Characteristics of Market Solid Waste in Akure, Ondo State, Nigeria

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Abstract- The patterns of solid waste generation, collection, disposal and treatment in Oja Oba and Odopetu markets in Akure South local government area in Akure, Ondo State, Nigeria has been investigated. This was to determine the efficiency of waste management in the markets. A descriptive cross-sectional method was used to collect information from shop owners on waste generation, storage disposal, and treatment. The instrument adopted for the study was a structured questionnaire administered to randomly selected 419 and 16 shop owners from Oja Oba and Odopetu respectively. The study population reflected the sizes of the markets. Three pre-labelled polythene bags were assigned to each participant with an instruction on how to keep different types of waste. The bags were retrieved three times a week (Monday, Wednesday and Friday) for six weeks, sorted, counted (where possible) and weighed to determine the type, number and quantity of waste generated. Data obtained were analysed using appropriate statistical methods. Results obtained revealed that on the order of number of waste types collected was polythene > paper/carton > plastics > glass/electrical/electronics in Oja Oba and paper >polythene > plastics > glass/electrical/electronics in Odopetu market. For waste weight the order was glass/metal/electrical/electronic >putrescible > plastic > paper > polythene in Oja Oba and putrescible >.plastic > polythene > paper in Odopetu. There is no management structure in Odopetu but although there is a waste management authority in Oja Oba modern facilities were either lacking or inadequate. There was no time frame for waste evacuation in Odopetu but takes a week or more in Oja Oba. The study concluded that waste management was poor ineffective in both markets.

Index Terms- Solid waste, management, Oja Oba, Odopetu, Akure South, Nigeria

I. Introduction

Markets are authorized public concourse where buyers and sellers of commodities meet to browse the merchandise in search of what best to spend money on (Benova *et al*., 2014). As an indispensable medium for chain commodity distribution, they play very vital roles in the economic life of individuals and communities. Besides, markets strengthen the economic base of towns and also sustain the tax base of local authorities (Ojo, 2008; Okemakinde, 2016). They also provide platforms for social interaction among people of diverse cultures, socio-economic backgrounds and sellers and buyers of diverse goods (Vargo and Lusch, 2008). Activities in some of these markets take place daily or at other regular intervals such as every four days or at most every week. Some of these activities involve processes that generate varying types and volumes of solid waste also of varying characteristics. The hygienic condition of markets usually depends on the framework established for the management of these waste in each market. Such frameworks are either weak or absent in several Nigerian markets and that is why the problem of solid waste management has remained a concern in all economic sectors of the country (Mbah and Nzeadibe, 2017). Abigo *et al.* (2016) observed that the solid waste challenges seen in the larger population also exist in most Nigeria markets. These challenges include but not limited to the inefficient collection methods, insufficient coverage of the collection system and improper disposal and treatment of waste. These inefficient management systems could lead to several unexpected consequences such as environmental pollution, blockage of drainage systems, unpleasant odours, flooding and health hazards. While efforts are being made at all levels of government to improve solid waste management, information is required from all sources to capture all affected areas particularly the markets where diverse and large bulk of waste is constantly generated (Ogwueleka, 2010). Information on the characteristics of waste in markets located in Akure, the capital of Ondo State is sparse, so are the systems employed by the market authorities to manage such wastes. This paper presents the findings of a study carried out to provide basic information on types of waste generated in some selected markets in the city, as well as the patterns of waste generation, disposal and treatment in each of the selected markets. This was with the view for providing information that could go a long way towards effective planning for a sustainable waste management in the markets.

II.

III. Research Elaborations

The Study Area

Two markets (Oja-Oba and Odopetu) were selected for study in Akure, Akure South Local Government Area in Ondo State, Nigeria. Akure lies between Longitudes 007°5´-7°19´N and Latitudes 05°5´-5°20´E (Fig. 1). It is the administrative capital of Ondo State, comprises of two local government areas (Akure South and Akure North) and has a total population of 491,033 according to 2006 Census figures (Macaulay and Odiase, 2016). The population is predominantly of Yoruba ethnic group although

people of other ethnic groups in Nigeria such as Igbo, Hausa, Fulani etc. constitute more than 10%.

