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DOMESTIC WASTES GENERATION PATTERN AND COMPOSITION IN OSOGBO AND ENVIRONS, OSUN STATE, NIGERIA

S. O OJOAWO, F. A OGINNI, M. JOLAYEMI & O. J ADENRELE

Department of Civil Engineering, College of Science, Engineering and Technology,

University of Osun, Osogbo, Nigeria

ABSTRACT

Most notable environmental challenges of this century are directly or remotely connected to solid wastes and its concomitant impacts. Domestic wastes have been identified as a contributing factor to these environmental issues. The effective management of domestic solid wastes in a given area is largely dependent on accurate waste generation and composition data. This paper has thus studied the domestic wastes generation pattern and its composition in both Osogbo and Olorunda Local Government Area (LGA)s of Osun State, South-Western Nigeria. Structured questionnaires were designed and administered in sixty (60) randomly selected buildings and at the Government's Waste Management Offices of the two LGAs. Information gathered from residents include those on waste generation, collection, transportation and disposal while the Officials assessed the funding, facilities, personnel and the compliance of the residents to sanitation rules. The waste composition was examined over a 7-day period and the per capita waste generation rate of the study area was determined. Findings revealed that most residents in the study area practice open dumping of wastes; collection by the Waste Management Agency is not as regular as the residents desire; and lack of adequate funding and facilities hamper the effectiveness of the Government's Waste Management Agency. Osogbo LGA has about half its wastes being recyclables while food wastes dominate in Olorunda LGA. The per capita waste generation rates for Osogbo and Olorunda LGAs are respectively found to be 0.484 and 0.457 kg/day. A functional sanitary landfill is therefore recommended in place of current open dumps that are rampant in the study area.

KEYWORDS: Domestic Wastes, Recyclables, Sanitary Landfill, Waste Management

INTRODUCTION

Solid wastes are all the wastes arising from human and animal activities that are normally solid and that are discarded as useless or unwanted. This includes heterogeneous mass of throwaways from residences and commercial activities as well as the more homogeneous accumulations of a single industrial activity. The term solid waste is all inclusive and encompasses all sources, type of classification, composition and properties. Municipal solid wastes comprise those from diverse sources such as residential, offices, agriculture, institution, industrial and commercial activities, mining and miscellaneous wastes [1].

Six general sources of solid waste generation include: Domestic, Commercial, Industrial, Agricultural, Institutional and Natural. Households are the highest producers of domestic waste. Domestic waste includes; among others, organic matter, paper, nylon, plastic, textile, glass, metal, silt and ash. The main agents of commercial waste producers are stores, business premises, markets and restaurants. Industrial wastes refer to wastes such as construction and demolition debris and food processing outlets. Agricultural wastes refer to the waste outcomes from dairy and poultry farms, livestock

and other agricultural activities like vegetation cultivation. Most of the agricultural wastes contain biodegradable components. In case of institutional wastes, major producers are schools, offices and banks. This type of waste contains paper and cartons. Natural waste consists of leaves, tree branches, seeds and carcasses of animal. Municipal solid waste (MSW) is defined by [2] as non-air and sewage emissions created within and disposal of a municipality, including household garbage, commercial refuse, construction and demolition debris, dead animals, and abandoned vehicles. Municipal solid waste is generally made up of organic matter, paper, nylon, plastics, textiles, glass, metals, silt and ash [3].

Solid wastes have continually become growing problems at global, regional and local levels and one of the most intractable problems for local authorities in urban centers. Municipal solid waste disposal is a major concern in developing countries across the world, as high poverty, population growth, and high urbanization rates combine with ineffectual and under-funded governments hampers efficient management of wastes [4], [2]. In most cities and large towns of developing countries, solid waste is not only heaped in huge quantities on refuse dumps but also thrown and made to lie around in piles in the street and in small illegal dump on any piece of unused land. Most third world countries have worst cases than industrialized countries which have the money and technical know-how and public attitudes to control and manage their waste to some degree.

