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ASSESSMENT OF WASTE MANAGEMENT PRACTICES IN THE DIFFERENT LAND USES OF ASABA, DELTA STATE, NIGERIA

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Abstract

Municipal waste management remains a recurrent issue, particularly in less developed countries. The poor waste management policies and practices have been major reasons the problem of waste persists in the developing country. The current effort was initiated to evaluate the waste management practices in Asaba, Delta State. The study deployed the multi-stage research design. A modified Likert questionnaire was deployed to gather primary data from respondents, while the Kruskal Wallis H test was used for data analysis. The results showed that more waste materials were generated from commercial activities and residences with 23.4 kg and 14.5kg per week/ household respectively. The lack of enforcement of the extant environmental laws is fecund as many of the operators of urban farms are not sanctioned or prosecuted. 20.8% of respondents agreed they sort their waste before disposing of it, while others decided to deploy very un-environmentally friendly means to manage waste. The Kruskal Wallis test was significant at $p<0.05$, indicating a significant variation in the waste management methods adopted in the different land uses. Similarly, the Kruskal Wallis test showed no significant difference in the factors of poor waste management in different land uses in Asaba. The study recommended the recycling of waste materials, the use of biodegradable materials for production and the strengthening of waste management laws.

Keywords: Municipal-Waste; Waste-Management, Land-use, Asaba, Waste-Recycling

1.1 Introduction

Waste is an unavoidable by-product of most human activity (Ozabor & Obaro, 2016; Sundramurthy et al., 2023). As population increases, and land uses become more diversified, the menace of waste becomes more deleterious in developed and developing countries (Kolawole & Iyiola, 2023). Developed countries are transitioning to the use of sustainable waste management practices to create wealth, jobs and improve public health, but the case is different in low-income countries. Kumari & Raghubanshi, (2023) argue that developing countries are still battling with the waste management question. Reports from the Basel Convention submit that "wastes are substances or objects, which are disposed of, are intended to be disposed of, and are required to be disposed by the provisions of national laws". The argument that there is no waste in nature has gained significant inroad into the literature, but there is a consensus among academics that "waste materials are not prime products that are market worthy given that the value has depleted considerably, and the initial user do not find them very relevant (Gunasekara et al., 2023).

Put differently, waste are spent products that require recycling to mutate into relevance (Olawumi et al.., 2023). Diverse sources of waste have been recognized (Ononogbo et al., 2023); waste can be generated from the extraction of raw materials, the processing of

materials, the consumption of products and other human activities (Pavlić et al., 2023). The United Nations provides that residual waste could be reused or recycled at the point of generation (Masud et al., 2023). The nature of waste takes solid, liquid, and gaseous states, others are radioactive, particularly electronic waste (Kalkanis et al., 2022), and other forms of waste from hospitals and manufacturing plants are toxic when disposed into the environment without treatment (Nwagbara et al., 2017). However, solid waste remains the most visible menace in the streets of Asaba given the defects on the landscape.

Generally, there is a consensus that the culture of waste disposal in Nigeria affects the aesthetic outlook of the streets (Famous & Adekunle, 2020). Previous reports have estimated that the volume of solid waste generated in Nigeria is increasing rapidly beyond the financial and technical capacity to manage (Salami et al., 2019). The implication is that residents in Nigerian cities resort to using methods that are not sustainable to discard waste. Solid waste management is characterized by insufficient coverage of the built environment and a lack of adequate waste collection and evacuation facilities. The quantity of solid waste generated in highly industrialized countries is higher than what is generated in developing countries (Omololu & Lawal, 2013), but there is evidenced variation in municipal solid waste management approaches given the progress made in developed countries and the waste management quagmire in low-income countries (Lee, 2020). Many developing countries including Nigeria are battling to find the right policies to manage the waste generated by the rising population (Jagun et al., 2023). The composition, density, volume of waste, proximity to waste collection and treatment plant, attitude and awareness level of the populace are the themes that characterize dialogue for finding solutions to the waste management question. Andeobu et al. (2023) averred that the waste generated in developing countries are heavier, toxic, corrosive and more pervasive than what obtains in developed countries.

Effective waste management is a critical aspect of urban development and environmental sustainability. In developing regions, the challenges associated with waste management are often exacerbated by rapid urbanization, population growth, and limited infrastructure (Agamuthu & Babel, 2023). Asaba, the capital city of Delta State in Nigeria, exemplifies these challenges (Ezemonye et al., 2016). The city has witnessed significant growth over the past few decades, leading to increased waste generation and the subsequent need for efficient waste management systems.

