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(REVIEW ARTICLE)

Investigating waste disposal methods and public perceptions of government-supervised contractors in selected Port Harcourt residential communities

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Abstract

This research investigates waste disposal methods and the public's perceptions of government-supervised contractors in selected residential communities within Port Harcourt, Nigeria. The study focuses on the Public Private Partnership (PPP) approach implemented by the Rivers State Government through the establishment of the Rivers State Waste Management Agency (RIWAMA). It explores various dimensions of waste management, encompassing practices of refuse disposal, public attitudes, waste segregation, household waste disposal behaviours, community satisfaction levels, and community involvement. The study unveils a spectrum of refuse disposal methods utilized by households, emphasizing their regulatory and environmental implications. Public perceptions of the waste management system exhibit considerable diversity across different aspects, underscoring the necessity of addressing concerns and enhancing overall public satisfaction. Furthermore, the research highlights a lack of waste segregation practices among residents and service providers, stressing the importance of promoting waste segregation for recycling and environmental sustainability. Private waste handlers are predominantly relied upon by residents for household waste disposal, necessitating vigilant regulation and environmental considerations. In light of these findings, recommendations are put forth, including bolstered regulation, increased infrastructure investment, educational campaigns, advocacy for recycling, and enhancements in service quality. These recommendations aim to establish a more efficient and sustainable waste management system in Port Harcourt, aligning with global sustainability objectives and environmental preservation.

Keywords: Waste management; Waste disposal methods; Public perception; Port Harcourt; Household disposal; Urban sustainability; Public-private partnership

1. Introduction

Waste management is a complex global challenge driven by factors such as population growth, urbanization, and evolving consumption patterns (Gutberlet, 2018). This multifaceted issue, referred to as Solid Waste Management (SWM), encompasses political, socio-economic, institutional, and environmental dimensions, with direct implications for the environment, including air, water, and soil quality, as well as public health (Debrah, Vidal & Dinis, 2021).

Governments worldwide have proposed various strategies to address this resource-intensive challenge (Khajuria, Yamatoto & Morioka, 2010). The term 'waste' holds diverse interpretations. It can signify any material that has served its purpose and is no longer needed. It can also denote a missed opportunity, where one fails to seize an available chance, rendering it 'wasted.' Additionally, waste can indicate something surplus to requirements, classifying it as 'gone to waste' (Kofoworola, 2007).

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In this study, waste primarily refers to any material that has been used and is no longer wanted, typically due to the extraction of its valuable or useful components. Waste can be categorized into solid, liquid, and gaseous forms, further sub-categorized into biodegradable and non-biodegradable waste, including toxic waste. Biodegradable waste mainly originates from plant or animal sources and naturally decomposes through bacterial action. In contrast, non-biodegradable waste, such as plastics, metals, and ceramics, consists of materials that do not naturally break down through environmental processes or by living organisms. Waste sources encompass agricultural activities, municipal waste, commercial and industrial operations, construction and demolition activities, sewage sludge, and waste generated from mining and quarrying activities (Annan, 2001).

Efficient waste management includes activities such as collection, transportation, disposal, and recycling efforts. In Nigeria, like many other rapidly developing nations, this issue is particularly pronounced (Ugwu, Ozoegwu, Ozor, Agwu & Mbohwa, 2021). The city of Port Harcourt, situated in the oil-rich Niger Delta region, exemplifies this challenge, experiencing rapid urban expansion and a consequent surge in waste generation (Amasuomo & Baird, 2016; Ayotamuno & Gobo, 2004). Despite the critical importance of effective waste management, Port Harcourt's waste management system faces various challenges, including inadequate infrastructure, limited resources, and occasional mismatches between residents' expectations and the services provided by government contractors (Ayotamuno & Gobo, 2004).

In Port Harcourt, government-supervised contractors share the responsibility for waste management, tasked with maintaining cleanliness and public health standards. Households also play a significant role in waste management through their individual disposal practices.

To address these challenges and enhance waste management practices in Port Harcourt, a comprehensive understanding of both household waste disposal methods and public perceptions of government-supervised contractors is indispensable. Such insights can inform evidence-based policies and interventions to improve waste management efficiency and sustainability.

1.1. Problem Statement

The city of Port Harcourt, situated in the heart of the Niger Delta region, grapples with significant challenges in waste management. Rapid urbanization, population growth, and changing consumption patterns have led to a substantial increase in waste generation. In the face of this mounting waste, there exists a pressing need to effectively collect, transport, and dispose of refuse to maintain public health and environmental sustainability.

Central to this issue are two critical aspects: the methods employed by households for refuse disposal and the perceptions of residents regarding the performance of government-supervised contractors responsible for waste management. While the government and its contractors bear the responsibility for waste collection and disposal, the cooperation and compliance of households in adopting responsible disposal practices are equally pivotal.

The problem at hand in the view of the researchers is multifaceted:

- Inefficient Waste Disposal Practices: Many households in Port Harcourt employ diverse and often unregulated methods of waste disposal. These practices can vary significantly, from proper waste separation and disposal to indiscriminate dumping, resulting in a lack of consistency and efficiency in the city's waste management efforts.
- Inconsistent Contractor Performance: Government-supervised contractors play a crucial role in waste collection and disposal. However, there have been concerns and complaints from residents about the reliability and effectiveness of these contractors in maintaining cleanliness and hygiene standards in residential neighbourhoods.
- Financial Constraints and Access to Equipment: One of the significant issues faced by private firms seeking to operate waste management businesses in Nigeria, particularly in urban centres like Port Harcourt, is the lack of adequate capital and limited access to financing for acquiring essential equipment such as trucks, tippers, and incinerators. This financial challenge hampers their ability to address the waste management needs effectively.
- Environmental and Health Impacts: Inadequate waste management practices can have severe consequences, including environmental pollution, health hazards, and the degradation of the urban environment. Addressing these issues is not only crucial for the well-being of Port Harcourt residents but also vital for the sustainable development and growth of the city.

