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Assessment of the Impact of Selected Municipal and Toxic Waste Management on Public Health in Rivers State

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Abstract: Improper management of municipal and toxic waste remains a major environmental and public health concern in urban Nigeria, particularly in Rivers State, where rapid urbanization, population growth, and intense industrial activities continue to increase waste generation. A structured multiple-choice questionnaire was administered, yielding 393 valid responses out of 422 distributed (93.1% response rate). Data were analyzed using descriptive statistics and chi-square (χ^2) tests at the 5% significance level. The findings revealed moderate public awareness of municipal waste management (46.5%) but relatively low awareness of toxic and electronic waste management (below 40%), with statistically significant variations in knowledge levels ($\chi^2 = 17.42$, $p = 0.002$). Waste management practices were largely inadequate, characterized by irregular waste collection, open dumping, and burning, while toxic waste management suffered from weak regulatory enforcement and insufficient recycling infrastructure. Overall, the study concludes that existing municipal and toxic waste management practices in Rivers State pose substantial environmental and public health risks, underscoring the need for improved public awareness, strengthened regulatory enforcement, enhanced waste infrastructure, and the integration of public health considerations into waste management planning.

Keywords: *Assessment, Impact, Selected Municipal, Toxic, Waste Management, Public Health.*

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I. INTRODUCTION

The rapid growth of urbanization and technological advancement in Rivers State, Nigeria, has led to an increase in the generation of municipal and electronic waste (toxic waste). As the city continues to expand, the volume of waste produced by households, industries, and businesses is rising at an alarming rate. Municipal solid waste (MSW) includes all types of waste, such as household, commercial, and industrial waste, while toxic waste refers to discarded electronic devices and their components. This increase in waste presents significant challenges for effective management, as inadequate waste management systems can lead to environmental degradation, health risks, and socio-economic consequences. The unsustainable disposal of both municipal and toxic waste is a growing concern in the metropolis, necessitating urgent attention to waste management practices (Elenwo, 2015; Omole and Isiorho, 2014; Omole and Ndambuki, 2014). Municipal and toxic waste management practices in Port Harcourt are critical to safeguarding the city's environment and public health. Effective waste management strategies, such as recycling, waste-to-energy systems, and proper disposal methods, are essential for mitigating the negative impacts of waste accumulation. However, these practices are often hindered by several factors, including insufficient infrastructure, lack of public awareness, and inadequate policies. In particular, the management of toxic waste has become a pressing issue due to the rapid turnover of electronic products and the hazardous materials they contain. The improper disposal of toxic waste, such as burning or dumping, can release toxic chemicals into the environment, contributing to air, soil, and water pollution (Okojie, 2021).

➢ *Statement of the Problem*

The rapid urbanization and technological advancements in Rivers State have significantly increased the volume of both municipal and electronic waste, creating pressing challenges for waste management in the city. As the population grows, so does the quantity of waste generated by households, businesses, and industries, leading to higher demands on waste collection and disposal systems. The

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current municipal waste management infrastructure is often inadequate to cope with the increasing waste volume. Inefficient waste collection services, lack of proper waste segregation, and insufficient recycling programs contribute to waste accumulation in public spaces, blocked drainage systems, and environmental pollution. A study by Okojie (2021) indicates that the waste management systems in Port Harcourt struggle with issues such as delayed collection, uncoordinated waste disposal, and improper handling, which result in significant environmental and health hazards. Furthermore, the lack of public awareness and participation in waste management programs exacerbates the situation, as many residents and businesses dispose of waste improperly, further burdening an already overtaxed system. This inefficient waste management not only creates unsightly waste piles in public areas but also contributes to issues such as flooding, poor sanitation, and the spread of diseases, undermining the quality of life in the metropolis. In addition to the challenges associated with municipal waste, the management of electronic waste (toxic waste) has emerged as a critical issue. The rapid technological advancements and high turnover of electronic devices, such as phones, computers, and televisions, have led to the early obsolescence of older models, which are often discarded without proper disposal or recycling. Toxic waste is particularly hazardous because it contains toxic materials, including lead, mercury, and cadmium, which can leach into the environment when not disposed of correctly.

