, & Awosika, 2001). Nevertheless lack of knowledge of waste management practices and pitiable design causes blockage of drainage system which lead to flood in Bukuru Metropolis. As it is seen in a disaster of 2012 flood actually destroys millions of lives and lead to important economic losses. This is they reasons why our drainage in the area should be of standard so as to avoid repeated flood related to health risk. In the year 2012, 363 people were feared dead while 2.1 million citizens were displaced across Nigeria as a result of floods. According to the National Emergency Management Agency (NEMA), 30 states out of 36 in Nigeria were affected by that flood experience and it was concluded as the worst that has ever happened in the past 40 years, causing damages of an estimated value of N2.6 trillion Naira (Jimoh, 2008).

The fast development in Nigeria, branded by an annual urban population growth rate of nearly 6% in the 1980s, has been a double-edged sword. Meanwhile it increases human investment and economic opportunity, therefore roads, housing and proper drainage system draining infrastructure. Lack of not following standard of building ordinances, joint with pitiable urban planning intensifies the problem of flooding. Effective drainage design is essential for road durability and environmental sustainability, as excessive water can lead to pavement failure and structural damage. Urban flooding is also linked to anthropogenic activities such as unplanned construction and poor waste disposal, further complicating the management of urban areas like Plateau State's Bukuru region.

Poorly maintained drainage systems and poor waste management habits can adversely affect our environment (Okupe, 2002).

As urbanization gathered pace in most developing countries, the problem of inadequacy of infrastructure services and deteriorating urban environment became enormous (Sule, 2009). These problems range from poor housing conditions, inadequate infrastructure, to squatter settlements (Arimah, 2002).

The issues of flooding happens when there is poor drainage system in a particular geographical area and it happen to be global issues/ problem mostly in the urban region of low and middle income countries been particular vulnerable. Environmental degradation, loss of life, property occurred in Nigeria when flood happens annually. Basic infrastructure has been denied to urban dwellers including all whether road and proper drainage system. This deficiency leaves low-income populations, often residing in flood-prone areas, particularly vulnerable to the effects of climate change and increased storm intensity.

Loss of livelihood, spread of disease like malaria and diarrhea happens when there is Derisory drainage systems in Nigerian cities, including Plateau State, contribute to severe flooding, during rainy season the problem of Flooding in Bukuru, Plateau State, has become a recurrent issue, primarily due to blocked or poorly managed drainage systems. The gathering of garbage, silt, and vegetation in drains further worsens the situation,

causing waterlogging and significant infrastructure damage. Dwellers frequently report drainage-related complaints, highlighting the urgency of addressing this issue.

The poor state of drainage systems not only hampers road functionality but also poses health risks to dwellers. The absence of proper stormwater management systems has led to frequent flash flooding, destroying homes and roads and claiming.

lives annually. This study aims to assess the effects of inadequate drainage systems on flash flooding in Bukuru, emphasizing the need for improved infrastructure and waste management practices to mitigate these challenges. According to Folorunsho & Awosika, 2001) three millions of peoples in most areas of our cities are been affected by flooding in our dear country Nigerian a lot of increase population of peoples that been affected are in the cities which include low – and middle income nations because storm and flooding are also aggregate in economic damages, globally there has been an increase growth in the number of humans that are killed or seriously impacted by this flood and storm

(Giwa, 2007) revealed that the outcome of inadequate drainage system has actually leads to flooding and other environmental issues such as roadway pavement failure.

Henderson (2004) revealed that the level of risk and vulnerability in urban areas of developing countries is attributable to socio-economic stress, aging and inadequate physical infrastructure. Indeed, according to Satterthwaite, et' al, (2007), hundreds of millions of urban dwellers have no all-weather roads, no piped water supplies, no drains and no electricity supplies; they live in poor quality homes on illegally occupied or sub-divided land, which inhibits any investment in more resilient buildings and often prevents infrastructure and service provision.