The solid waste management practices are required for embodying an Integrated Solid Waste Management System (ISWMS). Broadly, the material flow-stream of waste from generation to ultimate disposal comprises the following: generation, collection/transportation, treatment and disposal. However, the solid waste management practices encompass the full range of activities for these streams, from the generation to the final disposal. To achieve an environmentally sound waste management, a hierarchy of objectives and programs should be focused on as minimizing wastes; maximizing environmentally sound waste reuse and recycling; promoting environmentally sound waste disposal and treatment; and extending waste service coverage.

According to the European Topic Centre on Waste (ETC/W), prevention means elimination or reducing the quantity of waste which is produced in the first place. Reuse means the use of a product on more than one occasion, either for the same purpose or for a different purpose without the need for reprocessing. Recycling involves reprocessing or treatment of a discarded waste material to make it suitable for subsequent re-use either for its original or other purpose. Energy recovery can be done in a number of different forms including heat, high calorific-value gasses, solid and liquid fraction. Land filling is the least desirable option for the management of municipal waste. Sanitary land filling of waste has some potential negative impacts such as production of leachate and land fill gas, odours, flies, vermin and the waste of land.

There is no single right way to manage municipal waste responsibly as described by [5]. It was argued by [6] that the waste management practices should not rely only on one option; it should make of a combination of methods of waste management such as recycling, material recovery, incineration and land filling. Integrated waste management, or IWM, is a tool to determine the most energy efficient, least polluting ways to deal with the various components and items of a community's solid waste stream. Therefore Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, by recycling, composting and disposal program in ways that most effectively protect human health and the environment. Integrated Municipal Solid Waste (MSW) management is a tedious task requiring the simultaneous fulfillment of technical, economical and social constraints.

It combines a range of collection and treatment methods to handle all materials in the waste stream in an environmentally effective, economically affordable and socially acceptable way [7].

The concept of waste management involves the collection, removal, processing, and disposal of materials considered as wastes. Waste materials can be solid, gaseous, liquid, or even hazardous and are generally generated through human activity. Historically, developed nations have dealt with their wastes by sending it to landfills or burning it in incinerators. Both of these options come with some significant environmental problems. Conversely, waste data is almost non-existence in developing countries and where it exists, it is only for few isolated cases, and they are not easily accessible and are grossly inadequate for decision making [8].

An integrated waste management approach attempts to solve this problem by considering the entire life cycle of a product and determining the best processing method for it in order to extract as much useful material while saving energy, water, and other resources. One of the problems with this way of viewing waste management is that it assumes the stuff we throw in the trash has no value – that it is indeed "waste". Therefore, if we were to turn our thinking around and think of leftover materials as resources for making new products, the problem of "waste management" would become an opportunity for resource extraction. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources.

All waste materials, whether they are solid, liquid, gaseous or radioactive fall within the remit of waste management. Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management for non-hazardous waste; residential and institutional wastes in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous, commercial and industrial wastes is usually the responsibility of the one generating them, subjected to local, national or international controls.

This paper focuses on household waste generation pattern and the composition of solid wastes in both Osogbo and Olorunda Local Government Areas (LGAs) of Osun State, South-Western Nigeria. The daily per capita waste generation pattern was studied, as well as the collection, transportation and disposal means of the wastes. It also examines the treatment options/methods available in the study area. Appropriate recommendations were made based on the findings.

RESEARCH METHODOLOGY

The Study Area

It comprises of both Osogbo and Olorunda LGAs of Osun State, South-Western Nigeria. Oshogbo LGA is in Osogbo city. It has a coordinate of $7^0$46'N and $4^0$34' E, and covers an area of 47km^2 (18sqmi). According to NPC, 2006 Osogbo LGA has a total population of 156,694 people and contains 15 Political/Administrative Wards. The Olorunda LGA which is also located in Osogbo city has a population of 131,761people [9]. Figure 1 shows the Map of Osun State with the 2 LGAs.

