Characteristics of Solid Waste Generated and their StorageFacilities in Jalingo, Taraba State, Nigeria

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ABSTRACT

In recent years, managing solid waste has become one of Nigeria's biggest problems, especially in metropolitan and semi-urban areas. The problem of waste generation, handling and disposal has reached a disturbing level in Nigerian urban centers. The study analyzed solid waste management practices in Jalingo, Taraba State, Nigeria. These were achieved through characterizing the types of solid wastes generated and ascertain the solid waste storage facilities of the study area. The majority of the information used in this study came from the distribution of a questionnaire, with additional information coming from oral interviews, direct field observations, and photographs of the subject area. Tables of frequencies and percentages were used to provide answers to the study questions. Tests of the relationship's Pearson product moment correlation coefficient were conducted. The findings demonstrated that the majority of the solid waste generated in the study area was organic waste (53%). The storage facilities in the study area were dustbins, poly bags, refuse carts, and nearby refuse heaps. The Pearson product moment correlation coefficient analysis showed strong and significant differences between the solid wastes generated and sold waste storage facilities in the study area, with an alpha value of 0.05. The findings of this study showed that the characteristics of the solid waste generated are not in line with the storage facilities. This implies that not much attention has been given to solid waste management in the study area. The study also recommends public awareness to promote waste management practices; more government approved waste collection centers, awareness campaign on waste reduce, reuse, recycle and waste separation method in the study area.

Keywords: Solid Waste, Management, Characteristics, Collection, Storage, Transportation and Disposal.

INTRODUCTION

Cities, towns, and surrounding areas in Africa are under tremendous pressure as a result of the continent's growing urbanization [1, 2]. According to [3], this has increased the production of urban waste, which has negative consequences for health risks, the quality of the air, and aesthetics. It raises serious concerns that these wastes are not being appropriately managed in developing nations like Nigeria [4].

The components of the waste stream are listed according to their percentage of mass or volume in the waste composition. Although the primary components of solid waste are the same around the world, the quantities differ greatly from one nation to the next and even within a single city due to the close relationship between these variances and income levels. Waste produced in poor nations often contains three times as much organic material as waste produced in industrialized nations. Due to the widespread consumption of fresh fruits and vegetables as well as unpackaged food, the trash is also more dense and humid.

According to [5], urban solid waste is a heterogeneous material whose generation rate and content differ from location to location and season to season. In developing countries, solid waste is wetter, heavier, and more corrosive, which makes handling it more challenging, according to [6]. Papers, polythene, plastic, metals, and glasses are abundant in wealthy neighborhoods, while organic garbage predominates in low-income neighborhoods.

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However, the majority of what is often referred to as waste, which comprises goods that people discard on a daily basis, is typically categorized as municipal solid waste. According to [7] and [8], it includes all materials that are thrown away, such as packaging products, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, and batteries. According to [9], a location's population, industrialization degree, socioeconomic position, and types of commercial activity all have a significant impact on the amount and rate of solid waste generated there.

According to Areme et al. (2007), reported in [10], a substantial proportion (60–80%) of the garbage produced in the nation is made up of home and commercial waste. As a result, garbage has a high density and is therefore particularly alluring to rats, cockroaches, flies, and other pests. Additionally, according to [11], solid wastes are typically made up of intricate mixes of biodegradable and non-biodegradable materials and are normally quite diverse.

According to [12], the biodegradable nature of solid waste in Nigeria is comparable to that seen in nations with comparable economic and demographic features, such as Ghana, India, and Bangladesh. Solid waste generation, control, and disposal issues are among the most urgent environmental and public health concerns in Nigeria today [13]. The truth is that in many places, the issue of solid waste disposal has grown to be so overwhelming that even the government is overburdened, despite the fact that it is a problem that has existed for as long as mankind has existed and is closely related to the generation of waste [14]. The amount of solid waste produced is still growing faster than the agencies' capacity to raise the financial and technical resources required to counteract this expansion [15]. According to [16], Nigeria produces 0.49 kg of solid trash per person per day on average.