Recently Plateau especially Bukuru is facing widespread water logging during the rainy season (August to October) as result of a serious problem of poor drainage. Inadequate/ lack of drainage has become one the major issue that resident compliant in the study area and this issues becomes worse in every year. Poor existing drains and their improper operation and management mainly cause severe flooding which creates damages and problems to the road pavement and road users. In addition, deceases are spread and give problems to the population such as malaria and diarrhea. This critical situation was severely aggravated because the natural drainage system, which conveys storm runoff from the areas to the river were not fully operated and the existing drains blocked with huge amount of garbage, solid waste, silt sand accumulation and vegetation.

Materials and Methods

This study employed a descriptive cross-sectional research design to assess the effect of poor drainage networks on flash flooding in Bukuru Metropolis, Jos South Local Government Area, Plateau State, Nigeria. The study was conducted through a combination of field surveys, direct observations, and structured questionnaires administered to residents within the affected areas. Both qualitative and quantitative data were collected to analyze the relationship between drainage inefficiencies and the occurrence of flash floods.

Study Setting

The study was conducted in Bukuru Metropolis, an urban area within Jos South LGA, characterized by poor drainage infrastructure, rapid urbanization, and frequent flash floods. The metropolis consists of residential, commercial, and industrial zones, with major drainage systems often blocked due to poor waste disposal and inadequate maintenance.

Sampling Size and Sampling Techniques

A total of 221 respondents, include residents, business owners, and local government officials are selected for the study. The sample size will determined using the Taro Yamane formula:

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

Where;

n = sample sizes

N = population sizes (estimated at 280 people)

e = margin of error (0.05)

$$n = \frac{280}{1 + 280(0.05)^2} = \frac{280}{1 + 280(0.0025)} = \frac{280}{1.4} = 200$$

The sampling technique involves a stratified random sampling method, where resident, business owners, local government officials and community members serve as strata. A proportionate random sampling method was used within each stratum to ensure fair representation of participants from different areas.

Instruments Design

The researcher made use of the following instrument obtaining the needed information;

Questionnaire

Through the help of these instruments it was possible for the researcher to get the necessary information from the respondents.

Method of Validating Instrument

The researcher's justification for valid sampling procedure is not unconnected with fact that the method gives the element of population an equal chance to be chosen. Thus the bias in sampling is reduced or eliminated to some extent.

Method of Data Collection

Data were collected form the two main types of sources- primary data sources and secondary data sources.

Primary Data Collection

Primary data were collected through Questionnaire of the respondent in their resident at the selected community. Final questionnaire was asked to respondents and their answers wrote to the definite place in the questionnaire sheet

Secondary Data Collection

Apart from primary data, secondary data were collected from the official records of some books, journals, reports, and internet sources etc. which are enlisted on the reference.

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Method of Data Analysis

The primary data collected was subjected to descriptive statistical tools for analysis such as frequency distribution table, percentages and charts

RESULTS AND DISCUSSION

Data Presentation

This chapter present and analyze the data collected from the field survey. A total of 221 questionnaires were administered to the respondents out of which 200 were successfully retrieved while 8 questionnaires were not properly filled and 13 were not retrieved. This gives a response rate of 90.5% which formed the basis for data analysis in this chapter. From the final analysis the researcher uses 200 successful retrieve questionnaire for the analysis.

Table 4.1 Socio Demographic Characteristics of the Respondents

Sex	Frequency	Percentage
Male	93	46.5
	107	53.5
Females		
Total	200	100

Source field, 2024

From table 4.1: 93 respondent represent (46.5%) were male and 107 respondent represent (53.5%) are females.

Tables 4.2: Employment status of the respondent

Employment status	Frequency	Percentage
Self-Employ	84	42
Employed	78	39
Unemployed	38	19
Total	200	100

Source field: 2024

Table 4.2: reveals that 84 respondent represent (42%) of them were self-employed, while 78 respondent represent (39%) were employed, and only 38 respondent represent (19%) were unemployed. This means that a majority of the respondents were self-employed, making life easier for them.