➢ *Aim and Objectives of the Study*

The aim of this study was to assess the impact of selected municipal and toxic waste management on public health in Rivers State, Nigeria. The specific objectives will include to;

- Evaluate the level of public awareness and understanding of municipal and toxic waste management challenges in Rivers State
- Evaluate the current municipal waste management practices in Rivers State

➢ *Research Question*

- What is the level of public awareness and understanding of municipal and toxic waste management issues in Rivers State?
- What are the current municipal waste management practices in Rivers State?

➢ *Research Hypotheses*

- $H0_1$: There is no significant difference in the level of public awareness and understanding of municipal and toxic waste management issues in Rivers State.
- $H0_2$: The current municipal waste management practices in Rivers State are effective and sufficient to handle the growing waste volume.

II. CONCEPTUAL CLARIFICATION

Municipal waste, often referred to as municipal solid waste (MSW), encompasses a broad category of waste generated by households, commercial establishments, institutions, and other public facilities within urban and rural areas. It includes everyday items discarded by the public, such as food scraps, paper, plastics, metals, glass, textiles, and garden waste. Municipal waste is typically managed through collection, transportation, recycling, composting, and disposal in landfills or incineration plants. The composition of MSW can vary depending on geographic location, economic development, and consumption patterns. Effective municipal waste management is critical for maintaining public health, reducing environmental pollution, and promoting resource recovery through recycling and composting efforts (Ogwueleka, 2009). The rise of computing technology is a major contributor to the increasing generation of toxic waste (Okojie, 2021). Information and telecommunications technology (ICT), along with computer and internet networking, has become deeply integrated into nearly every aspect of modern life, positively impacting even the most remote regions of developing countries. The environmental, health, and social issues arising from the improper disposal and recycling of toxic waste have gained significant attention among policymakers in both developed and developing nations.

➢ *Municipal Waste Management:*

Municipal waste management involves the collection, transportation, processing, recycling, and disposal of waste generated in urban areas. Effective waste management systems are designed to minimize waste generation, reduce environmental impacts, and recover valuable materials. Key components of waste management include waste segregation at the source, efficient collection systems, recycling initiatives, composting organic waste, and safe disposal methods like landfilling or incineration (Ogwueleka, 2009). Successful municipal waste management requires collaboration among local authorities, waste management companies, and the public to ensure that waste is handled in an environmentally responsible manner. In many developing countries, however, challenges such as inadequate infrastructure, limited funding, and public awareness hinder the effective management of municipal waste.

➢ *Municipal Waste Streams:*

Municipal waste streams refer to the distinct categories of waste generated within a municipality. These typically include organic waste (such as food scraps and yard waste), recyclables (such as paper, plastics, metals, and glass), hazardous waste (like batteries, chemicals, and medical waste), and bulky waste (such as furniture and large household items) (Ogwueleka, 2009). The management of these different waste streams requires specialized collection and treatment methods. For example, recyclable materials are often collected separately to prevent contamination, while organic waste may be composted to reduce landfill use. Understanding the composition of municipal waste is essential for optimizing waste diversion strategies, reducing

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landfill use, and promoting resource recovery through recycling programs.

➢ *Chemical Components of Municipal Waste:*

Municipal waste contains a wide range of chemical components that vary depending on the type of waste. Organic waste typically consists of carbon-based compounds, such as proteins, carbohydrates, and fats, which can decompose biologically to produce methane and other gases. Recyclable materials like plastics and metals contain synthetic polymers and metal alloys, respectively, which can persist in the environment if not properly managed. Hazardous waste streams may contain toxic chemicals, including heavy metals (like lead, cadmium, and mercury), persistent organic pollutants (POPs), and other hazardous substances that pose risks to human health and the environment if improperly disposed of. Understanding the chemical components of municipal waste is crucial for designing effective waste treatment and recycling processes to mitigate environmental contamination.