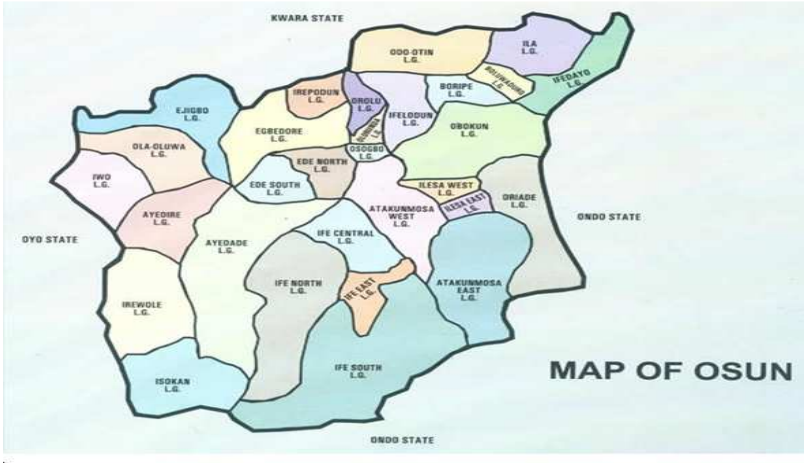

Figure 1: Map of Osun State Showing all the LGAs

- **Questionnaire:** Two sets of questionnaires were designed and administered on the study, one for the residents and the other for the Waste Management Officials. The subjects in the residents' own bother on the location of the dumpsites with respect to buildings, number of occupants in the building, dominant waste type, collection mode, regularity of collection, payment for the collection, waste transportation, and disposal means. The contents of the questionnaires for the Officials were adapted from the ones from the residents, with addition of funding status and its regularity/adequacy.

- **Waste Collection Method:** A general overview of the study area shows that there are two main types of buildings which are: residential and commercial ones. For Osogbo LGA fifteen houses were randomly selected while same numbers were equally selected from commercial zone. Same was carried out at Olorunda LGA, where the Oroki Estate and Igbonna commercial area had fifteen locations selected from them. This makes total of thirty (30) locations in each LGA. Three different waste bags were attached to each selected building for waste collection throughout the week-long exercise. One for the collection of organic wastes (food and decomposable wastes), another one for the yard wastes (agricultural waste) while the third was for the recyclables (plastic, cans, and nylon). After the period of one week, the collected wastes were manually sorted and weighed using the weighing balance.

- **Analysis:** The wastes analysis was purposive and simplified using percentage compositions of wastes after sorting. Parameters of interest measured and employed in the analysis include questionnaire data, number of waste collection days, and number of households, total weight of waste per household, and the percentage of each category of waste components.

The daily per capita waste generation was estimated from = $\frac{\text{Total weight of daily wastes (kg)}}{\text{No of occupants generating the wastes}}$

RESULTS AND DISCUSSIONS

- **Questionnaire Findings:** The waste distribution pattern in Osogbo LGA is as shown in Figures 2 and 3.

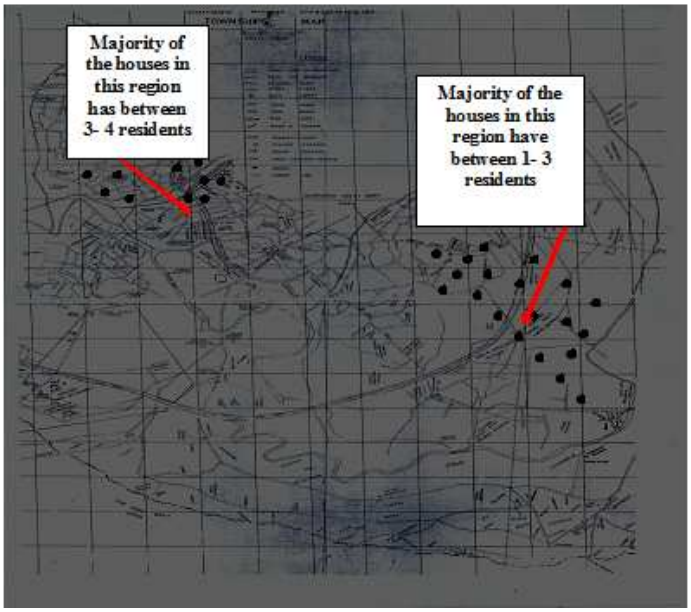

Figure 2: Location of the Selected Residences in the Sampled Region of Osogbo LGA

