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FACTORS RESPONSIBLE FOR FLOODING OF RESIDENTIAL PROPERTIES IN IBADAN, NIGERIA

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ABSTRACT

The rate of flooding of residential properties is on the increase with its antecedent implications on real estate values. This study investigates the factors responsible for flooding of residential properties in Ibadan, Nigeria. The data set used in this study was obtained from the residents who live within 500 meters radius to the Orogun, Kudeti and Ogunpa rivers in Ibadan North West local government area, Ibadan, Oyo state, Nigeria. This is because of their proximity to the rivers known for overflowing their banks. Both descriptive and inferential statistical analyses were applied to arrive at the findings of the study. Relative importance index (RII) showed that encroachment of flood plains is the chief of all factors responsible for flooding while blocked drainage, heavy rainfall, violation of planning regulation and poor refuse disposal ranked 2nd, 3rd, 4th and 5th respectively. On the other hand, terrain (7th) and lack of drainage (8th) had the least ranks. It was recommended among others that Relevant statutory bodies such as Ministry of Land and Urban & Rural development, ministry of

Introduction

The term flood simply refers to an overflowing of a large amount of water beyond its normal confines (Djimesah, Okine and Mireku, 2018). Generally, a flood is an overflow of an expanse of water that submerges land. Floods are among the most devastating natural disasters in the world, claiming more lives and causing more property damage than any other natural phenomenon (Anunobi, 2013). Across the globe, floods have posed tremendous danger to people's lives and properties accounting for one-third of all deaths, one-third of all injuries and one-third of all damages of natural disasters (Etuonovbe, 2011). Flooding remains a major hazard regularly affecting Nigeria and the world at

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Works and other relevant agencies together with law enforcement agencies should ensure flood prevention control policies are properly implemented.

Keywords: flood, residential flooding, tenancy, residential properties, flood risk factors

large and it has been put straight that Nigeria remains a disaster prone country (Acreman, 2011).

In Nigeria, raining season is not always the best of time especially for those living in areas which are susceptible to flooding as it is a period that comes with the intimidating problem of flooding. Flood events often leave devastating impacts, as homes become submerged, valuable properties worth millions of naira are destroyed, and in severe cases, human lives are lost (Olanrewaju et al., 2022). In the case of residential properties floods, areas with flat or low-lying terrain and inadequate surface drainage or worse still where the existing drainages have been blocked with municipal waste, refuse or eroded soil sediments usually play node to the occurrence (Acreman, 2011). Nigeria has witnessed a lot of flood events in recent times with often devastating consequences evidenced in loss of lives and colossal damage to properties. Nkwunonwo et al (2020) reported that over the period 1985 to 2014, flooding in Nigeria has affected more than 11 million lives with a total of 1100 deaths and property damage exceeding 17 billion US dollars. Nigeria experienced its worst flooding in more than four decades in 2012, triggered by prolonged heavy rainfall and storms that lasted for several days, leading to widespread destruction and displacement (Ebele & Emodi, 2023). The occurrence of heavy rainfall and subsequent flooding has not only raised the issue of climatic change and the effect on the environment but also the more local issues of the impact on residential property development, residential property values and the ability of residential property owners to gain both finance and insurance for their properties (Ogungbemi et al., 2020). Hence, the factors responsible for this avoidable menace must be known so as to mitigate future occurrence.

Flooding significantly disrupts socio-economic activities, often resulting in loss of lives, destruction of properties, and long-term impacts on community livelihoods (Akinbobola & Adeoye, 2021). The effect of flooding on the value of properties has been of serious concern to property owners, their agents or representatives and even tenants occupying properties within the affected areas, this is so because after a flood occurrence, property values often decrease because the utility that can be derived from the affected property often reduced. Consequently, prospective investors, tenants and buyers of landed property often consider the susceptibility of an area to floods in the choice of the property they want to let or buy (Bariweni et. al, 2012). Demand for properties that are

susceptible to flood occurrence is therefore affected by accessibility since value is a function of demand and supply (Akeh et. al, 2018).

Ibadan, the largest city in West Africa has a long history of flooding usually during the rainy season (Ajibade. 2020). Studies have shown that Ibadan experienced severe flood disasters in many years, including 1963, 1978, 1980, 1987, and 2011, as part of its long-standing flood history (Adelekan, 2020). According to Ajibade (2020) the flood disaster of August 31, 1980 remains one of the most devastating in the history of flood disasters in Ibadan that resulted in about five hundred (500) deaths and 50,000 displaced people. Another catastrophic and devastating flood that hit Ibadan occurred on 13th August 2013. It was caused by a twelve-hour downpour. The flood disaster led to extensive human and material losses, with reports indicating over 500 fatalities, displacement of more than 30,000 residents, and the destruction of properties valued at billions of naira (Nkwunonwo, Whitworth & Baily, 2020).

