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Waste Generation and Trend among Households in Bida Town

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Abstract

Urbanization bring about an increase in population with consequent increase in municipal solid waste generation in Bida, a town with significance economic, social, cultural, environmental, and national tourism influence as heritage setting. However, there is dearth of basic data for solid waste management design. This study was carried out to quantify and characterize the solid waste generated by households within Bida town. A total of 400 households were sampled using a stratified random techniques base on 'core traditional' and 'modern' settings. The study employed experimental approach involves the weighing of household's daily solid waste generation three consecutive days for four months using weighing Scale after sorting. The per capita waste generation and future waste generation was estimated. The result reveals that 1,085 kg of solid wastes was generated at the average generation rate of 0.47 kg/capita/day in Bida. This indicated that based on this rate the town have generated 150.49 metric tons of solid waste per day, equivalent to 55million tons in that same year (2020). The scenario is estimated to increase to 299.58 metric tons per day at an average generation rate of 0.64kg/capita and 1.09

billion tons for the year 2030 based on projected population of 468,096 of the town. This study revealed rapid increase in the rate of household solid waste generation in Bida, thus recommends modalities to exploit recycling option to or by converting solid waste to energy thus a good solution for waste management.

Keywords: Urbanization, Waste generation, Municipal Solid waste management, Household waste, Bida town.

Introduction

Urbanization brings about an increase in population with consequent increase in municipal solid waste generation in Bida, a town with significance economic, social, cultural, environmental, and national tourism influence as heritage setting. Increase in waste generation according to Pardini et al., (2019) is a significant challenge to most urban centres globally, and a menace to the fast growing cities with rapid population. Report on global review of solid waste management (2019) revealed that the rate at which municipal solid waste grows is far ahead of the rate of urbanization. It further stated that, in the past ten years, about 2.9 billion urban residents generated 0.64 kg of municipal solid waste per person per day (0.68 billion tons per day). However, this amount has increased with about 3 billion urban residents generating 1.2 kg per person per day (1.3 billion tons per year), and it is expected that by the year 2025, as urban residents increase to 4.3 billion, solid waste generation will increase by 1.42 kg/capita/day amount to 2.2 billion tons per year. Solid waste generation is one of the major environmental problem (Osra et al., 2021), and growing rapidly with the rate beyond the reach of the city authorities to control for a sustainable urban environment (Umunna, 2011). About 25 million tons of solid waste are generated yearly in Nigeria at the rate between 0.66kg/capita/day in cities and 0.44kg/capita/day in rural areas as against 0.7 – 1.8kg/cap/day in developed countries of the world (Beatrice and Jussi, 2013). This amount increases daily due to the rapid population increase and modern development, yet there is dearth of data on the rate and composition coupled with poor management (Massoud et al., 2019). This study, therefore, quantify and characterize the solid waste generation among households within Bida town.

Quantification of the solid waste generation within town is critical in determination of appropriate methods of waste management within that municipality (Ephantus et al., 2021). This information can also be useful in assessing whether this waste is sufficient to put up a waste to energy conversion facility within the municipality (Cudjoe et al., 2021).

Study Area

Bida town is traditional emirate and a Local Government Headquarters in Niger state. Its located-on latitude between 6°01'E and 6.017oE of Greenwich Meridian and longitude 9°05'N and 9.08oN of the equator, along A124 highway that linked Ilorin to Minna and Abuja. It has population of 188,181 people based on 2006 National Population Census, and covered a land area of about 51sq km. The major ethnic group found in this city is Nupe, with other tribes from all part of the country. Bida is about 240 kilometres to Abuja (Federal Capital Territory) and situated to the South western part of Minna (state capital). It stretches along Bako River, which is a minor offset of the River Niger on the vertex of roads from Jebba, Zungeru, and Agaie. Bida is a home to Federal institutions like Federal Polytechnic Bida, Edusoko University, Federal Medical Centre and proposed University of Health Technology.