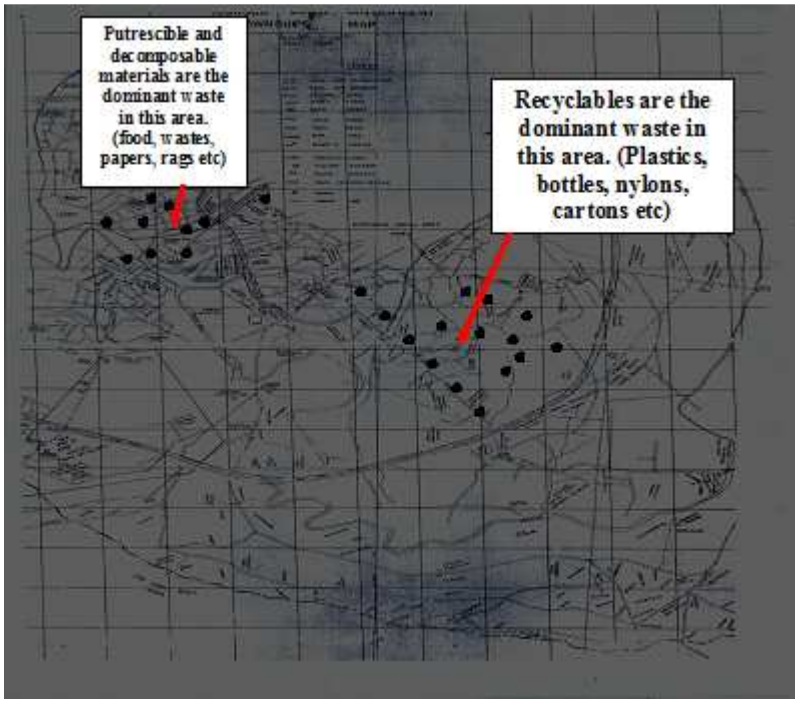

Figure 3: Distribution of Wastes Types in the Sampled Region of Osogbo LGA

The result obtained from questionnaire analysis shows that people in Osogbo LGA as those of higher class, taste and standard of living when compared with those in Olorunda LGA. When administering the questionnaires, it was also observed that a few of the residents in Olorunda LGA keep domestic animals like goat, dog, sheep, chicken etc, these reflect in their wastes components being highly decomposable in nature. The information from the questionnaire shows that the majority of residents in both LGAs practice the open dumping system of disposal as there is no modern sanitary landfill serving them. Organized recycling is not practiced in the study area but in Osogbo LGA residents disclosed that few people trade in purchase of empty bottles, spoilt bathroom slippers, old necklaces, textiles and the rests. They also confirmed of the scavenging attitudes of some outsiders combing their dumpsites for used automobile spark plugs, scrap

metals, condemned spare parts, used tyres and related items. It was also gathered from the questionnaires that the Government of the State has proposed a recycling system of polymers (nylons) but yet to take off as at the time of this study. The questionnaire analysis of the Olorunda LGA also gave information about the public waste collection system created by Government. Residents claim they do not pay for the collection but are faced with the challenge of meeting up with once-a-day collection method, especially by those whose houses are not close to the major streets. According to Osogbo LGA residents, the trucks take the waste collected to the Onibueja dumpsite along Iwo-Ibadan road where the final disposal takes place. In Olorunda LGA where waste collection trucks don't regularly ply, about 70% of the respondents make use of open dumps created on undeveloped plots of lands and river banks. From the responses, most Olorunda LGA residents have their wastes collected by the Government Agency only once in a month during the Environmental Sanitation period approved by the Government. As a result, only 30% of them claimed to be paying, and even once in a while, for refuse collection services in the area.