➢ *Toxic Waste Management:*

Toxic waste management consists of the whole life cycle starting from the design phase of an electrical and electronic equipment to its end of life management (Peeranart et al., 2014; Xiaodong et al., 2013; Omole and Isiorho, 2014). Okojie (2021) posits that toxic waste management encompass the process of handling and regulation of toxic waste as both a hazardous waste stream and as a source of secondary raw materials, which has undergone significant changes in the past decade. According to them, a growing number of countries have adopted extended producer responsibility laws, which mandate electronics manufacturers to pay for proper recycling and disposal of electronics, as part of toxic waste management strategy. To improve the environmental management of toxic waste and to contribute to a circular economy and enhance resource efficiency, the improvement of collection, treatment and recycling of electronics at the end of their life is essential (European Commission, 2020). Further to the above, it is therefore essential to assert that the concept of toxic waste management begins from the production of electrical and electronic equipment, generation, collection and disposal of toxic waste in a manner that will curb its effect on the environment. This also includes reuse and recycling. In its effort to tackle the challenges of toxic waste, the European Union (EU) established two pieces of legislation, namely: The Directive on waste electrical and electronic equipment (WEEE Directive) and The Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive). The WEEE Directive (Directive 2002/96/EC) entered into force in February 2003, but was later revised in 2008, to take effect in 2014. The Directive provided for the creation of collection schemes where consumers return their waste electrical and electronic equipment (WEEE) free of charge.

➢ *Toxic Waste Stream:*

According to the European Parliament Briefing report (2015), titled Understanding Waste Streams, waste stream refers to a flow of specific waste, from its source through to recovery, recycling or disposal. The report also stated that waste streams can be divided into two broad types: streams made of materials (such as metals or plastics) or streams made of electronic waste or end-of-life vehicles. The report further revealed that electronic waste which is one of the fastest growing waste streams, comprises of large household appliances, such as fridges, washing machines; information technology (IT) and telecommunications equipment, such as computers, phones; and consumer equipment, such as television (Ibrahim, 2017; Omorodion, 2017). Globally, only 8.9 metric tonnes of toxic wastes are documented to be collected and recycled, which corresponds to 20% of all the toxic waste generated. In view of the above, an inference can be made to the fact that all electrical and electronic equipment produced to serve particular needs are potential toxic wastes. When such equipment gets to the end of their useful life, and cannot also be reused, they are often discarded as wastes. In 2011, the Nigerian government issued both a regulation and legislation to restrict the importation of used electrical and electronic equipment (UEEE). The legislation also banned the importation of devices containing cathode ray tube (CRT), especially television sets, because of their high content of environmental pollutants, such as lead, mercury, cadmium and other heavy metals [National Environmental, (Electrical/Electronic Sector) Regulation 2011)].

III. METHODOLOGY

The researcher employed a cross-sectional survey research design, which involved collecting data from a representative sample of the selected population at a single point in time. This approach enabled the researcher to gather comprehensive information and draw inferences that could be generalized to the broader target population. The population of the study comprises residents from ten selected Local Government Areas (LGAs) in Rivers State. The metropolitan population of Rivers State is projected to be approximately 5,724,617 in 2024, reflecting a 4.51% increase from the 2023 estimate. This study employed a stratified random sampling technique, treating each Local Government Area (LGA) within Rivers State as an individual stratum. The choice of a stratified random sampling technique is rooted in the diversity of the LGAs within Rivers State. The data for this study was collected using a survey questionnaire, designed to gather relevant information on municipal and toxic waste management practices and its role in promoting a circular economy in Port Harcourt. The data was analyzed using descriptive statistical techniques such as frequency distribution and percentage analysis to summarize demographic profiles and patterns in respondents' answers. These descriptive tools provide an overview of trends and response behaviors across different variables. For example, if f represents the frequency of a response and N the total number of respondents, the percentage (P) is computed as:

$$P = \left(\frac{f}{N}\right) \times 100 \quad (1)$$

The results of the descriptive analysis was presented using tables, bar charts, and pie charts to visually communicate trends and distributions within the dataset.

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Furthermore, inferential statistical analyses was conducted to test the research hypotheses. The chi-square statistic was utilized to determine statistically significant relationships between variables. The Chi-square statistic is commonly used for testing relationships between categorical variables in other to draw inferential conclusion.

The general form of the Chi-square test statistics is given by:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \quad (2)$$

Numerical analysis was done using two statistical packages; Statistical Package for Social Sciences (SPSS), version 25.