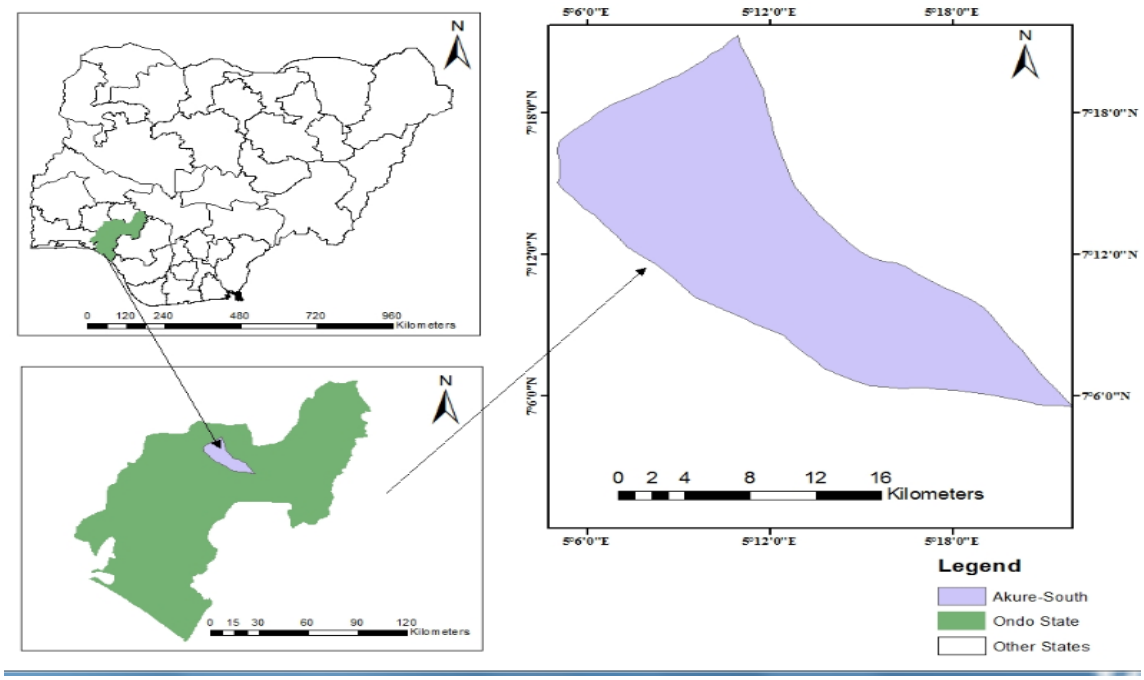

Figure 1: Map of Study Area Showing Sampling Points

Study Design and Data Collection

Two markets investigated were the smallest and biggest of 13 markets in the local government area (LGA). Both descriptive and cross-sectional study designs were utilized to collect mixed data (qualitative and quantitative) for the study. Instruments used to collect qualitative data were key informant interviews and structured questionnaires while weighing scales were used to weigh waste materials. Key informant interviews were conducted among key decision makers including (i) Heads of Sanitation and Primary Health Care Departments at the State Waste Management Board and the chairpersons of market associations. These respondents provided information on the patterns and methods of collecting solid waste in the markets, method of waste disposal as well as treatments of solid waste at the dump site. They also provided information on fees charged for services and penalties for defaults.

For the purpose of this study, each selected market was divided into sections based on predominant goods sold in different parts of the market. The sections were food stuff, clothes, provisions, kitchen utensils, among others. Inventory of stalls in each section was then undertaken and systematic sampling technique used to select stalls that participated in the study. All participating stalls met some pre-defined inclusive criteria. These were (i) that the current user of a selected stall must have been using the stall for at least 6 months prior to this study. (ii) that the said user accepts to be enrolled to the study and to keep waste in accordance with the study design (Francis *et al.*, 2016). A total of 440 stalls owners were enrolled for participation in the study. Pretested semi-structured questionnaire was administered to each participant. The questionnaire collected information on the respondent's bio-data, type and rate of waste generation, patterns of waste disposal as well as perception and acceptance of the activities of waste management authorities. Three polythene bags of standard waste colours were assigned to each participant with an instruction on how to keep different types of waste in three categories of waste types. The categories were**;** Category "A" (Paper, plastic, tins, nylon, cloth and glass waste), Category "B" (Garbage, food waste, agricultural waste) and Category "C" (Electrical, electronic and battery waste). The bags were retrieved three times a week (Monday, Wednesday and Friday) for six weeks. At the point of retrieval, waste held by each bag was sorted, counted (where possible) and weighed to determine the type, number and quantity of waste generated.

