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Assessment of Solid Waste Management Practices among Urban Households in Makurdi Local Government Area of Benue State Nigeria

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ABSTRACT

Solid Waste Management (SWM) remains an environmental challenge, particularly in developing nations like Nigeria, where there is rapid urbanization, inadequate infrastructure, and weak enforcement of regulations. This study examines the waste management practices, challenges, and potential solutions in Makurdi, Nigeria, with focus on household waste collection and disposal patterns. A descriptive research design was employed, surveying 379 respondents across five locations in Makurdi metropolis. The demographic analysis revealed a predominantly male, working-age population actively involved in waste management, with diverse educational and occupational backgrounds. Household characteristics reflected socioeconomic diversity, with most homes comprising of 4-6 members residing in flats or thatch houses. Findings indicated high daily waste generation, predominantly consisting of organic waste, plastics, and paper/cardboard. Current waste disposal methods relied heavily on municipal systems (82.3%) and composting (58%). Challenges such as inadequate infrastructure, improper waste segregation, and open dumping were pervasive. Urbanization, economic constraints, and education levels were identified as factors influencing waste management behaviors. Respondents expressed dissatisfaction with existing SWM practices, citing environmental and health risks associated with improper disposal. Suggested solutions included infrastructure development (81.8%), strict regulatory enforcement (53.3%), community-based initiatives, and public private partnerships. Incentives for recycling, public education campaigns, and investment in monitoring systems were also recommended to promote sustainable practices.

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Keywords: Solid Waste Management (SWM), Household Waste, Makurdi, Demographic Characteristics

Introduction

Solid waste management (SWM) remains an environmental challenge in both developed and developing countries. Solid waste refers to the discarded materials generated from residential, industrial, commercial, and institutional activities that are no longer useful and require proper disposal [1]. Globally, the volume of solid waste generated has increased due to rapid population growth, urbanization, industrialization, and changes in consumption patterns. Inadequate waste management poses significant threats to public health, the environment, and sustainable development [2]. Effective SWM is essential to mitigating these challenges, promoting a cleaner environment, and ensuring efficient resource utilization [2].

In developing nations, including Nigeria, SWM practices are often inefficient and poorly regulated. Challenges such as limited infrastructure, lack of enforcement of environmental regulations, and inadequate public awareness contribute to ineffective waste management [3]. Nigeria, with its growing population and rapid urbanization, faces significant SWM challenges. The country generates an estimated 32 million tons of solid waste annually, of which only 20-30% is collected [4,5]. The urban centers, including Lagos, Abuja, and Port Harcourt, produce the majority of this waste due to high population densities and economic activities. Waste types predominantly include organic materials, plastics, metals, and paper, reflecting Nigeria's consumption patterns. The legal and institutional frameworks for SWM in Nigeria are governed by several policies and regulations, such as the National Environmental Sanitation Policy and the National Environmental (Sanitation and Waste Control) Regulations. Despite these frameworks, enforcement remains weak due to insufficient funding, corruption, and lack of coordination among stakeholders [6]. Consequently, indiscriminate dumping, open burning, and improper disposal practices are widespread, leading to environmental pollution and health risks.

Makurdi, the capital of Benue State, is not left out in the challenges of SWM in Nigeria. As an urban center with a population exceeding 300,000, Makurdi generates substantial quantities of solid waste daily [7]. The city's waste composition is largely organic due to the predominance of agricultural activities in the region, along with plastic and other non-biodegradable materials [8].

The management of solid waste in Makurdi is primarily the responsibility of the Benue State Environmental Sanitation Agency (BENSESA). However, the agency faces numerous challenges, including inadequate funding, insufficient waste collection vehicles, and poor waste disposal infrastructure [9,10]. These issues have resulted in the proliferation of open dumpsites,

littering, and the contamination of water bodies such as the River Benue, posing severe health and environmental risks. The aim of this study is to examine household solid waste collection and disposal pattern within Makurdi metropolis. The findings of this study will contribute to the body of knowledge on SWM in Nigeria, providing insights into the unique challenges faced by urban households in Makurdi. It will also inform policymakers, environmental agencies, and other stakeholders on effective strategies to enhance SWM, thereby promoting environmental sustainability and public health.