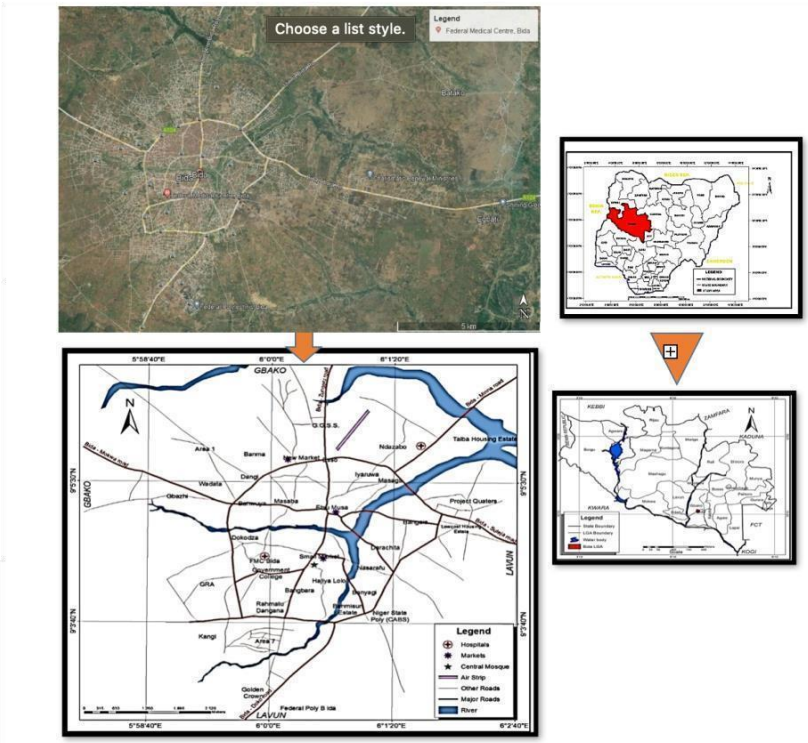

Figure 1: Study Area

Material and Methods

The study sampled 400 households solid waste from eight selected wards out of fourteen administrative wards in Bida town based on strata _core traditional‘ and _modern‘ settings. The waste weighing was carried out among the selected households for three consecutive days for four months. Weighing procedures were conducted by four teams each consist of three persons. The study measured the amount of waste collected directly from the households‘ solid waste generation after hand sorting, weighed and recorded in a site-specific approach using Mettler Toledo Weighing Platform Scale. The sampled solid waste characteristics was

determined by sorting and weighing of the components of waste stream directly measured in the field by separating based on its components, namely food waste, polythene, paper, and others (e.g., sand, ashes). Percent composition of waste was obtained from the weight of each component of waste that have been weighed and divided by the total weight of the overall waste. The per capita waste generation was then estimated by dividing the total waste generated with the number of people living in that same household for that day (Przewoźna et al., 2020; Palanivel & Sulaiman, 2014). The future waste generation thus, is determined by multiplying the average generation rate by the total population and then divide by 1000(Suryati et al, 2021).

$$\text{Per Capita Waste Generation per day} = \frac{\text{weight or volume of waste (kg)/day}}{\text{area or number of waste producer (m2or person}}$$

Results and Discussion

The households waste generations sampled from eight (8) randomly selected wards 4-modern and 4 in core traditional areas in Bida were analysed. A total of 1,085kg of solid wastes generated was recorded. According to the study, the average per capita waste generation for each ward was 0.47 kg/person/day by weight among households in Bida (Table 1). The highest solid waste generation rate was observed in the core traditional area. Umaru Majigi _A‘ (0.56 kg) and Umaru Majigi _B‘ (0.55 kg) with average household size of 5 and 6 generate solid waste per person per day respectively. While in the modern setting, Cheniyan and Kyari wards both with the highest average household size of 7 persons generated 0.34kg and 0.39kg solid waste per person per day respectively. This finding revealed that number of persons does not really determine the rate of waste generation in a setting (Figure 1). The people in the modern areas in Bida use more of the processed food materials than those in the core traditional setting where less food waste is produced but more of other waste products generated (Figure 2). This finding in comparison was within the generation rate reported in Nigeria and other developing countries. Ogwueke (2009) found that 0.48kg of daily solid waste was generated in Makurdi, Nnsuka (0.44kg), Ibadan (0.51kg), and Kano (0.56kg). In the developing world, studies

revealed that East African countries of Kenya, Tanzania and Uganda generate between 0.26 – 0.78 kg /per/day (Okot Okunu, 2012), Vietnam generates 0.76 kg/per/day (Trang et al, 2017), Pakistan generates between 0.33 and 0.46 kg/per/day for low and high income respectively (Ilyas et al, 2017), Bahir Dar City generates 0.22kg/per/day (Wegedie, 2018).

