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EFFECTS OF FLOODING ON URBAN LIVES AND PROPERTIES IN LAGOS, NIGERIA

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ABSTRACT
Flooding in the past few decades has made people experience economic losses. Floods in Lagos, Nigeria have increased in many folds and have resulted in major loss of livelihoods, and destruction of economic and social infrastructure. This paper examines the effects of flooding on urban lives and properties in Lagos, Nigeria with the view to evolving best practices to limit its impacts on the residents' livelihood and properties. The paper assessed the causes of flooding, the garbage disposal method and the impact of floods on the residents. Data were sourced from both primary and secondary sources through field survey; 128 questionnaires were administered to the respondents which resulted in 124 being retrieved. Findings show that it takes about a whole day (24 hours) for water to dissipate, and that the most common garbage disposal method in the study area is through PSP (Private Sector Participation). Findings also showed that prolonged rainfall, strong winds, impervious nature of the soil, improper waste disposal, and inadequate drainage system are the major causes of flooding. The study concluded that flooding has effects on residents' lives and properties and often results in livelihoods being lost. Therefore, steps should be taken to dredge waterways and tributaries by the National Inland Water Authority (NIWA). Furthermore, the development of buildings should be closely monitored by the concerned Government agencies to ensure houses are not built on natural water drainage channels.

Keywords:
Flood, lives, properties, urban, drainage, environment

INTRODUCTION

Flooding has become a common environmental problem in Nigeria and it has a devastating impact on human livelihood and infrastructural development (Yin, Ye, Yin & Xu, 2015; Adegun, 2023). The menace often occurs when a body of water moves over and above an area of land and submerges it. It is an occurrence which is peculiar to many low-lying regions of the world, one of which is Lagos State. With this ever-increasing urban population vis-a-vis scarcity of dry lands, encroachment, illegal structures and slum developments, flooding has therefore become an issue and a challenge for the State Government. Lagos State can be described as an incomplete delta because it has only one estuary mouth. This estuary is the commodore channel (at Onikan and near Bar Beach) that discharges the entire contents of the Lagos Lagoon, Badagry Creek, Lekki Creek and Ologe Lagoon into the Atlantic Ocean (Tapia-Silva, Itzerott, Foerster, Kuhlmann & Kreibich, 2011; Rose & Abubakar, 2014; Dube, K., Nhamo, G. & Chikodzi, 2021).

In terms of relief, Lagos occupies a low-lying site, generally below 17m with many parts of the metropolis at or below sea level (Adegbola & Jolayemi, 2012; Lawson & Odunbaku, 2017; Yoade, Adeyemi & Adelabu, 2020). The characteristic flatness of the terrain of Lagos implies that the ability of surface water to drain rapidly away is restricted; joined with extensive impervious paving this often causes pools of standing water to build up very quickly following rain downpour. The climate of Lagos is similar to that of the rest of Southern Nigeria, which is characterized by two rainy seasons; rainy season 1 (April – July) and rainy season 2 (October – November). Season 1 produces the heaviest rains and consequently the most likelihood of flooding. The temperature averages about 270 C and humidity can be higher than 80%.

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The work of Adelekan (2011) gives insight into the increasing risk of flooding in Lagos. From his expository studies, Lagos is expected to rank as the fifth most exposed city to climate change threats by 2070 (Rustum, & Adeloye, 2007; Yoade, Onifade, Olatunji & Husseni, 2023). A computation of the Climate Change Vulnerability Index (CCVI) identified Lagos as one of the ten cities with 'high risk' from climate change globally (Pender, 2006). An important effect of climate change in Lagos is the increasing severity and impact of both inland and coastal floods (Bates & Roo, 2000; Bubeck, P., H. De moel, Ouwer & Aerts, 2011; Cammerer, Thieken & Lammel, 2013; Huan & Manteghi, 2022).

The severity of flooding in Lagos has increased over the years and has had devastating effects on the residents' livelihoods, (Olajide & Lawanson, 2014; Vincet & Yusoff, 2022). The agonies of flood have become the lot of nearly every nook and cranny of Lagos metropolis. In various communities that have been experiencing it across the metropolis, the tales of woes and pains follow every heavy downpour that lasts more than three to four hours. It is more serious when the rain lasts more than four hours (Agbola, Ajayi, Taiwo & Wahab; Aderogba, 2012 Cirella & Iyalomhe, 2018; Yoade, 2018). Counting the cost of flooding further revealed that economic activities have been negatively disrupted, many lives have been lost (human and livestock), buildings have collapsed, and electricity supplies have been disrupted because poles have been damaged by flood. Many lives are at risk of malarial with the increase in mosquitoes as a result of stagnant waters brought about by floods. Due to the above reasons and many others, the study aims to assess the effects of flooding on urban lives and properties in Lagos State so as to find out the cause of flooding within the selected area in Lagos and proffer possible measures taken to curb flooding in the state.