Materials and Methods

Study Design

This study used a descriptive research design. According to Sekaran and Bougie, descriptive research is a design used to answer the what, how and why. Descriptive design was appropriate for this study because it enabled collection of data by measurement of central tendency, variation and correlation. The research design selected for the study is the descriptive survey method in which questionnaire was administered to obtain a reliable data for the study.

The Study Area

Makurdi is located within the Benue trough, in a depression drained by the Benue River and its valley. Because of its position and the construction of road and rail bridges across it, Nyabga refers to it as "bridge town [11]. The town acts as an important link between Nigeria's geographical north and south, as well as the country's eastern bloc. Makurdi town is one of the oldest and biggest in North Central Nigeria; it plays a dual role of being a State capital City and the same time Local Government Headquarters [12]. The residential areas in the town include; North bank I, North bank II, Modern market, Ankpa quarters, High level, Idye, Wadata, Wurukum, Kanshio, Logo and Lobi. However, Makurdi town has developed to include other residential areas such as Akpehe, Apir, Gaadi, Fiidi and Gyadovilla [13]. This brings the number of residential areas or neighbourhoods in the town to sixteen as seen in figure 1. The town is located within the low relief zones of the Benue valley, with relief height averaging only 250 metres [14]. Makurdi town does not have a good drainage system mainly to the fact that the town is low-lying especially near the banks of river Benue where appreciable flood plains with swamps occur.

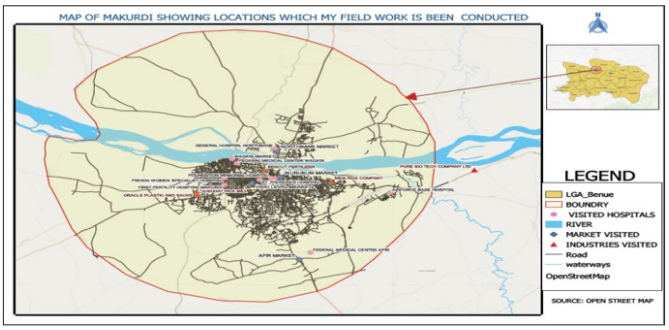

Figure 1: Map of Makurdi showing Study Areas

Attempts by successive State Governments to develop drainage systems have achieved little positive result, yet the town continues to suffer from yearly floods due to inadequate drainage system [12]. The town has tropical sub-humid wet and dry climate with two distinct seasons, designated Aw climate by Koppen's classification system [14]. The overwhelming domination of Makurdi town by civil service over business people and the near absence of industries make the town to be known as civil service city [15].

Population of Study

The population of study consisted of 379 respondents including eight (8) Council Wards in Makurdi Local government, to ensure equal representation without any form of bias. These council wards are; North Bank ward 1, North Bank ward 2, Fiidi, Modern market, Clarks/market, Wailomayo, Ankpa/wadata and Bar.

Sampling and Sampling Techniques

Multistage sampling was adopted for this study to select locations and places for data collection. Households were purposively from five (5) locations in Makurdi LGA. These include: North Bank, Wurukum, High Level, Wadata, and Ankpa/Modern market. Thirty percent (30%) sample size of 129 of respondents selected was determined from 2006 National population census as projected to 2024 in the formula below.

Determination of from 2006 Census Population Projected to 2024

The formula by George, (2014) was used to calculate population projection.

$$Pn = Po(1 + r)t \quad (1)$$

Where
P_n = Projected Population
P_o = Last population to be projected

The determination of Makurdi sample size from 2006 census population projected to 2024 was done as follows;

LGA	Population (2006 Census)	Projected Population	Sample Size
Makurdi	300,377	315876.45	129

R = population Growth rate (0.028% = 0.028)
t = number of years of projection

Determination of Sample Size

Sample size of projected 2006 Makurdi projected population was calculated using Taro Yamane formula (1967)

$$n = N/(1 + N(e)2 \quad (2)$$

Where:
n = sample
N= population
e = error (0.005)

Community Sample Size

$$nh\,(A) = (n\,x\,Nh)/N \quad (3)$$

Where:
n = sum of sample size
Nh = population of each community
N = Sum total of projected population

However, a total of 144 respondents were purposively selected and interviewed for data collection from household. Excess of 15 respondents to the 129 calculated sample size was recorded. The sum total of respondents chosen from households around hospitals was 100. A total sum of 75 respondents were sampled from household around industries.