Table 1: Average Daily Generation Rate and Composition

Wards	Settings	Waste Components (%)				Average household size (person)	Average Total weight (kg)	Average Generation rate (kg)
		Food	Polythene/ cellophane	paper	Others (ash/sand)			
Bariki	MA	50	20	15	15	5.0	2.2	0.44
Cheniyan	MA	40	25	15	20	7.0	2.4	0.34
Kyari	MA	45	20	15	20	7.0	2.7	0.39
Wadata	MA	40	20	25	15	5.0	2.6	0.52
Masaba 'A'	CT	55	10	10	25	6.0	2.7	0.45
Masaba 'B'	CT	60	10	10	20	6.0	2.9	0.48
Umaru Majigi A'	CT	65	10	10	15	5.0	2.8	0.56
Umaru Majigi 'B'	CT	60	10	10	20	6.0	3.3	0.55
Grand Total		415	125	110	150	47	21.6	

Note:(MA) = Modern Areas, (CA) = Core-Traditional Area.

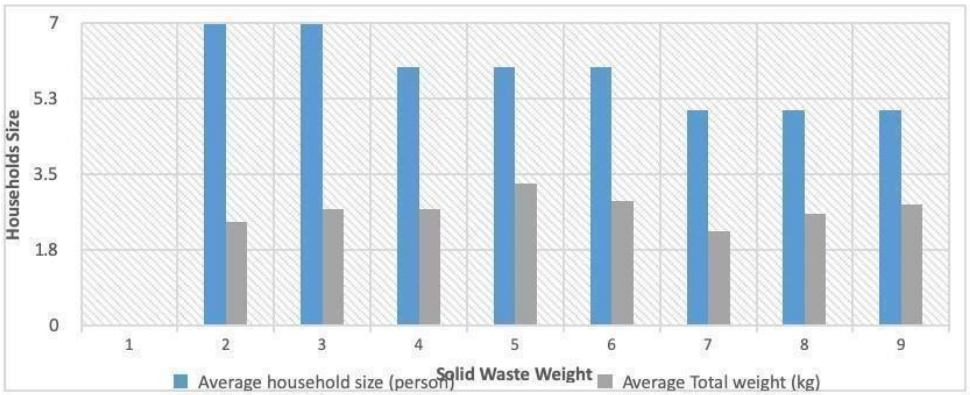

Figure 1: The sum Average Solid Waste Generation in Bida

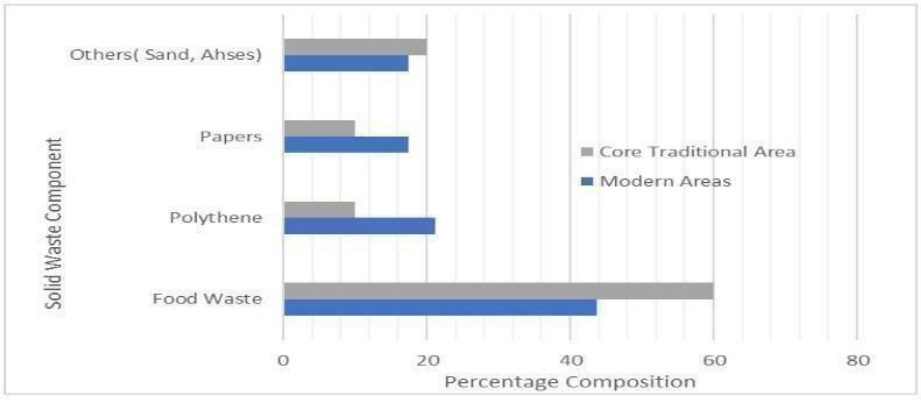

Figure 2: Composition of Solid Waste Generation by Setting in Bida

Based on the composition of waste from both (Modern and Core traditional areas) in the study area, four different fractions of waste have been segregated in the collected sample. The dominant waste was organic waste (73.8%) and non-organic waste account for 26.2% of the total weight collected. The results clearly indicate that the composition of organic waste was dominated by food waste in both modern and core-traditional areas. Food waste mainly includes leftover food residue, vegetable waste, leaves and decayed vegetables, which accounts for 60% and 44% by weight in both settings. The results have clearly shown that huge