Tables 4.3 Aged Distributions

Age distribution	Frequency	Percentage
16-25	34	17
26-35	45	22.5
36-45	78	39
46 and above	43	21.5
Total	200	100

Source field: 2024

Tables 4.3 reveals that 34 respondent represent (17%) were in between they aged of 16-25, 23 respondent represent (22.5%) were in between the ages of 26-35 while 78 respondent represent (39 %) were between the ages of 36-45 and 46 and above had 26 respondent which represent (21.5%)

Tables 4.4 Marital status

Marital status	Frequency	percentage
Single	65	32.5
Married	105	52.5
Divorce	30	15
Total	200	100

Source field: 2024

Table 4.4: reveals that 65 respondent represent (32.5%) of them were singles, while 105 respondent represent (52.5%) were married, and only 30 respondents represent (15%) were Divorce. This means that a majority of the respondents were married.

Table 4.5: Educational Qualification

Educational Qualification	Frequency	Percentage
SSCE	47	23.5
National Diploma	53	26.5
NCE	65	32.5
Degree	35	17.5
Total	200	100

Source field: 2024

Tables 4.5 reveals that 47 respondent represent (23.5%) were SSCE, while 53 respondent represent (26.5%) were National Diploma while 65 respondent represent (32.5%) are NCE and 35 respondent represent (17.5%) were Degree.

Tables 4.6 Occupations

Occupations	Frequency	Percentage
Student	23	11.5
Farmer	33	16.5
Trader	124	62
Civil servant	20	10
Total	200	100

Source field: 2024

Tables 4.6 reveals that 23 respondent represent (11.5%) were Student, while 33 respondent represent (16.5%) were Farmers while 124 respondent represent (62%) were Traders and 20 respondent represent (10%) were civil Servant.

Table 4.7 Knowledge of residents on drainage system

Frequency of drainage	Frequency	Percentage
Strongly agreed	112	56
Agreed	20	10
Undecided	68	34
Disagreed	0	0
Strongly disagreed	0	0
Total	200	100

Source filed, 2024

From table 4.7: 112 respondent represent (56%) strongly agreed that they residents have knowledge on drainage system while 20 respondent represent (10%) agreed that they residents have knowledge on drainage system while 68 respondent represent (34%) were undecided about the resident having knowledge about drainage system, 0 respondent represent (0%) disagreed from the above point and 0 respondent represent (0%) strongly disagreed from the above point.

Table 4.8 Frequency and intensity of flood in Bukuru of Plateau State

Frequency of Flooding	Frequency	Percentage
Strongly agreed	110	55
Agreed	20	10
Undecided	56	28
Disagreed	9	4.5
Strongly disagreed	5	2.5
Total	200	100

Sources field; 2024

From table 4.8: 110 respondent represent (55%) strongly agreed that there is no frequency and intensity of flood in Bukuru of Plateau State, 20 respondent represent (10%) agreed from the above point, 56 respondent represent (28%) were undecided from the point, 9 respondent represent (4.5%) were disagreed and 5 respondent represent (2.5%) strongly disagreed

Table 4.9 Poor drainage system affect resident of Bukuru metropolis

Frequency of Flooding	Frequency	Percentage
Strongly agreed	102	51
Agreed	34	17
Undecided	26	13
Disagreed	17	8.5
Strongly disagreed	21	10.5
Total	200	100

Source filed, 2024

From table 4.9: indicate that 102 respondent represent (51%) strongly agreed that poor drainage system affect resident of Bukuru metropolis, 34 respondent represent (17%) agreed for the point above, 26 respondent represent (13%) were undecided from the point above, 17 respondent represent (8.5%) were disagreed from the point and 21 respondent represent (10.5%) strongly disagreed.