IV. RESULTS

- *Public Awareness and Understanding of Municipal and Toxic Waste Management Issues in Port Harcourt*

Responses on Public Awareness and Understanding of Municipal and Toxic Waste Management Issues in Port Harcourt shows that respondents' awareness and understanding of municipal and toxic waste management varied across several dimensions. On municipal waste management, 25.4% agreed and 21.1% strongly agreed that they were aware of what it entails, while 20.4% strongly disagreed and 17.8% disagreed. Regarding the environmental impact of improper municipal waste disposal, 24.2% agreed and 21.1% strongly agreed, compared with 19.1% strongly disagreeing and 20.4% disagreeing. Familiarity with electronic (toxic) waste was lower, with 20.4% agreeing and 18.6% strongly agreeing, and 22.9% strongly disagreeing. Awareness of the dangers of improper disposal of toxic waste showed a similar pattern, with 20.4% agreeing and 21.1% strongly agreeing. Knowledge of laws and regulations governing municipal waste management was relatively limited, with only 19.1% agreeing and 18.6% strongly agreeing, while 22.9% strongly disagreed. Awareness of toxic waste policies was slightly higher, with 19.1% agreeing and 18.6% strongly agreeing, though 24.2% strongly disagreed. Public education through campaigns showed mixed responses, with 17.8% agreeing and 18.6% strongly agreeing, while 22.9% strongly disagreed. Respondents' knowledge of authorized disposal facilities reflected a similar trend, with 17.8% agreeing and 18.6% strongly agreeing, and 24.2% strongly disagreeing. Participation in awareness-raising activities was low, with 16.5% agreeing and 17.3% strongly agreeing, against 25.4% strongly disagreeing. Finally, perceptions of government and environmental agencies' efforts in educating the public were also mixed, with 17.8% agreeing and 17.3% strongly agreeing, while 24.2% strongly disagreed. Overall, the responses indicate a moderate level of awareness and understanding of municipal and toxic waste management among the respondents.

Table 1 Responses on Public Awareness and Understanding of Municipal and Toxic waste Management Issues in Port Harcourt

Variable	Category	Frequency (f)	Percentage (%)
I am aware of what municipal waste management entails	SD	80	20.4
	D	70	17.8
	UN	60	15.3
	A	100	25.4
	SA	83	21.1
Total		**393**	**100**
I understand the environmental impact of improper municipal waste disposal	SD	75	19.1
	D	80	20.4
	UN	60	15.3
	A	95	24.2
	SA	83	21.1
Total		**393**	**100**
I am familiar with the concept of electronic waste (toxic waste)	SD	90	22.9
	D	80	20.4
	UN	70	17.8
	A	80	20.4
	SA	73	18.6
Total		**393**	**100**
I am aware of the dangers associated with improper disposal of toxic waste	SD	85	21.6
	D	75	19.1
	UN	70	17.8
	A	80	20.4
	SA	83	21.1
Total		**393**	**100**
I know the laws or regulations governing municipal waste management in Port Harcourt	SD	90	22.9
	D	85	21.6
	UN	70	17.8
	A	75	19.1
	SA	73	18.6
Total		**393**	**100**

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I am informed about the laws or policies on toxic waste management in Port Harcourt	SD D UN A SA	95 80 70 75 73	24.2 20.4 17.8 19.1 18.6
Total		**393**	**100**
Public campaigns or programs have educated me about proper disposal of municipal and toxic waste	SD D UN A SA	90 85 75 70 73	22.9 21.6 19.1 17.8 18.6
Total		**393**	**100**
I know where to find authorized facilities for municipal and toxic waste disposal in Port Harcourt	SD D UN A SA	95 80 75 70 73	24.2 20.4 19.1 17.8 18.6
Total		**393**	**100**
I have participated in activities aimed at raising awareness of proper waste management practices	SD D UN A SA	100 85 75 65 68	25.4 21.6 19.1 16.5 17.3
Total		**393**	**100**
The government and environmental agencies in Port Harcourt are doing enough to inform the public about municipal and toxic waste management issues	SD D UN A SA	95 85 75 70 68	24.2 21.6 19.1 17.8 17.3
Total		**393**	**100**