According to [6], the phenomenon of trash generation is universal to all communities and frequently associated with the process of urbanization, particularly when both the natural and migratory net gains are sizable. As a result, human activity in household, commercial, and industrial processes results in certain unfavorable impacts that are pollutants of all kinds. The rate and characteristics of garbage created were influenced by a number of variables. These include the intensity of economic activity, consumption habits, income levels, cultural norms, population size, and economic development levels. But because it affects each person's purchasing habits, it has been discovered that personal income has the biggest impact on trash output. According to [17] and [18], urbanization, economic conditions, living standards, and population all have an impact on how much municipal solid waste is generated.

According to [19], waste generation is influenced by the spatial variation of socio-economic and demographic characteristics as well as the degree of technological development in our environment. Without populations, there would be no pollution, and pollution is the price of progress. According to [20], the quantity and type of trash produced by a community would be greatly influenced by its economic activities. For instance, in an agrarian economy, the most typical types of waste are typically leaves, food scraps, and harvest wastes, among others. Tin cans and plastic packaging, among others, are widely used in the industrial economy. Given that garbage will inevitably be produced, protecting our ecosystem becomes of utmost importance. [21] added that when a population expansion occurs, houses tend to grow larger, which results in heavier trash production. The source of trash formation, he added, depends on a number of interrelated factors, including economic activity, consumption patterns, income levels, cultural norms, population density, and economic development levels.

Waste samples are obtained, sorted into different material categories like paper and aluminum cans, and then weighed to obtain data on waste characteristics. Typically, trucks transporting waste from residential, commercial, and self-haul sources to landfills and transfer facilities are sampled. Open solid waste dumps and improper solid waste management in Jalingo, which are prime breeding grounds for houseflies, rats, and mosquitoes, have been made worse by the failure of waste collection and sorting systems [22] and [23]. This has led to an increase in communicable diseases like fever, dysentery, diarrhea, cholera, and malaria.

Globally, the production of solid waste is rapidly increasing due to ongoing economic expansion, urbanization, and industrialization. Municipal solid waste generation was predicted to have reached 2.02 billion tons worldwide in 2006, an increase of 7% per year since 2003. According to another estimate [24], between 2007 and 2011, the amount of municipal waste generated globally increased by 37%, or about 8% each year.

According to international norms, the Beitbridge Municipality has struggled to collect solid garbage from the refuse collection stations once each week. Due to urbanization, natural population growth, and in-migration from other cities, the population of the border town has been doubling every ten years [25]. According to reports, the fleet used for collecting trash was out of date and consequently unable to handle the volume of solid garbage produced [25]. As a result, temporary garbage storage and collection facilities have been established in the suburbs. Due to waste burning at these collection stations, this has also contributed to the proliferation of disease vectors and air pollution [25].

Both urban and rural areas have issues with the generation, disposal, and management of solid waste. Every individual has the ability to produce garbage, making them part of the issue. Producing garbage is one thing, but the kind of waste produced and the methods used to manage or dispose of it are quite different. In our culture today, the rate at which solid waste is produced is frequently much higher than the ability to manage this trash. Different types of waste are produced, including waste from home, institutional, commercial, and industrial settings, among others.

In many cases, including Nigeria, the government or a public body is solely responsible for trash management. The state ministry of environment oversees sanitation and trash management in Taraba State's capital city, Jalingo. As a result, there is growing awareness of the need for a cooperative partnership between all waste stakeholders, including the public, the government, and the private sector, to work together to address the issue of solid waste, which poses serious risks to both the environment and human health.