Table 4.10: The Month that Flood Disaster often Occur in Plateau

Month of Flood	Frequency	Percentage
January to March	0	0

April to June	30	15
July to October	160	80
November to December	10	0.5
Total	200	100

Sources Field , 2024

Table 4.10 shows that overwhelming majority of the respondents (80%) indicated that the previous year of flood disaster often occurs between the months of July to October and 15% thinks it is from April to June while 0.5% believes it is from November to December

Table 4.11 Assessing and Evaluating network distribution in Bukuru

Frequency of Flooding	Frequency	Percentage
Strongly agreed	55	27.5
Agreed	69	34.5
Undecided	22	11
Disagreed	30	15
Strongly disagreed	24	12
Total	200	100

Sources Field , 2024

From table 4.11: it indicate that 55 respondent represent (27.5%) strongly agreed that there is means of assessing and evaluating network distribution in Bukuru, 69 respondent represent (34.5%) agreed from the point above, 22 respondent represent (11%) were undecided from the point above, 30 respondent represent (15%), 24 respondent represent (12%) strongly disagreed from the point above.

Table 4.12 Attitude towards proper drainage system and flooding prevention in the area

Frequency of Flooding	Frequency	Percentage
Strongly agreed	97	48.5
Agreed	18	9
Undecided	68	34
Disagreed	17	8.5
Strongly disagreed	0	0
Total	200	100

Sources Field , 2024

From the table 4.12: it indicate that 97 respondent represent (48.5%) strongly agreed that residents of Bukuru metropolis have shown their attitude towards proper drainage system and flooding prevention in the area, 18 respondent represent (9%) agreed to the point above , 68 respondent represent (38%) were undecided from the point , 17 respondent represent (8.5%) and 0 respondent represent (0%) were strongly disagreed.

Table 4.13: The Volume of Flood in Bukuru

Flood Volume	Frequenc y	Percentag e
Very high	20	10
Considerabl y high	48	26
Moderate	52	24
Low	64	32
Very low	16	0.8
Total	200	100

Sources Field, 2024

Table 4.13 shows that about one third of the respondents (32%) indicated that the volume of the flood in Bukuru is Low compare to it occurrences in other states like Lagos, Ibadan etc. About 26% of the respondents indicated that the volume of the flood is considerably high while 24% of them confirmed that there is moderate volume of flood in the area. However, 10% of them admitted that there is very high volume of flood in the area while 0.8% of them indicated that the volume of the flood is very low

Table 4.14: Factors of Flood Occurrence

Factors of Flood	Frequency	Percentage
Building on water channels	130	65
Poor Physical Planning	22	22
Inadequate Drainage Channel	25	25
Heavy rainfall	15	15
Dumping of wastes on channels	8	8
All of the above		
Total	200	100

Sources Field, 2024

The incidence of floods in Bukuru metropolis was attributed to diverse causes. Plateau like other cities in Nigeria has adequate storm water way. This is evident in the recurrent waves of flood events in the study area. Table 4.14 revealed that heavy rainfall was claimed to be the main factor of flood occurrence in Plateau (15%), 130 respondent represent 65% indicate that building on water channels is the major factors of flood occurrence Statistical evidence from the Nigerian Meteorological Agency (NIMET), Plateau shows that the mean annual rainfall for the city based on 1912-2011 rainfall data of the area is 125.78mm. These will mean volumes of water running off roofs and paved surfaces from such storms are enormous. All too often, drains and culverts cannot cope and localized flash flooding occurs. These flash floods happen suddenly, with little lead time for warning; they are fast-moving and generally violent, resulting in threat to life and severe damage to property and infrastructure; and they are generally small in scale with regard to area of impact. The table further indicates that 25% of the sampled population attributed flood events in the city to inadequate drainage channels. In a similar vein, poor physical planning was also identified as another factor of flood occurrence with a response intensity of 16 percent. Despite the efforts of the plateau State government to keep the city of Bukuru

Metropolis clean, waste can still be seen strewn in gutters and road junctions.