The economic impact of flooding has received increased attention in the scientific community and commercial housing sector owing to the prospect of several projections of changing magnitude and frequency of flooding in future (Hallegatte et al., 2022; IMF, 2024). A major concern is that property values are influenced not only by the direct physical impacts of flooding, such as structural damage, but also by indirect factors including social perceptions, economic implications, and political considerations surrounding the risk status of affected assets (Ajibola, Oloke & Ogungbemi, 2021). Recent assessments indicate that Ibadan's urban growth has been accompanied by increasing population density, which places significant pressure on land resources and heightens environmental risks such as flooding. For instance, Adegun and Ajayi (2021) note that rapid urban expansion in Ibadan has led to higher settlement densities, often without corresponding infrastructural development, thereby exacerbating vulnerability to climate-related hazards. The city continues to grapple with inadequate environmental infrastructure, reflected in poor waste management services, indiscriminate dumping of refuse, blocked drainage systems, and unregulated construction of buildings, all of which exacerbate flood risk (Ajibade & McBean, 2020). These challenges are further aggravated by continuous settlement on floodplains, which has caused significant damage to residents in flood-prone areas. Ibadan Northwest Local Government Area was selected for this study because it contains neighborhoods highly vulnerable to flooding due to their proximity to the Ogunpa, Kudeti, and Orogun rivers. According to the National Population Commission's projection, the local government, with a 2006 population of 152,834, is estimated to have grown substantially by 2022 (NPC, 2022). The administrative headquarters remains at Onireke.

The focus of the study is to examine the factors responsible for flooding of residential properties in flood prone areas in Ibadan, Oyo State, Nigeria. The remainder of the paper

is organized as follows; Section 2 consists of a revision of literature on the subject of the discourse. Section 3 presents the data description and methodology, followed by the research results in section 4 results of findings. The closing section (5) presents recommendation and conclusion.

Flooding of Residential Properties

Etuonovbe, (2011) defined flood as a situation that results when land that is usually dry is covered with water of a river overflowing or heavy rain, it occurs naturally on the flood plains, it also occurs when water in the river overflows its banks, or sometimes results from a damaged constructed dam. Flooding often occurs suddenly, leaving communities unprepared for its impacts. Areas that experience recurrent inundation are commonly referred to as floodplains (UNDRR, 2022). Flooding has remained a recurrent natural phenomenon throughout human and earth's history, and it is expected to persist as long as the hydrological cycle continues to operate (Tellman et al., 2021). Several contemporary studies highlight that flooding is driven by multiple interacting factors such as sea-level rise, land subsidence, sediment compaction, riverbed aggradation, soil erosion from unsustainable land use, unplanned urban development, damming of rivers, seismic activities, and the broader impacts of climate change. These factors collectively increase both the frequency and intensity of flood events (Hirabayashi et al., 2021). On the other hand, Ojo (2011) identified causes of flood in developing nations as unregulated developments, invasion of public areas, lack of institutional capacity at the municipal level, unrealistic regulations, economic pressures from developers, ineffectiveness of planning regulation by allowing development on flood plains and poor and lack of standard drainage system on roads.

Recent research on Lagos, particularly in areas such as Ikoyi and Victoria Island, shows that flooding is primarily caused by excessive rainfall, poorly designed drainage systems, blocked channels due to refuse and sediment deposition, obstruction of natural waterways by buildings, and inadequate drainage capacity to cope with stormwater. These factors compound the city's vulnerability to recurrent urban flooding (Adelekan, 2020). A number of recent studies have investigated the factors responsible for recurrent flooding in Ibadan metropolis. Using household surveys and questionnaires administered to residents in flood-prone areas, researchers identified key drivers such as rapid urban expansion, inadequate drainage infrastructure, indiscriminate waste disposal, and settlement on floodplains as major contributors to flood risk (Olanrewaju, Chukwu & Eze, 2022). These were residential areas within less than 15m, between 16-30m and within 31-45m to major rivers in Ibadan metropolis. In each of these strata, there were 327,219 and 189, residential buildings. Twenty percent (20%) of the buildings was systematically selected for survey in each stratum out of which 11.7% of

buildings in less than 15m to the river had incidence of flooding, 8.8% and 1.4% of buildings within 15-30m and 31-45m respectively had been flooded at one time or the other. Residents attributed causes of flood in the metropolis to one or more factors. It was established that indiscriminate dumping of waste was the major cause of flooding in Ibadan metropolis (33.2%). Other causal factors were poor channelization (29.4%), flood plain encroachment (19%), and Pave surface (13.2%). Only excessive rainfall (5.3%) while clearing of drainage (36.4%) was the major actions of the residents toward reducing flooding in the area. The study concluded that various factors were responsible for flooding in Ibadan and strategies to reduce this menace must address each of the factors.