Like the majority of urban areas in Nigeria, Jalingo is struggling with the issues brought on by the growing accumulations of solid garbage in its surroundings. In Jalingo City, it was found that due to population pressure, rapid urbanization has exceeded the financial means for the provision and administration of basic infrastructure. Because of insufficient logistics for managing solid waste and people's negative attitudes toward environmental quality, increased solid waste output is also having an impact on the city's citizens' quality of life. This battle can only be won if the community, businesses, traders, institutions, and residents of Jalingo metropolis come to understand that they are all stakeholders in solid waste management rather than believing that garbage disposal is the sole province of the government.

Lack of adequate solid waste management is one of the main causes of poor garbage collection and management in Jalingo. Problems in coordination and collaboration among solid waste management players, including the public (government), private, and community sectors, are the cause of the low participation.

This study aims to investigate the procedures for collecting and classifying solid trash in the Nigerian state of Taraba's Jalingo Local Government Area. The existing state of waste classification and its improvements must be made to the city's solid waste collection.

Specific objectives

This study's objective is to evaluate the qualities of solid waste produced and storage facilities in the Jalingo local government region in light of management problems and opportunities. Examining the solid waste composition and storage facilities in the Jalingo Local Government Area is the specific goal.

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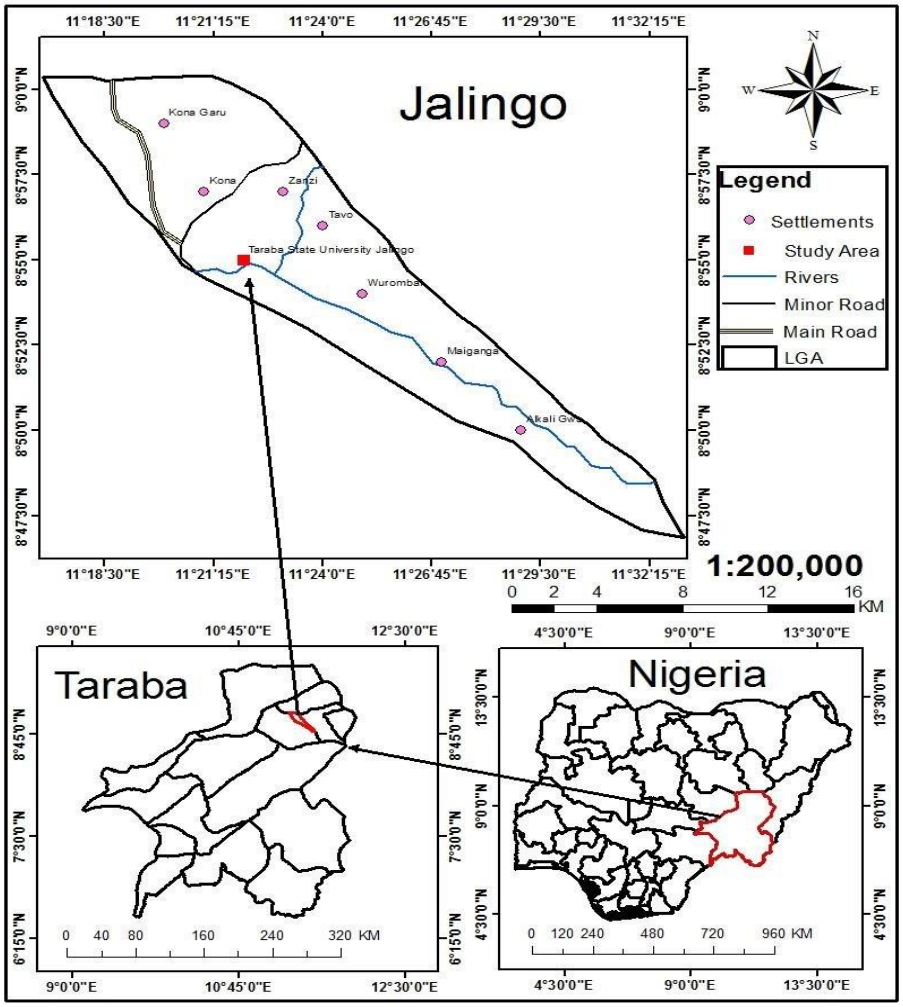
MATERIALS AND METHODS