Table 4.15: Causes of inadequate network in Bukuru Metropolis

Perceived Causes	Frequency	Percentage
Government negligence	36	18
Inadequate funding	34	17
Poor monitoring and evaluation of projects	44	22
Nonconformity to land use planning	50	25
All of the above	36	18
Total	200	100

Sources Field, 2024

The result in Table 4.15 presents the perceived causes of inadequate drainage network in the city of Plateau. It can be observed that non-conformity to land use planning was identified as a major factor responsible for inadequate storm water channels in the study area. About 25% of those interviewed linked poor drainages to non-conformity to land use zonation. Closely following this factor was poor monitoring and evaluation of project as high as 22% of those sampled accepted that poor monitoring and evaluation is a serious problem that affects the standardization of drainages in the city. In addition, 17% of the sampled population attributed inadequate funding as a factor that hampered the provision of adequate drainages in the city. Also about 18% of the respondents claimed government neglects this segment of urban infrastructure development while 18% of them said all the above mentioned are attributed to the causes

Table 4.16: Quality of drainage network in bukuru metropolis

Month of Flood	Frequency	Percentage
Very Narrow	78	39
Not well designed	60	30
Not well plastered	32	16
Highly fractured	30	15
Others	-	-
Total	200	100

Sources Field, 2024

The result in Table 4.16 presents data on the quality of drainage networks in the study area. From the table, it can be observed that there was an overwhelming agreement across the sampled flood prone areas that the dimensions of the drainages is well below the volume of storm water that is often experienced in the area. The table revealed that more than one third (39%) of the sampled households accepted that the drainage channels in their area were very narrow. The table further revealed that some of the respondents (30%) are of the view that the drainages were not well designed. These views were unevenly distributed in the sampled area. For instance, 16% of the respondents said the drainages were not plastered properly, while, 15% of the sampled population held almost similar views that the drainages were highly fractured

Table 4.17 Poor drainage system in Bukuru destroys people property

Frequency of Flooding	Frequency	Percentage
Strongly agreed	85	42.5
Agreed	54	27
Undecided	31	15.5
Disagreed	12	6
Strongly disagreed	18	9
Total	200	100

Sources Field, 2024

From the table 4.17: it indicate that 85 respondent represent (42.5%) strongly agreed that poor drainage system in Bukuru destroys people property, 54 respondent represent (27%) agreed to the point above, 31 respondent represent (15.5%) were undecided from the point, 12 respondent represent (6%) and 18 respondent represent (9%) were strongly disagreed.

Table 4.18 Poor drainage network serve as a breeding places for mosquito

Frequency of Flooding	Frequency	Percentage
Strongly agreed	77	38.5
Agreed	62	31
Undecided	25	12.5
Disagreed	36	18
Strongly disagreed	0	0
Total	200	100

Sources Field, 2024

From the table 4.18: it indicate that 77 respondent represent (38.5%) strongly agreed that poor drainage network serve as a breeding places for mosquito, 62 respondent represent (31%) agreed to the point above, 25 respondent represent (12.5%) were undecided from the point, 36 respondent represent (18%) and 0 respondent represent (0%) were strongly disagreed.

Table 4.19 Flooding actually affect the activities of people in Bukuru Metropolis

Frequency of Flooding	Frequency	Percentage
Strongly agreed	100	50
Agreed	35	17.5
Undecided	23	11.5
Disagreed	40	20
Strongly disagreed	2	1
Total	200	100

Sources Field, 2024

From the table 4.19: it indicate that 100 respondent represent (50%) strongly agreed that flooding actually affect the activities of people in Bukuru Metropolis, 35 respondent represent (17.5%) agreed to the point above, 23 respondent represent

(11.5%) were undecided from the point , 40 respondent represent (20%) and 2 respondent represent (1%) were strongly disagreed.