Studies (Singh, 2024; Kwakye et al., 2024; Dada et al., 2024) have highlighted the importance of proper waste management practices to mitigate environmental and public health risks. According to Godspower et al. (2023), improper waste disposal and inadequate waste management systems can lead to significant environmental pollution, including water and soil contamination, which poses serious health risks to the population (Ozabor & Obaro, 2016). Furthermore, Echendu, (2023) emphasizes that the effectiveness of waste management practices is crucial for sustainable urban living, as poor practices can lead to clogged drainage systems, flooding, and other infrastructural problems.

This survey aims to evaluate the current waste management practices in Asaba, Delta State, identifying key areas for improvement and potential strategies for enhancing efficiency. By examining the existing systems, this study seeks to provide a comprehensive overview of how waste is managed in Asaba, the challenges faced by the city, and the perceptions and attitudes of

its residents towards waste management. The findings from this survey will contribute to the body of knowledge necessary for developing more effective waste management policies and practices in Asaba and similar urban areas.

The lack of documentation on the volume of waste generated from different land uses in Asaba is conspicuous in the waste management literature. The rise in the population of the town has manifested in the expansion of the commercial and manufacturing sectors. The waste management culture and technology do not keep pace with population increase (Hajam et al., 2023). The utility of plastics for packaging and the lack of a framework to ensure retrieval, reduction, recycling and reuse has manifested in the ubiquity of plastic materials in the town (Oceng et al., 2023). Other third-party waste collection firms have resorted to dumping waste in surface water. Poor investment in waste treatment plants also suggests public health concerns given the toxicity of hospital waste and waste from manufacturing (Sandhu et al., 2017). The role of scavengers has not been properly investigated in the literature (Dhiab et al., 2023). It is reported that scavengers in Nigeria play remarkable role in removing abandoned vehicles that are no longer usable, but their role in waste management has not been properly documented (Ezeala et al., 2023). The foregoing backdrop provides the rationale to investigate the volume of waste generated from different land uses in Asaba. The study would specifically explore the waste management practices in Asaba. The study would culminate in the development sustainable remedies to fill the policy gaps in waste management in Asaba.

2.1 Materials and Method

This study was carried out in Asaba. This city is the capital city of Delta State. It is located on Latitudes 6° 09' 35°N & 6° 13' 48°N and longitude 6° 40' 56°E & 6° 44' 17°E (Ozabor & Ajukwu, 2023) (see figure 1). The city based on function, plays both administrative and institutional roles. These functions the city plays act as pull factors to the population and settlers in the city, to the intent that, the conurbations such as Igbuzor, Okpanam, and Illah must be developed into one city. The economic activities of these populations (such as businesses and trades, agriculture, and industries) and the wastes from domestic consumption pose serious defacement to the city, this is because of the poor waste management infrastructure available and the waste management practices of the locals. The poorly managed wastes of the city have become a serious cause for concern. This is because not only is there a serious smell coming from the many unauthorized waste dumps, but also that the wastes find their ways into the water channels and the rivers leading to serious environmental and health issues in the area (Ozabor & Obaro, 2016).

Generally, the area falls under the tropical climate type that is characterized by high temperature and rainfall. The mean temperature range is between 27°C to 30°C; while rainfall ranges between 1575 mm and 1790 mm annually. The climate characteristics produce an abundance of rainfall, which are sometimes trapped in the blocked channels, and consequently results in rodents and insets breeding (especially mosquitoes). This partly explains the spate of malaria and other diseases prevalence in the area. According to the Nigerian Population Commission (NPC, 2006) the population of Asaba was 149,603; and projecting this population with a growth rate of 3.3% the estimated population of Asaba is 268378. The concentration of this population in the Asaba area, without corresponding infrastructure to manage wastes, is a potential

for high environmental and health challenge resulting from poor waste management and pollution.