Study area

The state of Jalingo Taraba is in the northeastern region of Nigeria. The Jalingo Local Government Area, with a land area of roughly 204,073 km2 and an elevation of 351 meters above sea level, is located between latitudes 08° 43'N and 09° 07'N of the equator and longitudes 10° 50'E and 11° 25'E of the Greenwich meridian. According to [26], Jalingo is bordered to the north by the Ardo-Kola Local Government Area, to the east by the Yorro Local Government Area, and to the south and west by the Lau Local Government Area. Ten administrative wards (Turaki A, Turaki B, Sintali A, Sintali B, Majidadi, Sarkin Dawaki, Kachalla Sembe, Barade, Kona, and Yelwa) make up the city's political and administrative structure.

The majority of solid trash in the form of packaging materials, including polythene, cans, bottles, and cardboard boxes, is produced by cross-border activity. Banking, retail, and the freight industry make up the majority of the town's formal commerce, while auto mechanics, food vendors selling things like cell phone accessories, and apparel flea markets dominate the informal sector [25].

Figure 1: The Study Area



Source: Geography Department Taraba State University Jalingo, (2022).

Study design

To analyze and contrast estimates of the different types of solid waste created and solid waste storage

facilities in the study area, a cross-sectional survey was conducted. The study's design was appropriate since it made it possible to ascertain the connections between the different categories of solid waste produced and the different types of solid waste storage facilities employed in the study area. This kind of study provided an overall picture of the traits and regularity of trash creation, waste collection, and storage facilities related to solid waste management in the study area.

Study population and sampling

The estimated population of the ten administrative wards that make up the Jalingo Local Government Area is 266,841 [27]. These wards are Barade, Kona, Majidadi, Sarkin-Dawaki, Mayo-Goi, Turaki A, Turaki B, Kachalla-Sembe, Abbare-Yelwa, and Sintali. However, this study only examines five of the 10 wards in the Jalingo Local Government Area, namely Barade, Kona, Majidadi, Sarkin-Dawaki, and Mayo-Goi, which have a combined estimated population of 88,014 people.

The population of the study area is used to determine the sample size. The sample size for an area with a population between 75,000 and 999,999 was 400, according to the Kreijcie and Morgan (1970) table of sample size determination.

$$n = \frac{N}{1 + N\,(e)2}$$

Where n = sample size

N = Total Population

$(e)^2$ = the level of precision

(e) = 5% (0.05)

$$n = \frac{88104}{1+88104 \text{ X } 0.0025} \quad n = \frac{88104}{220.3} = 400$$

Using the formula above, 400 respondents were randomly selected from the 88,014 total population of the study region (Table 2.1). The technique of purposive random sampling was later adopted because it was seen to be more suitable for locating cases for in-depth research. The respondents in the study area were given copies of the questionnaire at random. Taraba State's 3% growth rate was used in the forecast of the National Population Commission's (2006) population census statistic to 2021 (NPC, 2021).

$$n = \frac{88104}{1+88104 \text{ X } 0.0025} \quad n = \frac{88104}{220.3} = 400$$

Table 2.1: List of Selected Wards and Questionnaire Administered

S/N	Wards	2006 Estimated Population	2021 Estimated Population	Questionnaire Copies
1	Barade	15,891	19,864	90
2	Kona	17,981	22,476	102
3	Majidadi	10,687	13,359	61
4	Sarkin-Dawaki	11,493	14,366	65
5	Mayo Goi	14,359	17,949	82
	Total	**70,411**	**88,014**	**400**

Source: National Population Commission (NPC, 2021).