Instrument of Data Collection
The researcher uses structured questions for gathering of his information. The questionnaires were used to collect data to cover all aspect of the research questions.

Validation of Instrument
The structured questionnaire developed by the researcher was subjected to scrutiny by two (2) experts' all from Joseph Sarwuan Tarka University Makurdi. They assisted in vetting the instrument and ascertain its contents and validity by criticism. Thereafter, the identified errors were corrected.

Reliability of the Instruments
A trial test was carried out on some selected respondent in Makurdi. The instrument yielded the Cronbach's Alpha coefficient based on the single cluster. The overall reliability coefficient obtained for the instrument was 0.71 which indicated that the instrument is reliable enough for the study.

Data Collection
Respondents were interviewed with semi-structured Google Form questionnaire.

Data Analysis Techniques
Data obtained was analyzed using descriptive statistics: Tables and charts.

Results
Demographic Characteristics of Respondents
Table 1 show the demographic characteristics of 379 respondents who were interviewed on waste management in Makurdi. The result revealed a predominantly male population (61.7%) with a mean age of 38.5 years. The majority of respondents identified as Christian (70.4%), and 66% were married. The primary occupations were business (48.5%), civil servant (26.9%), and student (13.7%). The secondary occupations were business (52%), civil servant (11.1%), and farming (24%). The educational status showed a significant proportion of respondents with non-formal education (39.3%), followed by undergraduate education (27.4%).

Table 1: Demographic Characteristics of Respondents in Public and Private Places in Makurdi

Variables	Frequency	Percentage (%)	Mean
Sex			
Male	234	61.7	
Female	145	38.3	
Total	379	100	
Age Range			
18 – 25	5	1.3	
26 – 35	139	36.7	38.5±8.4
36 – 45	117	30.9	
46 – 50	99	26.1	
51 – 55	18	4.7	
56 – 60	1	0.3	
Total	379	100	
Religion			
Christianity	267	70.4	
Islam	106	28	
Traditional	4	1.1	
No religion	2	0.5	
Total	379	100	
Marital status			
Single	92	24.3	
Married	250	66	
Divorced	37	9.8	
Total	379	100	
Primary Occupation			
Civil Servant	102	26.9	
Farming	41	10.8	
Business	184	48.5	
Student	52	13.7	
Total	379	100	
Secondary Occupation			
Farming	133	35.1	
Teaching	5	1.3	

Business	197	52	
Student	44	11.6	
Total	379	100	
Educational Status			
Primary	12	3.2	
Secondary	81	21.4	
Undergraduate	104	27.4	
Postgraduate	33	8.7	
Non formal	149	39.3	
Total	379	100	

Characteristics of Households of Respondents within Makurdi

The characteristics of respondents in households within Makurdi are presented in Table 2. The results showed that the majority of households had a size of 4-6 members (50%). The most common type of house was a flat (45.1%), followed by single-room houses (18.8%). Thatch houses accounted for 19.4% of the households, while bungalows made up 16.7 % of the total.

Table 2: Characteristics of Households of Respondents within Makurdi

Variable	Frequency	Percentage (%)
Household size		
1 – 3	41	28.5
4 – 6	72	50.0
7 – 10	31	21.5
Total	144	100.0
Type of house		
Thatch house	28	19.4
Single room	27	18.8
Flat	65	45.1
Bungalow	24	16.7
Total	144	100.0

Frequency of Waste Generation within Makurdi

The frequency of waste generation in Makurdi metropolis is presented in Figure 2 indicating that the majority of respondents (83.4%) generate waste daily. A significant proportion (14.5%) generates waste after 2-3 days, while a small percentage (1.8%) generates waste weekly.