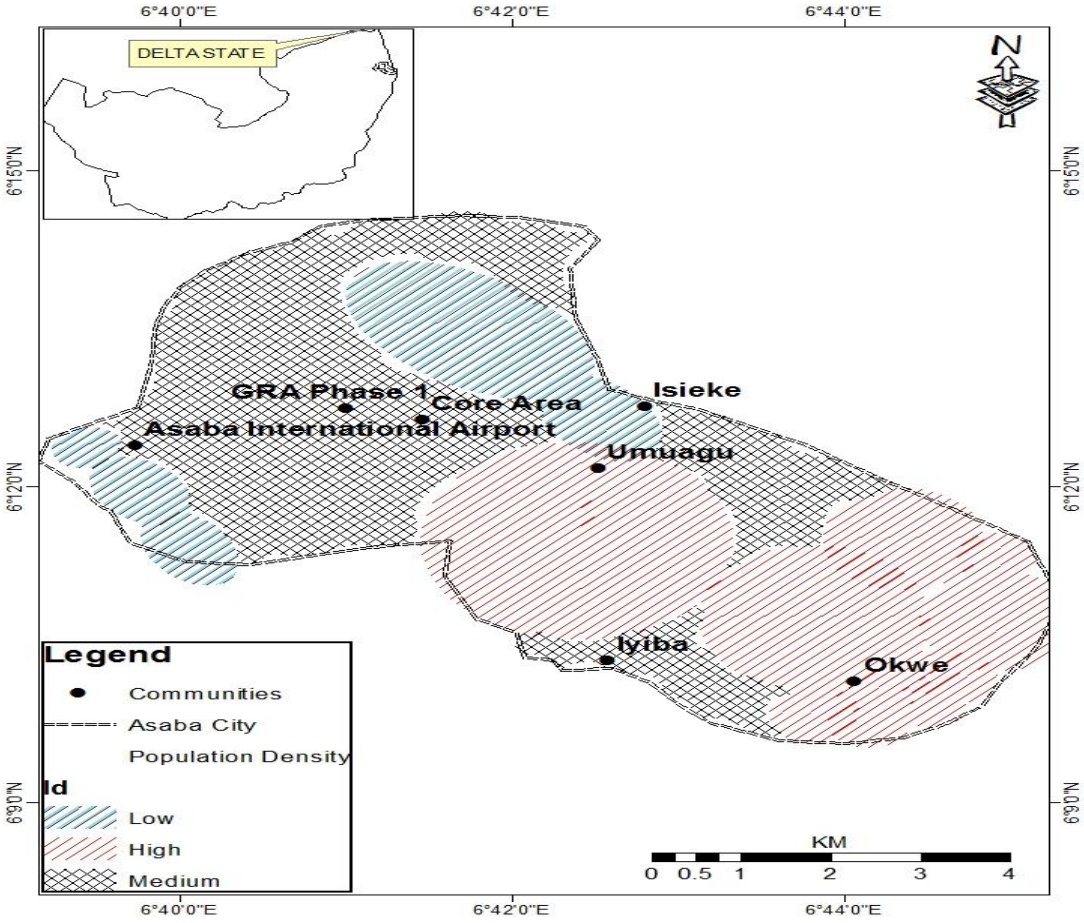

Figure 1: Asaba region and the major communities
Source: Adapted from Ministry of Lands, Surveys and Urban Development, Asaba, 2012

The study deployed the multi-stage research design. First the area was stratified into five using the land uses. The basic land uses that exist in the area (Asaba) are Industrial, residential, institutional, recreational and commercial land uses (see table 1). At the second stage the population of the land-uses were determined via enumeration (see table 2). Third stage, the Taro Yamane formula was used to determine the sample size for the study (see equation 1-4) and a population of 400 was derived.

$$\boldsymbol{TYS} = \frac{\mathrm{N}}{1+\mathrm{N}(\mathrm{e})^2}$$ ----------equation (1)

Where:
TYS = Sample size
e = error margin (0.05)

1= is a constant
N = No of total population

$$TYS = \frac{268378}{1+268378\,(0.05)^2}$$ ----------equation (2)

$$TYS = \frac{268378}{1+268378\,(0.0025)}$$ ----------equation (3)

$$TYS = \frac{268378}{671.945}$$ ----------equation (4)

TYS= 400
The sample size for the study is 400.

Fourth stage, the proportional equation was used to a lot the population derived using the Taro Yamane equation, to each of the land uses, based on the sizes of their enumerated populations (see table 2). Fifth stage was deployed after determining the sample size. Herein, the instrument (questionnaire) was administered to the respondents using the simple random techniques

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Table 1: The distribution of Population across the different land uses in Asaba

Land uses	Target population
Industrial	14264
Residential	119886
Institutional	47652
Recreational	10234
Commercial	76342
Total	**268378**

Source: Fieldwork, 2024

The distribution of population in Asaba show that residencies are more populated than other land uses. It is inferred that there are overlapping reports in the segmentation of population given that non state actors commercial areas also have their homes in the residential quarters. The recreational centres have 10,234 persons, institutional 47652, industrial 14264, and commercial 76342.