quantities of food waste are generated from household in Bida. The Figure 3 follows a study on waste generation and composition conducted in previous studies reported the in developing countries (Adelodun et al., 2021; Utako Aoike, 2019; Dangi et al., 2011).

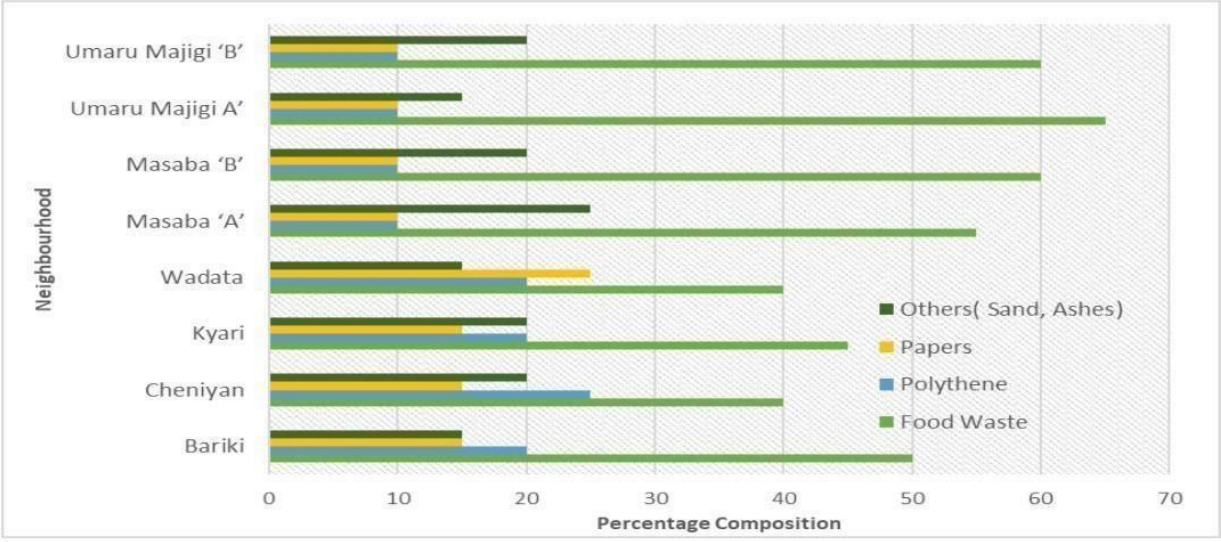

Figure 3: Component of Solid Waste Generated by Neighbourhood



Plate 1: Waste Dumped in Public Open Space in Masaba 'A' and 'B' Wards in Bida

Trend of Solid Waste Generation in Bida

Trend of waste generated in Bida (Plate 1) was assessed and projection made to understand future scenario of households' solid waste generation within the town. The Average daily generation rate estimated from the analysis was 0.46kg/person/day, with the projected population of Bida (320,212) based on the growth rate of 3.87%, the rate of increase in domestic solid waste generation was estimated to be 1.87%. The future waste generation therefore was estimated by multiplying the Average Generation rate by the total population and then divide by 1000 (Table 2). The Figure 4 indicated that at the end of year 2020, Bida with the total population of 320,212 had generated 150.49 metric tons of solid waste per day at the rate of 0.47kg/capita, equivalent to 0.55million tons in that same year. This value is expected to increase to 299.58 metric tons per day at an average generation rate of 0.64kg/capita amounting to 1.09 million tons for the year 2030 based on projected population of 468,096.