Table 4.20 Poor drainage network actually have health implications

Frequency of Flooding	Frequency	Percentage
Strongly agreed	112	56
Agreed	20	10
Undecided	68	34
Disagreed	0	0
Strongly disagreed	0	0
Total	200	100

Sources Field, 2024

From the table 4.20: it indicate that 112 respondent represent (56%) strongly agreed that poor drainage network actually have health implications, 20 respondent represent (10%) agreed to the point above , 68 respondent represent (34%) were undecided from the point , 0 respondent represent (0%) and 0 respondent represent (0%) were strongly disagreed.

Table 4.22 The last time you experience flooding in Bukuru metropolis

Frequency of Flooding	Frequency	Percentage
2022-2023	11	5.5
2020-2021	35	17.5
2018-2019	44	22
2016-2017	20	10
None of the above	90	45
Total	200	100

Sources Field, 2024

From the table 4.20: it indicate that 11 respondent represent (5.5%) agreed that 2022 – 2023 that it was the last time they experienced flooding in Bukuru metropolis 35 respondent represent (17.5%) agreed that 2020 -2021 was the last time they experienced flooding in Bukuru metropolis , 44 respondent represent (22%) agreed that the last time they experienced flooding in Bukuru metropolis was between 2018 -2019 , 20 respondent represent (10%) agreed that the last time they experienced flooding in Bukuru metropolis and 90 respondent represent (45%) agreed none of the above.

Discussion

from table 4.7: 112 respondent represent (56%) strongly agreed that they residents have knowledge on drainage system while 20 respondent represent (10%) agreed that they residents have knowledge on drainage system while 68 respondent represent (34%) were undecided about the resident having knowledge about drainage system, 0 respondent represent (0%) disagreed from the above point and 0 respondent represent (0%) strongly disagreed from the above point. While From table 4.8: 110 respondent represent (55%) strongly agreed that there is no frequency and intensity of flood in Bukuru of Plateau State, 20 respondent represent (10%) agreed from the above point, 56 respondent

represent (28%) were undecided from the point, 9 respondent represent (4.5%) were disagreed and 5 respondent represent (2.5%) strongly disagreed While From table 4.9: indicate that 102 respondent represent (51%) strongly agreed that poor drainage system affect resident of Bukuru metropolis , 34 respondent represent (17%) agreed for the point above, 26 respondent represent (13%) were undecided from the point above, 17 respondent represent (8.5%) were disagreed from the point and 21 respondent represent (10.5%) strongly disagreed. While Table 4.10 shows that overwhelming majority of the respondents (80%) indicated that the previous year of flood disaster often occurs between the months of July to October and 15% thinks it is from April to June while 0.5% believes it is from November to December While From table 4.11: it indicate that 55 respondent represent (27.5%) strongly agreed that there is means of assessing and evaluating network distribution in Bukuru, 69 respondent represent (34.5%) agreed from the point above, 22 respondent represent (11%) were undecided from the point above, 30 respondent represent (15%), 24 respondent represent (12%) strongly disagreed from the point above. While From the table 4.12: it indicate that 97 respondent represent (48.5%) strongly agreed that residents of Bukuru metropolis have shown their attitude towards proper drainage system and flooding prevention in the area, 18 respondent represent (9%) agreed to the point above , 68 respondent represent (38%) were undecided from the point , 17 respondent represent (8.5%) and 0 respondent represent (0%) were strongly disagreed. While Table 4.13 shows that about one third of the respondents (32%) indicated that the volume of the flood in Bukuru is Low compare to it occurrences in other states like Lagos, Ibadan etc. About 26% of the respondents indicated that the volume of the flood is considerably high while 24% of them confirmed that there is moderate volume of flood in the area. However, 10% of them admitted that there is very high volume of flood in the area while 0.8% of them indicated that the volume of the flood is very low While The incidence of floods in Bukuru metropolis was attributed to diverse causes. Plateau like other cities in Nigeria has adequate storm water way. This is evident in the recurrent waves of flood events in the study area. While Table 4.14 revealed that heavy rainfall was claimed to be the main factor of flood occurrence in Plateau (15%), 130 respondent represent 65% indicate that building on water channels is the major factors of flood occurrence Statistical evidence from the Nigerian Meteorological Agency (NIMET), Plateau shows that the mean annual rainfall for the city based on 1912-2011 rainfall data of the area is 125.78mm. These will mean volumes of water running off roofs and paved surfaces from such storms are enormous. All too often, drains and culverts cannot cope and localized flash flooding occurs. These flash floods happen suddenly, with little lead time for warning; they are fast-moving and generally violent, resulting in threat to life and severe damage to property and infrastructure; and they are generally small in scale with regard to area of impact. The table further indicates that 25% of the sampled population attributed flood events in the city to inadequate drainage channels. In a similar vein, poor physical planning was also identified as another factor of flood occurrence with a response intensity of 16 percent. Despite the efforts of the plateau State government to keep the city of Bukuru Metropolis clean, waste can still been seen strewed in gutters and road junctions. While The result in Table 4.15 presents the perceived causes of inadequate drainage network in the city of Plateau . It can be observed that non-conformity to land use planning was identified as a major factor responsible for