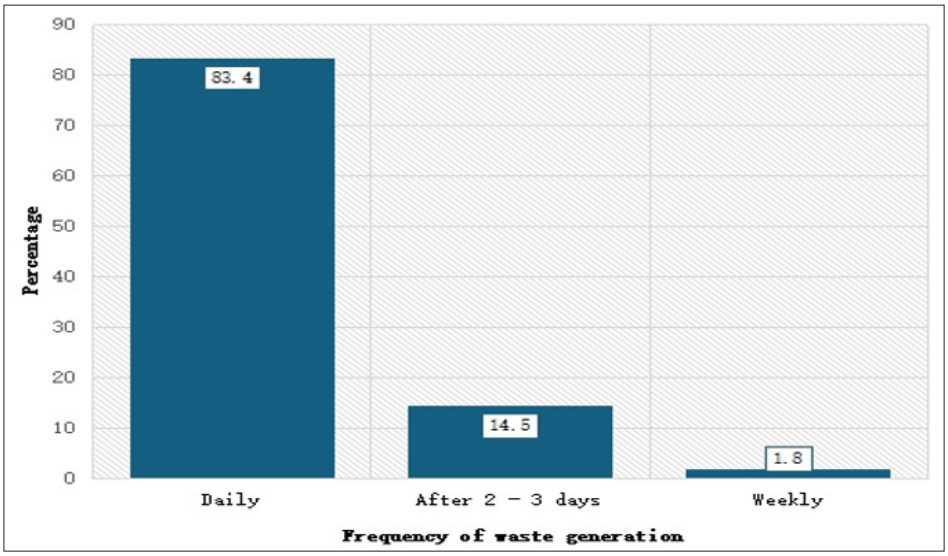

Figure 2: Frequency of Waste Generation within Makurdi

Types of Waste Commonly Generated from Households in Makurdi

Table 3 compared waste composition generated by locations in Makurdi. The composition revealed distinct patterns. In households, organic waste (98.8%), plastics (98%), and paper/cardboard (91.5%) are the predominant waste types.

Table 3: Types of waste commonly generated in Markets, household, and Industries

Location	Variable	Frequency	Percentage (%)
Household	Organic waste	81	98.8
	Paper and cardboard	75	91.5
	Plastics	73	98
	Glass	4	4.9
	Metals	8	9.8
	Electronic waste	7	8.5
	Construction wastes	0	0
	Textile wastes	0	0
	Hazardous waste	0	0

Method of Current Waste Management in Households within Makurdi

The methods of waste disposal in household are presented in Figure 3. Majority of respondents (82.3%) dispose of waste through municipal waste management systems. However, a significant proportion (58%) also engage in composting, indicating a willingness to adopt environmentally friendly practices. In contrast, dumping in open spaces (26.4%) and burning (31.4%) are less common methods, highlighting the need for education and awareness campaigns to promote sustainable waste management practices.

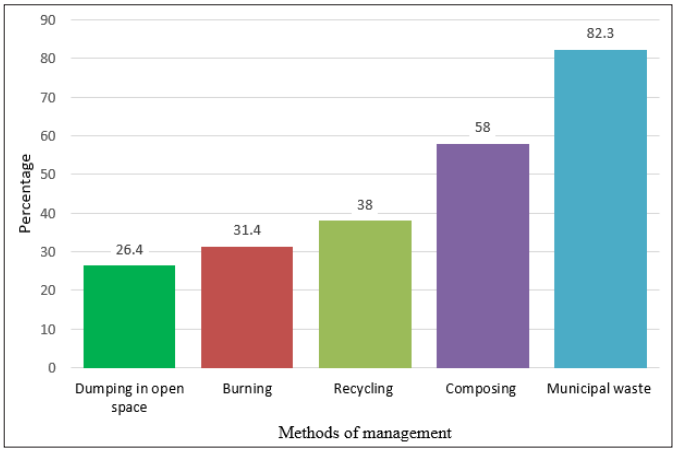

Figure 3: Method of Current Waste Management in Households within Makurdi

Respondents' Concerns on the Present Waste Management Practices in Makurdi

The survey results reveal that a significant majority of respondents (87.6%) were concerned about the environmental impact of the current waste management practices in Makurdi (Figure 4). However, only 45.4% of respondents were satisfied with the existing waste disposal practices, while 22.7% was not satisfied. The high level of concern about the environmental impact, coupled with the relatively low satisfaction with waste disposal, suggests that the current waste management system in Makurdi is inadequate and requires substantial improvements to address the environmental challenges.