Table 2: The sample size determination using the Taro Yamane equation

Land uses	Target population	Taro Yamane Sample
Industrial	14264	21
Residential	119886	179
Institutional	47652	71
Recreational	10234	15
Commercial	76342	114
Total	**268378**	**400**

Source: Fieldwork, 2024

The inclusive criteria were adults, who were educated to at least the senior secondary school level; adults who understood what wastes is; and finally, only heads of establishments or households were contacted for the questionnaire survey. The reasons for these criteria arose because the researchers wanted to be sure of the responses gathered from the respondents and the decision maker for waste management practices (whether in a business premise or household), would be the head of households. The data for this study was the primary type only. And the instrument used for the data gathering was the modified Likert 4 scale questionnaire, which was deployed for data gathering for the study. The basic questions asked using the questionnaire were the demographic questions of respondents, sources of waste generation in Asaba region, waste management practices in the Asaba region, factors of poor wastes management in Asaba, policy options for wastes management in Asaba. The questionnaire was validated using the face content validation with the help of a psychometrician. The reliability of the questionnaire was achieved using the test re-test techniques. This was done by administering questionnaire to the same respondents within the target population within a space of two weeks. A correlation (PPMC) was fitted between the two observations and an r value of 0.92 was derived. On the strength of this relationship between the two observations, the questionnaire was deployed. The data was presented with the aid means, weighted averages and statistical diagrams. The inferential statistics deployed was the Kruskal Wallis H test. These analyses were carried out in the environment of the statistical package for the social sciences (SPSS) version 25.

3.1 Results and Discussion

3.1.1 Demographic and Socio-economic Characteristics of Respondents

The demographic and socioeconomic characteristics of the residents is presented figure 2. The sampled population are spread between male (59.5%) and female (40.5%). The residents are spread among civil servants, artisans, students and businesspeople which is also reflected in the monthly income of the people which is 30,000 to 100,000 on the average. The literacy level is high given that many of the residents have attained SSCE, OND, HND, BSC and Post graduate certification.