Illustratively, in numerous developing nations, the Public-Private Partnership (PPP) approach to solid waste management has proven effective. Sri Lanka, for instance, has successfully utilized PPP to maintain the cleanliness of its cities, with the private sector contributing investment, technology, vehicles, and equipment for waste collection (Khajuria, Yamatoto, and Morioka, 2010). India has similarly embraced PPPs in municipal infrastructure provision, including waste management, at various administrative levels to overcome government agencies' capacity constraints and leverage private finance for enhanced efficiency (Khajuria et al., 2010).

Given these multifaceted challenges and the potential for innovative solutions through public-private partnerships, it is imperative to conduct an investigation into waste disposal methods and public perceptions of government-supervised contractors in selected Port Harcourt residential communities. This inquiry aims to shed light on the existing practices and perceptions, ultimately guiding the development of effective, data-driven strategies for improved waste management in the city.

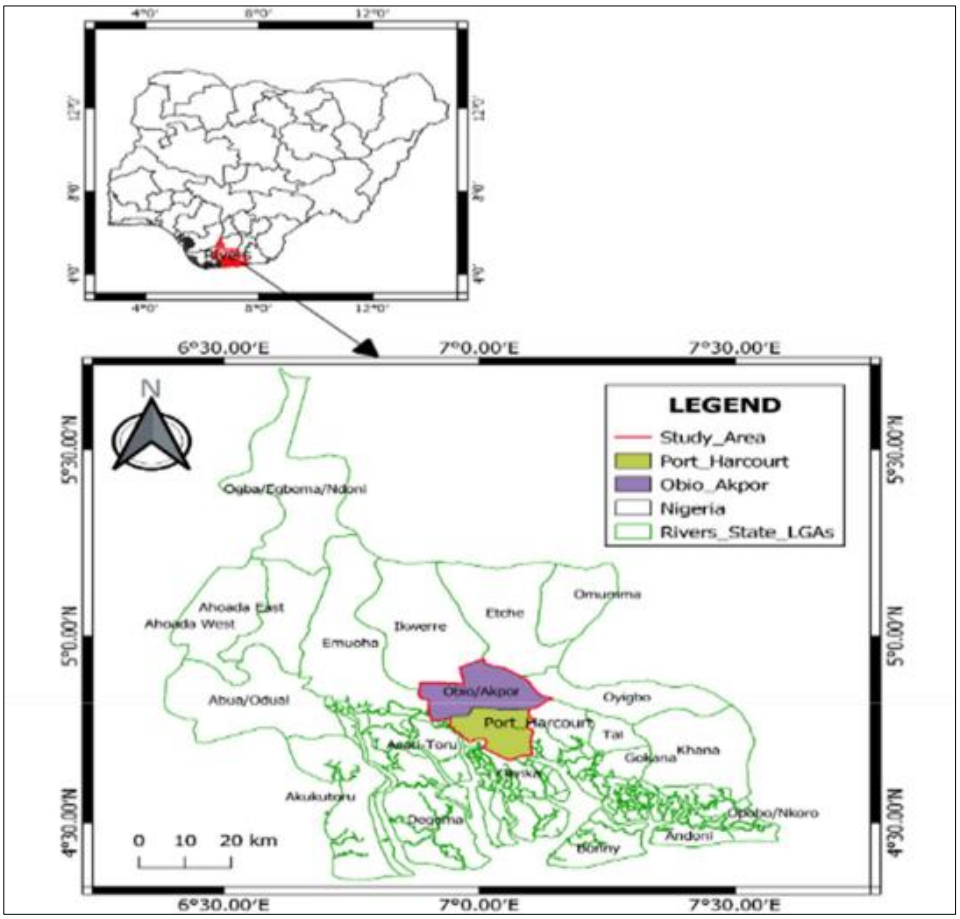
Aim of the study

To investigate waste management in Port Harcourt residential neighbourhoods, focusing on household disposal methods and residents' perceptions of government-supervised contractors.

Objectives of the Study

- Assess household waste disposal methods in Port Harcourt residential neighbourhoods.
- Determine residents' perceptions of Rivers State government-supervised waste management contractors in the same neighbourhoods.

1.2. Study Area



Source: RSU URP- GIS Lab, 2022

Figure 1 Map of Nigeria showing Rivers State and Port Harcourt Metropolis

Port Harcourt today extends beyond the Port Harcourt Local Government Area boundaries and includes portions of the Obio-Akpor Local Government Area. Port Harcourt City serves as the capital of Rivers State and is characterized by high population density, resulting from its status as the state's major urban hub (See Fig 1 showing the study area).

Based on the Rivers State government introduction of the Greater Port Harcourt vision, Port Harcourt now Greater Port Harcourt has encompassed eight local government areas, including Port Harcourt Local Government, Okrika, Obio-Akpor, Ikwerre, Oyigbo, Ogu–Bolo, Tai, and Eleme.

As of the 2012 population estimates, the Greater Port Harcourt had a total population of approximately 1,947,000 residents. This demographic size positions it as the fifth largest urban area in Nigeria, trailing behind only the urban areas of Lagos, Kano, Ibadan, and Abuja in terms of population magnitude.

2. Literature Review

Waste management is a critical aspect of urban governance, and it plays a pivotal role in ensuring the cleanliness, health, and environmental sustainability of a city. Effective waste disposal methods and the public's perception of government-supervised contractors are integral components of a successful waste management system. This literature review provides an overview of key concepts and previous research related to waste disposal methods and public perceptions in urban contexts, with a specific focus on the city of Port Harcourt.