LITERATURE REVIEW

Flooding

The earliest historical record of flooding in Lagos state dates back to 1947 when Lagos was only a small coastal settlement (Bates & Roo, 2000; Echandu, 2020; Yoade & Onifade, 2020 Dube, Nhamo & Chikodzi, 2021). The pattern of flood occurrence has however changed drastically over the decades. Flooding of the city has been recorded with increasing frequency over the years (Ajibade, McBean & Bezner-Kerr, 2013). Changes in the intensity and pattern of rain storms, land use changes, and subsequent changes in the hydrological fluxes of the urban watershed associated with urban growth, compounded by inadequate or lack of drainage infrastructure, poor waste management, poor urban planning, and poor development control, have strongly exacerbated flooding in Lagos over the decades (Dutta & Nakayama, 2009).

Adelekan (2011) detailed some of the major flooding events from the late 1960s until the present time, including heavy flooding events in the years 1968, 1969, 1970, 1971, 1972, 1974, 1999, 2000 and 2004. Also, Komolafe, Adegboyega & Akinluyi (2015) wrote that in recent years, pluvial flooding (rainfall-related) has arguably been more widespread. With the exception of 1973, the drought year, flooding in Lagos has occurred annually (usually between July and October rainy season) with increasing intensity and increased severity of impacts from 1960 onwards (Rose & Abubakar, 2014). Ajibade et al (2013), noted that more severe flooding has been recorded in selected areas of Lagos including Lagos Island, Apapa, Ikeja, Mushin, Surulere and parts of Ikorodu. Also, Adeaga (2005) and Fasona, Omojola, Odunuga, Tejuoso & Amogu (2005), having observed the pattern of flooding in Lagos State, submitted that Lagos is prone to three distinct categories of flooding. They are:

- Urban area flooding: generated by flat topography, excessive rainfall, inadequate storm water drainage system and the obstruction of natural water courses. Urban area flooding occurs in towns and cities located on flat or low-lying terrain.
- Coastal area flooding: due to inundation of the lagoon and coastlands with ocean storm surges and high tidal levels. Coastal flooding occurs in the mangrove belt areas.

- River flooding: this is due to unusually high levels of rivers and discharges from the network of rivers and uplands of Lagos. River flooding occurs in the flood plains of large rivers.

Causes of flooding

In an attempt to find a way of curbing flood in Nigeria, Lagos State in particular, many scholars have endeavoured to find out the reasons why flood occurs and the reasons they proffered are true of Lagos. According to Dutta et al (2013), the reasons for flooding are essentially attributed to two major factors which are the climatological and anthropogenic factors. Nkeki, Henah & Ojeh (2013) wrote that the Lagos metropolis kept on experiencing an increase in area extent and population size that is adversely affecting the physical environment and the drainage system in particular. The damage flood might cause tends to increase as more people settle on vulnerable flood plains and block drainage channels. There are indications that should there be any slightly heavier rainstorm for a relatively long period of time, the incidence of flooding will be in greater dimensions and more disastrous.

Tightly linked with the menace of flooding is waste management. Improper disposal of waste products and inadequate methods of waste collection could result in the display of waste on roadsides, beside major drains, and when it rains, this waste is washed into the drainage system and ultimately into the water courses which would lead to blockage of drains as well as pollution of Lagos Lagoons and creeks. Faced with all these, the Lagos state authorities have put several measures in place that attempt to tackle those difficulties. For example, several initiatives, ranging from community self-help programmes to a World Bank loan for drainage improvements, are being implemented. These include the drain dock programme in 2000, the emergency flood abatement gang, and Lagos Metropolitan development and governance project. However, these have only had minimal effects or none at all (Adelekan, 2011; Chormanski Okruszko, Ignar, Batelaan & Rebel, 2011; Mayomi, Dami & Maryah, 2013; Komolafe et al. 2014; Rose et al., 2014; Alves, Angnuureng, Morand & Almar, 2020).