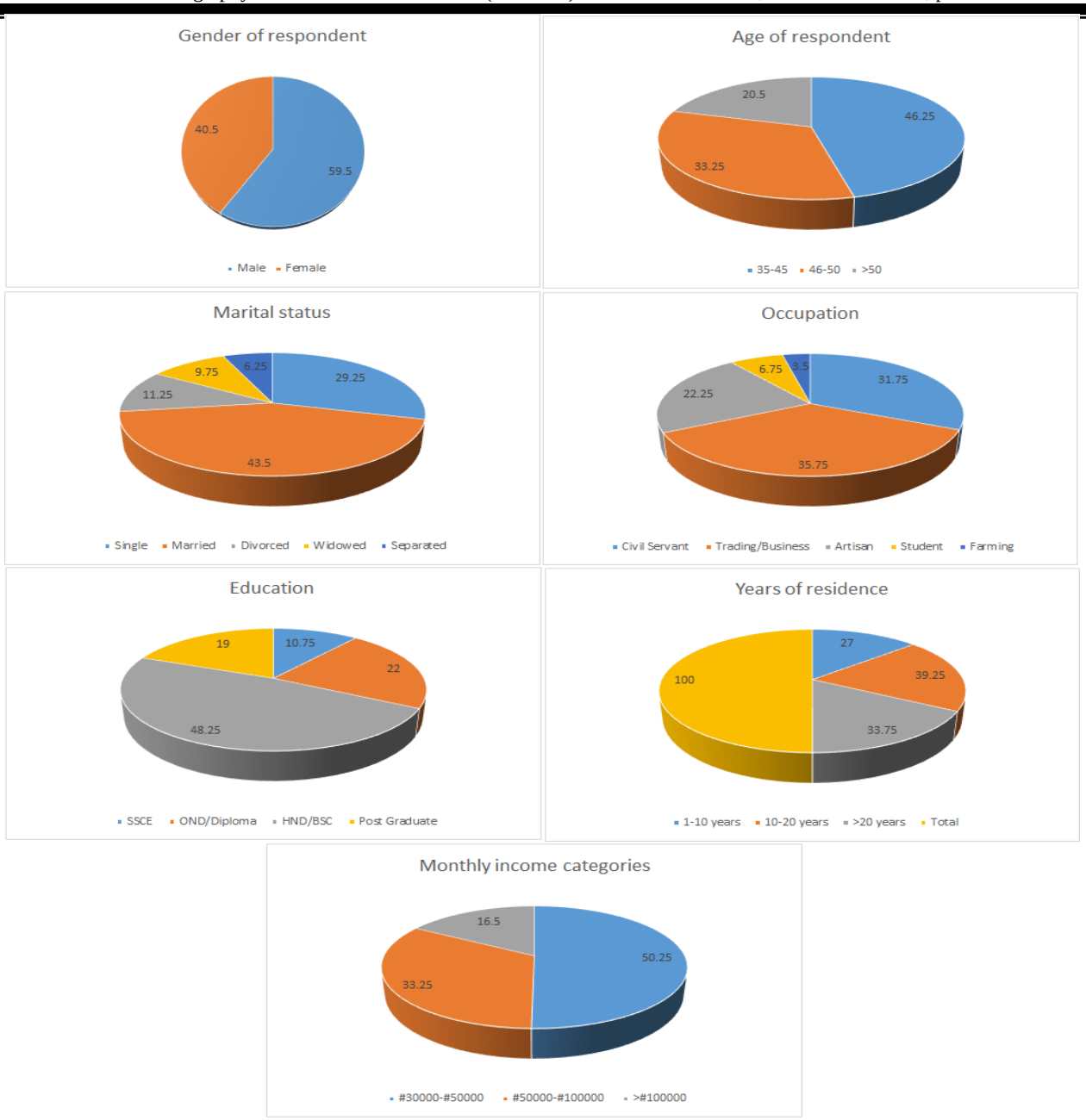

Figure 2: Demographic characteristics of the respondents in Asaba
Source: Fieldwork, 2024

The nexus between population increases and waste generation is documented in the literature, it is inferred that as population increases, the volume of waste generated from different urban land uses would increase, but what is lacking in the literature is the estimation of the quantum of waste generation from different rural and urban land uses. Previous studies have muddled up the volume of waste generated from different urban land uses such as industrial, residential, institutional and commercial as presented in Table 3.

Table 3: Estimated weight of waste generated weekly

Land uses	Total population	Estimated mean weekly waste weight in Kg per-head	Estimated waste volume in tons
Industrial	14264	10	57389.3
Residential	119886	14.5	699401.1
Institutional	47652	5.6	107364.1
Recreational	10234	4.1	16881.8
Commercial	76342	23.4	718735.7
Total	**268378**	**57.6**	1,599,772

Source: Fieldwork, 2024

Focus is also more devoted to solid waste with conspicuous neglect of the quantum of gaseous and liquid waste in the urban areas. Table 3 shows the waste generated by individuals weekly. Expectedly, more waste materials were generated from commercial activities and residencies with 23.4 and 14.5 kg respectively. This is consistent with observational studies in the town where it was noticed that the informal sector is growing rapidly, and the population increase is increasing household waste. The institutions, recreation and industrial facilities also generated considerable amount of waste. The survey also revealed that commercial activities generate 1,599,772 tons of waste monthly which is the highest, residencies 699,401 tons, and institutions 107,364 tons. Figure 2 demonstrates the nature of waste generated in the town, which reinforces the data presented in Table 3. Household waste is more prevalent, but there is evidenced urban farming activities in the fringes of the town given the perception of respondents.