2.1. Waste Disposal Methods

The literature on waste disposal methods covered a collection and transportation, disposal options and informal waste management.

Collection and Transportation: Waste collection and transportation are the initial stages of the waste management process. These processes are vital to prevent the accumulation of waste in residential areas and maintain public hygiene (Olanrewaju et al., 2012). In many urban areas, the efficiency of waste collection and transportation is a significant factor in waste management success.

Disposal Options: Waste can be disposed of through various methods, including land filling, incineration, recycling, and composting. Land filling is a common method, but it raises environmental concerns due to potential groundwater contamination and greenhouse gas emissions (Siddiqua et al., 2022). Recycling and composting are more sustainable options that reduce the volume of waste sent to landfills (Ayilara, Olanrewaju, Babalola & Odeyemi, 2020)).

Informal Waste Management: Informal waste pickers play a crucial role in waste management in many urban areas, including Port Harcourt. They often collect recyclable materials from waste bins, contributing to resource recovery and reducing the environmental impact of waste disposal (Gutberlet, 2018).

2.2. Public Perceptions of Government-Supervised Contractors

The literature reviewed on public perceptions of government supervised contractors covered trust and satisfaction, communication and engagement, and environmental concerns.

Trust and Satisfaction: Public trust and satisfaction with waste management services are essential factors that influence compliance with waste disposal regulations (Tchobanoglous et al., 1993). A lack of trust or dissatisfaction with government-supervised contractors can lead to non-compliance and illegal dumping.

Communication and Engagement: Effective communication between government agencies, contractors, and the public is critical for building trust and addressing concerns related to waste management (Gbadegesin et al., 2016). The promotion of public engagement in waste management, be it through legislative measures, political initiatives, or voluntary programs, has given rise to a novel discourse that reconfigures traditional knowledge hierarchies. This shift empowers not only experts in the field but also the broader society to assume central roles in discussions and decision-making pertaining to waste management policies (Pieczka & Escobar, 2013). As a result, it is altering the landscape of political decision-making concerning the governance of controversial waste management practices and technologies (Chilvers & Burgess, 2008).

Environmental Concerns: Public perceptions are often influenced by environmental concerns. Residents are more likely to support sustainable waste management practices when they understand the environmental benefits, such as reduced pollution and resource conservation (Debrah, Vidal & Dinis, 2021).

2.3. Port Harcourt Context

Port Harcourt, as a rapidly growing urban centre in Nigeria, faces unique challenges in waste management. The city's expanding population, coupled with changing consumption patterns, has led to increased waste generation (Amasuomo & Baird, 2016; Ikiriko, Enwin, Johnbull, Udom & Nwokaeze, 2023). However, the waste management infrastructure and services provided by government-supervised contractors have struggled to keep pace with this growth (Ayotamuno & Gobo, 2004). Inadequate infrastructure, limited resources, and occasional mismatches between residents' expectations and the services provided have posed significant challenges (Ayotamuno & Gobo, 2004).

Understanding how residents in selected Port Harcourt residential communities perceive waste disposal methods and the performance of government-supervised contractors is crucial for improving waste management practices in the city. It is in this context that this investigation seeks to contribute valuable insights to address the pressing waste management challenge in Port Harcourt.

3. Research Methodology

Research methodology serves as the guiding path that researchers follow during their investigative journey. It outlines the practical steps and techniques used to identify, select, process, and analyse information related to a specific research topic, ultimately ensuring the attainment of valid and reliable results that align with the research's aims and objectives. This section provides an in-depth exploration of the research methods applied throughout the study, encompassing the research design, the study target population, sample size determination and selection, instrumentation (questionnaire design), data collection methods, and data analysis techniques.

3.1. Research Design

The research design serves as the foundational framework for the study. A pivotal decision in the research design process revolves around selecting the appropriate research approach, as it dictates how pertinent information will be gathered. This study employed a passive observational research design, as described by Kumar, Leone, Aaker and Day, (2018) and elaborated upon by Creswell and Clark (2007) and Creswell (2012).

3.2. Population of the Study

The study population, from which generalized conclusions are drawn, encompasses the collective number of households' heads within the study area and the personnel of the Rivers State Waste Management Agency (RIWAMA). To elaborate, the study area comprises 846,034 residents across various communities, with a total of 141,007 household heads. RIWAMA, on the other hand, employs 341 staff members, as indicated by personnel records.

3.3. Sample Size Determination and Selection

The sample size was calculated using the sample size calculator within the Creative Research Survey System Software, Version 12. This specialized software, tailored for survey research, facilitates questionnaire creation, data management, processing, and presentation of survey research findings. It also computes the required sample size by considering the chosen confidence level (ranging from 80% to 99%), the confidence interval (margin of error) between 5% and 10%, and the population size.

The population under scrutiny consists of two distinct categories: the residents (household heads) of the Port Harcourt metropolis and the staff of the Rivers State Waste Management Agency (RIWAMA). The standard sample size formulas utilized by the Creative Research Survey System (2016) are outlined below. The first formula calculates the sample size necessary to achieve a specific confidence interval (plus or minus margin) from a considerably large population or one of indeterminate size. If the sample size represents a substantial percentage of the population size, the researcher may apply the correction for finite population.

$$\mathrm{SS} = \frac{\mathrm{Z}^2 * (p) * (1 - P)}{\mathrm{C}^2}$$

Where:

Z^2 = Z value (1.96 for 95% confidence level) squared
p = Population Proportion, expressed as decimal (assumed to be 0.5 (50%) used for sample size needed)
C^2 = confidence interval or margin of Error, expressed as decimal (0.10 = ±10), squared Correction for finite population, Start with result from SS from above and then:

$$SS = \frac{SS}{\frac{1 + (\mathrm{SS} - 1)}{Pop}}$$

Where Pop = Population

(The Creative Research Survey System, 2016)

At 95% Confidence level, 5% margin of error, population proportion 50% and population of 846034 (44918 households), the sample was 384 while for the 341 population of staff of RIWAMA, the sample size was 181.