Year	Population	Generation Rate	Total waste generated	
			Per day (Metric ton)	Per year (Million ton)
2020	320,212	0.47	150.49	0.55
2021	332,604	0.48	159.60	0.58
2022	345,475	0.49	169.23	0.61
2023	358,844	0.51	183.01	0.66
2024	372,731	0.52	193.82	0.70
2025	387,155	0.54	209.06	0.76
2026	402,137	0.56	225.19	0.82
2027	417,700	0.58	242.26	0.88
2028	433,865	0.60	260.32	0.95
2029	450,656	0.61	274.90	1.00
2030	468,096	0.64	299.58	1.09

Table 2: Ten (10) Years Prediction of Daily Solid Waste Generation in Bida.

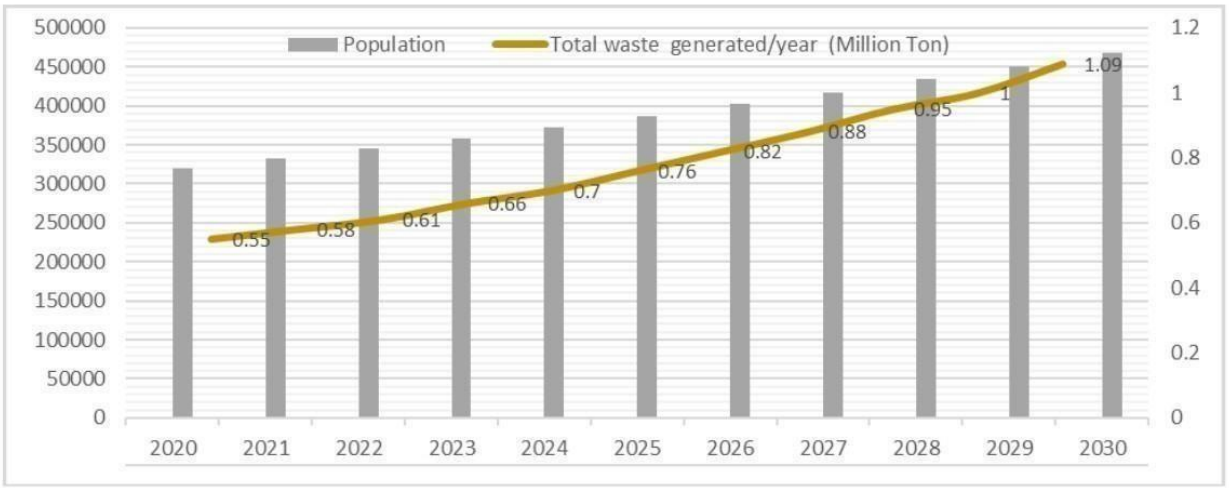

Figure 4: The Trend of Solid Waste Generation in Bida

Conclusion

As the world moves toward its urban future couple with the present urban agglomerations, the amount of municipal solid waste is rapidly increasing. The generation of municipal solid waste is increasing due to the increased population density, consumption pattern, life style behaviour and economic development etc. This study revealed that households waste generated within Bida was 0.47kg daily per person and it was estimated that by the year 2030 it will increase to 0.64kg per person and largest percentage of which was organic materials such as food waste (mixed) and paper waste and inorganic waste like polythene and ashes. The waste stream has higher percentage of organic waste compared to the inorganic. The high amount of organic waste can be effectively used as organic manure through composting whereas recycling and energy recovery would be an appropriate option for the inorganic fraction of the waste stream. This waste generated in Bida has energy potential if appropriate waste to energy technologies are used. Waste to energy is a proven, environmentally sound process that provides reliable electricity generation and has been extensively used in developed nations including Europe and Asia (Lees et al., 2008). Solid wastes are a good source of energy however, this depends upon the moisture and energy content of waste material (Rao et al., 2010). According to Sastry et al., (2009), combusted thermal treatment of Solid wastes is proven to generate about 500 to 600 KWh capacity of electricity per ton. The study therefore, recommends modalities to exploit recycling option or converting solid waste to energy thus a good solution for waste management in Bida town.

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