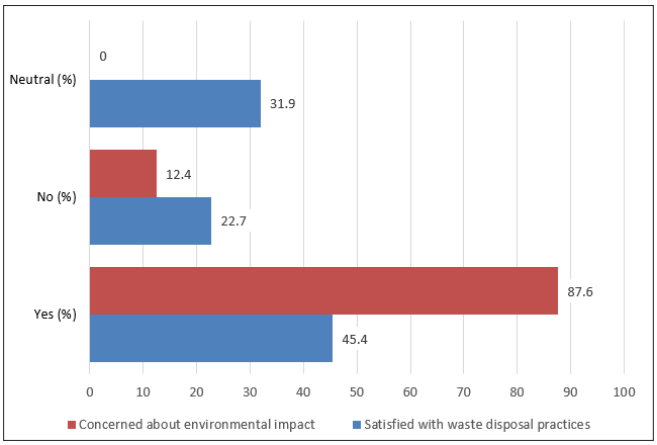

Figure 4: Respondents' Concerns on the Present Waste Management Practices in Makurdi

Methods of Waste Disposal Management in Household and Market in Makurdi

Figure 5 presents the methods of waste disposal management in households and markets in Makurdi. The data reveals that the majority of households (78%) and markets (56.6%) use open baskets for waste disposal. Closed baskets are also used by a significant proportion of households (19.5%) and markets (24.2%). Special trash buckets are used by a small percentage of households (1.2%) and markets (5.6%). In contrast, throwing waste around is not a common practice in households but is used by 7.6% of markets.

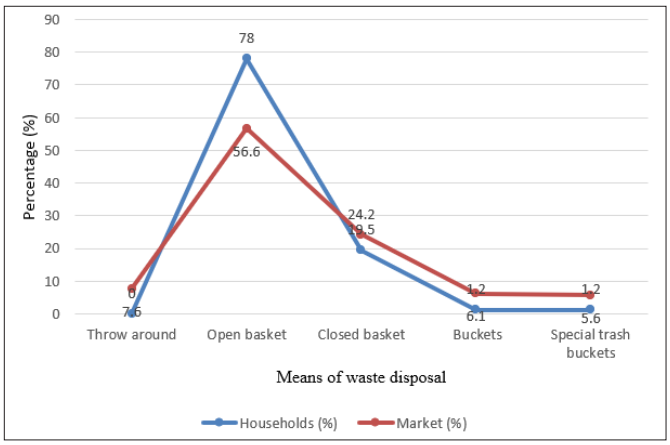

Figure 5: Methods of Waste Disposal Management in Household and Market in Makurdi

Challenges Faced by Makurdi Residents in Waste Disposal Management

Figure 6 shows on some challenges faced by Makurdi residents in waste disposal management. The results reveal that the majority of Makurdi residents (82.3%) face the challenge of lack of proper infrastructure in waste disposal management. Other significant challenges include open dumping and littering (55.1%), illegal dumping and fly-tipping (49.9%), and improper waste segregation (26.1%). Limited access to recycling facilities (21.9%) and lack of awareness (14.8%) are also notable challenges.