3.4. Sampling

Sampling involves the methodical selection of a statistically representative subset of individuals from the broader population of interest (Kamangar & Islami, 2013). This process is essential in research studies since the population of interest is typically too extensive to include entirely within the scope of any single research endeavour. An effective sample is one that faithfully mirrors the characteristics of the population of interest and is of a size sufficient to address the research objectives (Browner, Newman, Cummings & Hully, 1988). In this study, the sampling technique employed is the stratified random sampling method, which is a probability-based approach.

A total of 384 questionnaires were distributed to 'heads of households' within the study area. Half of the questionnaires were administered in the Port Harcourt City Local Government Area (LGA), while the remaining half were distributed in the Obio/Akpor LGA, each accounting for 50% of the sample. The allocation of questionnaires to specific areas was based on the proportional representation of the population data of the selected communities.

3.5. Sample Selection

The Port Harcourt City Local Government Area encompasses 25 distinct communities, while the Obio/Akpor Local Government Area comprises 65 communities, resulting in a combined total of 90 communities within the Port Harcourt metropolis. Utilizing 10% of the total communities, which equates to 9 communities, it became apparent that obtaining a statistically and practically meaningful fraction of a community was not practicable. Consequently, the decision was made to round this number up to 10 communities. Purposefully, these 10 communities were distributed evenly between the two LGAs, resulting in 5 communities allocated to each LGA. The selection of representative communities was carried out using a simple random sampling technique. Consequently, 5 communities were selected from the Port Harcourt City LGA, and another 5 communities were chosen from the Obio/Akpor LGA (Refer to Table 1 for the List of Randomly Selected Communities for the study).

The selected communities and their respective streets where questionnaires were administered are as follows: Orominike, Elekahia, Abuloma, Borokiri, and Old GRA within the Port Harcourt City LGA, as well as Ogbogoro, Choba, Rumuobiakani, Woji, and Rumuokwuta in the Obio/Akpor LGA. The systematic sampling technique was applied to select buildings or households on the streets for the questionnaire administration. Population estimates were generated using the exponential formula $Pb = P0\ (1+r)^n$, where a growth rate of 6.5 (based on NPC in Vanguard, 2018) was used to project the population from 1991 to 2021. The number of households in each settlement was calculated by dividing the projected population for the settlement by an average household size of 6.

Table 1 List of Randomly Selected Communities in the Study Area

Stratum 1: The Local Government Area		
	Port Harcourt City LGA	**Obio/ Akpor LGA**
S/N	**Stratum 2: Communities**	
1	Orominike	Ogbogoro
2	Elekahia	Choba

3	Abuloma	Rumuobiakani
4	Borokiri	Woji
5	Orije Old GRA	Rumuokwuta

Source: Researchers' Conceptualization, 2022

Table 2 Summary of Samples Per Settlements

S/N	Settlement	Population in 1991	Projected Population 2021	No. of Households	Sample No. of Households Heads (HH)
PORT HARCOURT LGA					
1.	Orominike	21377	132765	22128	44
2.	Elekahia	15302	95035	15839	32
3.	Abuloma	10454	64926	10821	22
4	Borokiri	39214	243545	40591	81
5	Old GRA	6482	40257	6710	13
	Total	92829	576528	96089	192
OBIO/ AKPOR LGA					
6	Ogbogoro	9350	58070	9678	41
7	Choba	10968	68119	11353	49
8	Rumuobiakani	8451	52486	8748	37
9	Woji	6635	41208	6868	30
10	Rumuokwuta	7990	49623	8271	35
	Total	43394	269506	44918	192
Grand Total		136223	846034	141007	384

Source: Projected Population from (NPC, 1991), Researchers, (2022)

3.6. Data Collection and Analysis Methods

This research paper relied primarily on a questionnaire survey instrument to collect data from the Heads of Households within the study area. The questionnaire was designed to elicit responses on personal socio-economic factors, household characteristics, and solid waste management practices prevalent in the study area.

Data collection encompassed both primary and secondary sources. Primary data was gathered through the administration of questionnaires and direct personal observations. Secondary data was retrieved from a variety of sources, including periodicals, journals, relevant textbooks, reports, and online resources, encompassing both published and unpublished research works pertaining to solid waste management within the study area.

3.7. Method of Data Analysis

In this study, the analysis of data employed descriptive statistics, which included the presentation of findings in tables, frequencies, and percentages. Simple percentage calculations were utilized to elucidate the distribution and prevalence of responses to various survey questions. Additionally, the study incorporated a Likert scale and the weighted mean score (WMS) as a statistical measure. The weighted mean is defined as the sum of the product of weights and quantities divided by the sum of the weights themselves, allowing for a more nuanced understanding of certain data points and their significance within the research context.

$$\text{Weighted mean} = \sum(\text{weights} \times \text{quantities}) / \sum(\text{weights})$$

$$= (w1x1 + w2x2 + w3x3 + w4x4 + w5x5) / (w1 + w2 + w3 + w4 + w5)$$

This is indicated in the table below:

Table 3 Likert Scale and Weighted Mean Score

Strongly Agree (SA)	5 points
Agree (A)	4 points
Neither Agree Nor Disagree (N)	3 points
Disagree (D)	2 points
Strongly Disagree (SD)	1 point

Source: Creswell, (2012).