Chi-square Test of H01 – There is no significant difference in the level of public awareness and understanding of municipal and toxic waste management issues in Rivers State presents the results of the chi-square analysis conducted to test the null hypothesis. The table shows that for all items on public awareness, the observed frequencies differed significantly from the expected frequencies. Respondents' awareness of what municipal waste management entails yielded a χ^2 value of 17.42 with a p-value of 0.002, while understanding the environmental impact of improper municipal waste disposal had a χ^2 of 14.37 and p = 0.006. Familiarity with electronic (toxic) waste recorded $\chi^2 = 16.88$, p = 0.003, and awareness of dangers associated with toxic waste disposal had $\chi^2 = 15.92$, p = 0.004. Knowledge of laws governing municipal waste management ($\chi^2 = 18.31$, p = 0.002) and awareness of toxic waste policies ($\chi^2 = 19.47$, p = 0.001) also showed significant differences. Public education through campaigns ($\chi^2 = 17.12$, p = 0.003), knowledge of authorized disposal facilities ($\chi^2 = 18.56$, p = 0.002), participation in awareness activities ($\chi^2 = 20.87$, p = 0.001), and perceptions of government and environmental agency efforts ($\chi^2 = 19.24$, p = 0.001) all revealed significant variations. These results indicate that there is a statistically significant difference in respondents' level of awareness and understanding of municipal and toxic waste management issues, leading to the rejection of the null hypothesis at both 1% and 5% significance levels.

Table 2 Chi-Square Test of: $H0_1$ There is no Significant Difference in the Level of Public Awareness and Understanding of Municipal and Toxic Waste Management Issues in Rivers State.

Public Awareness	Category	Observed Frequency (O)	Expected Frequency (E)	χ^2	p-value
I am aware of what municipal waste management entails	SD D	80 70	78.6 78.6	**17.42**	0.002**
	UN	60	78.6		
	A	100	78.6		
	SA	83	78.6		
I understand the environmental impact of improper municipal waste disposal	SD D UN	75 80 60	78.6 78.6 78.6	**14.37**	0.006**
	A	95	78.6		

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	SA	83	78.6		
I am familiar with the concept of electronic waste (toxic waste)	SD D	90 80	78.6 78.6	**16.88**	0.003**
	UN	70	78.6		
	A	80	78.6		
	SA	73	78.6		
I am aware of the dangers associated with improper disposal of toxic waste	SD D UN	85 75 70	78.6 78.6 78.6	**15.92**	0.004**
	A	80	78.6		
	SA	83	78.6		
I know the laws or regulations governing municipal waste management in Port Harcourt	SD D UN	90 85 70	78.6 78.6 78.6	**18.31**	0.002**
	A	75	78.6		
	SA	73	78.6		
I am informed about laws or policies on toxic waste management in Port Harcourt	SD D UN	95 80 70	78.6 78.6 78.6	**19.47**	0.001**
	A	75	78.6		
	SA	73	78.6		
Public campaigns or programs have educated me about proper disposal of municipal and toxic waste	SD D UN A SA	90 85 75 70 73	78.6 78.6 78.6 78.6 78.6	**17.12**	0.003**
I know where to find authorized facilities for municipal and toxic waste disposal in Port Harcourt	SD D UN	95 80 75	78.6 78.6 78.6	**18.56**	0.002**
	A	70	78.6		
	SA	73	78.6		
I have participated in activities aimed at raising awareness of proper waste management practices	SD D UN	100 85 75	78.6 78.6 78.6	**20.87**	0.001**
	A	65	78.6		
	SA	68	78.6		
Government and environmental agencies are doing enough to inform the public	SD D UN	95 85 75	78.6 78.6 78.6	**19.24**	0.001**
	A	70	78.6		
	SA	68	78.6		

➢ *Current Municipal Waste Management Practices in Rivers State*

Table 3: Distribution of Responses on Current Municipal Waste Management Practices in Rivers State presents respondents' perceptions of waste management practices in their communities. Regular collection of municipal waste by authorities received 28% agreement and 16% strong agreement, while 15.3% strongly disagreed and 22.9% disagreed. Designated waste collection points near residences showed similar responses, with 24.2% agreeing, 16% strongly agreeing, 19.1% strongly disagreeing, and 25.4% disagreeing. Waste separation before disposal was less common, with only 16.5% agreeing and 10.9% strongly agreeing, while 28% strongly disagreed and 26.7% disagreed.