Ethics and Consent to Participate

The ethical approval with number IPHOAU/12/853 was approved by the Ethical Committee of the Institute of Public Health of the Obafemi Awolowo University, Ile-Ife, Nigeria. Respondents' gave their consent freely and willingly after they were briefed about the purpose of the study and were informed that participation was voluntary and refusal to participate attracts no penalty. Personal identifiers were removed in the data to ensure confidentiality.

Statistical Analysis of Data

The study response rate was 98.9% and the outcome of the univariate responses were presented in frequency and percentages while the differences in group response to each question were evaluated using Chi-square test from the Contingency table. Chi-square was also used to assess differences in the number of waste generated by stalls and sectors in the study areas. Differences in mean weight of waste collected from different markets were determined using the t-test for variables with two levels, while One-way Analysis of variance (ONE WAY) was used analyse variable with more than two levels. All the decisions on the significance were made at p-value of 0.05 or less.

IV. RESULTS

Socio-Demographic Profile of the Respondents

A total of 440 stalls (one participant/stall) were selected out of which 435 (98.9%) that met all inclusive criteria participated. Table 1 presents the socio-demographic characteristics of the participants. Four hundred and nineteen (419) of the participants were selected from Oja-oba market and 16 from Odopetu market to reflect the proportionate size of the markets. Most of the participants were females 275 of 419 (65.6%) and 14 of 16 (87.5%) in Oja-Oba and Odopetu markets, respectively. Most respondents in Oja Oba were Christians (349, 83.3%) while majority in Odopetu were traditional worshippers. Most respondents in both markets were Yorubas (280, 66.8%; 14, 87.5%) and married (356, 85.0%; 15, 93.8). Furthermore, while slightly above a half (236, 56.3%) of respondents had a secondary education in Oja Oba, slightly above a third (6, 37.5%) in Odopetu had either had a primary or a secondary education. Their ages ranged from 20 to 70 years, though, the age group 31-40 years had the highest number of participants (201, 46.2%) while age group 20-30 years had the least number (25; 5.97%). Statistically, the age-distribution was significantly different ($p< 0.01$). Most of the respondents 418 (96.1%) had spent more than 5 years trading in the market by the time of this study. This is a clear indication that most participants have a good knowledge of the market. Statistically, only the distribution of gender, age and religion varied significantly in the two markets investigated.

Table I: Demographic Characteristics of Study Participants in Oja-Oba and Odopetu Markets, Akure

Parameter	Oja-Oba	Odopetu	Total
Gender			
Male	144	2	146
Female	275	14	289
χ^2-value (*df= 1*)	3.88		
p-value	<05		
Age-group			
20-30	25	1	26
31-40	193	8	201
41-50	152	4	156
50+	49	3	37
χ^2-value (*df= 3*)	15.90		
p-value	<0.01		
Marital Status			
Single	57	1	58
Married	356	15	371
Widow/Widower	6	0	6
χ^2-value (*df= 2*)	1.36		
p-value	>0.05		
Ethnic Group			
Yoruba	280	14	294
Hausa	11	-	11
Igbo	102	1	103
Others	26	1	27
χ^2-value (*df=3*)	4.71		
p-value	>0.05		
Religion			
Christian	349	5	354
Muslim	68	4	72
Traditional	2	7	9
χ^2-value (*df=2*)	44.13		
p-value	<001		
Educational Background			
None	11	3	14
Primary	91	6	97
Secondary	236	6	242
Tertiary	81	1	82
χ^2-value(*df= 3*)	10.51		
p-value	>0.05		
Number of years spent in the market (years)			
1-2	7	0	7
3-4	10	0	10
5+	402	16	418
χ^2-value(*df= 2*)	1.30		
p-value	>0.05		
Total	419	96.3	435

