

## SOLID WASTE MANAGEMENT PRACTICES AND URBAN DRAINAGE BLOCKAGE AS DRIVERS OF FLOOD RISK IN YENAGOA METROPOLIS

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### Abstract

The study investigated solid waste management practices and urban drainage blockage as drivers of flood risk in Yenagoa Metropolis. The study was carried out in Yenagoa Metropolis, with a focus on communities like Yenagoa, Ekeki, Amaratha, Okaka, Swali, Azikoro, Agudama, Biogbolo Epic, Opoo, Onopa, Igbogene, and Kpansia Epic. The study employed a descriptive survey and correlational research designs. The study's population consisted of 352,285 residents. A purposive sampling technique was employed to select the respondents in areas where solid waste was produced or found prominently, across the selected communities in the study area. Solid Waste Management Practices and Urban Drainage Blockage Questionnaire (SWMPUDBQ) and "Solid Waste Management Practices and Flood Risk Questionnaire (SWMPFRQ)" were used to gather data. The instrument underwent validation and reliability testing, achieving a reliability coefficient of SWMPUDBQ = 0.834 and SWMPFRQ = 0.816 through the Cronbach's Alpha method. The research questions were analyzed using mean and standard deviation, as well as Pearson Product-Moment Correlation (PPMC), whereas the hypotheses were tested using an Analysis of Variance (ANOVA) and PPMC at a 0.05 level of significance. The study's results indicated, among others, that while residents demonstrate some level of proper waste management practices, improper disposal methods are still prevalent in Yenagoa Metropolis. The corresponding hypothesis revealed that there is no noteworthy disparity in solid waste management practices among residents across different neighbourhoods in Yenagoa Metropolis. The study concluded that while residents of Yenagoa Metropolis demonstrate some level of awareness and engagement in proper solid waste management practices, improper disposal methods such as open dumping, burning, and disposal into drains remain prevalent due to inadequate waste collection services and limited access to waste bins. The study recommended, among others, that waste management authorities should improve the efficiency and coverage of waste collection services and ensure the provision of adequate and accessible waste bins across all neighbourhoods to discourage indiscriminate waste disposal.

**Keywords:** *Solid Waste, Management Practice, Urban, Drainage Blockage, Flood Risk*

### Introduction

Urban environments in developing countries are increasingly confronted with the dual challenge of ineffective solid waste management (SWM) and inadequate drainage infrastructure, both of which significantly contribute to rising flood risks. SWM refers to the systematic collection, transportation, processing, recycling, and disposal of waste materials in a manner that minimizes environmental and public health impacts (United Nations Environment Programme [UNEP], 2023). In many rapidly urbanizing cities in sub-Saharan Africa, including those in the Niger Delta region of Nigeria, SWM systems are often underdeveloped, resulting in widespread practices such as open dumping, burning, and disposal of waste in unauthorized locations (Kaza et al., 2023). These practices are particularly prevalent in Yenagoa Metropolis, where increasing population growth and urban expansion have outpaced the capacity of municipal waste management systems, thereby intensifying environmental degradation.

Urban drainage systems are designed to convey stormwater runoff away from built environments to prevent waterlogging and flooding. However, urban drainage blockage (UDB), the obstruction of

drainage channels by solid waste, sediments, or structural encroachments, has become a persistent environmental issue in many Nigerian cities (Adelekan, 2022). Drainage blockage reduces the hydraulic efficiency of drainage networks, leading to water stagnation, overflow, and eventual flooding, especially during periods of intense rainfall. The spatial pattern of drainage blockage often reflects variations in land use, population density, and waste disposal behavior across different neighbourhoods, while its severity is influenced by both anthropogenic and infrastructural factors. Flood risk, defined as the probability and potential consequences of flooding events, is closely linked to both solid waste management practices (SWMP) and the condition of urban drainage systems (Intergovernmental Panel on Climate Change [IPCC], 2022). In low-lying coastal regions such as Yenagoa, flood risk is further exacerbated by high rainfall intensity, poor drainage design, and human-induced environmental changes. Empirical evidence suggests that indiscriminate waste disposal into drainage channels significantly impedes water flow, thereby increasing the likelihood and magnitude of urban flooding (World Bank, 2023). Consequently, the interaction between SWM practices and drainage blockage constitutes a critical pathway through which flood risk is amplified in urban settings.

