



Challenges of Substandard Drainage Systems and Effects of Flooding on the Sustainability of Inhabitants of Ogun State, Southwestern Nigeria

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Abstract: *Substandard drainage systems can have detrimental effects on the livelihood of a community due to their inability to withstand the flood rate after every heavy downpour, resulting in both immediate and long-term deterioration of infrastructure and aesthetics. This research work was based on an assessment of the challenges of a bad drainage system and the effects of floods on some communities within Ogun State, Southwestern Nigeria, to determine the factors that favour flood impacts and their implications. The research engaged field observation and descriptive analysis with the use of a questionnaire. One hundred fifty (150) structured questionnaires were used to collect data from all consenting residents. 69 (46%) were male, while 81 (54% were female). Most of the respondents had bad experiences with flood incidents in the study area. The major causes of flooding are poor drainage and uncultured human activities during rainfall. 81 (54%) respondents stated destruction of infrastructure within the communities, 58 (38.7%) stated destruction of properties, and 11 (7.3%) stated loss of life. The study concluded that flooding is a natural hazard that may devastate every culture on earth. Its prevalence in several locations throughout the world has demonstrated that it is a universal situation that does not exclude any community. The common characteristics of all flood disasters experienced in the research area are massive physical and environmental devastation. Hence, there is a need for a massive campaign against improper dumping of refuse in the drainage system, as it does not only create room*



for flooding but also encourages flooding in the area; well-engineered drainage by competent human resources should be ensured.

Keyword: *Flooding, Drainage, Substandard, Refuse, Environment, Sustainability.*

1. INTRODUCTION

Through observation, substandard drainage systems in Ogun State have been accountable for several environmental issues. Since most communities lack access to proper, conventional drainage, it collapses at the first glimpse of rain. The drainage systems built for these settlements have poor quality due to poor design and construction, poor maintenance structures, and the use of low-quality materials.

A drainage system transports water away from areas where it is not needed so that it may be disposed of in the proper places (Agbonkhese *et al.*, 2014). According to Dyachia *et al.* (2017), a "drainage system" might encompass anything from drainage pipes and gutters in homes that collect rainfall to storm water systems that channel precipitation from roads into roadside drains. Road safety depends on effective highway drainage (Egbinola *et al.*, 2017). To prevent floods, roads must be properly drained. In addition to causing maintenance issues, standing water on roadways can also put motorists in danger by softening the ground beneath them and causing the road surface to crack (Adeloye and Rustum 2011). Potholes arise because of water logging, particularly during rainy seasons when blocked drainage systems allow water to collect on the pavement and take the bitumen away (Adeloye and Rustum 2011). When the overflowing water submerges the ground and generates a deluge, a flood occurs (Ezeaku, 2017).

With more fatalities and property damage than any other natural occurrence, flooding is one of the most catastrophic natural catastrophes in the world (Smith, 2017; Salami *et al.*, 2017; Olalekan, 2018). According to the Nigerian Meteorological Agency (2023), the state should prepare for 3,646 mm of rain, which could cause a flash flood, between April and November 2023. However, some areas may also experience coastal flooding because of the Ogun River's tidal lock by Lagos Lagoon and the potential overflow of Oyan Dam. One of the main causes of floods, which can force natural or man-made dams to fail and unleash impounded waters, is heavy rainfall (Okoye, 2019). During rainy seasons, several parameters are utilised to explain the scope and type of floods (Mullan *et al.*, 2019). For instance, the amount of precipitation, its duration, area of coverage, flow velocity, and volume of water discharged per unit time, as well as the nature of the soil, the slope's nature, and the geomorphic characteristics of the area, will all combine to determine the type of drainage system that will be sustainable (Adeloye and Rustum 2011; Mullan *et al.* 2019). According to De la Paix *et al.* (2013) and Adekola and Lamond (2018), Poor farming practices, excessive grazing and agriculture, poor water pressure, and population pressure are also significant causes of floods. Large regions are being quickly cleared of trees. As a result, soil is readily eroded and settles at the bottom of rivers and oceans, raising the water level in such bodies of water and ultimately causing flooding (Aliyu and Amadu, 2017; Adeniji, 2018). People have been forced to construct homes in flood-