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Questionnaire Return Rates from the Respondents

This shows the actual number of questionnaires that were completed, properly filled out by the respondents, and collated for the study. Table 2.1 shows that out of the 400 copies of questionnaire that were administered, 11 were not returned, 389 were recovered, 10 were not properly filled and were later discarded due to errors, that is to say 21 questionnaires were not used, leaving a total of 379 questionnaires on which analysis was based. This represents about 94.6% of the questionnaires distributed**.**

Table 2.2: Questionnaire Return Rates from the Respondents

Sampled Wards	NO of Q Issued	NO of Q Not Returned	NO of Q Returned	NO of Q Not Properly Filled	NO of Q Properly Filled	% of Properly Filled
Barade	90	3	87	2	85	22.4
Kona	102	3	99	2	97	25.6
Majidadi	61	2	59	2	57	15.0
Sarkin Dawaki	65	1	64	2	62	16.4
Mayo Goi	82	2	80	2	78	20.6
Total	**400**	**11**	**389**	**10**	**379**	**100**

Source: Author's Fieldwork (2021).

Data Collection and Tools

Data were primarily sourced using a questionnaire administered to waste generators, preliminary field investigations, and face-to-face interviews with TASEPA and DWEJ staff. 400 copies of the structured questionnaire were distributed randomly in households and shops in Jalingo. Data collected through a questionnaire survey were on the following variables: demographic and socioeconomic characteristics of the respondents, characteristics of solid waste generated and waste storage facilities of the study area.

The questionnaire was piloted with the households in Jalingo Township, and no adjustments were made. Heads of households or adult members who were 18 years of age and older and gave their written consent to participate in the study were surveyed. The questionnaire had pre-determined responses, from which the respondents would then choose yes or no options depending on whether they had experienced the solid waste storage facilities. There were also multiple choices for the different age groups regarding household waste management practices, which may or may not predispose the respondents to the health hazards.

Data Analysis

Data were analyzed using descriptive statistical techniques, and the Pearson product moment correlation coefficient was used to test for statistically significant differences in solid waste management practices in the study area.

Data Presentation

The majority of the data were presented using tables, percentages, plates, and maps.

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RESULTS

Respondents profile

The overall response rate was 84% as 389 of the 400 study participants successfully responded to the questionnaire. Females constituted about 55% of the respondents and this trend was similar across all five sampling sites. The majority of the respondents were in the age group of 31–40 years which constitutes 40%. 65% of the respondents were married couples, while family size one to three has the highest respondent of 36%. Of these respondents, about 37% of them were civil servants who earned 22,000 to 37,000 naira monthly. These findings are presented in Table 3.1.

Table 3.1 Respondents Profile

Sex of the Respondents	**Frequency**	**Percentage %**
Female	209	55.1
Male	170	44.9
Total	**379**	**100**
Age Distribution	**Frequency**	**Percentage %**
Below 20	38	10
20 – 30	93	24.5
31 – 40	152	40.2
41 – 50	87	22.9
Above 50	9	2.4
Total	**379**	**100**
Marital Status	**Frequency**	**Percentage %**
Single	86	22.7
Married	246	64.9
Divorced	17	4.5
Widowed	30	7.9
Total	**379**	**100**
Occupation	**Frequency**	**Percentage %**
Farmers	81	21.4
Businessmen	75	19.8
Civil Servant	139	36.7
House Wife	38	10
Others	46	12.1
Total	**379**	**100**

Source: Author's Fieldwork (2021).

Characteristics of Solid Waste Generated in the Study Area

The results on the characteristics of solid waste generated in the study area are shown in Table 3.2. From the study, it was observed that about 53.3% of all the solid waste generated in the study area was mainly organic waste in nature, while 8.4%, 26.1%, 10.3%, and 1.9% were from paper as shown in Plate I, plastic waste as shown in Plate II, metal waste as shown in Plate III, and textile wastes, respectively. The paper waste can be attributed to the presence of Peacock College in the study Area, as students tend to generate paper waste from photocopied materials and other sources. This means that a very large percentage of the solid wastes

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generated in the study area are biodegradable (61.7%) compared to the non-biodegradable (38.3%) wastes generated in the study area. This means that the biodegradable waste can be decomposed and used for other purposes.