Causes of flooding have been considered from diverse angles by researchers. Olajide and Lawanson (2014) established that flood is a natural phenomenon, caused mainly by natural events; however, the incidence of floods and its associated risks have been exacerbated by human-induced activities. Human activities such as deforestation, wetland reclamation, greenhouse gas emission, poor planning, improper development and poorly designed infrastructure, particularly drainage systems, are capable of increasing flood events and vulnerability to the associated risks. In the explanation provided by Agbonkhese et al (2014), flooding is not totally a natural phenomenon but an environmental hazard. It becomes a hazard when it impinges unfavourably on human activities as it frequently does because of the affinity which man tends to have for flood plains and coastal locations. They thereby, highlight five factors that often result in flooding. These include heavy rainfall synchronizing with spills of rivers; main rivers backing up the water in their tributaries; inadequate and inefficient drainage of low-lying and flat areas to the overflow; ponding back of stream flow by rising tides, particularly during spring tide conditions; and peak floods occurring at the same time in a main river and its tributaries.

Okoko (2008) submitted that flooding is essentially attributed to two major factors which are the climatological and anthropogenic factors. The climatological factors include prolonged rainfall, an increase in sea level and strong winds in the coastal areas. These three factors show how climate change indirectly aggravates flooding by altering the pattern of flooding in flood-prone areas. The anthropogenic factors have to do with man's interaction with his environment in the form of urbanization, deforestation, shoreline modification and deposition of sand and silt in drainage channels. Other causes established by Okoko (2008) include dam breaking, improper waste disposal and development of buildings on the waterways.

Effects of flooding

While many flood events in Lagos have been reported by the local media, only major flood disasters have been documented by global flood/disaster observatories. Recent flood events with severe impacts are those of 2010 in Ikorodu and the widespread floods of July 2011 and July 2012. In July 2011, heavy rainfall which lasted about 17 hours precipitated a total of 233.3mm of rainfall – the equivalent of the amount expected for the entire month. About 25 people were reported killed as a consequence of the floods while 5,393 persons were displaced from their homes (IFRC, 2011).

The total cost of the 2011 flood, in terms of goods and properties, was estimated at N30 billion by the Nigerian Insurance Industry (2013). Substantial properties lost to flood are not insured and are owned by middle-class and poor residents, some of whom live in informal settlements.

Also, in June 2012, 216.3mm of rainfall was recorded in a single rainstorm event. The resulting flood wrecked widespread and severe damage to infrastructure, roads, bridges, rail tracks, houses and other properties, and claimed seven lives (Ikusemoran, M., Anthony, U. & Maryah, 2012; Adelekan, 2016; Olatunji & Yoade, 2022).

The livelihoods and economic activities of residents were also affected by floods. The floods of 2010 which had severe impacts in Ikorodu were a result of the release of water from the Oyan dam upstream on the course of the Ogun River. As a consequence, the problem of flooding in Lagos is increasingly raising serious concerns among the general public and government.

The effects of flooding in Nigeria, especially Lagos State, is at an alarming rate that if preventive measures are not taken very urgently, future occurrence might be too costly. A study on the impact of flooding on residential property values, focussing on the Ajegunle-Ikorodu Local Government Area of Lagos State, shows the effects of flooding on human lives and property values. The effects of floods on countries, social life and the economy have been so great that it attracts worldwide attention. Yet, in spite of the inherent dangers that accompany flooding, man continues to carry out their daily activities, erecting properties in flood plains and renting accommodation in flood areas (Lawanson & Odunbaku, 2017. Ajegunle-Ikorodu is uniquely prone to perennial flooding arising from rainfall and water released from Oyan Dam. The findings of the research show that flooding affects property values but most residents prefer to remain in the area in spite of the menace of flood.

Aderogba (2012) wrote that the Lagos metropolis kept on experiencing increases in area extent and population size that is adversely affecting the physical environment and the drainage system in particular. The damages caused by a flood might increase as more people settle on vulnerable flood plains and block drainage channels. There are indications that should there be any slightly heavier rainstorm for a relatively long period of time, the incidence of flooding will be in greater dimensions and more disastrous. Research and investment should focus on the mapping of flood-prone areas for the purpose of planning and physical planning of upcoming suburbs should be in conformity with those in existence and the natural landscape (Jonkman, Bočkarjova, Kok, & Bernardini, 2008; Oyekale, 2013).