From a geographical perspective, the relationship between SWM, drainage blockage, and flood risk represents a complex human–environment interaction shaped by socio-economic, institutional, and physical factors. Residents' waste disposal behaviors, level of environmental awareness, and access to waste management services directly influence the accumulation of waste within drainage systems. At the same time, infrastructural limitations, including inadequate drainage capacity and poor maintenance regimes, further compound the problem (UN-Habitat, 2022). These dynamics are particularly evident in Yenagoa Metropolis, where unplanned urban development, weak regulatory enforcement, and limited environmental governance have contributed to persistent drainage obstruction and recurrent flooding events.

Furthermore, understanding the linkages among these variables is essential for developing integrated urban environmental management strategies. SWMP determine the volume and type of waste entering drainage systems, while the extent of drainage blockage influences the efficiency of stormwater discharge and the spatial distribution of flood impacts. This interconnectedness underscores the need for a holistic assessment of how human practices and infrastructural conditions jointly drive flood risk. Therefore, this study examines SWMP and UDB as key determinants of flood risk in Yenagoa Metropolis, with a view to providing evidence-based insights for sustainable urban planning and environmental management.

### **Statement of the Problem**

Rapid urbanization in Yenagoa Metropolis has intensified environmental management challenges, particularly in the areas of SWM and urban drainage systems. Despite the presence of formal waste management structures, many neighbourhoods experience irregular waste collection services, inadequate provision of waste bins, and weak enforcement of environmental sanitation regulations. As a result, residents often resort to indiscriminate waste disposal practices such as open dumping, burning, and dumping of refuse into drainage channels and waterways. These practices not only degrade the urban environment but also contribute significantly to the obstruction of drainage systems, which are already limited in capacity due to poor planning and maintenance. In addition, unregulated physical development, including the construction of buildings along natural drainage paths, further compounds the problem of drainage inefficiency in the metropolis.

These challenges have direct implications for urban flooding, which has become a recurring environmental hazard in Yenagoa. Blocked and poorly maintained drainage systems reduce the effective flow of stormwater, leading to water stagnation, overflow, and increased flood risk, especially during periods of heavy rainfall. This situation threatens public health, damages infrastructure, disrupts economic activities, and increases the vulnerability of urban residents.

Although existing studies have examined aspects of waste management and flooding in Nigerian cities, there remains a limited empirical understanding of how specific SWMP interact with the spatial pattern and severity of UDB to drive flood risk in Yenagoa Metropolis. Therefore, there is a need for a systematic investigation of these variables to provide evidence-based insights that can inform sustainable urban environmental management and flood mitigation strategies.

### **Aim and Objectives of the Study**

This study aimed to investigate SWMP and UDB as drivers of flood risk in Yenagoa Metropolis. Specifically, the study aims to:

1. assess the prevailing SWMP among residents in Yenagoa Metropolis.
2. examine the spatial pattern and severity of UDB in Yenagoa Metropolis.
3. determine the correlation between SWMP and UDB in the study area.
4. evaluate the correlation between UDB and flood risk in Yenagoa Metropolis.

### **Research Question**

1. What are the prevailing SWMP among residents in Yenagoa Metropolis?
2. What are the spatial patterns and severity of UDB in Yenagoa Metropolis?
3. What is the correlation between SWMP and UDB in Yenagoa Metropolis?
4. What is the correlation between UDB and flood risk in Yenagoa Metropolis?

### **Hypotheses**

**H0<sub>1</sub>:** There is no significant difference in SWMP among residents across different neighbourhoods in Yenagoa Metropolis.

**H0<sub>2</sub>:** There is no significant difference in the severity of UDB across different neighbourhoods in Yenagoa Metropolis.

**H0<sub>3</sub>:** There is no significant difference between SWMP and UDB in Yenagoa Metropolis.

**H0<sub>4</sub>:** There is no significant difference between UDB and flood risk in Yenagoa Metropolis.

### **Methodology**

The study was carried out in Yenagoa Metropolis, comprising communities like Yenagoa, Ekeki, Amaratha, Okaka, Swali, Azikoro, Agudama, Biogbolo Epic, Opoo, Onopa, Igbogene, and Kpansia Epic. Yenagoa is the capital city of Bayelsa State in southern Nigeria. Located in the heart of the Niger Delta region, it is a strategic oil-producing center that has rapidly transformed from an agricultural and market hub into an expanding urban metropolis since becoming a state capital in 1996.

The study employed a descriptive survey and correlational research designs. This approach was deemed suitable because it enables the systematic collection and description of data on existing conditions without manipulating any variables.

The study's population consisted of 352,285 residents based on the 2006 National Population Census report. The sample size for this study was 400 respondents, derived through the use of the Taro Yemen Sampling formula. A purposive sampling technique was adopted to select the respondents in areas where solid waste was produced or found prominently, across the selected communities in the study area.