The score of 3.00 was used as the criterion for decision on the responses to each item. Any mean response which is equal to or more than 3.00 is positive or satisfactory while any mean response less than 3.00 was treated as negative or not satisfied.

4. Data Presentation and Analysis

This section presents the findings of this research in line with the answers to the research questions.

4.1. Number of Questionnaire Administered and Retrieved

A total of 384 questionnaires were administered to heads of households in the study area. A total of 340 were retrieved representing 88.5% which is good for the study (See Table 4 for details).

Table 4 Questionnaires Administered and Retrieved in the Study Area

N	Settlement	No. of Questionnaires Administered	No. of Questionnaires Retrieved	Percentage Retrieved
1	Orominike	44	40	90.91%
2	Elekahia	32	28	87.50%
3	Abuloma	22	20	90.91%
4	Borokiri	81	66	81.48%
5	Old GRA	13	13	100%
6	Ogbogoro	41	36	87.80%
7	Choba	49	38	77.55%
8	Rumuobiakani	37	34	91.89%
9	Woji	30	30	100%
10	Rumuokwuta	35	35	100%
	Grand Total	384	340	88.54%

Source: Projected Population from (NPC, 1991), Researcher, (2022)

4.2. Socio-economic Characteristics of Heads of Households

4.2.1. Sex of Respondents

Out of a total of 340 respondents, the study found out that 185 representing 54.4% were male while the remaining 155 respondent heads of household representing 45.6% were women. It shows that most of the respondents who are heads of household were men who took part in the survey (See Table 5 for details)

Table 5 Sex of Respondents

Gender	Number	Percentage (%)
Male	185	54.4
Female	155	45.6
Total	340	100

Source: Researcher, (2022)

4.2.2. Marital Status of Respondent

Out of the 340 respondent heads of households that were administered with questionnaire, the study found that 30.0% were single, 43.0% were married, 20.0% were separated while the remaining 7.0% were widow (er)(See Table 6 for details)

Table 6 Marital Status of Respondent

Marital Status	Number	Percentage (%)
Single	102	30.0
Married	146	43.0
Separated	68	20.0
Widow (er)	24	7.0
Total	340	100

Source: Researcher, (2022)

4.2.3. Age of Respondents

Out of the total of 340 respondents (heads of households who took part in the survey, 11.2% were within the age bracket (18-29), 36.2% were within the age bracket (30-41), 25.8% were within the age bracket (42-53), 21,5% were within the age bracket (54-65) while the remaining 5.3% were of age 66 and above (See Table 7 for details).

Table 7 Age of Respondents (House Hold Heads)

Age	Number	Percentage (%)
18-29	38	11.2
30-41	123	36.2
42-53	88	25.8
54-65	73	21.5
66 and above	18	5.3
Total	340	100

Source: Researcher, (2022)

4.2.4. Respondents (Head of Household) Years of Residents in the Neighbourhood

Out of the total of 340 respondents, 23.0% have resided in Port Harcourt for a period of 1-3 years, 25.8% have stayed for a period of 6-10 years, while 51.2% had stayed for a period that is 11 years and above. The study found that most of the head of households/ respondents have stayed for a period of more than 11years (See Table 8 for details).

Table 8 Respondents (Head of Household) Years of Residents in the Neighbourhood

Years	Number	Percentage (%)
1-5	78	23.0
6-10	88	25.8
11 and above	174	51.2
Total	340	100

Source: Researcher, (2022)

4.2.5. Respondents Household Size

The size of household has a way of influencing the volume of waste that is generated. Out of the total of 340 respondents, 30.0% of households has 1-3 persons, 31.5% of households has 4-6 persons, 22.4% of household has 7-9 persons while the remaining 16.1% has 10 and above (See Table 9 for details)

Table 9 Respondents Household Size

Household Size	Number	Percentage (%)
1-3	102	30.0
4-6	107	31.5
7 -9	55	22.4
10 and above	76	16.1
Total	340	100

Source: Researcher, (2022)

4.2.6. Educational Status of Respondents

Education today cut across every span of life as it serves as a major tool that shapes decision making. Out of the 340 participants in the survey, 16.5% had primary education, 68.0% had secondary school education while the remaining 15.5% had tertiary education (See Table 10 for details)

Table 10 Educational Status of Respondents

Educational Status	Number	Percentage (%)
Primary	56	16.5
Secondary	231	68.0
Tertiary	53	15.5
None	0	0
Total	340	100

Source: Researcher, (2022)

4.2.7. Employment Status of Respondent

Out of the 340 participants of the survey, 65.6 were civil servants, 13.0% works in the private sector, 9.1% were self-employed, 5.6% were retired while the remaining 6.7% were unemployed. The study shows that most of the respondents were employed and doing civil service job (See Table 11 for details)

Table 11 Employment Status of Respondent

Employment Status	Number	Percentage (%)
Civil Servant	223	65.6
Private Sector	44	13.0
Self employed	31	9.1
Retired	19	5.6
Unemployed	23	6.7
Total	340	100

Source: Researcher, (2022)

4.2.8. Monthly Income Status of Respondents

The modal monthly income category of the respondents was '60,001-90,000', representing 36.2% of the distribution. This was followed by those who earned 90,001-120,000 and 30,001-60,000 which accounted for 28.8% and 16.2% respectively (See Table 12 for details).

Table 12 Monthly Income Status of Respondents

Monthly Income Status (N)	Number	Percentage (%)
0-30,000	19	5.6
30,001-60,000	55	16.2
60,001-90,000	123	36.2
90,001-120,000	98	28.8
Above 120,000	45	13.2
Total	340	100

Source: Researcher, (2022)

4.3. Residents Appraisal of Public Private Partnership Approach of Waste Management System

4.3.1. Awareness of RIWAMA

The question was presented to residents of the study area: Are you aware of the Rivers State Waste Management Agency (RIWAMA) and her role in collaborating with other stakeholders to achieve a clean Port Harcourt City? Table 13 shows the distribution of residents' awareness of RIWAMA. Most of the respondents (95.0%) said that they are aware while the remaining 5.0% said 'No' meaning that they are not aware.