STUDY AREA

Lagos State is a low-lying coastal region occupying 180km of Nigeria's coastline. It covers an approximate 3,577Sq km which represents 0.45% of Nigeria's territorial land mass. The State drains two-thirds of the South West and is characterised by wetlands and basin for five major upstream rivers from neighbouring states to discharge into the Atlantic Ocean. The low-lying wetlands occupy 78% of the entire land mass of the State. It is also known that about 85% of Lagos's population resides in 37% of the State's land mass. Lagos State (Figure 1) has a land mass of about 3,577 square kilometres and it is located between latitudes 6° 23' N and 6° 41' and longitudes 2° 42'E and 3° 42'E on the Greenwich Meridian. It is bounded on the West by the Republic of Benin and on the South by the Atlantic Ocean. It is regarded as the smallest state in the country; however, it has the highest population density in the nation. According

to a 2006 census, the state is considered the second most populous state in the federation, with the population status placed at 9,113,605.

Lagos State is a low-lying coastal region with a 180km coastline on the South-western part of the country. Lagos State has about 279,000 hectares of low-lying wetland, which constitutes about 78% of its entire land mass and 22% of Lagos consists of lagoons and creeks. Lagos State has two main seasons which are the dry season and the rainy season. The dry season usually lasts from October to March while the rainy season lasts from April to October. The rainy season has two peak periods which are May to July and September to October, with rainfall being the heaviest during the first peak period. Floods usually result during these periods, which are aggravated by poor surface drainage systems on the coastal lowland. Lagos is also blessed with a littoral type of climate with the highest mean monthly annual rainfall recorded amounting to 450mm and annual mean rainfall of around 1850mm. The mean annual rainfall varies from one location to another. For instance, Ebute-Meta, Yaba and Bariga in the Mainland areas record 1750mm while Agege in the North West records 1567.2mm.

Lagos State has an extremely flat terrain with an average height of 0.8m above Mean Sea Level. Ajeromi/ifelodun, Apapa, Amuwo-Odofin, Badagry, Eti-Osa, Epe, Ibeju-Lekki, Kosofe, Lagos Island, Lagos Mainland, Ojo, Shomolu and Ikorodu Local Governments all have flat terrains and are naturally liable to coastal flooding because of the inability to rapidly evacuate run-off due to high water in lagoons and creeks, resulting from tidal levels and sea-level rise. Areas around Ikeja, Ifako/Ijaiye, which have an average elevation of over 25m above Mean Sea Level, are not usually affected by topography (Yoade, Onifade, Olatunji & Husseni, 2023).

Figure 1: Picture showing Lagos State Map
Source: Lagos State Ministry of Land and Physical Development, 2016

In the Köppen climate classification system, Lagos has a tropical wet and dry climate that borders on a tropical monsoon climate. There is a brief relatively dry spell in August and September and a longer dry season from December to March (Table 1).

Table 1. Climatic survey of Lagos, Nigeria

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	27.3 °C (81.2) °F	27.9 °C (82.2) °F	28.1 °C (82.7) °F	27.9 °C (82.1) °F	27.1 °C (80.8) °F	25.9 °C (78.5) °F	25.1 °C (77.1) °F	24.8 °C (76.6) °F	25.2 °C (77.4) °F	26.1 °C (78.9) °F	27.1 °C (80.7) °F	27.5 °C (81.4) °F
Min. Temperature °C (°F)	24.7 °C (76.5) °F	25.8 °C (78.4) °F	26.5 °C (79.6) °F	26.2 °C (79.2) °F	25.5 °C (77.9) °F	24.4 °C (76) °F	23.8 °C (74.9) °F	23.6 °C (74.4) °F	23.8 °C (74.9) °F	24.4 °C (76) °F	25.2 °C (77.4) °F	25 °C (77) °F
Max. Temperature °C (°F)	30.9 °C (87.7) °F	31.1 °C (87.9) °F	30.8 °C (87.4) °F	30.2 °C (86.4) °F	29.2 °C (84.6) °F	27.7 °C (81.9) °F	26.9 °C (80.3) °F	26.6 °C (79.9) °F	27.2 °C (80.9) °F	28.2 °C (82.8) °F	29.3 °C (84.8) °F	30.6 °C (87.1) °F
Precipitation / Rainfall mm (in)	39 (1.5)	54 (2.1)	100 (3.9)	145 (5.7)	231 (9.1)	302 (11.9)	227 (8.9)	155 (6.1)	204 (8)	190 (7.5)	93 (3.7)	43 (1.7)
Humidity (%)	75%	78%	81%	83%	85%	87%	86%	86%	87%	87%	84%	78%
Rainy days (d)	9	11	17	17	20	21	20	17	20	20	17	10
avg. Sun hours (hours)	8.2	7.9	7.7	7.6	7.0	5.9	5.8	5.4	5.6	6.3	6.9	8.0

METHODOLOGY

Research design

Both primary and secondary data were adopted for this study. This was done to accomplish direct field observation and collection of primary data.

