URBAN SOLID WASTE CHARACTERISATION AND MANAGEMENT FOR ABAKALIKI TOWN: ENGINEEERING APPROACH

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ABSTRACT

A survey research was conducted to work on the management and characteristics of solid waste generation and disposal for Abakaliki urban, the capital of Ebonyi State. The study area was divided into five zones that make up Abakaliki urban. Fifty households were selected in all the zones through stratified random sampling method for the study. The study revealed that 1.95 kg/hh/month and 0.18kg/Cc/Day of solid waste was generated from the selected areas. It was also observed that about 60% of the household make use of plastic dust bin for their waste storage, 10% make use of metal dust bin, 25% use polyethylene bags, 2% make use of basket and about 3% do not have storage containers in their houses, so they drop their waste indiscriminately around the environment. Result shows that putricible waste is the highest generated solid waste in Abakaliki followed by plastic wastes and waste papers. Metals, glasses and textiles waste materials are the least generated. It also revealed that the month of August is the period when the area has the highest waste generation. It was equally observed from the study that Abakaliki urban has only one approved solid waste disposal site, this makes the people to pile up their refuse indiscriminately in open dumps along the road and streets which give rise to environmental pollution and encourages the growth of rodents, cockroaches and mosquitoes. It is therefore recommended that State government should create more disposal sites. More workforces, solid waste disposal facilities for proper and adequate handling should be provided. There should also be enforcement of laws that will prohibit people from indiscriminate dumping of refuse within the area. Finally there should be public enlightenment on the management and disposal of solid waste in the area.

KEYWORDS: Solid waste, Abakaliki, environment, management, government

1. INTRODUCTION

Urban solid waste management is the term applied to all the activities associated with management of solid waste generated by the urban dwellers Tchobanoglous et al., (1993). Solid waste is a system of Engineering, involving substantial engineering content, that is particularly set for actions which best accomplish the overall objectives of the decision makers, within the constraints of law, morality, economic resources, political and social pressures and which govern the physical life and other natural sciences, Otti., (2010). The basic goal of urban solid waste management is to manage their waste in such a manner that meets public health and environmental concerns and the public's desire to reuse and recycle waste materials.

Problem with the disposal of waste can be traced from the time when man first began to congregate in tribes, villages, towns which the accumulation of waste becomes a consequence of life. People littering food and other solid waste in the town by the practice of throwing waste into the streets, roadways and vacant land resulted in the breeding of flies, rats and other agents of epidemic diseases that increase high risk of death tolls. Public health authorities have shown that vectors, diseases agents were bred in open dumps and poorly maintained housing and in food storage facilities. The U.S. Public Health Services (USPHS) has published the result of a study tracing the relationship of twenty-two (22) human diseases to improper solid waste management. Water and air pollution have been attributed to improper management of solid waste. Poorly engineered landfill has also contaminated surface water and groundwater. In 1965,

the United States Congress concluded that inefficient and improper method of disposal of solid waste in scenic blight create serious hazard to public health, including pollution of air and water resources, accident hazard and increase in insect's vectors of diseases which have adverse effects on land value that interfere with community life and development. Therefore, the overall goal of urban solid waste management is to collect, treat and dispose solid waste generated by the urban population groups in an environmentally and socially satisfactory manner using the most economic means available. Rapid urbanization along with its increasing human activities in urban areas imposes great challenges to urban environmental management (Xiao et al., 2006). One of the most important environmental problems in the cities is the production and contaminant of urban solid waste Buenristro et al., (2003) and Pokhrel et al., (2005). Global generation of municipal solid waste in 1997 was 0.49 billion tones with an estimated annual growth rate of 3.2-4.5% in developed nations and 2-3% in developing nations Snocheng et al., (2001). Inappropriate management of urban solid waste not only increases the pollution of the environment but also threatens human health through its collection, transfer and disposal processes Xiao et al., (2006).

Problems and issues of solid waste characteristics and management in Abakaliki have posed risks to the environment have posed risks to the environment. They were based on the way the solid wastes were handled, stored, collected and disposed of. What motivated this study is that there are no major and well designed dumping sites of solid wastes in Abakaliki let alone weighing facilities in the disposal sites, and there are no private sectors potentials for recycling.