The questionnaire responses of the contacted Government's Waste Management Officials in both LGAs are however slightly differed from those of the residents with 80% of them claiming that the waste management system is satisfactorily good. They offered suggestions for improvement to the Government like provision of from more funding, personnel, facilities, and incentives. Stoppage of refuse dumping into drains and water channels, eradication of indiscriminate dumping of wastes and compliance to Sanitation orders including 3 hrs monthly mandatory clean-up programme of the Government were some of the advice of the Waste Management Officials to the residents of the study area.

- **Wastes Composition:** the average summaries of sorted and weighed quantities of wastes generated from both LGAs are shown on Tables 1 and 2.

Table 1: Results of the Wastes Generated in Selected Locations in Osogbo LGA

S/N	Location	Recyclables (kg)	Organic/Food Wastes (kg)	Yard Wastes (kg)	Total Wastes at the Location (kg)
1	Oke- bale H1	5.7	4.1	2.7	12.5
2	Station road H1	4.3	2.4	2.5	9.2
3	Capital H1	4.6	3.9	2.8	11.3
4	Arogunmasa	4.5	3.5	3.0	11.0
5	Oke- bale H2	11.7	2.7	2.4	16.8
6	Costain area H1	6.6	__	__	6.6
7	Costain area H2	9.2	__	__	9.2
8	Capital H2	8.7	__	__	8.7
9	Oke- bale H3	6.6	5.2	__	11.8
10	Station road H2	6.1	6.0	__	12.1
11	Fakunle H1	5.3	5.3	__	10.6
12	Olorunkemi H1	4.5	4.6	2.9	12.0
13	Abeobi H1	6.6	__	4.0	10.6
14	Oke-baale H4	5.7	__	4.1	9.8
15	Oke- bale H5	8.7	2.9	2.6	14.2
16	Olorunkemi H2	7.6	2.8	2.7	13.1
17	Abeobi H2	10.6	4.1	__	14.7
18	Kasmo H1	8.9	5.6	__	14.5
19	Olorunkemi H3	7.8	3.7	__	11.5
20	Arogunmasa	7.6	__	3.7	11.3
21	Abeobi H3	7.0	6.6	3.4	14.0
22	Abeobi H4	5.6	4.0	3.0	12.6
23	Oke- bale H6	6.7	6.2	__	12.9

Table 1: Contd.,

24	Ogo-oluwa H1	5.3	__	3.9	9.2
25	Fakunle H2	5.2	3.9	__	9.1
26	Olorunkemi H4	5.1	2.8	2.6	10.5
27	Abeobi H5	5.7	5.9	__	11.6
28	Ogo- oluwa H2	10.6	3.1	3.1	16.8
29	Kasmo H2	7.0	2.9	2.7	12.6
30	Abeobi H5	8.4	4.1	2.5	15.0
	Total	**181.9**	**100.3**	**73.6**	**355.8**

Table 2: Results of the Wastes Generated in Selected Locations in Olorunda LGA

S/N	Location	Recyclables (kg)	Organic/Food Wastes (kg)	Yard Wastes (kg)	Total Wastes at the Location (kg)
1	Igbonna Market	2.5	7.5	4.5	14.5
2	Oke Onitii H1	3.0	6.0	4.0	13.0
3	Ajewole H1	3.5	5.0	12.0	20.5
4	Igbonna (Famson St.) H1	5.5	9.0	_	14.5
5	Igbonna (Ajibade St.)	4.0	5.5	_	9.5
6	Oroki Estate H1	6.0	_	5.5	11.5
7	Igbonna (Famson St.) H2	5.0	5.2	5.1	13.3
8	Oroki Estate H2	4.5	5.0	5.1	14.6
9	Oroki Estate H3	5.1	_	4.5	9.6
10	Oroki Estate H4	7.2	_	_	7.2
11	Ajewole H2	3.5	4.1	5.2	12.8
12	Igbonna (Wasimi St.) H1	4.5	_	4.1	8.6
13	Igbonna (Agowande) H1	4.2	_	3.5	7.7
14	Oroki Estate H5	3.7	3.2	3.0	9.9
15	Igbonna (Agowande) H2	0.5	3.5	2.3	6.3
16	Oke Onitii H2	4.5	_	4.3	8.8
17	Oke Onitii H3	8.2	_	_	8.2
18	Oroki Estate H6	4.8	_	4.3	9.1
19	Oroki Estate H7	3.5	_	3.3	6.8
20	Igbonna (Wasimi St) H2	3.2	6.7	3.1	13.0
21	Igbonna (Agowande) H3	3.7	6.2	4.5	14.4
22	Igbonna (Agowande) H4	1.7	3.2	1.3	6.2
23	Igbonna (Agowande) H5	4.9	7.3	_	12.2
24	Ajewole H3	3.5	_	4.5	8.0
25	Oroki Estate H8	2.5	4.2	3.3	10.0
26	Oroki Estate H9	2.7	3.2	2.5	8.4
27	Igbonna (Wasimi St) H3	4.0	6.1	4.2	14.3
28	Oroki Estate H9	4.8	_	5.5	10.3
29	Igbonna (Famson St) H3	1.5	3.9	1.3	6.7
30	Oroki Estate H10	3.3	4.3	5.2	12.8
	Total	**98.5**	**118.1**	**107.1**	**323.7**