Population and sample size

The justification for selecting Mushin LGA as the study area is that Mushin is one of the major commercial hubs in Lagos with a lot of business activities. These heavy commercial activities have also attracted the development of residential property within and around the area. Also, the areas for the focus of this study were selected among the numerous areas in Mushin because of the frequency of flooding activity that has been experienced in the past.

Eight neighborhoods in this settlement that frequently experienced flooding were selected for analysis in this study. These areas are Idi-Oro, Alamutu, Agege motor road, Olaniyi, Matuwo, Labinjo, Bankole and Ojuwoye. The research population for this study was located in a number of buildings in the selected flood-prone areas of the settlement, obtained through a reconnaissance survey. A total of 429 buildings were counted using Google Earth map.

Considering the fact that it was cumbersome to study all the buildings due principally to time, cost and accessibility, a subset of the population was studied.

The Evans Morris Model (2007) formula was used to determine the sample size;

$$n = \frac{NZ^2Pq}{e^2(N-1) + Z^2Pq}$$

Where n = sample size

N = Number of Buildings (429 Buildings) e^2= 10% = 1.0 (level of accuracy)

1 = Unity (a constant)

Z= 95%= 0.95 (level of significance)

Pq= 0.5(Population proportionality)

Therefore;

$$n = \frac{429 \times 0.95^2 \times 1.0}{0.05^2(429-1) + 0.95^2 \times 1.0}$$

n = 196

Therefore, a total number of 196 questionnaires was administered across the eight flood-prone street in the study area. A 100% survey was carried out in respect of the physical characteristics of existing structures including the condition of social basic amenities in the study area.

Data Collection

The research instruments used for the collection of data for this study included the questionnaire and personal interview. The questionnaires are a compilation of relevant and well-structured questions for selected routes. Personal interviews were conducted with relevant environment officials of Lagos State Public Works Corporation (LSPWC), drainage departments and residents of the study area. Research Assistants were also engaged to make the administering of questionnaires easier and less cumbersome. The Research Assistants were trained on the concept of the questionnaire, the content of the questionnaire, and the administration of the questionnaire to the targeted respondents

The sampling procedure that was adopted for the study was the systematic random sampling. This type of sampling procedure allows for samples to be taken at a predetermined regular interval or order. A building was selected in each area as a starting point for questionnaire administration and another questionnaire was administered at the next third building, after which the questionnaire was randomly distributed in the selected building to an available eldest person. Therefore, the eight neighborhoods that make up the flooded area served as the sample frame.

Data collection was by administration of structured and open-ended questionnaires. The questionnaire was designed to elicit information on the causes of floods, and impacts of floods on the respondents in the study area. Out of the 128 questionnaires sent out, 124 were retrieved back from the field. Field trips and observation of existing drainage facilities and channels were assessed. This includes the visitation of the six existing stormwater drainage channels that have been provided in different parts of Lagos and the studying of the connectivity and links.

Data Analysis and interpretation of the results

The data collected were analyzed using both descriptive and the Flood Causative Index (FCI), the Flood Effect on Human assets Indices (EHI), the Flood Effect on Physical assets Indices (EPI), and effects of flood which caused financial losses (EFI), which were generated by ranking calculated mean values of

the variables. Percentage distribution and interpretation of the data were done. Likert Scale was used to analyse respondents' levels on the causes and effects of flood; the variables were obtained using a five-point Likert-type scale ranging from strongly agree (rated as 5), to strongly disagree (rated as 1).

RESULTS

Descriptive results

Time taken for flood water to dissipate

Findings revealed that 42.2% of 88 respondents who responded to this question said that it takes about a day for flood water to dissipate in their area. Of the 42.2%, some further expressed that it could take less than three hours for flood water to dissipate in their areas. 10.2% expressed that it could take two days while 7.0% replied that it could take three days for storm water to dissipate in their area.

Table 2: Time taken for flood water to dissipate

Time	Frequency	(%)
1 Day	54	42.2
2 Days	13	10.2
3 Days	9	7.0
1 Week	4	3.1
Others	8	6.3
Total	88	68.8

Source: Author's Fieldwork, 2016

Garbage disposal method

Findings revealed that 89.8% of respondents said that the method of garbage disposal in their area is majorly by PSP (Private Sector Participation) through the use of garbage disposal trucks and the frequency of disposal is every week. This means that the weekly disposal of refuse should ensure and enhance the general cleanliness of the area but there are still cases of refuse piled up on the gutters and drains, impeding the flow of water.