Objectives of this study are; to determine the characterisation and management of urban solid wastes in Abakaliki municipality; to determine municipal solid wastes generation rate in Abakaliki urban; and also to recommend the best management practices for Solid Wastes Management in Abakaliki Urban.

2. MATERIALS AND METHOD

Abakaliki is the capital city of Ebonyi state which came into being in the year 1996 and was carved out from former Enugu state and Abia state. According to the ministry of environment, the city's population is estimated at 208,654. Abakaliki urban is made up of five major zones, namely, Abakaliki Centeral, Abakaliki North, Abakaliki South, Abakaliki East and Abakaliki West. These five zones have sub-divisions or unit.

Three sets of primary data were collected for the study. The first were drawn from solid waste disposal sites located at Enugu/Abakaliki express way. The second were drawn from questionnaires from the five zones that make up Abakaliki town. Ten buildings from each zone were selected for sampling. The samplings were spread among the households in each building of the selected area. Therefore the entire households in each building of the selected area were surveyed. About four hundred and seventy structured questionnaires were administered.

Another set of data were based on measurement of solid waste generated in one fifth of the buildings sampled with questionnaire. Therefore 10% of the sampled household had their waste measured. Most residents use a range of waste receptacles including; baskets, polythene materials, plastic container, open metal drums, paper/cardboard container. The study employed graduated plastic containers for convenience of volumetric determination.

Two groups of graduated plastic containers labeled "A" and "B" and a weighing machine, were used in the study. The population of each sampled household was noted. The containers labeled 'A' were used to collect solid waste of food and fruit materials. The ones labeled B were used to collect polythene, rags, nylon, rubber materials, paper, metals and pieces of broken bottle. The two graduated containers were first measured empty. Two households from each major zone have their solid waste measured, making a total of ten households in all. A pair of labeled containers was given to each household for their daily collection

of solid waste. Every day, the "A" and "B" containers with their content were measured to determine both the volume and weight of solid waste. This was done for a period of five months for each household representing a zone. At the end, the data generated were used to determine the waste density and waste generation rate (kg/capital/day).

3. RESULTS AND DISCUSSION

The collection of solid waste is one of the functions of Ebonyi State Environmental Protection Agency (EBSEPA). Informal collectors also aid the agency in providing the services with a token payment mainly in market areas of the city. Ebonyi State ministry of environment provides stationary containers for waste collection. The waste container is stationed at various points of waste generation within the town and the residents deliver their waste to the storage containers. It is distributed among the major zones that make up Abakaliki urban. The containers were kept at some open spaces and some were located at road junctions from where the agency picks them up with their truck on daily bases. This arrangement is however inadequate as people still dump their waste in the stream (Iyiokwu stream) and in open spaces.

In Abakaliki urban, solid waste is collected and transported by trucks directly to the disposal site.
The data collected from this study was presented and analyzed using tables with descriptive statistical methods and graphs. Table 1 shows the sex distribution of the respondents. 58.7% of them are females while only 41.3% are males. The high rate of female respondents was because the respondents could either be husband or wife. Most men allowed their wives to fill the questionnaire on behalf of their household since household waste comes from the kitchen which traditionally is managed by wives. It was also observed that some of the women had their husbands working in other places outside Abakaliki, making them automatic household heads in the absence of their husbands.

Table 1: Sex Distribution of the Respondents

Sex	No of respondents	Percentage (%)
Male	190	41.3
Female	270	58.7
Total	460	100

Table 2: Household Size and Solid Waste Generation

Household group	Household Size (persons)	Solid Waste Generation (%)
W	1-2	3.5
X	3-5	24
Y	6-10	32
Z	11 and above	40.5
	Total	100