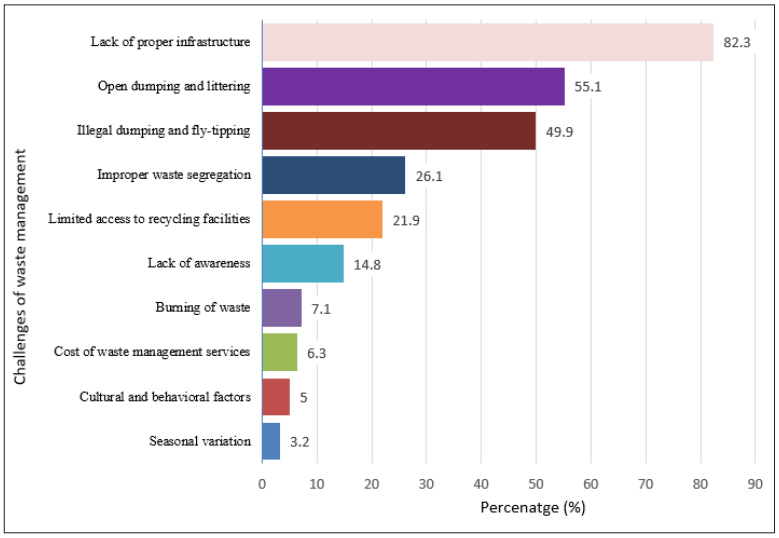

Figure 6: Challenges Faced by Makurdi Residents in Waste Disposal Management

Factors Influencing Poor Waste Management Challenges in Makurdi

Table 4 shows the factors influencing poor waste management challenges in Makurdi. The majority of respondents agreed that urbanization (76.3%), economic factors (84.4%), level of education (61.5%) and cultural practices (55.7%) influence solid waste disposal among residents. These findings suggest that addressing the challenges of urbanization, economic factors, and education levels are key to improving solid waste management in Makurdi. Targeted interventions addressing these determinants could help promote better waste disposal practices and mitigate the negative environmental and health consequences of poor waste management in the region.

Table 4: Factors influencing poor waste management challenges in Makurdi

Variable	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
	F(%)	F(%)	F(%)	F(%)	F(%)
Urbanization influences solid waste disposal among residents.	65(17.2)	289(76.3)	20(5.3)	4(1.1)	1(0.3)
Economic factors influences solid waste disposal among residents	51(13.5)	320(84.4)	8(2.1)	0(0)	0(0)
Level of education influences solid waste disposal among residents	53(14)	233(61.5)	57(15)	36(9.6)	0(0)
Cultural practices influences olid waste disposal among residents	8(2.1)	211(55.7)	89(23.5)	69(18.2)	2(0.5)

Respondents, Suggestions on Ways to Improving Waste Management Practices in Makurdi

Results on respondents, suggestions on ways to improving waste management practices in Makurdi are shown on Figure 7. The data highlighted the importance of infrastructure development (81.8%) in addressing waste management challenges. Other key factors include enforcement of regulations (53.3%), incentivizing sustainable practices (36.3%), enhanced public education (27.2%), promoting reduce and reuse (42.5%) and continuous monitoring and evaluation (49.3%). Community engagement (15.3%) and support for informal waste pickers (18.8%) also play significant roles. Integration of technology (9%) and collaboration with stakeholders (13.2%) were less prominent but still crucial. Findings emphasize the need for a comprehensive approach that incorporates multiple factors to effectively manage waste in Makurdi.

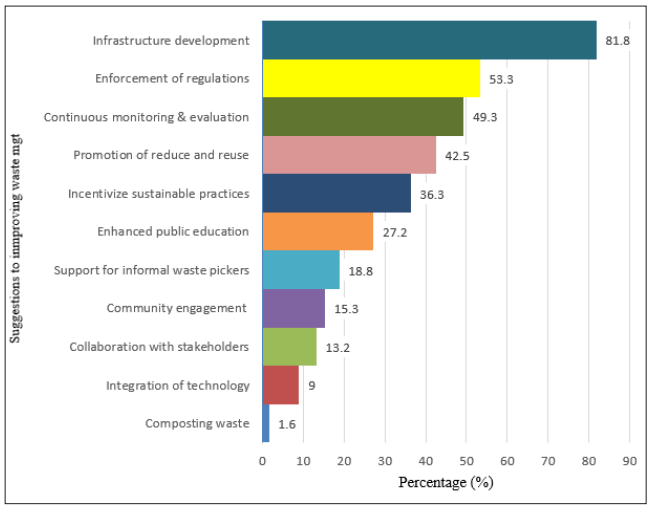

Figure 7: Respondents, Suggestions on Ways to Improving Waste Management Practices in Makurdi