prone areas without adequate drainage systems due to population pressure and poverty (Adeloye and Rustum 2011). One of the states in the country that experiences flooding is Ogun State, particularly in areas like Ilese, Ado-Odo Ota, Molipa, Olorunsogo, Ilaro, Ogun Waterside, Sagamu, Abeokuta, Ado-Ota, Ifo, Akute, Onikoko, Owode, and Sokori, among other places. Floods in these places are mostly caused by inadequate drainage, which cannot contain large volumes of water and allows them to flow into nearby areas. According to Aliyu and Amadu (2017), Raimi et al. (2018), Rieckmann et al. (2018), and Aliyu and Amadu (2017), flooding can have a direct impact on human and animal health and wellbeing. It can also cause riverbank erosion and sedimentation, the dispersal of nutrients and pollutants, contamination of surface and groundwater sources, and the destruction of local landscapes and habitats. As a result, drainage systems need to be strengthened and made more efficient.

This will guarantee that water may flow freely both during and following a rainstorm (Egbinola et al., 2017). The relevant authorities must recognize this, take steps to prevent it, be ready for it, and lessen its impacts. To maximize the durability of the road superficial and related infrastructure, it is crucial to have a well-designed and well-maintained road drainage system (Okoye, 2019). This will ensure that surface water is quickly removed, improving safety, and causing the least amount of disruption to road users. As a result, the goal of this research is to evaluate the difficulties caused by inadequate drainage systems and the consequences of flooding on the sustainability of residents in Ogun, Southwestern Nigeria.

Statement of the Problem

In developing countries, population expansion and rapid urbanization have boosted human density in unplanned areas. As a result, people decide to develop homes, businesses, and storage facilities in flood-prone locations. Due to poverty, sand is routinely dug up illegally along stream channels. In the research region, inadequate drainage systems result in severe ecological damage, including washaway roads, gullies, traffic jams, human and property casualties, and decreased fertility of the soil. A lasting solution is needed to address the issue of flooding due to poor drainage in the study area.

Aim of the Study

The aim of this study is to evaluate the challenges of poor drainage systems and flood control within Ogun Southwestern Nigeria (Abeokuta-North, Ijebu-Ode, Ado-Odo Ota).

Objectives

1. To determine the factors that are responsible for flooding within Ogun, Southwestern Nigeria
2. To assess the major impacts of poor drainage system on flood occurrences.
3. To study with a view to establishing reliable control and management measures of flood hazards in the study area.

Research Questions

The following are the research questions on which the survey hinged:

1. What are the factors that are responsible for flooding in Ogun, Southwestern Nigeria?

2. What are the major impacts of poor drainage on flood occurrences within Ogun, Southwestern Nigeria?
3. What are the reliable control and management measures for flood hazards within Ogun State, southwestern Nigeria?

Location and Accessibility

The research region is in Ogun State, about 70 kilometers (km) east of Lagos (Figure 1). With a complex sedimentary and basement geological environment (Gbadebo *et al.*, 2012). It encompasses the latitudes $6^{\circ} 49$ to $6^{\circ} 53$ and the longitudes $3^{\circ} 52$ to $3^{\circ} 57$ east. The river has a dendritic drainage pattern, which is typical of terrain with consistent slope gradients and rock types. According to geological data, the research region is migmatite gneiss of the Abeokuta Group cretaceous sedimentary terrain Southwestern Nigeria (Gbadebo *et al.*, 2012). The research area's rock types include quartz schist, migmatite biotite gneiss, and gneiss complex. The area was reachable by a network of major roads and footpaths.