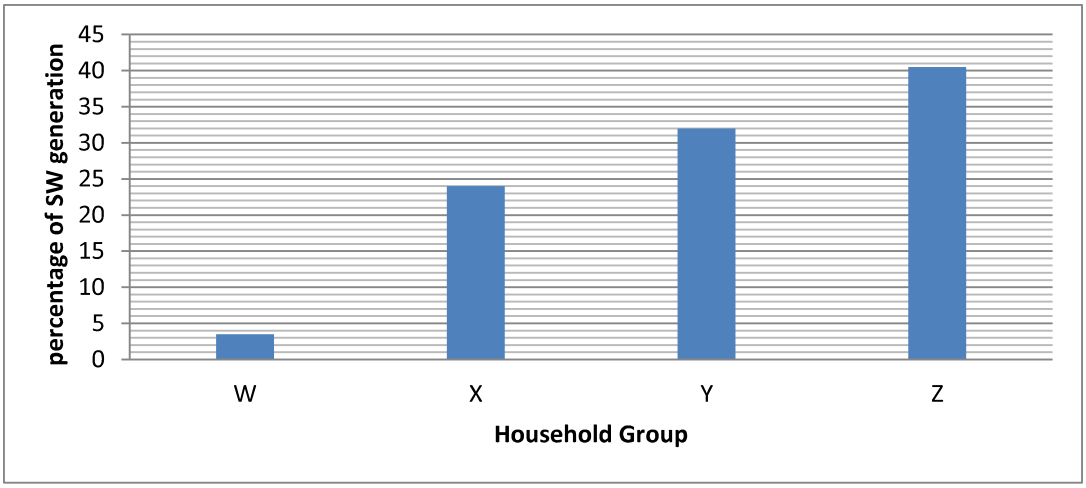

Figure 1: Household Sizes and Solid Waste Generation

Table 2 and Figure 1 contain the relationship between the household size and waste generation. It could be observed that households in group W with 1-2 persons had smallest percentage waste generation of 3.5% while the households in group Z with 11 and above had the highest percentage waste generation of 40.5%. This indicates that waste generation is proportional to the population or sizes of each household. The implication is that more refuse dump sites and disposal facilities should be provided with respect to household sizes and general population of an area. In Abakaliki, there is only one disposal site which is along the Abakaliki-Enugu express way, besides the Iyiokwu stream. The numbers of truck loads that enter the site everyday were counted to generate the data shown in Table 3.

Without a weighing bridge to weigh the loaded trucks, the quantity of the solid waste generated per day was noted but its weight was unknown. The volume was estimated by measuring the dimensions of the refuse space in each truck that entered the site. The quantity of waste transported to the site daily was thus noted.

Table 3: Monthly Solid Waste Generation in Abkaliki Urban (load count)

Period	Estimated Population	No. of Trucks	Volume of SW/Month (m^3)
July 2010	208,654	183	1152.9
August 2010	208,654	190	1197.0
September 2010	208,654	188	1184.4
October 2010	208,654	179	1127.7
November 2010	208,654	176	1108.8
December 2010	208,654	160	1008.0
January 2011	208,654	165	1039.5
February 2011	208,654	170	1071.0
March 2011	208,654	172	1083.6
April 2011	208,654	175	1102.5
May 2011	208,654	178	1121.4
June 2011	208,654	180	1134.0

Table 3 shows the volume of solid waste generation in Abakaliki urban. It could be observed that the least volume of waste generation of 1008.0m^3 is in the month of December, while the highest waste generation of 1197.7m^3 is in the month of August. The implication of this is that more trucks should be engaged in this

period to transport the generated waste from collection points to the final disposal sites to reduce much refuse being piled up at the collection or storage points.

Table 4: Composition of Waste Stream Characteristics for the Sampled Area (%)

S/n	Zone	Putricible	Plastic	Paper	Textile	Metal	Glass	*Others
1	A	60.0	10.0	12.0	4.5	5.2	3.5	4.8
2	B	50.0	20.0	10.0	1.0	10.2	2.9	5.9
3	C	35.0	22.0	30.0	2.2	3.6	2.3	4.9
4	D	40.0	25.0	5.0	6.2	15.2	7.2	1.4
5	E	62.5	10.2	7.8	4.3	5.6	6.7	2.9
Average		49.5	17.44	12.96	3.6	7.96	4.52	3.98

*** Others:** rubbers, dust, ash, soil, bones and ceramics**.**

Table 4 shows the major types of waste materials that are generated at the study area at different periods. It indicates that the highest percentage of the waste materials were recorded by putricible wastes having mean waste generation of 49.5%, followed by plastic with 17.44%, and papers with 12.96%. metals, glasses and textiles recorded the least average percentage waste generation of 7.96%, 4.52% and 3.6% respectively. Other waste materials such as rubbers, ashes, and ceramics have average generation of 3.98%. The result shows that industrial recycling/conversion of organic waste from putricible waste such as food and food related materials are viable for Abakaliki urban. It was observed that wastes of plastic origin should be a major source of concern. Plastic wastes from packaged water (pure water) are growing in quantity and bounds because of its very slow rate of decay. It poses the major source of soil and environmental pollution in the near future.