Data for the study were collected using two self-structured questionnaires titled "Solid Waste Management Practices and Urban Drainage Blockage Questionnaire (SWMPUDBQ)" and "Solid Waste Management Practices and Flood Risk Questionnaire (SWMPFRQ)". SWMPUDBQ comprised 16 items, which specifically measured objectives 1 & 2, while SWMPFRQ comprised 24 items, which specifically measured objectives 3 & 4. The questionnaires were designed using a four-point Likert

scale comprising Strongly Agree (SA = 4), Agree (A = 3), Disagree (D = 2), and Strongly Disagree (SD = 1). A criterion mean of 2.50 was used as the benchmark for making decisions.

The instruments underwent face and content validation by specialists in Environmental Science, Agricultural Extension, and Soil Science to ensure that the items were clear, relevant, and adequate for measuring the variables of interest. Its reliability was determined using the Cronbach's Alpha method, which produced coefficients of SWMPUBQ = 0.834 and SWMPFRQ = 0.816, indicating a high level of internal consistency and confirming its suitability for the study.

Trained research assistants helped with data collection by giving the questionnaires directly to the people who lived in the selected communities. The respondents were given help when they needed it to make sure they filled out the instrument correctly. All the data was filled out, and the questionnaires were retrieved right away to ensure a high response rate. The research questions were analyzed using mean and standard deviation, as well as Pearson Product-Moment Correlation (PPMC), whereas the hypotheses were tested using an Analysis of Variance (ANOVA) and PPMC at a 0.05 level of significance.

## Results

**Research Question One:** What are the prevailing SWMP among residents in Yenagoa Metropolis?

**Table 1: Mean and SD of the prevailing SWMP among residents in Yenagoa Metropolis**

S/N	Items	Respondents (n=400)		
		$\bar{x}$	SD	Decision
.1	I dispose of my household waste through authorized waste collection services	3.09	0.94	Agree
.2	Waste is regularly collected by the government or private agencies in my area	1.83	0.86	Disagree
.3	I sort my waste before disposal (e.g., plastics, organic, metal).	3.27	0.80	Agree
.4	Open dumping of waste is common in my neighbourhood	3.34	0.68	Agree
.5	Residents in my area dispose of waste into drains or waterways	3.18	0.87	Agree
.6	Waste bins are readily available and accessible in my community	1.61	0.65	Disagree
.7	Burning of waste is a common disposal method in my area	3.33	0.70	Agree
.8	I am aware of proper waste management practices	3.25	0.79	Agree
<b>Grand Mean</b>		<b>2.86</b>		

(Criterion Mean = 2.5, Mean  $\geq$  2.5, Agree, Mean < 2.5, Disagree)

Table 1 shows the prevailing SWMP among residents in Yenagoa Metropolis. A large proportion of the respondents agreed with items 1, 3, 4, 5, 7, and 8, with mean scores at or above the criterion mean of 2.5. This indicates that residents dispose of waste through authorized services, sort waste, and are aware of proper waste management practices. However, they also acknowledged that open dumping, disposal of waste into drains or waterways, and burning of waste are common in their neighbourhoods.

Conversely, respondents disagreed with items 2 and 6, as their mean scores are below the criterion mean, indicating irregular waste collection and inadequate availability of waste bins. With a grand mean of 2.86, the result implies that while residents demonstrate some level of proper waste management practices, improper disposal methods are still prevalent in Yenagoa Metropolis.

**Research Question Two:** What are the spatial patterns and severity of UDB in Yenagoa Metropolis?

**Table 2: Mean and SD of the spatial pattern and severity of UDB in Yenagoa Metropolis**

S/N	Items	Respondents (n=400)		
		$\bar{x}$	SD	Decision
.9	Drainage channels in my area are frequently blocked	3.09	0.87	Agree
.10	Solid waste is a major cause of drainage blockage in my area	2.96	0.96	Agree
.11	Drainages are regularly cleared by the authorities	1.68	0.72	Disagree
.12	Floodwater stagnates due to blocked drainage systems	3.02	0.91	Agree
.13	Buildings or structures obstruct natural drainage paths	3.20	0.86	Agree
.14	Drainage systems are inadequate for the population size	3.20	0.79	Agree
.15	Heavy rainfall easily overwhelms the drainage system	2.99	0.92	Agree
.16	Community members contribute to drainage blockage through poor waste disposal	3.07	0.88	Agree
<b>Grand Mean</b>		<b>2.90</b>		

(Criterion Mean = 2.5, Mean  $\geq$  2.5, Agree, Mean < 2.5, Disagree)

Table 2 shows the spatial pattern and severity of UDB in Yenagoa Metropolis. A large proportion of the respondents agreed with items 9, 10, 12, 13, 14, 15, and 16, with mean scores at or above the criterion mean of 2.5. This indicates that drainage channels are frequently blocked, largely due to solid waste, poor waste disposal practices, structural obstructions, and inadequate drainage systems. Respondents also agreed that floodwater often stagnates and that heavy rainfall easily overwhelms the drainage system.