inadequate storm water channels in the study area. About 25% of those interviewed linked poor drainages to non-conformity to land use zonation. Closely following this factor was poor monitoring and evaluation of project as high as 22% of those sampled accepted that poor monitoring and evaluation is a serious problem that affects the standardization of drainages in the city. In addition, 17% of the sampled population attributed inadequate funding as a factor that hampered the provision of adequate drainages in the city. Also about 18% of the respondents claimed government neglects this segment of urban infrastructure development while 18% of them said all the above mentioned are attributed to the causes. While The result in Table 4.16 presents data on the quality of drainage networks in the study area. From the table, it can be observed that there was an overwhelming agreement across the sampled flood prone areas that the dimensions of the drainages is well below the volume of storm water that is often experienced in the area. The table revealed that more than one third (39%) of the sampled households accepted that the drainage channels in their area were very narrow. The table further revealed that some of the respondents (30%) are of the view that the drainages were not well designed. These views were unevenly distributed in the sampled area. For instance, 16% of the respondents said the drainages were not plastered properly, while, 15% of the sampled population held almost similar views that the drainages were highly fractured. While From the table 4.17: it indicate that 85 respondent represent (42.5%) strongly agreed that poor drainage system in Bukuru destroys people property, 54 respondent represent (27%) agreed to the point above, 31 respondent represent (15.5%) were undecided from the point, 12 respondent represent (6%) and 18 respondent represent (9%) were strongly disagreed. While From the table 4.18: it indicate that 77 respondent represent (38.5%) strongly agreed that poor drainage network serve as a breeding places for mosquito, 62 respondent represent (31%) agreed to the point above, 25 respondent represent (12.5%) were undecided from the point, 36 respondent represent (18%) and 0 respondent represent (0%) were strongly disagreed. While From the table 4.19: it indicate that 100 respondent represent (50%) strongly agreed that flooding actually affect the activities of people in Bukuru Metropolis, 35 respondent represent (17.5%) agreed to the point above, 23 respondent represent (11.5%) were undecided from the point, 40 respondent represent (20%) and 2 respondent represent (1%) were strongly disagreed. While From the table 4.20: it indicate that 112 respondent represent (56%) strongly agreed that poor drainage network actually have health implications, 20 respondent represent (10%) agreed to the point above, 68 respondent represent (34%) were undecided from the point, 0 respondent represent (0%) and 0 respondent represent (0%) were strongly disagreed. While From the table 4.20: it indicate that 11 respondent represent (5.5%) agreed that 2022 – 2023 that it was the last time they experienced flooding in Bukuru metropolis 35 respondent represent (17.5%) agreed that 2020 -2021 was the last time they experienced flooding in Bukuru metropolis, 44 respondent represent (22%) agreed that the last time they experienced flooding in Bukuru metropolis was between 2018 -2019, 20 respondent represent (10%) agreed that the last time they experienced flooding in Bukuru metropolis and 90 respondent represent (45%) agreed none of the above.