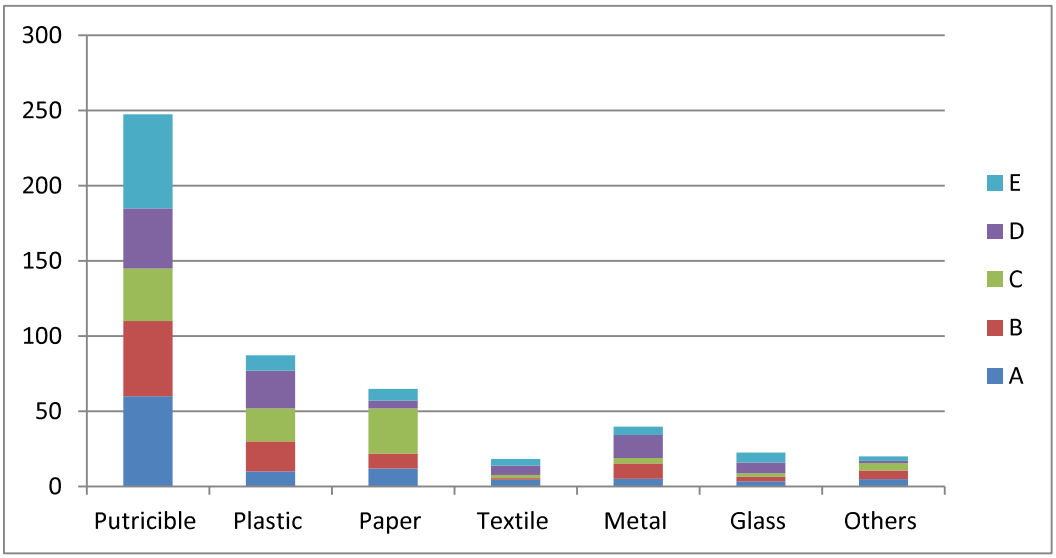

Figure 2: Waste Stream Characteristics

Figure 2 is the bar chart of types of waste generation plotted against the percentage amount of wastes generation for the five zones of the study area. The graphs slope downward from the highest waste generation for all the zones and vary horizontally for various types of waste generation. The graph shows that zone E has the highest putricible waste generation of 62% and least textile waste materials generation of 4.3%, followed by zone A with highest putricible waste generation of 60% and least glass waste materials generation of 3.5%. This is also followed by zone B with 50% putricible waste generation and least textile waste material generation of 1%. Zone C and Zone D have least putricible waste generation of 40% and

35%. From the bar chart, it is recommended that more work force and disposal facilities should be provided in zone E, A and B with highest percentage waste generation to enhance quick waste removal from such areas to the disposal sites to avoid refuse pile at the collection and storage points.