Akeh *et al.* (2018) study in Wulari Ward of Maiduguri metropolis, Borno state, Nigeria made use of a set of questionnaires which was administered to identify factors responsible for flood and 205 respondents who were randomly chosen within the study area for this purpose. The data collected were analyzed using tables and percentages. The results obtained showed that heavy rainfall (96.57%), lack of drainage channels (86.05%), blockage of drainage channels (84.88%), encroachment of flood plains (62.93%), violation of planning regulations (94.15%) and illegal structures on drainage channels (85.85%) were the major causes of floods in the study area. Areola, Also, Mamman, Onweluzo and Omotoso (2005) in their study identified poor land drainage systems such as lack of drainage ditches, blocked drainage ditches and narrow, shallow drainage ditches as the causes of flooding. Additionally, commercial and industrial development, unplanned urban residential often exacerbates the occurrence of floods in an area.

Nwigwe and Emberga (2014) examined the substantive causes and selected effects of floods in south western Nigeria with a view to identify solution for sustainable development. The work was limited to the cities and town of the region. Flood occurrences and effects in major cities and towns of the region were observed and studied for thirty years. Living habits of the urbanities were studied. 6 monarchs and 240 other urban dwellers were interviewed. Documentaries on radio and televisions were listened to and used. Records of physical planning were pursued in the ministries of physical planning and environment/infrastructure in the states of the region. No city or town of the south western Nigeria is absolutely free from floods in any year and the numbers of occurrences, magnitudes, affected area and adverse socio-economic consequences have been increasing over the year. To complicate issues, the living habits of the urban dwellers, urban policies and programs, government concerns and others have been unsustainable. They recommend that there must be pragmatic physical planning and sustainable living habit of the urbanities otherwise, with global warming; the effects of floods in the region may be more grievous identified causes of flooding as

natural and human causes, the natural causes identified were heavy or torrential rains/rainstorm, Oceans storms and tidal waves usually along the coast while the human causes were burst water main pipes and dam spills.

Magami, Yahaya, Mohammed, (2014) highlighted dam failure (such as Sokoto flood in 2001), overfilling of the major rivers, coastal storms, ignorance of warnings from the Nigerian Meteorological Agency (NIMET), delay in evacuation of flood victims and settlement of people at flood-prone areas such as riverine areas and sea coast as causes of flooding and this corroborates the studies of Ebele & Emodi (2023) and Etuonovbe (2011) that factors responsible for flooding can be grouped into natural causes (heavy torrential rains or storm, ocean storms and tidal waves, usually along the coast and blockade of river or drainage courses by waste) and human causes (lack of meteorological data for weather forecasting, burst of main pipes, dam burst/levee failures, dam spills, property development along river setbacks and indiscriminate waste disposal).

From the foregoing literature review, it is noticeable that there have been a track record of flooding of residential properties from time memorial. However, the factors that causes floods in contemporary times have not been captured in the existing literature and studies. This study contributes to the body of knowledge in this regard.

DATA DESCRIPTION AND METHODOLOGY

The data set used in this study was obtained from the residents who live within 500m radius to the Orogun, Kudeti and Ogunpa rivers in Ibadan North West local government area, Ibadan, Oyo state, Nigeria. This is because of their proximity to the rivers known for overflowing their banks (Ajibade, 2020). In this study, a survey research design was adopted, involving the collection of primary data through the administration of standardized questionnaires and structured interviews to generate reliable responses on the subject matter (Creswell & Creswell, 2021; Saunders, Lewis & Thornhill, 2019).