Respondents' Suggestions to Local Authorities or Organizations Ways to better Management

Figure 8 presents the respondents' suggestions for local authorities or organizations to better manage waste in the region. The most prominent suggestions include establishing comprehensive waste management policies and regulations (77.6%), implementing monitoring and evaluation mechanisms (65.7%), and providing door-to-door waste collection services (50.9%). Offering incentives for waste reduction and recycling (40.1%), investing in waste collection infrastructure (37.2%), and developing public awareness campaigns (35.4%) were also identified as important measures. Promoting community-based initiatives (21.6%) and encouraging public-private partnerships (12.4%) were seen as additional strategies. Implementing innovative technologies (7.1%) and providing training for waste management staff (4.01%) were considered less critical but still relevant.

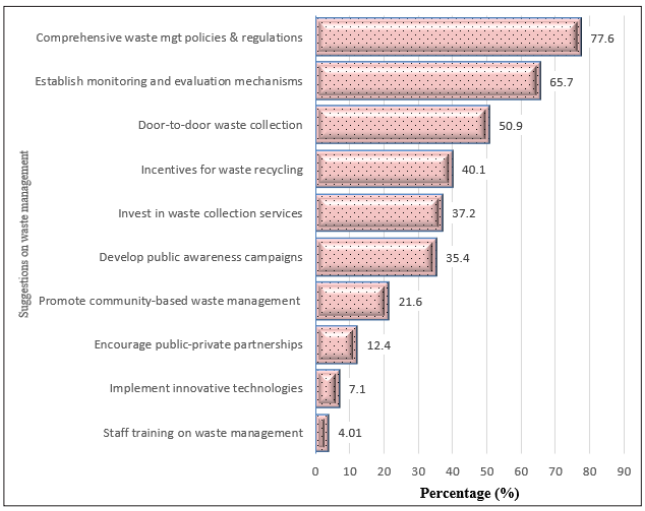

Figure 8: Respondents' Suggestions to Local Authorities or Organizations Ways to better Management

Discussion

Demographic and Household Characteristics of Respondents

The respondents were predominantly male. This aligns with studies of Onyilokwu et al., and Asen et al., that found a gender imbalance in waste management roles in Nigeria [8,16]. The mean age of respondents was 38.5 years old, indicating a working-age population involved in waste management practices. The majority of respondents identified as Christian, which reflects the religious composition of the Makurdi region. Most respondents were married, suggesting waste management activities involve both single and married individuals. The primary occupations were business, civil servant, and student. This diverse mix of professions indicates waste management is not limited to a specific vocational group. A significant proportion had non-formal education, followed by undergraduate education. This highlights the need to improve educational outreach and training on proper waste management practices.

The results of this study also provide insights into the household characteristics of respondents in Makurdi. The majority of households had 4-6 members, which is consistent with the average household size in Nigeria as reported by Omole [17]. The most common housing types in Makurdi were flats, single-room houses, and thatch houses. This diverse mix of housing reflects the urban and rural nature of the Makurdi metropolis. The findings from Makurdi are broadly consistent with other studies on waste management practices in Nigeria: A study in Lagos, Nigeria by Asen et al., also found a predominance of male respondents involved in waste management activities [16]. Research in Benue State by Aguoru and Alu, and Abah et al., highlighted the challenges of improper waste disposal, including environmental and health impacts, similar to the issues identified in Makurdi [18,19].

Waste Generation Patterns in Makurdi

Results from this research revealed important findings on waste generation patterns in Makurdi. The majority of respondents generate waste daily, indicating a high volume of waste produced in the region which agreed with the findings of Onyilokwu et al., [8]. Households primarily generate organic waste, plastics, and paper/cardboard also reported by Onyilokwu et al., and Aguoru and Alu, [8,18]. Onyilokwu et al., and Akaakohol and Aye, reported high frequency of daily waste generation and the composition of waste, with a dominance of organic and plastic materials, aligns with findings from other urban centers in Nigeria [8,20].