Table 13 Awareness of RIWAMA

Awareness of RIWAMA	Number	Percentage (%)
Yes	323	95.0
No	17	5.0
Total	340	100

Source: Researcher, (2022)

4.3.2. Available Public Private Partnership Services in Residential Neighbourhood

Table 14 shows the available Public Private Partnership Services in the study area. A total of 97.3% said that Government Receptacle/ Open Dump site is within 1 km from their home. 19.4% of respondents agreed that 'Door-to-Door Refuse Collection Service' is available within the study area, 13.2% said that 'Street Sweeping Services' is available while only 6.7% said that 'Drain cleaning Services' are available.

Table 14 Available Public Private Partnership Services in Residential Neighbourhood

Public Private Partnership Services	Available	Percentage (%)	Not Available	Percentage (%)
Street Sweeping Services	45	13.2	295	86.8
Drain cleaning Services	23	6.7	317	93.3
Door-to-Door Refuse Collection	66	19.4	274	80.6
Government Receptacle/ Open Dump site within 1 km	331	97.3	9	2.7

Source: Researcher, (2022)

4.3.3. Temporary Household Waste Storage Methods

Table 15 shows temporary household waste storage methods. Out of the 340 respondents, it was revealed that 20.0% use RIWAMA containers, 52.4% uses polythene/ sack bags, 9.7% use paint bucket, 8.2% use open dumps while another 9.7% uses other methods.

Table 15 Temporary Household Waste Storage Methods

Temporary Household Waste Storage Methods	Number	Percentage (%)
RIWAMA Containers	68	20.0
Polythene/ Sack Bags	178	52.4
Paint/ Other Buckets	33	9.7
Open Drums	28	8.2
Others	33	9.7
Total	340	100
	Source: Researcher, (2022)	

Source: Researcher, (2022)

4.3.4. Temporary Household Waste Segregation Method

Waste segregation is one of the very important aspect of waste management. Table 16 shows temporary household waste segregation methods. Out of the 340 respondents, 95.0% bundle waste together while only 5.0% segregate their waste.

Table 16 Temporary Household Waste Segregation Methods

Temporary Household Waste Segregation Method	Number	Percentage (%)
Waste is bundled together	323	95.0
Waste is sorted first	17	5.0
Total	340	100
Source: Researcher, (2022)		

Source: Researcher, (2022)

4.3.5. Household Waste Disposal Methods

To the question: What is your relationship of waste disposal with government Approved Receptacles/ Open Dump Sites within your Neighbourhood or how do you dispose your waste? Table 17 shows household waste disposal methods. The modal response was 'Waste Collected and disposed by Private Waste handlers (Cart Pushers)' represented by 56.0%.

Table 17 Household Waste Disposal Method

Household Waste Disposal Method	Number	Percentage (%)
Waste collected door-to-door by RIWAMA PPPS Operators	66	19.4
Waste Collected and disposed by Private Waste handlers (Cart Pushers)	190	56.0
Household Personally Dispose Waste at approved Dump Site	38	11.2
Disposed by Burning	23	6.7
Kept at Street Corners/ Kerbs	23	6.7
Total	340	100

Source: Researcher, (2022)

4.4. Residents Perception of Government-Supervised Contractors Waste Management Approach

The study delved into residents' perceptions of the government supervised contractors (Public Private Partnership (PPP) approach) to waste management in their neighbourhood. Each perception statement was evaluated using a five-point Likert scale, ranging from 'Strongly Disagree' to 'Strongly Agree.' The results of this perception assessment as outlined in Table 18 are presented below:

'Government approved partners run a house-to-house pick up of garbage very often in our neighbourhood.' The responses indicated that 88 residents 'Strongly Disagree,' 84 'Disagree,' 34 'Neither Agree Nor Disagree,' 77 'Agree,' and 57 'Strongly Agree.' The weighted mean score for this statement is 2.79, suggesting a negative perception.

'Government approved partners and their trucks are seen very often evacuating and cleaning up government-approved waste receptacles/open dump sites in the neighbourhood.' For this statement, 78 residents 'Strongly Disagree,' 85 'Disagree,' 10 'Neither Agree Nor Disagree,' 89 'Agree,' and 78 'Strongly Agree.' The weighted mean score for this statement is 3.01, indicating a positive perception.

'The Rivers State government and her partners enforce sanitation activities in our neighbourhood.' The responses included 89 'Strongly Disagree,' 72 'Disagree,' 12 'Neither Agree Nor Disagree,' 89 'Agree,' and 78 'Strongly Agree.' The weighted mean score for this statement is 2.98, suggesting a negative perception.

'The Rivers State government and her partners prosecute residents for non-compliance with approved waste management principles in her approved waste receptacles and dumps.' The responses showed 89 'Strongly Disagree,' 72 'Disagree,' 12 'Neither Agree Nor Disagree,' 89 'Agree,' and 78 'Strongly Agree.' The weighted mean score for this statement is 2.98, indicating a negative perception.

'Our neighbourhood enjoys a better waste management system from government and her partners.' The responses included 86 'Strongly Disagree,' 82 'Disagree,' 24 'Neither Agree Nor Disagree,' 81 'Agree,' and 67 'Strongly Agree.' The weighted mean score for this statement is 2.80, suggesting a negative perception.