Conversely, respondents disagreed with item 11, as the mean score is below the criterion mean, indicating that drainages are not regularly cleared by authorities. With a grand mean of 2.90, the result implies that UDB is widespread and severe in Yenagoa Metropolis, driven by both human activities and infrastructural inadequacies.

**Research Question Three:** What is the correlation between SWMP and UDB in Yenagoa Metropolis?

**Table 3: PPMC summary of the correlation between SWMP and UDB in Yenagoa Metropolis**

Variables	n	r	Strength of r
SWMP			
Vs	400	0.57	Moderate
UDB			

Table 3 shows that the correlation between SWMP and UDB in Yenagoa Metropolis is moderate ( $r = 0.57$ ,  $r \geq \pm 0.40$  to  $\pm 0.59$ ). This result implies that SWMP moderately correlate with UDB in Yenagoa Metropolis.

**Research Question Four:** What is the correlation between UDB and flood risk in Yenagoa Metropolis?

**Table 4: PPMC summary of the correlation between UDB and flood risk in Yenagoa Metropolis**

Variables	n	r	Strength of r
UDB			
Vs	400	0.77	Strong

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Flood Risk

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Table 4 shows that the correlation between UDB and flood risk in Yenagoa Metropolis is strongly ( $r = 0.77, r \geq \pm 0.60$  to  $\pm 0.79$ ). This result implies that UDB strongly correlates with flood risk in Yenagoa Metropolis.

**Hypothesis One:** There is no significant difference in SWMP among residents across different neighbourhoods in Yenagoa Metropolis.

**Table 5: Summary of ANOVA of the disparity in SWMP among residents across different neighbourhoods in Yenagoa Metropolis**

<b>ANOVA</b>					
<b>Sources</b>	<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>
Between Groups	33.95	7	4.85	1.04	0.40
Within Groups	1822.43	392	4.65		
Total	1856.38	399			

Table 5 shows that there is no noteworthy disparity in SWMP among residents across different neighbourhoods in Yenagoa Metropolis ( $F_7, 392 = 1.04, P = 0.40 > 0.05$ ), hence the null hypothesis is retained at the 0.05 level of significance.

**Hypothesis Two:** There is no significant difference in the severity of UDB across different neighbourhoods in Yenagoa Metropolis.

**Table 6: Summary of ANOVA of the disparity in the severity of UDB across different neighbourhoods in Yenagoa Metropolis**

<b>ANOVA</b>					
<b>Sources</b>	<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>
Between Groups	261.00	7	37.29	4.36	0.00
Within Groups	3355.60	392	8.56		
Total	3616.60	399			

Table 6 shows that there is a noteworthy disparity in the severity of UDB across different neighbourhoods in Yenagoa Metropolis ( $F_7, 392 = 4.36, P = 0.00 < 0.05$ ), hence the null hypothesis is rejected at the 0.05 level of significance.

**Hypothesis Three:** There is no significant difference between SWMP and UDB in Yenagoa Metropolis.

**Table 7: PPMC analysis of the correlation between SWMP and UDB in Yenagoa Metropolis**

<b>Correlations</b>			
<b>Variable</b>		<b>Prevailing SWMP</b>	<b>UDB</b>
Prevailing SWMP	Pearson Correlation	1	0.57**
	Sig. (2-tailed)		0.00
	n	400	400
UDB	Pearson Correlation	0.57**	1

	Sig. (2-tailed)	0.00	
	n	400	400

\*\* . Correlation is significant at the 0.05 level (2-tailed).

Table 7 showed that there is a noteworthy correlation between SWMP and UDB in Yenagoa Metropolis ( $r = 0.57, p < 0.05$ ); the null hypothesis is rejected at the 0.05 significance level.

**Hypothesis Four:** There is no significant difference between UDB and flood risk in Yenagoa Metropolis.

**Table 8: PPMC analysis of the correlation between UDB and flood risk in Yenagoa Metropolis**

		<b>Correlations</b>	
<b>Variable</b>		<b>UDB</b>	<b>Flood Risk</b>
UDB	Pearson Correlation	1	0.77**
	Sig. (2-tailed)		0.00
	n	400	400
Flood Risk	Pearson Correlation	0.77**	1
	Sig. (2-tailed)	0.00	
	n	400	400

\*\* . Correlation is significant at the 0.05 level (2-tailed).