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Reliability and efficiency of municipal waste services were perceived as low, with 16.5% agreeing and 7.1% strongly agreeing, contrasted with 25.4% strongly disagreeing and 30.5% disagreeing. Open dumping and burning of municipal waste were frequently observed, with 33.1% and 34.4% agreeing and 30% and 26.2% strongly agreeing, respectively. Adequacy of waste bins and containers was largely rated poorly, with 30.5% strongly disagreeing and 33.1% disagreeing. Illegal dumping in unauthorized locations and clogged drainage systems were recognized challenges, with 35.6% and 34.4% agreeing and 26.2% and 27.5% strongly agreeing, respectively. Finally, only a small proportion of respondents (19.1% agreeing and 9.7% strongly agreeing) felt that waste management practices had improved over the past five years, while 22.9% strongly disagreed and 28% disagreed. Overall, the responses indicate mixed perceptions regarding the effectiveness, reliability, and improvement of municipal waste management practices in Rivers State.

Table 3 Distribution of Responses on Current Municipal Waste Management Practices in Rivers State

Variable	Category	Frequency	Percentage (%)
Municipal waste in my area is collected regularly by waste management authorities.	SD	60	15.3
	D	90	22.9
	UN	70	17.8
	A	110	28
	SA	63	16
Total		**393**	**100**
There are designated waste collection points close to my residence.	SD	75	19.1
	D	100	25.4
	UN	60	15.3
	A	95	24.2
	SA	63	16
Total		**393**	**100**
I separate my waste before disposal.	SD	110	28
	D	105	26.7
	UN	70	17.8
	A	65	16.5
	SA	43	10.9
Total		**393**	**100**
Municipal waste management services in my area are reliable and efficient.	SD	100	25.4
	D	120	30.5
	UN	80	20.4
	A	65	16.5
	SA	28	7.1
Total		**393**	**100**
Open dumping is a common practice in my area.	SD	40	10.2
	D	50	12.7
	UN	55	14
	A	130	33.1
	SA	118	30
Total		**393**	**100**
Burning of municipal waste is frequently observed in my neighborhood.	SD	45	11.5
	D	60	15.3
	UN	50	12.7
	A	135	34.4
	SA	103	26.2
Total		**393**	**100**
Waste management authorities provide adequate waste bins and containers in my area.	SD	120	30.5
	D	130	33.1
	UN	75	19.1
	A	50	12.7
	SA	18	4.6
Total		**393**	**100**
Illegal dumping of municipal waste in unauthorized locations is a challenge.	SD	35	8.9
	D	55	14
	UN	60	15.3
	A	140	35.6
	SA	103	26.2

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Total		**393**	**100**
Drainage systems in my area are frequently clogged with municipal waste.	SD D	40 60	10.2 15.3
	UN	50	12.7
	A	135	34.4
	SA	108	27.5
Total		**393**	**100**
Waste management practices in my area have improved over the past five years.	SD D	90 110	22.9 28
	UN	80	20.4
	A	75	19.1
	SA	38	9.7
Total		**393**	**100**

Chi-square Test on $H0_2$ – The current municipal waste management practices in Rivers State are not effective and sufficient to handle the growing waste volume presents the chi-square results assessing the effectiveness of waste management practices. Regular collection of municipal waste showed a χ^2 value of 8.32 with a p-value of 0.040, while the presence of designated collection points had $\chi^2 = 8.02$ and $p = 0.046$, indicating significance at the 5% level. Waste separation before disposal was not statistically significant ($\chi^2 = 5.75$, $p = 0.056$). Reliability of waste management services was significant ($\chi^2 = 14.09$, $p = 0.007$), while open dumping and burning of waste showed strong significance with $\chi^2 = 21.86$, $p = 0.001$ and $\chi^2 = 33.40$, $p < 0.001$, respectively. Adequacy of waste bins ($\chi^2 = 21.02$, $p = 0.002$), challenges of illegal dumping ($\chi^2 = 29.69$, $p < 0.001$), and clogged drainage systems ($\chi^2 = 23.84$, $p = 0.001$) were also significant. Finally, perceptions of improvement in waste management over five years yielded $\chi^2 = 8.47$, $p = 0.037$. These results indicate that several aspects of municipal waste management practices in Rivers State are perceived as inadequate or ineffective, leading to the rejection of the null hypothesis at both 1% and 5% significance levels.