Table 3: Garbage disposal method and frequency of garbage disposal

Garbage disposal method			Frequency of garbage disposal		
	Frequency	(%)		Frequency	(%)
PSP	115	89.8	Everyday	9	7.0
Truck Pushers	6	4.7	Every week	103	80.5
Burning	2	1.6	Every two weeks	9	7.0
Total	123	96.1	Total	121	94.5

Source: Author's Fieldwork, 2016

Causes of flooding in the study area

Findings as presented in Table 4 show that most (94.5%) of the respondents agreed that prolonged rainfall is a major cause of flooding in Lagos, while only 5.5% of them disagreed. 6.2% of the respondents agreed that an increase in sea level causes flooding in Lagos, while 93.8% of them disagreed. 81.3% of the respondents agreed that strong winds often result in flooding in their area. Only 18.7% disagreed. 36% of the respondents agreed that flooding occurs in Lagos due to the impervious nature of Lagos' land while 7% of them disagreed. From Table 4, 8.6% of the respondents agreed that the above assertion is true, whereas 91.4% of them disagreed. 84.4% of the respondents agreed that improper waste disposal is one of the factors that cause flooding in Lagos while the remaining 15.6% of the respondents disagreed. From this table, 92.2% of the respondents agreed that one of the reasons for flooding in Lagos is inadequate drainage system while only 7.8% of them disagreed. 95.3% of the respondents agreed that flooding occurs in Lagos because drainage facilities are not in good shape while 4.7% of them disagreed. Corroborating the findings of Adelekan (2011) Dutta et al. (2013), Nkeki, Henah & Ojeh (2013), Agbonkhese et al. (2014), Yoade et al. (2019), the reasons for flooding are essentially attributed to two major factors which are the climatological and anthropogenic factors.

Table 4: Causes of flooding in the study area

Causes Frequency (N=128)	Strongly Agree		Agree		Disagree		Strongly Disagree	
	F	%	F	%	F	%	F	%
Prolonged rainfall	75	58.6	46	35.9	3	2.3	4	3.1
Increase in sea level	4	3.1	4	3.1	56	43.8	64	50
Strong winds	56	43.8	48	37.5	14	10.9	10	7.8
Due to impervious nature of Lagos' land	77	60.2	42	32.8	5	3.9	4	3.1
Dam breaking	6	4.7	5	3.9	55	42.9	62	48.4
Improper waste disposal	49	38.3	59	46.1	10	7.8	10	7.8
People build houses on waterways	8	6.3	5	3.9	37	28.9	78	60.9
Inadequate drainage system	69	53.9	49	38.3	5	3.9	5	3.9
Drainage facilities are not in good shape	54	42.2	68	53.1	3	2.3	3	2.3

Source: Author's Fieldwork, 2016

Ranking results

Residents' perception of causes of flooding

Table 5 revealed that prolonged rainfall, with the highest Flood Causative Value (FCI) of 3.7 is believed to be the major cause of flooding in Lagos State. Drainage facilities are in bad shape (FCI 3.44), inadequate drainage (FCI 3.36), improper waste disposal practices (FCI 3.06) and impervious land (FCI 2.54) are also causes of flooding in Lagos State. This revealed that all the variables are major causes of flooding in the study area with FCI value greater than 3 except impervious land. Therefore, this finding aligns with the studies of Okoko (2008), Adelekan (2011), and Yoade et al. (2019), that established the anthropogenic causes of flooding with the interaction of the environment and urbanisation.

Table 5: Residents' perception on causes of flooding

Causes of flooding	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	FCI (mean score)	Deviation FCI - *FCI*	Standard Deviation (FCI - *FCI)*^{2}
	F	F	F	F	F				
Prolonged rainfall is a major cause of flooding in my area	33	59	6	26	3	474	3.7	0.81	0.6561
Increase in sea level is a major cause of flooding in my area	-	30	42	45	9	345	2.73	-0.16	0.0256
Windstorm often result to flooding in my area	1	6	31	69	19	123	2.21	-0.68	0.4624
One of the reasons why my area is often flooded is due to imperviousness of our land.	2	24	27	61	12	321	2.54	-0.35	0.1225
Improper waste disposal is one of the factors that cause flooding in my area	12	38	24	50	2	386	3.06	0.17	0.0289
My area is often flooded because people build houses on waterways.	-	11	12	73	29	255	2.04	-0.85	0.7225
One cogent reason for flooding in my area is inadequate drainage system.	5	73	10	38	-	423	3.36	0.47	0.2209
Flooding occurs in my area because the gutters and other drainage facilities are not in good shape.	19	60	3	43	-	430	3.44	0.55	0.3025
TOTAL	72	301	155	405	74	2757	23.08		2.5414