Table 3.2: Characteristics of Solid Waste Generated in the Study Area

Types of Waste	Frequency	Percentage (%)
Organic (food and fruit remnants)	202	53.3
Paper and Cardboard	32	8.4
Plastics and Nylon bags	99	26.1
Metal and Tin cans	39	10.3
Textile and other Materials	7	1.9
Total	**379**	**100**

Source: Author's Fieldwork (2021).

[28], [29], and [30], note that leaves, contaminated water, polythene bags, paper, food waste, tins, metal, glass, and other materials make up the majority of the waste in urban centers, the majority of which decompose to release a very unsettling odor.

Plate I: Paper Waste in the Study Area

Source: Author's Fieldwork (2021).

Plate II: Plastic Waste in the Study Area

Source: Author's Fieldwork (2021).

Plate III: Metal Waste in the Study Area.

Source: Author's Fieldwork (2021).

Solid Waste Storage Facilities

In order to achieve the second objective of the study, the results on the various storage facilities employed in the study area are shown in table 3.3. The reports are as follows 35% of the respondents used dustbin as their storage facility, 16% used polybag for waste storage, 22% used refuse cart for their waste storage while 26% used nearby refuse heap.

Table 3.3: Solid Waste Storage Facilities

Facilities	Frequency	Percentage
Dustbin	134	35.3
Polybag	62	16.4
Refuse Cart	83	21.9
Nearby Refuse Heap	98	25.9
Others	2	0.5
Total	**379**	**100**

Source: Author's Fieldwork (2021).

Given the abundance of trash found there, the implication is that the city is quickly turning into a garbage city. Waste management plans should be adequately available and contain private sector involvement in their management.

Relationship between Waste Generated and Storage Facilities

The correlation coefficient between types of solid waste generation and solid waste storage facilities in the study area is presented in Table 3.4.

Table 3.4: Correlation Coefficient on Waste Generated and Storage Facilities

		Waste Generated	Storage Facilities
Waste Generated	Pearson Correlation	1	.806*
	Sig. (2-tailed)		0.99
	N	5	5

Storage Facilities	Pearson Correlation	.806*	0.592
	Sig. (2-tailed)	0.99	
	N	5	5

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

There is a significant, strong positive correlation between the solid waste generated and the storage facilities in the study area ($r(5) = .806$, $p < 0.05$). It therefore means that the higher the solid waste generated in the study area, the more likely the increase in the solid waste storage facilities in the study area.

CONCLUSION

The findings from an examination of the characteristics of the solid waste produced in Jalingo City and the locations where it was stored suggest that, despite an increase in population, consumption patterns and lifestyles are evolving. Jalingo's procedures, means of waste collection, storage, separation, transportation, and labor needed for waste evacuation have not worked as well as they could have. The agency in charge of trash management has been doing a worse job of carrying out its responsibilities, and the degree of politics hasn't helped either. Solid waste management in Jalingo is hampered by a number of factors, such as inadequate and inefficient management and public attitudes regarding the city's garbage disposal methods. In order to provide proper collection, storage, separation, transportation, and disposal of waste and prevent the spread of epidemics that could have a negative impact on the city's population's health, public-private partnerships must be implemented.

RECOMMENDATIONS

Based on the findings of the research, the following recommendations were put forward to improve waste management practices in study area:

1. There should be a policy prescription in order to raise awareness, promote knowledge, and motivate households with regards to waste management practices in the study areas.
2. A government-approved communal dumpsite or waste collection center should be provided in the Jalingo community.
3. Awareness campaign on waste reduce, reuse, recycle should carried out in the study area.
4. Waste separation method should introduce to separate biodegradable waste and non-biodegradable waste in the study area.
5. More waste deposits should be made available in every ward to reduce open dumping, and the waste have to be evacuated frequently.

Lastly, each household should cooperate with board officials in ensuring that there are no refuse dumps around their premises.

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