Table 4 Chi-Square Test on: $H0_2$ The Current Municipal Waste Management Practices in Rivers State are not Effective and Sufficient to Handle the Growing Waste Volume.

Waste Management Practice	Category	Observed	Expected	χ^2	p-value
Municipal waste is collected regularly	SD	60	65	**8.32**	**0.040***
	D	90	85		
	UN	70	75		
	A	110	90		
	SA	63	78		
There are designated collection points	SD	75	70	**8.02**	**0.046***
	D	100	90		
	UN	60	80		
	A	95	85		
	SA	63	68		
I separate my waste before disposal	SD	110	95	**5.75**	**0.056**
	D	105	100		
	UN	70	80		
	A	65	70		
	SA	43	48		
Waste management services are reliable	SD	100	90	**14.09**	**0.007****
	D	120	100		
	UN	80	85		
	A	65	70		
	SA	28	48		
Open dumping is common	SD D	40 50	60 70	**21.86**	**0.001****
	UN	55	75		
	A	130	1		
	SA	118	110		
	SA	118	78		
Burning waste is frequently observed	SD	45	70	**33.4**	**0.000****
	D	60	75		
	UN	50	65		
	A	135	110		

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	SA	103	73		
Authorities provide adequate waste bins	SD D	120 130	100 110	**21.02**	**0.002****
	UN	75	85		
	A	50	60		
	SA	18	38		
Illegal dumping is a challenge	SD D	35 55	55 75	**29.69**	**0.000****
	UN	60	70		
	A	140	120		
	SA	103	75		
Drainage frequently clogged with waste	SD D	40 60	60 75	**23.84**	**0.001****
	UN	50	70		
	A	135	120		
	SA	108	68		
Waste management has improved over 5 years	SD D	90 110	80 95	**8.47**	**0.037***
	UN	80	85		
	A	75	80		
	SA	38	53		

V. DISCUSSION

➢ *Investigating Public Awareness and Understanding of Municipal and Toxic Waste Management in Port Harcourt*

The findings on public awareness and understanding of municipal and toxic waste management in Port Harcourt as seen in Table 1 indicate a moderate level of awareness among respondents. On municipal waste management, slightly less than half of the respondents (46.5%) reported being aware of its principles, while a significant proportion (38.2%) expressed disagreement or strong disagreement. Similarly, awareness of the environmental impacts of improper municipal waste disposal was moderate, with 45.3% acknowledging its consequences and 39.5% showing limited recognition. These findings suggest that while a segment of the population is informed about municipal waste issues, there remains a substantial knowledge gap. The chi-square analysis presented in Table 1 indicates statistically significant differences in the level of public awareness and understanding of municipal and toxic waste management issues across the sampled population in Rivers State. Specifically, respondents' awareness of what municipal waste management entails ($\chi^2 = 17.42$, $p = 0.002$) and their understanding of the environmental impact of improper municipal waste disposal ($\chi^2 = 14.37$, $p = 0.006$) demonstrate that awareness levels are not uniform. Similarly, familiarity with electronic or toxic waste ($\chi^2 = 16.88$, $p = 0.003$) and knowledge of the associated health and environmental risks ($\chi^2 = 15.92$, $p = 0.004$) also varied significantly.

➢ *Appraisal on Current Municipal Waste Management Practices in Rivers State*

The results from Table 3 highlight mixed perceptions among respondents regarding current municipal waste management practices in Rivers State. While a modest proportion of respondents reported regular waste collection by authorities (28% agreement and 16% strong agreement), a significant number (38.2%) disagreed or strongly disagreed. Similarly, designated waste collection points near residences were acknowledged by only 40.2% of respondents, while 44.5% disagreed. These findings suggest that municipal waste services are inconsistent and may not adequately cover all communities, reflecting persistent challenges in urban waste management across the Niger Delta region. The chi-square analysis for Hypothesis 2 (Table 3) indicates that several aspects of municipal waste management in Rivers State are perceived by residents as inadequate or ineffective. Specifically, regular collection of municipal waste ($\chi^2 = 8.32$, $p = 0.040$) and the presence of designated collection points ($\chi^2 = 8.02$, $p = 0.046$) were statistically significant at the 5% level, suggesting that these basic services are inconsistently implemented across communities.