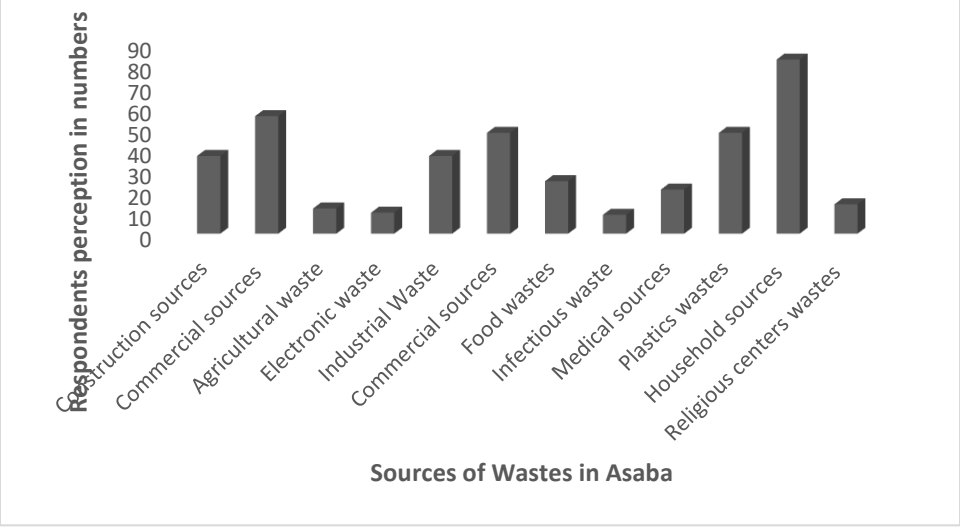

Figure 2: Sources of waste generation in Asaba
Source: Fieldwork, 2024

Previous studies on urban waste management have largely focused attention on the waste generated from commercial, industrial, and household and transportation activities. Only few studies have investigated the contribution of urban agriculture to the deterioration of the urban environment. Jamwal et al. (2023) contend that a significant increase in agricultural waste is anticipated if farming is intensified in developing countries to meet the need of the rising population. About 998 million tons of agricultural waste is produced yearly, and organic waste can amount to 80% of the total solid waste generated in the farm. Additionally, some urban dwellers go into rural and peripheral areas to practice agriculture, but process in the urban centres. This is because of the low access to the required expanse of land in urban areas which does not allow massive cultivation of crops, but poultry, fishery and of farming are practiced. In many cases, the stench oozing from these activities are intolerable and presents severe public health concerns for residents. Lack of enforcement of the extant environmental laws is fecund as many of the operators of urban farms are not sanctioned or prosecuted.

Beyond the enormous volume of waste generated from different land uses in Asaba, the outcome of this survey show consistency with previous empirical documentations that waste management practices adopted by residents, presents more daunting challenges (Table 4). It is argued that countries that are more populated have prioritized SDG 11 and 12 which sought to migrate to sustainable communities and cities within the framework of a circular economy where waste is reused but the case of Nigeria still lags behind. Perception of the population show that diverse methods are adapted to manage waste in Asaba. The practice to dump waste in undeveloped plots and unapproved waste dumps is due to the lack of investment in waste collection and evacuation facilities in residencies and other land uses.

Table 4: Waste management practices in the Asaba

Waste management practices adopted	SA (%)	A (%)	D (%)	SD (%)	Total (%)	WM	Remark
I dump my wastes in the open dumps	101(25.2)	124(31)	97(24.3)	78(19.5)	400(100)	2.6	Agree
I dump my waste in unapproved waste dump	88(22)	125(31.3)	94(23.5)	93(23.3)	400(100)	2.5	Agree
I dump my wastes on undeveloped plots near my house	91(22.8)	103(25.8)	109(27.3)	97(24.3)	400(100)	2.5	Agree
I dump my waste when it is rainy	87(21.8)	98(24.5)	124(31)	91(22.8)	400(100)	2.5	Agree
I use the services of a private waste manager	103(25.8)	114(28.5)	98(24.5)	85(21.3)	400(100)	2.6	Agree
Informer wastes collectors are used to collect my wastes	122(30.5)	109(27.3)	89(22.3)	80(20)	400(100)	2.7	Agree

I practice waste sorting and then reduce waste	22(5.5)	67(16.8)	187(46.8)	124(31)	400(100)	2.0	Disagree
My waste is reused	45(11.3)	65(16.3)	164(41)	126(31.5)	400(100)	2.1	Disagree
I sort my wastes and then give the degradable wastes to farmers	34(8.5)	49(12.3)	128(32)	189(47.3)	400(100)	1.8	Disagree
my waste is recycled	10(2.5)	14(3.5)	178(44.5)	198(49.5)	400(100)	1.6	Disagree
My waste generated is sold	46(11.5)	63(15.8)	177(44.3)	114(28.5)	400(100)	2.1	Disagree
I practice wastes composting	13(3.3)	28(7)	192(48)	167(41.8)	400(100)	1.7	Disagree

Source: Fieldwork, 2024

Studies conducted by Agabi (2021) reported from assessing environmental quality in Ughelli town that the high cost of waste evacuation by third party firms has proliferated many unapproved dump sites, and the use of undeveloped plots as waste dump. Only 8.5 % of the population in Asaba agreed strongly that they sort their waste before disposing them and this could be practiced in middle income and high-income quarters where environmental education is significant. The case of low-income residencies where literacy and per capita income is low show that waste is not sorted before they are disposed. Only 12.3% of the population agreed to sort their waste before that are evacuated. Other opinions affirmed the utility of composting and recycling which is consistent with extant literature, for example Yiougo et al. (2013) in their characterization and evaluation of the waste generation capacity of two cities (Fada N' Gourma and Ouytenga) Burkina Faso reported that empty spaces in the urban fabrics are used dump sites due to the lack of adequate waste collection and treatment plants. They also reported increase in household income manifests changes in lifestyle and consumption pattern; the implication is that more waste of different nature is generated with the potency to cause disaster for human health and the environment.