WV=weighted value; SWV= Sum Weighted value

Effects of flooding on physical assets

The Flood Effect on Physical Assets Indices (EPI) in Table 6 show that drainages are blocked with refuse (EPI 3.26), therefore, water cannot flow out and this causes damage to physical assets. Other effects of floods on physical assets include roads becoming non-motorable (EPI 2.69) and damage to electrical poles and cables (EPI 2.15). The analysis revealed that flooding affects major physical assets when refuse blocks the drainage channel and renders the road non-motorable.

Effects of flooding on human and financial assets

The Flood Effect on Human Assets Indices (EHI) in Table 7 show that many residents have been displaced by flooding with EHI (2.48), reduction in Manpower assets EHI (2.42), and loss of Human life (EHI 1.99). Effects on financial assets in Table 8 revealed that the cost of replacing and repairing properties that have been damaged by flood is high (EFI 3.67). Also, flood reduces tenancy rates in the area as well

as the price of tenancy if it is prone to flooding (EFI 2.94) and business owners have had to relocate due to the effects of flood which caused financial losses (EFI 2.83). It has shown that flooding has major effects on the livelihood and assets of the residents in the study area. This has corroborated the findings of Okoko (2008), Adenekan (2011), and Lawanson and Olajide (2014) that flooding has severe effects on the residents both physical and human assets.

Table 6: Effects of flooding on physical assets

Effect of flooding on physical assets	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	EPI (mean score)	Deviation EPI - *EPI*	Standard Deviation (EPI - *EPI)*^{2}
	F	F	F	F	F				
Drainage facilities in my area are blocked with refuse	13	50	25	33	5	411	3.26	0.78	0.6084
Roads in my area are not motorable due to damages caused by flooding	6	31	14	68	7	339	2.69	0.21	0.0441
Electrical poles and cables in my area have been damaged as a result of flooding	2	12	9	83	20	271	2.15	-0.33	0.1089
Many homes in my area have been abandoned due to the effects of flooding	4	9	14	79	20	276	2.19	-0.29	0.0841
Flooding has resulted in the collapse of some buildings in my area	2	12	7	79	26	263	2.09	-0.39	0.1521
TOTAL	27	114	69	342	78	1560	12.38		0.9976

Table 7.: Effects of flooding on human assets

Effect of flooding on human assets	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	EHI (mean score)	Deviation EHI - *EHI*	Standard Deviation (EHI - *EHI)*^{2}
	F	F	F	F	F				
Many residents in my area have been displaced by flooding	5	17	17	81	6	312	2.48	0.18	0.0324
Displacement of residents has grossly reduced	-	13	35	70	8	305	2.42	0.12	0.0144

manpower assets in my area									
Loss of human life is a constant experience whenever there is flooding in my area	2	10	11	63	38	247	1.99	-0.31	0.0961
TOTAL	7	40	63	214	52	864	6.89		0.1429

Table 8: Effects of flooding on financial assets

Effect of flooding on financial assets	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	EFI (mean score)	Deviation EFI - *EFI*	Standard Deviation (EFI - *EFI)*^{2}
	F	F	F	F	F				
The cost of replacing/repairing properties damaged by flood is very high	14	66	38	6	2	462	3.67	0.52	0.2704
Many traders/business owners in my area have left due to the financial loss they suffered because of flooding.	4	17	62	40	3	357	2.83	-0.32	0.1024
Many house owners in my area often complain of reduction in tenancy rate caused by the fear of occupying houses in a flood prone area.	6	32	41	43	4	371	2.94	-0.21	0.0441
TOTAL	24	115	141	89	9	1,190	9.44		0.4169

DISCUSSION

This work was carried out to examine the various factors responsible for flooding and its effects on lives and properties in Lagos State in order to proffer possible suggestions on how to control them. The study established that there are effects of flooding on the lives and properties of the residents of the study area which vary from displacement and reduction in manpower assets to loss of human lives. Also, the cost of replacing/repairing properties damaged by flood is very high, many traders /business owners in the area have left due to the financial loss they suffered because of flooding and it has invariably reduced the tenancy rate in some areas. This is in line with the findings of Okoko (2008), Adelekan (2011) and Yoade et al. (2019).