Respondents' Suggestions for Improved Waste Management in Makurdi

Establishing comprehensive waste management policies and regulations was the most prominent suggestion. This aligns with findings from other studies in Nigeria that have emphasized the need for robust legal frameworks to guide and enforce proper waste management practices [21,22]. Implementing monitoring and evaluation mechanisms was the second most recommended measure. Regular monitoring and evaluation are crucial for assessing the effectiveness of waste management strategies and identifying areas for improvement, as highlighted in studies across Nigeria [23,24]. Providing door-to-door waste collection services was another key suggestion by respondents. Improved waste collection coverage is essential for ensuring efficient waste management, as demonstrated in research conducted in Lagos and other parts of the country [22,25].

Offering incentives for waste reduction and recycling was seen as an important strategy to promote sustainable waste management practices. Similar recommendations have been made by Uwadiegwu and Chukwu and Onuigbo and Bello, in their studies in Nigeria, emphasizing the need to incentivize waste minimization and recycling efforts. Investing in waste collection infrastructure and developing public awareness campaigns were also identified

as crucial measures [26,27]. Adequate infrastructure and public awareness are fundamental for effective waste management, as demonstrated in various studies in Nigeria [28,29].

Promoting community-based initiatives and encouraging public-private partnerships were suggested as additional strategies. Engaging local communities and fostering collaboration between the public and private sectors have been highlighted in other studies as effective approaches for improving waste management in Nigeria [30,31].

The findings from Makurdi are broadly consistent with recommendations made in other studies on waste management in Nigeria: A study in Lagos, Nigeria by Adewole emphasized the need for comprehensive waste management policies, improved waste collection services, and public awareness campaigns to enhance waste management practices. Research in Enugu, Nigeria by Olukanni et al. highlighted the importance of monitoring and evaluation mechanisms, investment in infrastructure, and community-based initiatives for effective waste management [21,25]. Studies across Nigeria have consistently recommended the implementation of incentives for waste reduction and recycling, as well as the promotion of public-private partnerships, to drive sustainable waste management [27,31]. The suggestions made by respondents in Makurdi underscore the need for a multi-faceted approach to waste management, encompassing policy and regulatory frameworks, infrastructure development, public engagement, and innovative strategies.

Plate 1: Old GRA Solid Waste Collection

Plate 2: High Level Solid Waste Collection

Plate 3: Wurukum Solid Waste Collection

Plate 4: North bank Solid Waste Collection

Plate 5: Ankpa/Modern Road

Plate 6: Naka Road

Conclusion

This study examined the household waste management practices, challenges, and potential solutions in Makurdi, Nigeria. The findings provided insights into the demographic and household characteristics, waste generation patterns, disposal methods, and factors influencing waste management in the region. The demographic analysis revealed a predominantly male respondent population with a mean age of 38.5 years, reflecting a working-age group actively involved in waste management activities. The respondents represented diverse occupational and educational backgrounds. Most households comprised of 4-6 members, residing in a mix of urban

and rural housing types, reflecting the socioeconomic diversity of Makurdi. Waste generation patterns showed that the majority of households produce waste daily, with organic waste, plastics, and paper/cardboard constituting the bulk of the waste. This high volume of daily waste generation, coupled with the predominant organic and plastic components, mirrors trends observed in other Nigerian urban centers.

The study identified significant challenges in waste management practices in Makurdi, including insufficient infrastructure, improper waste segregation, and open dumping. Urbanization, economic constraints, education levels, and cultural practices were identified as factors influencing waste disposal behaviors. Respondents expressed concerns over the environmental impact of current waste disposal practices, with a significant proportion dissatisfied with existing waste management systems.

Suggestions for improvement emphasized the importance of infrastructure development, comprehensive waste management policies, and regulatory enforcement. Respondents also advocated for community-based initiatives, public private partnerships, and incentives to promote recycling and waste reduction. Public education campaigns and investment in monitoring and evaluation mechanisms were highlighted as critical for sustaining long-term improvements.

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