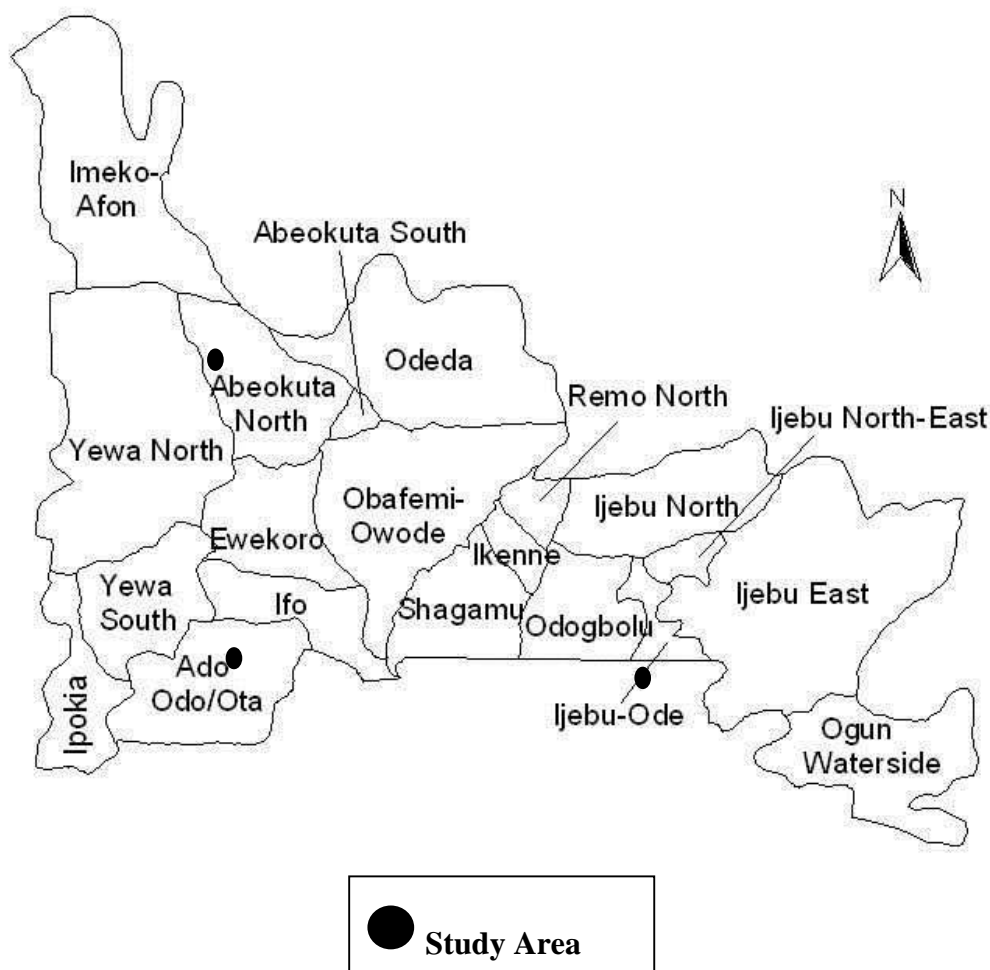


Figure 1: Map of Ogun State (After Gbadebo *et al.*, 2012)

2. MATERIALS AND METHODS

For this study, questionnaires, physical field observations, and semi-structured oral interviews were all employed as data gathering methods. Using a random sampling technique, 150 questionnaires were distributed to residents of Ijebu Ode, Ado-Odo Ota, and Abeokuta North Ogun State. Simple percentage and frequency distribution tables were used to code, tabulate, and analyze the acquired data. The field survey included the taking of photographs while on the field.

Photographs and Field Observations



Figure 2: Field observation of collapse drainage system at the study area with evidence of run-off water at Ado-ota Road



Figure 3: A residential house built on a flood plain without a proper drainage system at Ogun State



Figure 4: Road destroyed by flood due to lack of standard drainage, creating difficulties for community motorists and Business operations commuters at Abeokuta North.



Figure 5: Pictorial evidence of a lack of drainage system in Ijebu Ode, Ogun State

3. RESULTS AND DISCUSSION

The analysis of the data was based on the responses to questions by the respondents. The researcher distributed a total number of 150 questionnaires which were retrieved, fully filled by the residents of the study area. The data were analyzed systematically following the research objectives and the structured questionnaire.

Data Analysis

Table 1: Sex of the respondents surveyed

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Male	23	20	26	69	46
Female	27	30	24	81	54
Total	50	50	50	150	100

The above table shows distribution sex of the respondents 69(46%) were male while 81(54%) of the respondents were female.