The second finding shows the relationship between anthropogenic factors (i.e. urbanization, dam breaking, improper waste disposal, development of buildings on waterways) and flooding in Lagos State. The challenge of urbanization in relation to flooding is common in every city in Lagos. Development

brings people from other places that are less developed and this often brings overpopulation as one of its characteristics. Consequently, people begin to erect houses and pave their compounds; roads are tarred; and motor parks are created, the whole city becomes industrialized, etc. This finding corroborates the studies of Adelekan (2011), Odunuga, Oyebande & Omojola, (2012), Aderogba et al (2012), Rose & Abubakar (2014), Sojobi, Balogun & Salami (2016), Olanrewaju, and Chitakira, Olanrewaju & Louw (2019). All these studies found that the infiltration rate reduced as the larger part of the available land has become impervious. Storm water which cannot be absorbed into the ground then becomes runoff and eventually results in flood due to lack of control.

This study also reveals improper waste disposal as a major cause of flooding almost in every part of Lagos which led to incessant flooding occurrences in the study area. It is disheartening to discover that in this era of enlightenment, some people are still ignorant of the fact that dumping of refuse into drainage facilities is injurious to people's health. Some also ignorantly engaged the services of truck pushers in the disposal of their refuse who eventually emptied them into water bodies and canals. Consequently, this results in waste materials such as plastics, polythene materials and the likes blocking drainage channels and hindering the free flow of stormwater and flood water. This finding confirms the studies of Pender (2006); Komolafe et al. (2014); Rose et al. (2014); Lucas (2021), Meng and Manteghi (2021); and Umar & Gray (2023). These studies found that the impacts of flooding are felt by the individual and by society, through loss of property and infrastructure, damage to farmland, displaced water-living wildlife posing threats, contamination of drinking water, spread of waterborne diseases, fatalities and loss of wellbeing, loss of livelihoods, economic depression, and hindrance in achieving social development goals such as safety and eradication of poverty.

Lastly, this study has also confirmed that the erection of buildings on waterways causes flooding in Lagos State. In many parts of Lagos, buildings are erected illegally in places where they have not been authorized to do so. Some of these buildings are erected on waterways and cause a blockage to the path of moving water, thereby resulting in damage to buildings and properties because the water has nowhere to pass through.

CONCLUSION

This study examined the causes and effects of flooding in Lagos State with the aim of suggesting the various ways by which floods can be controlled. This study raised certain questions as regards the various factors causing flooding in Lagos State. These issues have been verified empirically and the findings obtained in the study are justifiably presented. It is not out of place to say that flooding is a global phenomenon, but the impacts in many urban areas in developing countries can be overwhelming. It is easier to understand the threats of flooding in Lagos State by the attention generated by the media and the academic world, especially in literature relating to social and environmental sciences.

Flood has negatively impacted Lagosians in the past and also in present time. It has destroyed infrastructure and disrupted economic activities. However, based on the current practices in flood management and flood risk reduction in the context of living with floods, the actions of the Lagos State Government and other stakeholders towards addressing the challenges of flooding have arguably been limited. More so, up-to-date information on flood events in Lagos State is not readily available and all efforts to ensure a city that is resilient to flooding seem to have proved ineffective. One of the reasons for this ineffectiveness is partly due to reliance on structural methods being put in place. To achieve more functional control, non-structural measures must complement the structural measures to curb the flood menace in the State. The following recommendations have been put up to arrest the incidence of flooding before, during and after the occurrence.

Before flooding

- Research and investment should focus on the mapping of flood-prone areas for the purpose of planning. Physical planning of upcoming suburbs should be in conformity with those in existence and the natural landscape.
- Flood occurrence can be predicted but at times, it occurs without warning and needs to be planned for. The following steps can be taken;
    - Proper disposal of refuse to the right channels and desisting from patronizing local truck pushers who dispose of the refuse wrongly.
    - The planting of trees, shrubs and decorative plants in individual homes would help reduce surface runoff as some of the water resulting from rainfall would be absorbed into the ground.
    - The use of interlocking blocks for pavements in homes, industries and other areas is advised as it allows some measure of infiltration of water into the ground when it rains.

During flooding

- Temporary or permanent evacuation of residents of flood-prone areas, especially during the rainy season to protect lives and property.
- Turn off electrical appliances; and avoid power lines or broken electricity transmission cables.
- Avoid entering into stormwater as it may contain chemicals and hazardous materials that have been carried along the way from industries and factories.

After flooding

- In the case of homes which have been affected by flood, leave electrical appliances off until electrical personnel have checked and given the go-ahead to use the appliances.
- Proper house cleaning should be carried out after the flood to remove any contamination that might have been caused by contaminated stormwater or flood water.

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