Respondents' Account of Waste Generation and Disposal in the Markets

The frequency of generating different types of solid waste according to the respondents in the markets is shown in Figure 2. Polythene waste was the most frequently generated in the two markets (65%) while can and bottles where the least (0.2%). The respondents reported sources of polythene waste to be disposed packages for food, water and other items. Over 90% of respondents in Oja Oba said the waste management authority collects their wastes either daily or weekly while in Odopetu all the respondents said they dispose their waste themselves because there is no waste management authority in the market. In Oja Oba about 48% of respondents said they do take their waste to collection centres while over 50% said waste management vehicles collect waste directly from their stalls. It was observed that waste was collected directly only from shops located on access roads in the market. On materials used to collect waste in shops, almost equal number of respondents in Oja Oba said they use either dustbin or sack while in Odopetu, more than four fifth said they use sack while less than a fifth (12.5%) use bin. The pattern of variation in all the variables was significantly different ($p<0.05$) in both markets investigated. Almost 99% of respondents said that the final destination of waste they generated was the state dumpsite while slightly above 1% said they burn their waste.

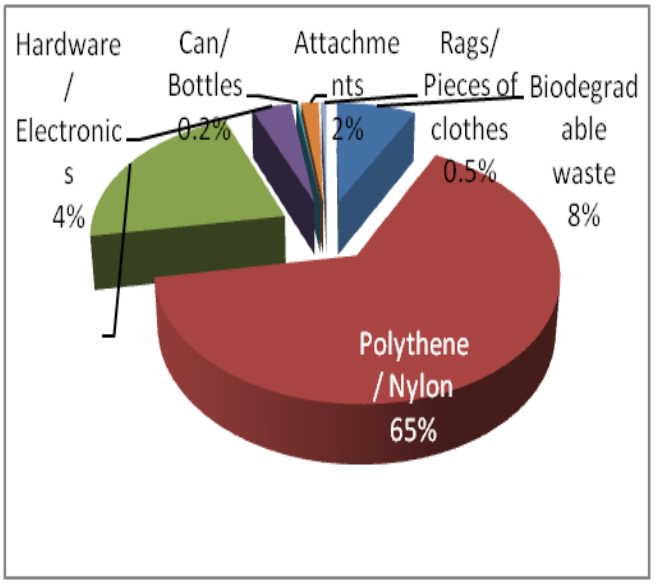

Figure 2: Components of Solid Waste Commonly Generated in the Study Area

Table II: Generation, Collection and disposal of Waste in Oja-Oba and Odopetu Martkets, Akure

Parameter	Oja-Oba (%)	Odopetu (%)	Total (%)
Material used to collect waste in the stall			
Bin	209 (49.9)	2 (12.5	211(48.5)
Sack	210 (50.1	14 (87.5	224(51.5)
χ^2-value (*df= 1*)	7.19		
p-value	<05		
Frequency of waste disposal			
Daily	218 (52.0)	16 (100)	234 (53.8)
Weekly	200 (47.7)	0 (0)	200 (46.0)
Monthly	1 (0.2)	0 (0)	1 (0.2)
χ^2-value (*df= 2*)	20.37		
p-value	<0.01		
Who disposes the waste			
Respondent	38 (9.1)	16 (100)	54 (12.4)
*MWMA	381 (90.9)	0 (0)	381 (87.6)
χ^2-value (*df= 1*)	93.01		
p-value	<0.01		
Location of final disposal			
Dumpsite	413 (98.6)	2 (12.5)	415 (95.4)
Private burning pit	6 (1.4)	14 (87.50	20 (4.6)
χ^2-value (*df=1*)	88.33		
p-value	<0.001		