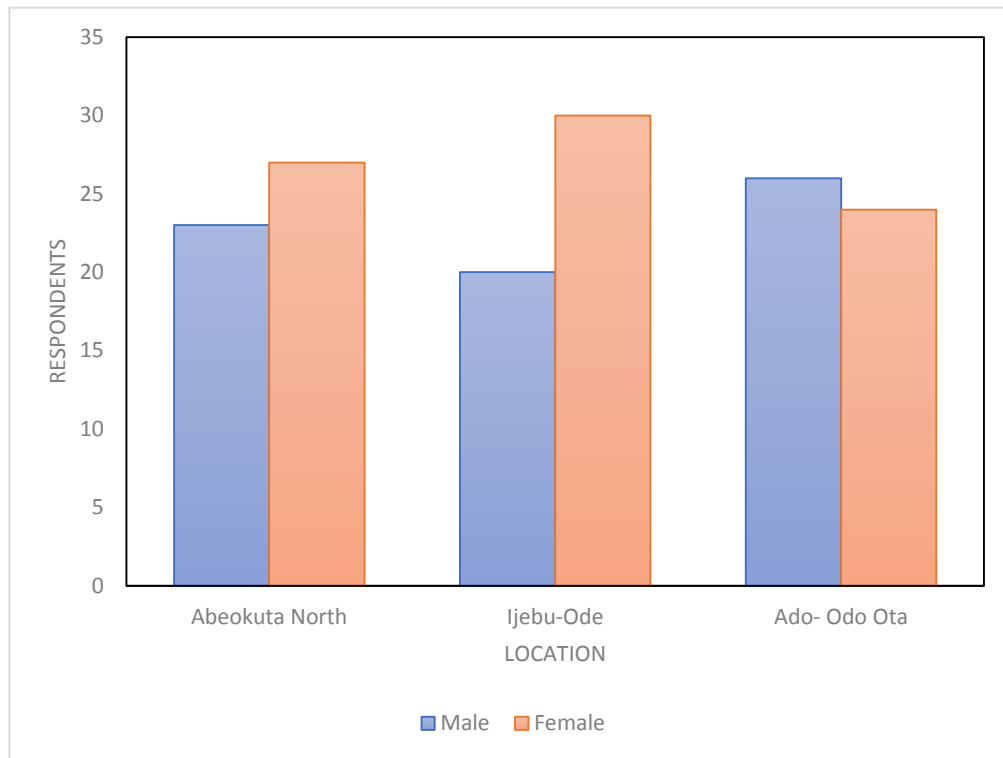


Figure 6: Distribution of sex of the respondents

Table 2: Age of the respondents

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total
20 – 30 yrs.	13	15	25	53
31 – 40 yrs.	20	18	10	48
41 – 50 yrs.	10	12	9	31
51 yrs. and above	7	5	6	18
Total	50	50	50	150

The above table shows the distribution of age of the respondents 53 of the respondents were 20 – 30 yrs., 48 were 31 – 40yrs, 31 were 41 – 50yrs, while 18 were 51yrs and above.

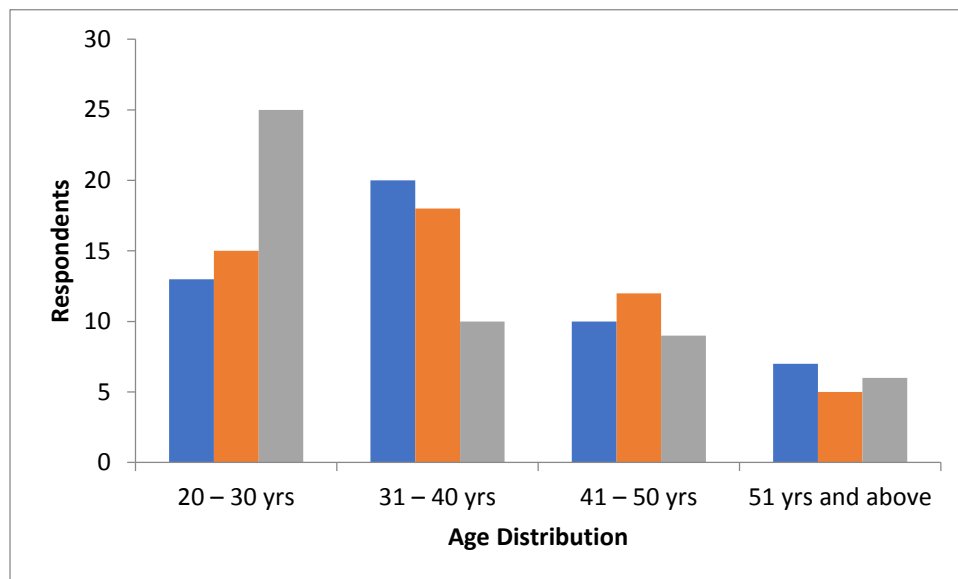


Figure 7: Distribution of age of the respondents

Table 3: Marital Status of the respondents

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Single	9	12	12	33	22
Married	34	31	29	94	62.7
Divorced	6	5	2	13	8.7
Separated	1	2	7	10	6.6
Total	50	50	50	150	100

The table 3 shows the distribution of marital status of the respondents 33(22%) of the respondents were single, 94(62.7%) were married, 13(8.7%) were divorced while 10(6.6%) were separated.