From Table 1, the per capita waste generation rate of the Osogbo LGA can be estimated as follows:

Number of days = 7

Number of households = 30

Total number of heads/people = 93

Total weight of Recyclables (kg) = 104.4

Total weight of Organic waste (kg) = 124.1

Total weight of Yard waste (kg) = 113.1

Total weight of wastes generated (kg) = 341.7

Therefore the per capita waste generation rate = $\frac{\text{Total Wastes generated}}{(\text{No of days}) \times (\text{No of heads})}$

$= \frac{341.7}{(7 \times 93)}$

= 0.484 kg per capita/day

In the same vein for Olorunda LGA from Table 2, the per capita waste generation rate of the Osogbo LGA can be estimated as follows:

Number of days = 7

Number of households = 30

Total number of heads/people = 101

Total weight of Recyclables (kg) = 98.5

Total weight of Organic waste (kg) = 118.1

Total weight of Yard waste (kg) = 107.1

Total weight of wastes generated (kg) = 323.7

Therefore the per capita waste generation rate = $\frac{\text{Total Wastes generated}}{(\text{No of days}) \times (\text{No of heads})}$

$= \frac{323.7}{(7 \times 101)}$

= 0.457 kg per capita/day

From Tables 1 and 2 it is observed that the predominant wastes in Osogbo LGA is the Recyclables which constitute about 52% of the total wastes generated. In Olorunda LGA however, Organic/food wastes form the largest quantity (36% of total wastes). The reason for this trend may be adduced from the fact that more commercial activities take place in Osogbo LGA, the city centre, as compared with the suburb Olorunda LGA where most residents generate domestic wastes which are organic in nature. The yard wastes generated from the suburb LGA expectedly surpassed those obtained from the city centre. The daily capita waste generation in the city centre is observed to be higher than that of the suburb are, with both having respective values of 0.484 and 0.457 kg per capita/day.

From the composition, it can again be re-affirmed that the residents of Osogbo LGA with more recyclable waste items have a slightly higher standard of living than those of the Olorunda LGA, where most of the wastes are organic in nature. This is in agreement with an earlier finding by [10] that the presence of new cartons, ragolis containers and other fairly-used items suggests a higher standard of living in the urban LGAs of Ogbomosoland.

CONCLUSIONS

The paper has studied the domestic waste generation pattern and its composition in both Osogbo and Olorunda Local Government Area (LGA) s of Osun State Nigeria and discovered that the per capita waste generation rates are respectively 0.484 and 0.457 kg/day. The waste composition of Osogbo LGA is majorly of recyclables whereas that of Olorunda is food waste-dominated. This further suggests that those at the city centre have slightly higher standard of living compared with those of suburbs whose major wastes are more of decomposable materials. Open dumping of wastes characterized both LGAs with intermittent collection intervention by the Government's Waste Management Authorities in the two LGAs. A functional sanitary landfill is recommended in place of current open dumps that dominate the study area.

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