Conclusion

In conclusion, this assessment underscores the critical importance of proactive infrastructure planning and maintenance in

mitigating the risk of flash flooding, particularly in vulnerable areas like Bukuru metropolis. Despite the absence of flash flooding incidents in the past decade, the findings reveal that poor drainage networks pose a significant threat to the community's resilience against such disasters. The absence of recent events should not breed complacency but rather serve as a timely opportunity for preemptive action.

By addressing deficiencies in the drainage system and implementing sustainable flood management strategies, authorities can fortify the community's defenses against potential flash floods. This project highlights the necessity of continuous monitoring and adaptation to evolving environmental dynamics, ensuring the long-term safety and well-being of Bukuru's residents. Through collaborative efforts between government agencies, local communities, and relevant stakeholders, the vision of a resilient and disaster-resilient Bukuru metropolis can be realized, safeguarding lives, livelihoods, and infrastructure against the ravages of flash flooding.

Recommendations

In view of these, the study put forward some recommendations which when implemented will help in mitigating flood incidence in Bukuru.

- The government of Plateau state should take proactive measure to mitigating the storm waters by clearing the drainage channel on regular basis.
- The government contract should be awarded to a competent company for the construction of under drainages covering the entire city of Bukuru, as surface drainages have created many problems to the resident including the loss of property.
- The government and NGOs should carry out massive awareness campaigns on the need for the people to stop dumping waste in the drainage channels.
- The Bukuru State government should re-enact the monthly sanitation exercise which will help in the total removal or reduction of waste in the drainage channels.
- Government should put in place flood early warning signal system with the capability to deliver reliable timely and effective flood information at an appropriate response time.

Implications of the Study

The findings of the study can inform the development and implementation of policies aimed at improving drainage infrastructure and mitigating the impact of flash flooding in Bukuru Metropolis. This could involve enacting regulations for proper urban planning, allocating resources for infrastructure upgrades, and establishing maintenance protocols for existing drainage systems.

The study can also influence urban planning decisions by highlighting the importance of integrating flood risk considerations into land-use planning and development projects. It can emphasize the need for sustainable drainage solutions, such as green infrastructure and permeable surfaces, to manage storm water effectively and reduce the risk of flash flooding. It also help us to understanding the effect of poor drainage networks on flash flooding can guide infrastructure investment priorities in Bukuru Metropolis. Decision-makers may allocate resources to improve

drainage infrastructure in areas identified as high-risk for flooding, thereby reducing property damage and enhancing public safety.

The study can raise awareness among residents about the risks associated with flash flooding and the role of drainage infrastructure in mitigating these risks. It can empower communities to take proactive measures to prepare for and respond to flooding events, such as adopting early warning systems, practicing flood-resistant construction techniques, and participating in community-based flood resilience initiatives. And By assessing the impact of poor drainage networks on flash flooding, the study can underscore the importance of preserving natural drainage systems and minimizing environmental degradation. It can advocate for sustainable land management practices that protect watersheds, reduce erosion, and enhance the natural capacity of landscapes to absorb and retain rainwater.

Suggestions

- There should be Survey residents and local authorities to gather anecdotal evidence and perceptions regarding the drainage network's adequacy and any past instances of flash flooding.
- The authority should Utilize GIS (Geographic Information System) mapping to analyze the existing drainage infrastructure and identify potential areas of concern or improvement.
- The community should consider the socio-economic impact of flash flooding, including damage to property, disruption of livelihoods, and potential health hazards.
- The community should engage with urban planners and civil engineers to develop recommendations for enhancing the drainage network's resilience to future flood risks.

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