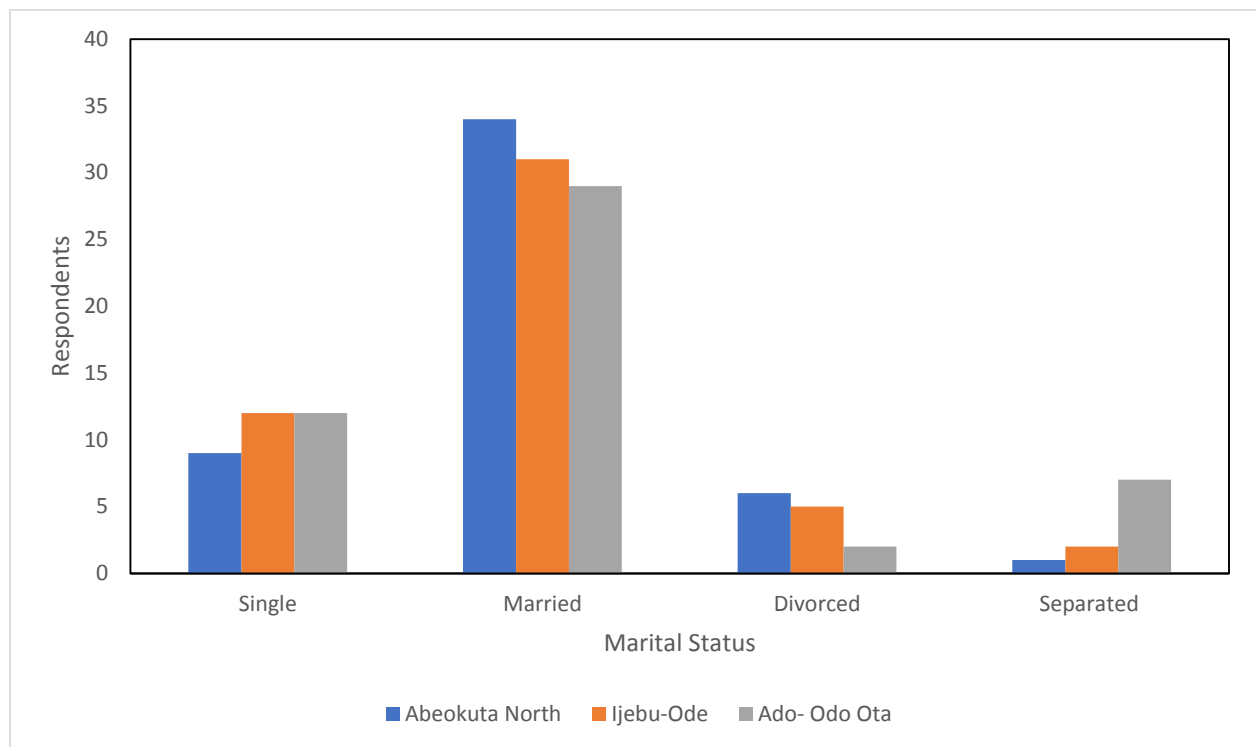


Figure 8: Distribution of marital status of the respondents

Distribution of Respondent’s Responses to Research Question

Table 4: Does flooding usually occur in your area

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Yes	44	47	32	123	82
No	6	3	18	27	18
Total	50	50	50	150	100

The above table shows the respondents knowledge of occurrence of flood in their area 123 (82%) stated yes while 27(18%) stated no.

Table 5: Are you aware that floods occur when overflowing water submerges land and causes deluge?

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Yes	47	41	37	125	83.3



No	3	9	13	25	16.7
Total	50	50	50	150	100

The above table shows if the respondents are aware that floods occur when overflowing water submerges land and causes a deluge; 125 (83.3%) stated yes, while 25 (16.7%) stated no. A larger percentage of the residents are aware that floods occur when overflowing water submerges the land.

Table 6: Distribution of opinion that flooding has impact on environment?