The sample frame for this study is residential properties that are within 500m radius to stream and/or rivers and as such vulnerable to flooding in Ibadan North West Local Government, using Orogun, Kudeti and Ogunpa as specific case studies. The target population for this study comprised of the residential properties in Ogunpa, Kudeti and Orogun; With Ogunpa (30,700), Kudeti (25,100), Orogun (19,700) and a total of 75,500. The sample size for the residential properties that are vulnerable to floods in Ibadan North west was calculated using Kothari's formula. Kothari (2005) noted that the population of study from which a sample size (n) could be derived could be finite or infinite. A finite population according to him consists of a fixed number of elements such that it can be enumerated in its totality e.g. population of people in a city, number of in a city. As a common rule of thumb confidence level of 95% and a sampling error of 3%,

which give the researcher a 95% confidence that the population will resemble the sample, and allows for a ±3% sampling error (Ngulube, 2005) will be adopted. Kothari gave the formula as thus;

$$n = \frac{Z^2 .P.q.N}{e^2 (N-1) + Z^2 .P.q} \quad \text{..... equation 1}$$

Where;
n = size of sample
z = the value of the standard variate at a given confidence level and to be worked out from table showing area under normal curve, e.g. 1.96 at 0.05(95%).
P = sample proportion (q=1-p) of defectives in the universe .0.5 is adopted as suggested by Kothari (2005)
N = Size of population
e = error margin is taken as 0.03 in this study

Since the population of study is large, the appropriate sample size used for this study was determine using four criteria, which are: population size of 75,500 houses (Spatial Analysis using Google Earth in 2021) with a specified precision level (±10%); the confidence level (95%); and variability degree (0.5) of the measured attributes. Hence, the sample size of Ogunpa was 263, Kudeti was 215, Orogun was 169 and a total of 647. In this study, multistage sampling techniques that involve probability and non-probability sampling was used to select samples, in order to collect both quantitative data. Systematic random sampling technique was used to select from the residential properties that are vulnerable to flooding in these areas. Although, developers are expected to maintain a setback of not less than 50m to stream or river before constructing a building and houses within 50m radius to stream or rivers are exposed to water overflow and more vulnerable to flooding. However, houses that are still within 500 m radius to stream/rivers are still vulnerable to flooding (Nkwunonwo et al, 2020). Relative importance index as a form of descriptive statistics was employed in the analysis of data collected for this study using Statistical Package for Social Scientists (SPSS) version 21. The relative importance of the factors responsible for flooding in the study area was quantified by the relative importance index (RII).
The formula for Relative Importance Index is given as:
RII (%) = n1 + 2n2 + 3n3 +4n4 + 5n5 / 5 (n1 + n2 + n3 +n4 + n5) x 100
Where RII (%) is the Relative Importance Index of each factor i, for each group of residents, k,

n1 = numbers of respondents who scored "1" representing extremely do not agree;
n2 = numbers of respondents who scored "2" representing do not agree;
n3 = numbers of respondents who scored "3" representing neutral;
n4 =numbers of respondents who scored "4" representing agree; and
n5 =numbers of respondents who scored "5" representing extremely agree

Socio-economic Background of Respondents

This presents the demographic information of the respondents of this study

Table 1; Demographic Characteristic of Respondents

Variables	Category	Frequency	Percentage (%)
Gender	Male	277	46.2
	Female	323	53.8
Marital Status	Single	299	49.8
	Married	280	46.7
	Separated	31	3.5
Level of Education	No Formal Education	13	2.2
	Primary Education	19	3.2
	Secondary Education	12	2.0
	Tertiary Education	528	88.0
	Other	28	4.7
Occupancy Status	Landlord	67	11.2
	Tenant	533	88.8
Property Type	Single room	285	47.5
	Room and Parlour	118	19.7
	Self-Contained	41	6.8
	2 Bedroom Flat	78	13
	3Bedroom Flat	63	10.5
	Duplex	15	2.5
Occupancy Length	1 year and below	278	46.3
	2	– 5 years	227
	6	– 10 years	36
	Above 10 years	59	9.8

Source: Field Survey Results (2024)

From table 1 above, Profile of gender indicated that 277 respondents representing 46.2% were male while 323 respondents representing 53.8% were female, indicating that most of the respondents were female. Demographic and personal profile of

respondents as shown in table revealed that 299 respondents representing 49.8% were single, 280 (46.7%) were married, while 31 (3.5%) were separated. In terms of formal education, findings revealed that 13 (2.2%) of the respondents have no formal education, 19 (3.2%) are primary school graduate, while 528 (88%) are tertiary institution graduate. In occupancy status, 67 (11.2%) of the respondents are landlords, while 533 (88.8%) of the respondents are tenants. In terms of property types, 285 respondents representing 47.5% of the population are landlords or living in single rooms, 118 respondents, representing 19.7% of the total population are owner or tenant of room and parlour, 41 respondents, representing 6.8% of the population are landlord or tenant of self-contained, 78 respondents, representing 13% of the total population are owners or living in 2 bedroom flat, while 63 respondents, representing 10.5% of the study population are staying in 3 bedroom flat, and 15 respondents, representing 2.5% of the study population are owners or tenants of duplex property. From the findings, it can be deduced that, 278 (46.3%) of the respondents have lived for 1 year and below in the study areas, 227 (37.8) have stayed for 2 – 5 years in the study environment, 36 (6.1%) of the respondents have lived for 6 – 10 years in the study area, while 59 (9.8%) of the respondents have occupied the property for a period above 10 years.