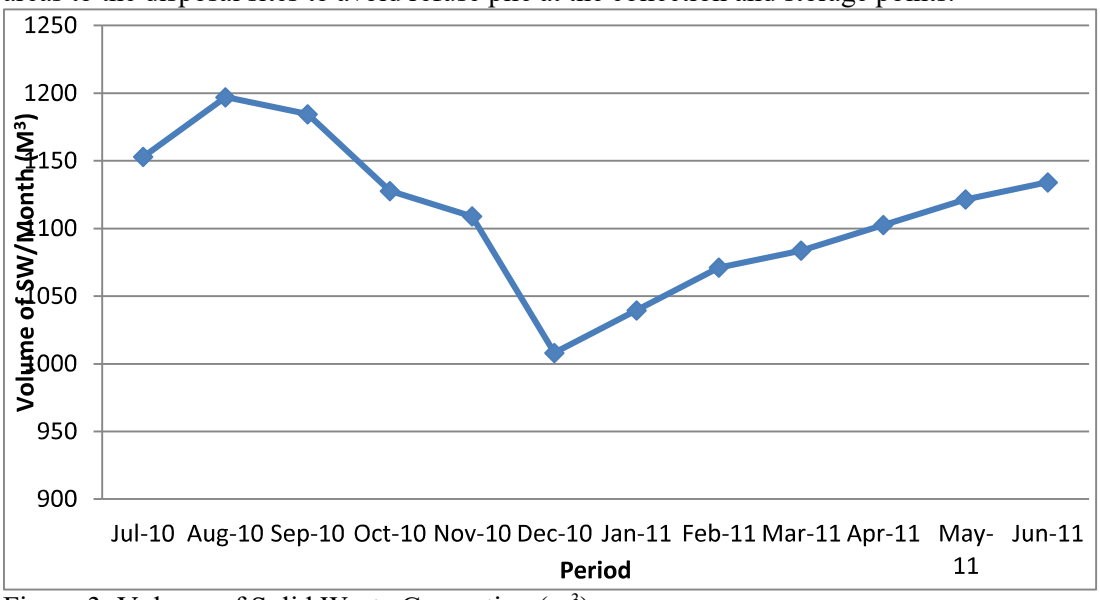

Figure 3: Volume of Solid Waste Generation (m^3)

Figure 3 is the graph of volume of waste generation plotted against months. The curve shows maximum waste generation of $1197m^3$ recorded on the month of August. This implies that more workforce and disposal facilities should be provided at the month of August to enhance fast and adequate waste disposal.

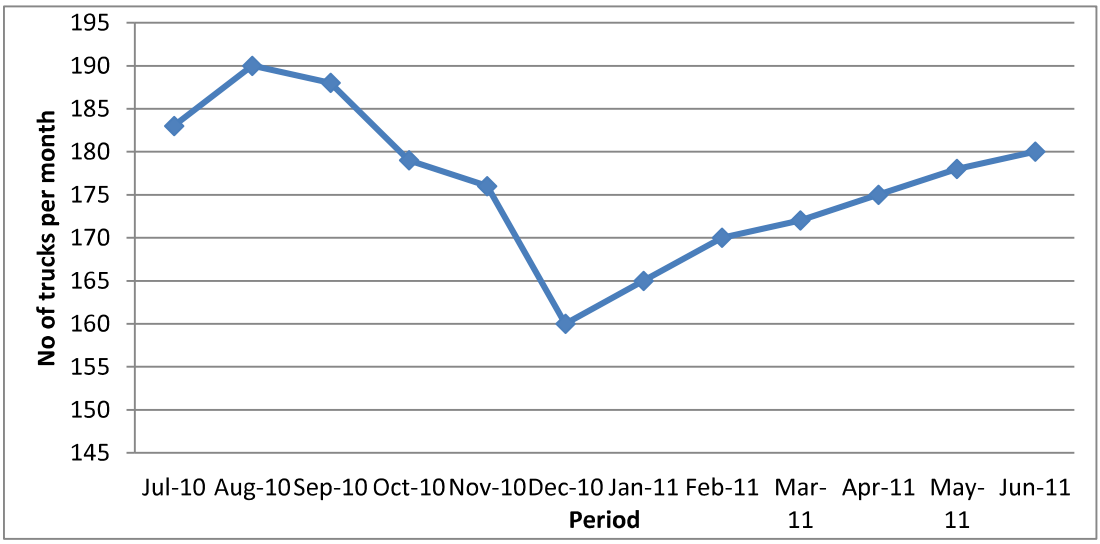

Figure 4: Number of Trucks Used Per Month

Figure 4 is the graph of number of trucks contracted to evacuate the solid waste generated plotted against month. It is a parabolic curve showing that at the month of August, highest number of trucks of 190 trucks have been contracted to haul the wastes generated to the disposal site. It simply shows that waste generated is at its peak of the year and need serious attention.

Table 5: Urban Solid Waste Generations

S/n	Zone	No persons	Volume (m^3)	Kg/ HH/Month	Kg/Cc/Day (x)

1	A	14	0.00042	2.89	0.21
2	B	16	0.00048	1.58	0.26
3	C	17	0.00051	1.27	0.07
4	D	11	0.00033	1.16	0.11
5	E	11	0.00035	2.84	0.26
			0.00209	9.74	0.91

Cc is the weight of the waste generated per person per day.

