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SOLID WASTE GENERATION RATE FOR EVBOTUBU COMMUNITY IN EDO STATE OF NIGERIA

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Abstract One challenge facing solid waste management is the absence of correct information on solid waste generation rate. This results in poor design computation of disposal systems and further leads to underperformance of the management systems. This wok therefore focused on solid waste generation rate in Evbotubu Community, Edo state of Nigeria. Thirty (30) representative houses were randomly selected. Mass of waste generated on weekly bases and on monthly bases was determine from the first week of January, 2019 to last week in December, 2019. The population was also sampled. The calculated average generation rate of 0.45 kg/p/d fell within the estimated range of 0.4 – 0.6 kg/p/d by United Nations Environmental Program for sub – urban communities of developing countries. This information is important for effective planning, design and management of solid waste disposal system in the community.
Keywords: Solid Waste, Evbotubu, Waste Management, Waste Generation.

Introduction

Ineffective solid waste management is a problem plaguing the environments of urban dwellings in Nigeria. This is intrinsic to high volume of waste generated (Amasuomo and Baird, 2017; Ezeudu *et al.*, 2020), lack of management funding and lack expertise on the part of management personnel (Amasuomo and Baird, 2017). The menace of solid wastes managements is a common challenge faced in urban communities in the globe (Amasuomo and Baird, 2017; Ezeudu *et al.*, 2020). This current management level is considered ineffective in numerous African communities - rural and urban (World Health Organization - WHO, 1997).

Lack of good solid waste management system results in numerous problems - among which are health challenges, damage to environmental aesthetics, air quality degradation, flooding of highways and useful land mass, water contamination, and release of objectionable gases rendering ecosystems disharmonious and sickly (Ndukwe *et al*., 2019; Zainu and Songip, 2017). Some diseases associated with poor solid waste management are cholera, typhoid fever, malaria and laser fever (Sincero and Sincero, 2016). In light of these, sustainable solid waste management system is a solution. The engineering approach to this management is recommended.

The engineering approach to solid waste management include generation; collection; transportation and transshipment; segregation, the 4Rs (recovery, reuse, recycling and reduction); treatment and disposal. Sustainable approach to solid waste management does yield dividends such as environmental sustainability, economic advancement, sustainable social and community development (Eleje *et al*.; 2017).

One of the components of challenge facing solid waste management is the absence of correct information on solid waste generation rate (Intharathirat *et al.*, 2015). This results in poor design computation of disposal systems and further leads to underperformance of the management systems; and ultimately, wrong disposal of solid waste (Intharathirat *et al.*, 2015; Sincero and Sincero, 2016). The accurate approach to this problem is a good solid waste survey and correct estimation of solid waste generation rate in a community needing management attention (Peavy *et al*., 2008; Sincero and Sincero, 2016).

This work therefore surveyed solid waste and determined the generation rate in Evbotubu community, Edo state of Nigeria. It aimed at providing this information for effective planning, design and management of solid waste disposal system in the community.

Material and Methods

Materials/Equipment

These include weighing scale, waste buckets, drums, dustbins, wheel barrows, bags, pencils, biros,

notebooks, screening equipment, and a pick-up vehicle.

Methods

Thirty representative houses were randomly selected (Atikpo and Erameh, 2019). Waste baskets were located in each house to receive their wastes at generation points (Atikpo *et al*., 2009; Howard *et al*., 2008). These generated wastes where transferred into strategically located drums positioned to accumulate wastes collected from its catchment (the surrounding houses) (Peavy et al., 2008; Atikpo and Erameh, 2019). The accumulated wastes were weighed at the end of each week, and the weekly mass of wastes generated were summed-up to make-up the monthly values and were recorded (Atikpo *et al.*, 2009; Atikpo and Erameh, 2019). The population in every house was determined and recorded (Peavy *et al*., 2008; Atikpo and Erameh, 2019). The monthly population vary from 170 – 200 persons.

This field survey was conducted from the first week of January, 2019 to the last week of December, 2019. The help of three graduates Engineers were enlisted to assist in weighing and recording of data every week, and adding up the weekly mass data to generate the monthly mass data.

On arriving at the mass of waste generated every month, the monthly and the average generation rates Γ and $\Gamma_{Average}$ kg/p/d were calculated using equations (1). (2), and (3).

$$ɱ = \frac{\dot{\omega}}{\Phi} \quad (1)$$

$$\Gamma = \frac{ɱ}{ɖ} \quad (2)$$

$$\Gamma_{Average} = \frac{\Sigma_1^{12}\Gamma}{12} \quad (3)$$

The $\dot{\omega}$ is the mass of waste (kg) generated in a month; ɱ is the mass of wastes generated per person with the unit (kg/p); Φ is the sampled population in a month with unit (p); ɖ is the number of sampling days in a month with the unit of (d); Γ is the monthly generation rate with the unit of (kg/p/d), and $\Gamma_{Average}$ in kg/p/d is the average generation rate. The symbol p stands for person, kg is kilogram, d is day, and kg/p/d is kilogram per person per day.

Results and Discussion

The masses of wastes generated every week in each month were aggregated to obtain the masses of waste generated in each month shown in Table 1. These masses were essentially necessary for the computation of monthly generation rate. The highest recorded mass of waste was in the month of December, while the least recorded mass was in the month of February.