Table 2: Factors Responsible for Flooding in the Study Area

	Strongly disagree	Disagree	Agree	Strongly agree	RII	Rank
Lack of drainage	47	213	287	53	4.13	8th
Terrain illegal construction	20	125	389	66	4.34	7th
Violation of Planning regulations	33	119	277	171	4.87	6th
Poor refuse	60	66	237	237	5.53	4th
Disposal	59	59	245	237	5.40	5th
Encroachment of flood plains	53	40	270	237	7.10	1st
Heavy rainfall	40	92	211	257	6.07	3rd
Blocked drainage	46	99	191	264	6.57	2nd

Source: Field Survey Results (2024)

Table 2 shows the ranking of the respondents on factors responsible for flooding in the study area. Relative Importance index was deployed and result showed that encroachment of flood plains ranked first and above all other causes amongst the factors responsible for flooding in the study area. When flood plains are encroached all in the name of urban development, flood is inevitable. This corroborates Etuonovbe (2011) that encroaching flood plains lead to flooding. Also, blocked drainage was ranked 2nd

while heavy rainfall was ranked 3rd in the order of importance. Once drainages which are meant to aid free flow of water are blocked and there is a heavy rainfall, floods will be inevitable as water would definitely find its course. This is in tandem with the study of Anunobi (2013) that flood hazard can be caused by heavy rainfall. Also, violation of planning regulation and poor refuse disposal ranked 4th and 5th, respectively. With good planning in place, provision would have been made for prevention of floods through planned development but when these regulations are violated for whatever reason, it exposes the whole area to flood. Also, when residential waste/refuse are poorly disposed in streams or into drainages at the sight of rain, the environment becomes open to floods as these dirts obstruct water channels. On the other hand, lack of drainage had the least rank, hence, it can be said that it has the least contribution to flooding in the study area. This is because the government are trying their best to make sure drainages are provided. However, it is left for the citizens to mention the drainages are clean and free from obstruction which can lead to flood. Although Ajibade (2020), assertions are not in agreement with this as the study revealed that government are not doing enough to fight flooding.

Summarily, the findings of this study align with recent empirical evidence that the major causes of flooding in Nigerian cities include indiscriminate waste disposal that blocks drainage channels, encroachment of residential and commercial buildings on floodplains, inadequate setback from rivers, and weak enforcement of building regulations by relevant authorities (Adelekan & Asiyanbi, 2020; Ebele & Emodi, 2023).

CONCLUSION AND RECCOMMENDATION

This study has shown that flooding can serve as a significant disamenity to residential properties and there are many factors responsible for it of which encroachment of flood plain is chief. Other factors responsible for flood incidence in the study area include; blocked drainage, heavy rainfall, violation of planning regulation etc.

In line with the findings of this study, it is recommended that:

1. Relevant statutory bodies such as Ministry of Land and Urban & Rural development, ministry of Works and other relevant agencies together with law enforcement agencies should ensure flood prevention control policies are properly implemented.
2. Enlightenment programmes should be organized periodically for the inhabitants in the study area, on the causes, effects and possible preventive measures of flooding. Keeping them informed of what to do during the raining season and to always keep their environment clean. The enlightenment will emphasize on the dangers associated with erecting building on flood prone areas, the effects of indiscriminate refuse dumping and other actions that can lead to flooding.

Appropriate environmental law should be put in place to prevent indiscriminate dumping of refuse on drainage channels as well as bringing offender to book through creation of mobile court to try and punish whoever abuses the environment.

3. The need for comprehensive approach to tackle drainage problem in the study area cannot be overemphasized. Drainages that are too narrow and are blocked up by debris and weeds should be evacuated, expanded and degraded.
4. Existing channel improvements. Deepening and widening the river bed are methods to increase capacity and thus reduce the area of the flood plain.
5. Emergency action plans should be put in place for unforeseen events, even if it seems insignificant. The common saying "prevention is better than cure" and "better safe than sorry" can be utilized as phrases for strategic planning.

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