Table 5: Kruskal Wallis test showing the variation in wastes management practices across Asaba

Test Statistics[a,b]

	Waste management practices
Chi-Square	16.438
Df	4
Asymp. Sig.	.015

a. Kruskal Wallis Test
b. Grouping Variable: identifiers

The outcome of the Kruskal Wallis test as demonstrated in table 5 showed significant variation in the waste management practices in Asaba. The sig of 0.015 is <*p*- 0.05 and shows that there is a significant variation in the methods adopted in the different land uses. It is observed that all the places in Asaba are accessible by the waste collection facilities, and unapproved dump sites are reported in all the places. While different land uses generate different volume of waste, it is contingent that there is variation in environmental quality.

Table 6: Factors of poor wastes management in Asaba

Factors	SA (%)	A (%)	D (%)	SD (%)	Total (%)	WM
Poor funding	132(33)	161(40.3)	64(16)	43(10.8)	400 (100)	3.0
Poor waste management equipment	149(33.7)	187(46.8)	36(9)	28(7)	400(100)	3.1
Poor communal waste management awareness	103(25.8)	139(34.8)	92(23)	66(16.5)	400(100)	2.7
Poverty and abundance of the urban poor	118(29.5)	125(31.3)	59(14.8)	98(24.5)	400(100)	2.7
Weather and climate change issues	134(33.5)	149(37.3)	92(23)	25(6.3)	400(100)	3.0
Insincerity of waste managers	147(36.8)	194(48.5)	42(10.5)	17(4.3)	400(100)	3.2
Irregularities of wastes managers visits	188(47)	192(48)	11(2.8)	9(2.3)	400(100)	3.4
Lack of wastes management plants	145(36.3)	187(46.8)	42(10.5)	26(6.5)	400(100)	3.1
Unwillingness to pay for wastes collection	89(22.3)	98(24.5)	114(28.5)	99(24.8)	400(100)	2.4

Source: Fieldwork, 2024

Residents' perception shows that the factors that determine the poor management culture in Asaba. There is overwhelming consensus that the investment into waste management is not sufficient (Alamu et al., 2024). Poverty was linked to the methods adopted to dispose waste which is consistent with previous documentations in the literature and corroborated by Aktar, (2023). The nexus between poverty and indiscriminate waste disposal is reported. Previous studies (Ifyalem & Jakada, 2023; Suryawan & Lee, 2024) have reported that low-income residencies such as slums tend to adopt waste disposal practices that are not sustainable. Curiously, many of the residents do not find it necessary to pay for waste collection and evacuation. The lack of sincerity on the part of waste managers was also reported, and this is manifested in delay to collect and evacuate waste. residents reported that when waste are deposed in sections in front of the housing and the approved dump sites, they are left for a long time before evacuation and this period causes proliferation of diseases with attendant public health implications. The findings reported in this study agrees with that of Mavroulis et al. (2023).

Table 7: Kruskal Wallis test showing the variation in perception of the factors of poor wastes management across Asaba

Test Statistics[a,b]

	Waste management practices
Chi-Square	1.421
Df	4
Asymp. Sig.	.112

a. Kruskal Wallis Test
b. Grouping Variable: identifiers

Residents' opinion did not vary on perception of the factors of poor wastes management across Asaba**.** Outcome of the Kruskal Wallis test in Table 7, shows Sig of 0.112 which is higher than the *p* value of 0.05. The result connotes that residents share different opinion on the factors of poor waste management in different land uses and households in Asaba. Perception in this context is a function of the income status, the education and the kind of policies implemented and enforced by the authorities. Poor investment in public enlightenment to educate the populace on the environmental and health consequences of indiscriminate waste disposal has manifested in improper waste disposal methods. Evidently, the diverse opinion demonstrated in table 7 is also replicated in the kind of waste management methods adopted.