Table 8 showed that there is a noteworthy correlation between UDB and flood risk in Yenagoa Metropolis ( $r = 0.77, p < 0.05$ ); the null hypothesis is rejected at the 0.05 significance level.

### Discussion of Findings

The findings for research question one show that while residents had some level of proper waste management practices, improper disposal methods are still prevalent in Yenagoa Metropolis. The corresponding hypothesis revealed that there is no noteworthy disparity in SWMP among residents across different neighbourhoods in Yenagoa Metropolis. This finding aligns with Ezeah and Roberts (2023), who reported that although urban residents in southern Nigeria exhibit awareness of proper waste management practices, open dumping and burning remain widespread due to inadequate infrastructure. It is also consistent with Adewumi et al. (2024), who found that irregular waste collection and lack of accessible waste bins significantly contribute to indiscriminate disposal practices in urban communities. Similarly, Oloruntade et al. (2022) observed that despite moderate awareness of proper waste handling, residents often resort to environmentally harmful practices such as dumping waste in drains due to systemic inefficiencies in waste management systems.

The result of research question two revealed that UDB is widespread and severe in Yenagoa Metropolis, driven by both human activities and infrastructural inadequacies. The corresponding hypothesis showed there is a significant relationship in the severity of UDB across different neighbourhoods in Yenagoa Metropolis. This finding agrees with Akinbile and Olatunji (2023), who identified solid waste disposal into drainage channels as a major cause of blockage and urban flooding in Nigerian cities. It is also in line with Okoye et al. (2024), who found that inadequate drainage infrastructure and poor maintenance by authorities contribute significantly to frequent drainage obstruction and water stagnation. Furthermore, Ibrahim and Musa (2022) reported that rapid urbanization, structural encroachment on drainage paths, and poor community waste disposal behaviors collectively intensify the severity of drainage blockage and flood risk in urban areas.

The result of research question three revealed that SWMP moderately correlate with UDB in Yenagoa Metropolis. The corresponding hypothesis showed there is a significant correlation between SWMP and UDB in Yenagoa Metropolis. This finding aligns with Nnaji et al. (2023), who found a significant

relationship between improper waste disposal and blockage of drainage channels in urban areas, this finding indicates that awareness of proper waste management does not necessarily translate into proper practices due to infrastructural deficiencies. It is also consistent with Afolabi et al. (2024), who reported that poor SWMP, particularly dumping in unauthorized locations, are strongly associated with increased drainage obstruction and localized flooding. Similarly, Yakubu and Musa (2022) observed that ineffective waste management systems significantly contribute to the accumulation of debris in drainage networks, thereby establishing a measurable link between waste practices and drainage blockage.

The result of research question four revealed that UDB strongly correlates with flood risk in Yenagoa Metropolis. Although the hypothesis indicated that there is a significant correlation between UDB and flood risk in Yenagoa Metropolis. This finding agrees with Oladokun and Proverbs (2023), who identified blocked drainage systems as a primary factor intensifying urban flood risk in developing cities. It is also in line with Eze and Nwibo (2024), who found that drainage obstruction leads to water stagnation and overflow, thereby increasing the frequency and severity of urban flooding. Furthermore, Suleiman et al. (2022) reported that inadequate and poorly maintained drainage systems significantly heighten flood vulnerability, particularly in rapidly urbanizing areas where drainage channels are easily overwhelmed.

## **Conclusion**

The study concludes that while residents of Yenagoa Metropolis demonstrate improper disposal methods such as open dumping and burning, the disposal into drains remain prevalent due to inadequate waste collection services and limited access to waste bins. These practices significantly contribute to widespread and severe UDB. Flood risk in the area of study is largely driven by the combined effects of improper waste disposal and ineffective drainage systems. While residents show some awareness of proper practices, infrastructural limitations significantly undermine effective waste management.

## **Recommendations**

1. Waste management authorities should improve the efficiency and coverage of waste collection services. and ensure the provision of adequate and accessible waste bins across all neighbourhoods to discourage indiscriminate waste disposal.
2. The State government should ensure the provision of adequate and accessible waste bins across all neighbourhood .
3. Bayelsa State government and urban planning agencies should invest in the construction, upgrade and maintenance of drainage systems.
4. Residents and community leaders should promote community-based awareness campaigns and enforce to discourage the dumping of waste in drains and encourage proper waste disposal habits.
5. Environmental protection agencies and policymakers should develop and enforce environmental regulations.

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