'There is effective enlightenment campaigns and public participation in waste management in our neighbourhood sponsored by the government.' The responses indicated 90 'Strongly Disagree,' 88 'Disagree,' 14 'Neither Agree Nor Disagree,' 81 'Agree,' and 67 'Strongly Agree.' The weighted mean score for this statement is 2.80, suggesting a negative perception.

'We pay money to cart pushers to make sure that our waste is evacuated and disposed.' For this statement, 24 residents 'Strongly Disagree,' 35 'Disagree,' 6 'Neither Agree Nor Disagree,' 112 'Agree,' and 163 'Strongly Agree.' The weighted mean score for this statement is 4.04, indicating a strongly positive perception.

Out of Seven (7) Key statements that were used to measure perception, only two were positive with weighted mean score of 3.01 and 4.04 respectively. The rest were below the 3.0 weighted mean score. (See Table 18)

The weighted mean scores provide a comprehensive assessment of residents' perceptions, with scores below 3.0 generally reflecting negative perceptions and scores above 3.0 indicating positive perceptions. These findings highlight the varied perceptions among residents regarding the effectiveness of the waste management system and the Public Private Partnership approach in their neighbourhood.

Table 18 Residents Perception of Government-Supervised Contractors Waste Management Approach

S/N	Residents Perception of Government-Supervised Contractors	Strongly Disagree (SD)	Disagree (D)	Neither Agree Nor Disagree (N)	Agree (A)	Strongly Agree (SA)	Weighed Mean Score	Decision
01	Government approved partners run a house-to-house pick up of garbage very often in our neighbourhood	88	84	34	77	57	2.79	Negate
02	Government approved partners and their trucks are seen very often evacuating and cleaning up government approved waste receptacles / open dump sites in the neighbourhood	78	85	10	89	78	3.01	Affirm
03	The Rivers State government and her partners enforce sanitation activities in our neighbourhood	89	72	12	89	78	2.98	Negate
04	The Rivers State government and her partners prosecutes residents for non- compliance with approved waste management principles in her approved waste receptacles and dumps	89	72	12	89	78	2.98	Negate

Source: Researcher, (2022)

The weighted mean is defined as the summation of the product of weights and quantities, divided by the summation of weights.

$$\text{Weighted mean} = \sum(\text{weights} \times \text{quantities}) / \sum(\text{weights})$$

$$= (w1x1 + w2x2 + w3x3 + w4x4 + w5x5) / (w1 + w2 + w3 + w4 + w5)$$

$$= (88x1 + 84x2 + 34x3 + 77x4 + 57x5) / (88 + 84 + 34 + 77 + 57$$

$$= (88 + 168 + 102 + 308 + 285)/340$$

$$= 951/340 = 2.7$$

5. Discussion of Findings

5.1. Refuse Disposal Methods Adopted By Households

The importance of effective waste management cannot be overstated, as every household, regardless of its location or socio-economic status, generates waste that needs to be managed and disposed of responsibly. This discussion highlights the findings related to household waste disposal methods in the study area and offers insights into the implications of these practices for waste management and environmental sustainability.

5.2. Awareness of RIWAMA and Government-Approved Dump Sites

The study found that there is a high level of awareness about the Rivers State Waste Management Agency (RIWAMA) among residents. This awareness is attributed to the presence of government-approved dump sites and receptacles located within a 1-kilometer radius of residents. This proximity to waste disposal facilities likely contributes to

residents' awareness of waste management efforts in their area. However, awareness alone does not guarantee effective waste management; it must be coupled with responsible disposal practices.

5.3. Predominance of Private Waste Handlers (Cart Pushers)

Source: Authors, 2023

Figure 2 Government Truck and Cart Pushers at Approved Waste dump Site in the study Area

Source: Authors, 2023

Figure 3 Cart pushers waiting to dispose what they've collected from residents

The most prevalent household waste disposal method reported by respondents is the use of private waste handlers, often referred to as 'cart pushers (See Fig 2 & 3).' This finding suggests that a significant portion of residents relies on informal and private channels for waste collection and disposal. While this approach provides a solution for waste removal, it raises concerns about the regulation, accountability, and environmental impact of these private waste handlers. It is crucial for authorities to establish oversight mechanisms to ensure responsible waste collection and disposal through these channels.

5.4. Personal Disposal at Approved Dump Sites

A notable proportion of respondents (11.2%) reported personally transporting their waste to approved dump sites for disposal. This practice reflects a proactive approach to waste management, where residents take individual responsibility for proper disposal. However, the effectiveness of this method depends on the accessibility and maintenance of approved dump sites. Adequate infrastructure and facilities are essential to support residents in this responsible waste disposal effort.

5.5. Burning and Informal Disposal

A minority of respondents indicated that they dispose of their waste by burning it (6.7%) or by keeping it at street corners or kerbs (6.7%). These practices are concerning from both environmental and health perspectives. Waste burning can lead to air pollution and the release of harmful substances, while informal disposal in public spaces contributes to environmental degradation. Public education and awareness campaigns are needed to discourage such practices and promote responsible waste management alternatives.

5.6. Residents Perception of Government-Supervised Contractors (Public Private Partnership Approach) of Waste Management System

The discussion of residents' perceptions of the government-supervised contractors approach to waste management in their neighbourhood is essential in understanding how the community views the effectiveness and impact of this waste management system. The findings presented in Table 18 reveal a range of perceptions among residents, each tied to specific aspects of waste management and government involvement. Let's delve into the key points and implications of these perceptions:

5.6.1. Positive Perception on Visible Clean-up Efforts

The second statement, 'Government approved partners and their trucks are seen very often evacuating and cleaning up government-approved waste receptacles/open dump sites in the neighbourhood,' garnered a positive perception with a weighted mean score of 3.01. This suggests that residents appreciate the visible efforts of government-approved partners in maintaining cleanliness in the area. This positive perception is crucial as it signifies that residents are observing proactive steps taken by authorities in waste management.