Table 8: Policy options for wastes management in Asaba

Policy options	SA (%)	A (%)	D (%)	SD (%)	Total (%)	WM
Waste reuse will help in managing solid waste in Asaba	155(38.8)	211(52.8)	23(5.8)	11(2.8)	400(100)	3.3
Waste reduction will help in managing solid waste in Asaba	144(36)	186(46.5)	48(12)	22(5.5)	400(100)	3.1
Waste repurpose will help in managing solid waste in Asaba	128(32)	197(49.3)	34(8.5)	41(10.3)	400(100)	3.0
Waste recycle will help in managing solid waste in Asaba	161(40.3)	189(47.3)	32(8)	18(4.5)	400(100)	3.2
Education of locals on the dangers of poor wastes management will help in managing solid waste in Asaba	135(33.8)	221(55.3)	24(6)	20(5)	400(100)	3.2
Developing a systematic framework for wastes management will help in managing solid waste in Asaba	119(29.8)	248(62)	21(5.3)	12(3)	400(100)	3.2
Initiating a public and private partnership for wastes management will help in managing solid waste in Asaba	128(32)	223(55.8)	18(4.5)	31(7.8)	400(100)	3.1

Source: Fieldwork, 2024

Previous studies have argued that Nigeria is not lacking the laws and regulation to checkmate indiscriminate waste management practices, but the major clog on the wheel is poor enforcement on the part of relevant agencies of government and poor compliance on the part of the populace. The data presented in table 8 show the various policy recommendations from the residents to manage waste in Asaba. Evidently, the residents are aware of the opportunities in the waste to wealth initiative and the prospects in the circular economy. Waste reuse, reduction, repurposing and recycling were recommended by the residents. Others recommended collaborative efforts to create systems that would ensure circular movement of products to waste, and from waste to products which is the cradle to the cradle model. Importantly, the residents recognized the utility of public private partnership (PPP) to ensure more efficient, effective, reliable and environmentally sensitive waste management methods. The findings agree with that of Asiedu-Ayeh et al. (2023); Famous et al. (2023). However, the suggestion to sell waste has been lacking. This is a new contribution of the article to the literature.

4. Conclusion

The waste management question has elicited diverse studies using qualitative and quantitative methods, but many of the previous studies conspicuously neglected the perception of residents. This study was conducted to evaluate the volume of waste generated in different land uses in Asaba and implication for environmental health. The study reported uniformity in the waste management practices across different residencies of the low middle- and high-income population in Asaba. It is evident that the volume of waste generated from different land uses has the potential to compromise public health and constitute serious threat to realizing SDG 11 and 12. Despite the deluge of studies conducted on the waste management question, the menace of waste remains a daunting challenge for state actors in developing countries. The case of Nigeria has assumed a deleterious manifestation, due to the outlook of Nigerians cities that have been described as among the dirtiest cities in the world. Poor implementation of findings from qualitative and quantitative studies have remained a policy gap. The case of Asaba showed consistency with previous reports with some significant exceptions. Exponential growth of Asaba is adduced to its administrative function as headquarter of Delta state in Nigeria. Influx of population into the town for education, work, recreation, business and residency has manifested in different land uses that generates waste consistently. Failure of the government to provide adequate waste collection and evacuation facilities, poor investment in waste treatment and recycling and the legislation to comply with waste management policies has manifested in clogging of drains by plastics, ubiquitous use of undeveloped plots as waste dumps and indiscriminate dumping of solid waste in the town. The effects of this linear movement of waste from the point of production to the environment is seemingly not sustainable.

5. Recommendations

Based on the findings of the research, the following recommendations are advanced in this study:

a) This study canvasses the adoption of a circular economy and the prioritization of SDG 11 and 12 which sought to migrate from the cradle to the grave linear movement of waste paradigm to the cradle movement

paradigm within the concept of the circular economy. The cyclical movement of waste engenders retrieval, reduction recycling and reuse and the benefits for the environment and the economy are inestimable.

b) Legislation would compel producers to think through the end point of the waste generated from the consumption of products.

c) The use of biodegradable materials for packaging would reduce the ubiquity of plastic waste which is currently a public menace in Asaba.

d) Enforcement of the monthly environmental sanitation exercise conducted every Saturday of the month in Delta state would improve the environmental outlook in Asaba.

e) More investment in waste treatment infrastructure is recommended to reduce the toxicity of waste generated in hospitals, factories and other land uses which are deposed in surface water and open dumps with the potential to cause environmental harm and compromise public health.

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