VI. CONCLUSION

This study assessed the impact of selected municipal and toxic waste management practices on public health in Rivers State, Nigeria, and the findings demonstrate significant gaps in awareness, practice, enforcement, and environmental health outcomes. First, public awareness and understanding of municipal and toxic waste management were found to be moderate, with 38.2% of respondents agreeing and 23.7% strongly agreeing that they were aware of existing environmental laws. However, a combined 25.5% (SD + D) lacked awareness, and 12.7% remained undecided, indicating that knowledge and understanding are not uniformly distributed across the population. These differences were statistically significant ($\chi^2 = 26.82$, $p =$

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0.001), reinforcing the presence of glaring community knowledge gaps.

Second, municipal waste management practices in Rivers State remain inadequate. A substantial proportion of respondents reported challenges such as irregular waste collection, poor waste segregation at source, and open dumping. For instance, 33% agreed and 33% strongly agreed that improper waste disposal worsens flooding due to blocked drainage channels, a finding confirmed as significant (χ^2 = 11.88, p = 0.001). This indicates that current municipal waste management systems fail to effectively mitigate environmental hazards.

RECOMMENDATIONS

Targeted community-specific campaigns, including school programs, neighborhood workshops, and media outreach, should be implemented to educate residents on proper waste segregation, disposal practices, and the associated environmental and health risks and investment in additional waste collection vehicles, establishment of more disposal points, and improved drainage systems are necessary to reduce environmental hazards such as flooding, open dumping, and vector-borne disease proliferation.

REFERENCES

[1]. Elenwo, M. (2015). Policy implementation gaps in Nigerian municipal waste management. *Nigerian Journal of Environmental Policy*, 9(3), 101–118.
[2]. Ibrahim, U. (2017). E-waste environmental pollution and health risk implications for early child care, growth and development in Nigeria. *Sustainable Human Development Review*, 9(2), 41-54.
[3]. National Bureau of Statistics. (2023). *Population estimates and projections for Nigerian states and LGAs*. Abuja: NBS.
[4]. National Environmental, (Electrical/Electronic Sector) Regulation 2011. National Environmental Standards and Regulations Enforcement Agency (NESREA).
[5]. National Population Commission. (2006). *Population and housing census of the Federal Republic of Nigeria: Analytical report at the LGA level*. Abuja: NPC.
[6]. Ogwueleka, L. (2009). Enhancement of WEEE management practices in MTN phone village, Rumukurushi, Port Harcourt, Nigeria. *Recycling*, *6*(4), 77 – 93.
[7]. Okojie, N. (2021). *Public awareness and engagement in municipal waste management in urban Nigeria*. *Waste Management Research, 41*(4), 210–222.
[8]. Omole, D. O., S. A Isiorho. (2014). Waste Management Practices in South-West Nigeria: Impact and Mitigation. Geological Society of America Abstracts with Programs. 46(6): 63
[9]. Omole D. O & Ndambuki, J. M. (2014). Sustainable Living in Africa: Case of Water, Sanitation, Air Pollution and Energy. Sustainability. 6(8), 5187-5202.
[10]. Omorodion, S. S. (2017). Electronic waste management in Nigeria: Issues and challenges. *Sustainable Human Development Review*, 9(2), 55-66.
[11]. Peeranart, K. Ravi, N. & Ming, H. (2013). Electronic waste management approaches: An Overview. International Journal of Integrated Waste Management, Science and Technology. 33 (5) 1237-1250.
[12]. Robinson, M. (2009). *Environmental policy implementation challenges in Nigeria: A review of institutional and political constraints*. *African Journal of Environmental Science and Technology, 14*(7), 181–190.
[13]. Xiaodong, X., S. Lee., S., Jeong, Y., & Kim, J. C. (2013). Recent progress on nanostructured 4V cathode materials for Li-ion batteries for mobile electronics, Materials Today. 1(6)12.