The highest recorded mass of waste in December was attributable to the highest recorded population in that month documented in Table 2. This was intrinsic to the volume of waste generated during festive periods of activities that drew people from all works of life in line with the work of Addel-Shafy and Mansour (2018) which pointed out that solid waste generation varies with seasons.

Months	January	February	March	April	May	June
Average Weight of Waste (kg)	2500.98	2000.27	2410.61	2500.47	2300.11	2310.62
Months	July	August	September	October	November	December
Average Weight of Waste (kg)	2290.59	2260.71	2300.39	2450.38	2420.81	2900.95

Table 1: Monthly Waste Generated

The claim of Addel-Shafy and Mansour (2018) that the volume and mass of solid waste generated vary with season was also reflected in the mass of waste generated in the month of April which was designated for the celebration of Easter by all Christians in the globe. This also reflected in the population of 182 sampled from 30 houses in that month as shown in Table 2. Volume and mass of solid waste generated is known to vary with seasons, population, Technology, economy (Sincero and Sincero, 2016; Addel-Shafy and Mansour (2018)).

Table 2: Monthly Population Data

Months	January	February	March	April	May	June
Sampled Population	180	172	170	182	180	176
Months	July	August	September	October	November	December
Sampled Population	171	176	175	180	177	200

The application of equations 1, 2, and 3 yielded the monthly and average generation rate (Table 3). The highest generation rate of 0.47 kg/p/d was discovered and this occurred in the month (December) people come home for festivity. The second highest generation of 0.46 kg/p/d was recorded in April – a festive month and March (the month people came around in preparation for April celebrations). It is a common occurrence that folks come together for other important functions/celebrations this critical months (December and April) for preparation and celebrations of different kinds besides the special Christians' celebrations which usually fall into these months.

In line with previous works (Peavy *et al*., 2008; Atikpo *et al*, 2009; Sincero and Sincero, 2016), the generation rates varied with the months as shown in Figure 1. This is true because different months are affected by different factors like festivities, economy and others (Addel-Shafy and Mansour (2018); Atikpo and Erameh, 2019).

Table 3: Generation rates in different months

Months	January	February	March	April	May	June
Generation rate, Γ (kg/p/d)	0.45	0.42	0.46	0.46	0.41	0.44
Months	July	August	September	October	November	December

Generation rate, Γ (kg/p/d)	0.43	0.41	0.44	0.44	0.46	0.47
Average Generation Rate, $\Gamma_{Average}$ (kg/p/d)					**0.45**	

Average generation rate (0.45 kg/p/d) was determined from the values of waste generated in each month. This value (0.45 kg/p/d) is relevant for planning, design and maintenance of disposal systems options (Peavy *et al.*, 2008; Intharathirat *et al.*, 2015; Sincero and Sincero, 2016). This generation rate fell within the estimated range of 0.4 – 0.6 kg/p/d by United Nations Environmental Program for sub – urban communities of developing countries (Joarder, 2000).

The generation rate is similar to 0.52 kg/p/d derived for a zone in Sango Ota, Ogun State of Nigeria (Olukanni and Mnenga, 2015); 0.50 kg/p/d derived for Ikpoba town in Edo State, Nigeria (Osarenmwinda, 2016); 0.59 – 0.79 kg/p/d derived for Federal Capital Territory, Abuja, Nigeria (Abur *et al.*, 2014); and 0.67 kg/p/d derived for Okada town in Edo State, Nigeria (Atikpo *et al.*, 2009).

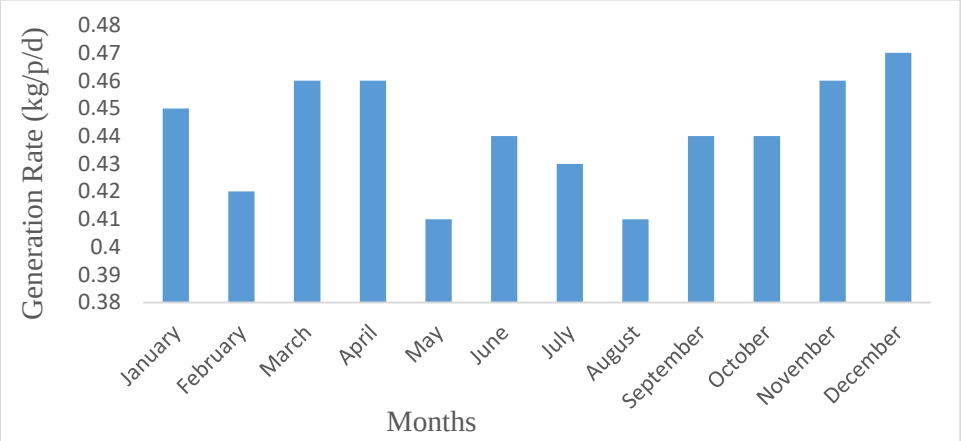

Figure 1: Variation of generation rate with months

Conclusion

This wok focused on solid waste generation rate in Evbotubu community, Edo state of Nigeria. The calculated average generation rate of 0.45 kg/p/d fell within the estimated range of 0.4 – 0.6 kg/p/d by United Nations Environmental Program for sub – urban communities of developing countries (Joarder, 2000). This work provides this information for effective planning, design and management of solid waste disposal system in the community.

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