Estimated density for the sampled household = $\frac{mass}{volume} = \frac{9.74}{0.00209} = 4660 kg/m^3$

Mean of kg/Cc/Day = $= \frac{\sum x}{n} = \frac{0.91}{5} =$ 0.18 kg/Cc/Day

Mean of kg/hh/Month = $= \frac{\sum x}{n} =$

$\frac{9.74}{5} =$ 1.95 kg/hh/Month

Table 5 contains population of each household sampled at the various zone with the solid waste generated per month. This helps to estimate the quantity of waste generate per person per day which is 0.18kg/Cc/day

Table 6: Waste Receptacle

S/N	Container	Respondents (%)
1	Metal dustbin	10
2	Basket	2
3	Plastic bucket	60
4	Polythene bag	25
5	*Others	3
	Total	100

***Others:** Carton, Pot, and Cardboard

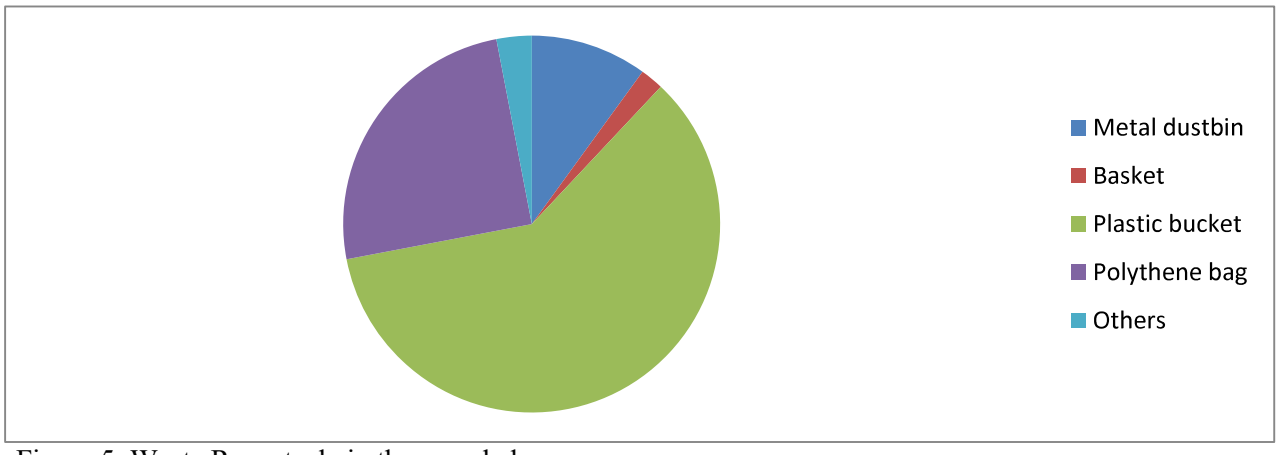

Figure 5: Waste Receptacle in the sampled area

Table 6 and figure 5 show that 60% of household in Abakaliki is using plastic solid waste bin for their temporal storage. While 25% uses polythene bags. The figure 4 presents the waste receptacle components. The high percentage of plastic solid waste bin was the impact of EBSEPA. The agency enforces each household in Abakaliki urban to have at least one covered plastic solid waste bin. It is more affordable to metal waste bin.

4. CONCLUSION

The result from study reveals that per capital municipal solid waste generation rate is 0.18 kg/capital/day. The per capital generation rate for various areas sampled in Abakaliki urban is shown in table 5. It is also shows that about 80% of people living in the urban area dispose their solid waste in containers whereas 20% littered theirs on the road side or street. It also discloses that only few people segregate their solid waste (biodegradable and non-biodegradable). About 85% use plastic and polythene bags for solid waste storage and disposal which are not biodegradable and pose problems to the environment. Inappropriate sitting, design, operations, and maintenance of dump sites increase the transfer and disposal cost and inadequate onsite storage facilities. Lack of institution arrangement: lack of expertise and manpower to run solid waste management program in Abakaliki. Majority of environmental workers have little or no functional background or training in engineering and management, so the operations result in inefficient and ineffective solid waste management.

It is recommended that more disposal site should be created by the State Government; provision of more workforce and waste disposal facilities for proper and adequate handling of solid wastes; preparation and enforcement of laws that will support solid waste management and there should be public enlightenment on the management and disposal of solid wastes.

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