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Yes	44	47	32	123	82
No	6	3	18	27	18
Total	50	50	50	150	100

The above table shows the knowledge of the respondents on the impact of flooding on the environment: 123 (82%) stated yes, while 27 (18%) stated no. A larger percentage of the residents are aware that flooding has impacts on the quality of their environment.

Table 7: Are you aware that land overused by human and animal activities can cause mechanical erosion?

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Yes	47	41	37	125	83.3
No	3	9	13	25	16.7
Total	50	50	50	150	100

The above table shows that respondents are aware that overused of land by human and animal activities, can cause mechanical erosion; 125 (83.3%) stated yes, while 25 (16.7%) stated no.

Table 8: Opinion on the main causes of flooding in the area

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Heavy rainfall	15	10	30	55	36.7
Blockage of water way	10	19	3	32	21.3
Building on flood liable plains	7	5	3	15	10
Improper planning and poor land use	13	14	11	38	25.3



Other reason	5	2	3	10	6.7
Total	50	50	50	150	100

The above table shows the distribution of respondents' perceptions of common causes of flooding in their area. 55 (36.7%) states that heavy rainfall is mostly the cause of floods; 32 (31.3%) state blockage of natural and artificial waterways; 15 (10%) state Building on flood-prone plains; 38 (25.3%) state improper planning and poor land use; and 10 (6.7%) state other reasons.

Table 9: Do you have Standard drainage systems in your area?

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Yes	18	23	26	67	44.7
No	32	27	24	83	55.3
Total	50	50	50	150	100

The above table shows the distribution based on the availability of adequate drainage around their houses. 67 (44.7%) of the respondents stated yes, while 83 (55.3%) stated no. This shows no adequate drainage facilities in the research area. And those available are not functioning well as they are of poor quality, as observed while on the field.

Table 10: Do you know that obstructions in the drainage system prevent the free flow of water, which leads to flooding?

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Yes	27	19	22	68	45.3
No	23	31	28	82	54.7
Total	50	50	50	150	100

The above table shows the distribution of respondents' responses to ascertain if they know that obstructions in the drainage system do not allow free flow of water, which leads to flooding. 68 (45.3%) of the respondents stated yes, while 82 (54.7%) stated no.

Table 11: Opinion on available drainage system maintenance.

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Very often	9	3	10	22	14.7
Rarely	35	39	28	102	68
Never	6	8	12	26	17.3
Total	50	50	50	150	100



The above table shows the responses on whether the populace cleans the drainage system provided. 22 (14.7%) stated it is very often, 102 (68%) stated it rarely, and 26 (17.3%) stated it never.

Table 12: Are you aware that poorly constructed drainage can dump runoff water and wastewater into your area?

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Yes	12	19	23	54	36
No	38	31	27	96	64
Total	50	50	50	150	100

The above table shows the knowledge of the respondents about the fact that poorly constructed drainage can dump runoff water and wastewater into your area. 54 (36%) stated yes, while 96 (64%) stated no.

Table 13: Causes of Substandard Drainage systems.

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Low level of technical know-how	25	16	22	63	42
Inadequate funding	05	17	12	34	23
Policy makers and Government negligence	15	10	06	31	21
Inadequate monitoring and law enforcement	05	07	10	22	14
Total	50	50	50	150	100

The above table shows the respondents' knowledge on the likely causes of substandard drainage systems in their area. 63 (42%) said low level of technical know-how may be responsible for the quality of the drainage. 34 (23%) indicated inadequate funding for the drainage systems as most drainage systems available were not constructed by competent engineers, and 31 (21%) believed the government was taking the construction of the drainage systems as a priority. Those defective ones were not repaired on time before they were destroyed; more so, 22 (14%) said there was inadequate monitoring and law enforcement in the communities on the proper way to care for the available drainage and community sensitization on ending dumping of refuse on drainage during heavy rainfall. This result shows



that the major causes of substandard drainage within the study area were low level of technical know-how, inadequate funding, policymakers, and government negligence.

Table 13: Effects of Substandard Drainage systems on flooding during heavy rainfall within the study area

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Lead to the destruction of infrastructure such as roads.	32	21	28	81	54
Destruction of physical properties such as houses	15	23	20	58	38.7
Loss of Life	03	06	02	11	7.3
Total	50	50	50	150	100

The above table shows the respondents’ knowledge on the likely effects of substandard drainage systems in their area. 81 (54%) said flood effects in their area due to substandard drainage usually led to destruction of infrastructure, such as power lines, roads, and electrical cables, while 58 (38.7%) indicated destruction of their houses, shops, and business stands. Some people recorded loss of life during heavy rainfall, and 11 (7.3%) show their grievances and pain they went through as a result of the loss of their loved ones during the rainy season. This result shows that the residents within this study area are not happy with the yearly experiences they always encounter during the rainy season.