5.6.2. Negative Perceptions on Enforcement and Sanitation

Statements three and four, which relate to the enforcement of sanitation activities and prosecution of non-compliance, both received negative perceptions with weighted mean scores of 2.98. These findings indicate that residents believe there is room for improvement in terms of enforcing waste management regulations and holding residents accountable for non-compliance. These negative perceptions may reflect concerns about the effectiveness of enforcement mechanisms or the consistency of enforcement efforts.

5.6.3. Mixed Perceptions on Overall Waste Management

Statements five and six address residents' perceptions of the overall waste management system, including effectiveness and public participation. Both statements received negative perceptions with weighted mean scores of 2.80. These findings suggest that a significant portion of residents feels that the waste management system in their neighbourhood needs improvement, particularly in terms of effectiveness and community engagement. This is an important insight as it highlights areas for potential enhancement in the waste management system's design and execution.

5.6.4. Strongly Positive Perception of Residents' Contribution

The seventh statement, 'We pay money to cart pushers to make sure that our waste is evacuated and disposed,' received a strongly positive perception with a weighted mean score of 4.04. This indicates that residents are willing to invest financially in ensuring proper waste disposal, even if it involves hiring private cart pushers. This positive perception

suggests that residents are actively engaged in waste management efforts, both in terms of their willingness to pay for services and their proactive approach to waste disposal.

In general, residents' perceptions of the government-supervised contractors approach to waste management in their neighbourhood are multifaceted. While there are positive aspects such as visible clean-up efforts and residents' active involvement through financial contributions, there are also concerns regarding house-to-house garbage collection and disposal, enforcement of environmental sanitation activities, street cleaning services, drains cleaning activities, enlightenment campaigns and community engagement and overall system effectiveness.

These perceptions provide valuable feedback for policy-makers and waste management authorities to identify areas for improvement and tailor strategies to better align with residents' expectations and needs. Engaging with the community to address these concerns and improve waste management practices can lead to a more effective and sustainable system. Residents' perception of government-supervised contractors Approach of Waste Management System in the study area presently is not positive. Most of the perception variable had an outcome that is negative. 'Government approved partners and their trucks are seen very often evacuating and cleaning up government approved waste receptacles / open dump sites in the neighbourhood applauds the government but the primary aspect that is silent is the money the respondents pay to private waste handlers or cart pushers to make sure that their waste is evacuated to the waste dump and a clean neighbourhood is maintained.

6. Conclusion

This study delved into the field of waste management in Port Harcourt, Nigeria, focusing on the government-supervised contractors (Public Private Partnership (PPP) approach) implemented by the Rivers State Government through the establishment of the Rivers State Waste Management Agency (RIWAMA) in 2013. The primary aim of this agency was to foster a clean and healthy city by engaging residents, raising awareness, and promoting best practices in waste management. In this bid, RIWAMA partnered with contractors who do the waste collection and transportation coupled with other services under the supervision of RIWAMA. But did the agency actually delivered in the execution of its primary assignment? The study has provided valuable insights into waste management practices and public perceptions in the study area of Port Harcourt, Nigeria. The findings and analysis presented in this research shed light on the current state of waste management, the challenges faced, and the areas where improvements are needed.

- **Refuse Disposal Methods:** The study has highlighted the diverse range of refuse disposal methods adopted by households in the study area. While some residents benefit from formal waste collection services provided by government-approved partners, others rely on private waste handlers, leading to concerns about regulation and environmental impact. The need to standardize and regulate these practices is evident.
- **Public Perception:** Residents' perceptions of the government-supervised contractors waste management system varied across different aspects. While some aspects of the system received positive feedback, others were met with dissatisfaction. It is crucial for waste management authorities to address these concerns and work towards improving public perception.
- **Waste Segregation:** The study revealed a lack of waste segregation practices among both residents and service providers. This lack of segregation has implications for recycling efforts and environmental sustainability. Promoting waste segregation should be a priority for waste management authorities.
- **Household Waste Disposal Methods:** The predominant household waste disposal method involved hiring private waste handlers (cart pushers), with a significant percentage of residents relying on this informal approach. The regulation of these private waste handlers and their environmental impact should be carefully considered.
- **Community Engagement:** Establishing effective mechanisms for community engagement and feedback is essential for fostering collaboration between waste management authorities and residents. Residents should have opportunities to participate in waste management initiatives and provide input.

To address the challenges identified in this study and create a more effective waste management system in Port Harcourt, several key recommendations can be made:

- **Regulation and Oversight:** Proper regulation and oversight of waste handlers, both private and public, to ensure responsible waste collection, disposal, and environmental impact mitigation.
- **Infrastructure Development:** Investment in waste collection infrastructure, such as accessible and well-maintained dump sites, to facilitate responsible waste disposal.

- **Education and Awareness:** Public awareness campaigns to educate residents about the environmental and health impacts of improper waste disposal and promote responsible waste management practices.
- **Recycling Initiatives:** Encouragement of recycling and composting practices to reduce waste generation and reliance on disposal methods.
- **Service Enhancement:** Continuous efforts to enhance the quality, reliability, and coverage of waste collection services, addressing residents' concerns and expectations.

In conclusion, effective waste management is a shared responsibility between the government and residents. Collaborative efforts, coupled with improved regulation, infrastructure, and public awareness, can lead to a cleaner and healthier environment in Port Harcourt and similar urban areas. By implementing the recommended measures and addressing the challenges identified in this research, stakeholders can work together to create a more sustainable and efficient waste management system for the benefit of the community and the environment.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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