Table 14: Opinion on measures considered necessary for reducing flood hazards.

Option	Abeokuta North	Ijebu-Ode	Ado- Odo Ota	Total	Percentage
Creation of drainage system	20	30	24	74	49.3
Raised foundation	4	1	5	10	6.7
Sandbags to keep flood away	7	1	4	12	8
Proper land use planning	13	13	16	42	28
Flood insurance	1	0	0	1	0.7
Others	5	5	1	11	7.3
Total	50	50	50	150	100



The above table shows responses to measures considered necessary for reducing flood hazards. 74 (49.3%) stated that the government and decision makers should ensure the creation of standard drainage systems through competent engineering rather than engaging inexperienced contractors. 10 (6.7%) stated raised foundations, the land topography should always be put into consideration when constructing the drainage, as many of the drainage systems are too low. 12 (8%) stated that sandbags can be erected at certain edges of the drains or flood plains to keep floodwater away. 42 (28%) stated that with proper land use planning, houses and shops should not just be built anyhow or anywhere; town planners are to enforce proper land surveys and vulnerability assessments before approving house construction for land buyers. 01 (0.7%) stated flood insurance, whereby victims can have succor in case of any unexpected events because of flooding. The insurance company will be able to assist the victims, while 11 (7.3%) stated others.

4. DISCUSSION OF FINDINGS

From the results analysed for this research, it could be seen that the flood situation is terrible and has a serious deleterious effect on the livelihood of the residents of the study area. Flooding occurs more at the Ijebu Ode axis than at the other two locations. Flood rate causes deluge within the study area, with higher experience at Abeokuta North than the other two locations. The flood rate is seriously having an environmental impact on the people, especially at Ijebu Ode (47%), followed by Abeokuta North (44%), and Ado-Odo Ota (32%). Causes of flooding within the study area include heavy rainfall, improper planning and poor land use, blockages of waterways, and building on flood plains, which are evidenced. Many communities within the study area lack access to a good drainage system, as most of the respondents indicate there is no adequate drainage. The devastating part of this issue is that because of neglect on the part of the residents and the government-appointed authorities, the few ones that are now accessible are not being adequately maintained. There aren't many drainages that can be cleared as they are blocked by refuse. The research further shows that low level of technical know-how on the part of the decision makers constituted major detrimental effects to the drain's sustainability. Most respondents voiced their disappointment that the government had not provided them standardized drainage system. As a result, many people have lost their homes and loved ones due to floods, particularly during the rainy season.

5. CONCLUSION

Any society in the world can be destroyed by flooding, which is a natural hazard. Its presence around the globe has demonstrated that it is a universal situation that does not exclude any society. The best way to ensure flood preparedness and risk reduction is to identify areas that are vulnerable to flooding as well as gather and analyze data on " network of drains, slope, elevation, orientation, proximity of built-up areas to drainage systems, presence of buffers, extent of inundation, cultural behaviors, and attitudes and perceptions geometric considerations like surface course thickness, road width, and cross slope, as well as material characteristics like anisotropy and clogging propensity, must be taken into considerations. To prevent floods, roads must be properly drained. High-quality drainage system should be provided at a level



appropriate for the degree of development in the study area and ought to be maintained in good condition. Furthermore, it is important to think of tree planting as a crucial element in reducing the likelihood of flooding. During rainy seasons, residents should refrain from disposing of garbage in drainage systems, streams, or rivers and instead develop the habit of using the State waste Management Authority programmes. People living in the study region need to cease building their houses, businesses, and retail establishments along run-off pathways.

Recommendations

- i. The residents should avoid building their homes on flood plains.
- ii. illegal dredging of sand on roads and riverbanks should be declined.
- iii. Residents should avoid drinking water from water wells and boreholes along the flood plain to avoid contamination.
- iv. Well-engineered standard drainage should be done by the policy decision makers to control the effect of flooding.
- v. Residents should also avoid dumping refuse into drains during the rainy season.

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Competing Interests

The authors affirmed that there are no conflicting interests of any type.

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