*MWMA =Municipal Waste Market of Authority

Types and Quantities of Waste Generated

The number and weight of major types of solid waste collected from the markets are presented in Table 4. On the basis of most countable, the order of occurrence of the waste collected was polythene > paper/carton > plastics > glass/electrical/electronics in Oja Oba and paper > polythene > plastics > glass/electrical/electronics in Odopetu market. The polythenes comprised mainly of nylon bags, disposed sachet water packages etc. The plastics were disposed buckets, jerricans, pipes, bottles and, basins of different sizes. The glass, metal, electric and electronic waste comprised of discarded bottles, glass wares, radios, cans, metal rods, pipes, wires and containers, telephones, batteries and touch lights. The waste weight was in the order glass/metal/electrical/electronic > putrescible > plastic > paper > polythene in Oja Oba while in Odopetu the order was putrescible >.plastic > polythene > paper. It was observed that most of the putrescible generated from the grocery section in Oja Oba were quickly collected by livestock managers to feed ruminant animals. Comparison of the two markets investigated showed that for each type of waste, more was significantly generated in Oja Oba than Odopetu both in terms of total number and weight as well as number and weight of each waste type per individual.

Table III: Types and Quantities of Waste Generated in Oja-Oba and Odopetu Markets, Akure, Akure South Local Government Area (20th of Feb- 6th of May, 2017)

Waste type	Number of Waste		Waste Weight (kg)		Mean number		Mean weight	
	Oja Oba (168)	Odopetu (8)	Oja Oba (168)	Odopetu (8)	Oja Oba (168)	Odopetu (8)	Oja Oba (168)	Odopetu (8)
Putrescible			502.63	101.09			2.99	12.64
Polythene	8774	252	36.82	1.24	52.23	31.5	0.22	0.16
Plastic	377	12	48.07	3.83	2.24	1.5	0.29	0.48
Paper	3035	260	40.70	0.94	18.07	32.5	0.24	0.12
Glass, metal and Electronics	71	0	2768.0	0	0.42	0	16.48	0
Total	12,257	524	3,396.22	107.10	72.96	65.5	20.22	13.39

V. DISCUSSION

This study examined waste generation and management in a big (Oja Oba) market and a small (Odopetu) market in Akure South local government area in Akure, the capital of Ondo State, Nigeria. The aim was to determine the effects of size of markets on waste generation and management in the study area.

Findings from the study revealed that in terms of weight, putrescible and electrical, electronics, metal and can were the most important waste types generated in the markets. Ironically, the latter waste group was the least frequently encountered waste but its enormous weight may be explained by its relatively large size. This trend is in agreement with the findings of Maso *et al*. (2008) which investigated municipal waste characteristics in Nicaragua. It also agreed with the findings of municipal waste appraisal in different parts of Nigeria (Amori *et al.*, 2013; Amalu and Ajake, 2014). The percentage composition of putrescible recorded in this study (40.44%) was however, low compared with the records of Awoniyi (2016) in Alaba market, Lagos State, and Topanou *et al.* (2011) in Benin Republic. Paper waste (29.3%) obtained by this study was more than four times (6.6%) higher than those obtained by Aye *et al*. (2006). There was an increase in the percentage of plastics (nylon and plastic) (11.32%) compared with a previous record of 7% by Oyawale *et al.* (2016) in the study area and Tharanathan (2003). The results also revealed that the overall number and weight of all types of wastes were higher in Oja-oba than Odopetu market. Also with the exception of paper waste, the per capita waste generation was also higher in Oja Oba than Odopetu. This could be explained by the apparent population differences between the markets.

Although open burning was a primary treatment option in Odopetu market while in Oja Oba where waste management authorities collect waste from individual generators, the ultimate treatment was still open burning though at the dumpsite while some of the wastes such as plastic bottle and cartons were been sorted out for sale. According to Ofoezie and Bulu (2015), burning of waste has generally been condemned as the worst method of waste treatment. It is also unethical and environmentally unacceptable. These findings agree with reports from some previous studies including Okojie *et al*. (2000), Awosusi, (2010) and Benedine *et al.* (2011). The finding that there is no formal arrangement for waste evacuation in Odopetu market and that in Oja Oba where a management authority exists, it took over a week to evacuate waste generated and stored in more than half of the stalls is a clear sign of poor waste management. The implication of this untimely evacuation of waste in the markets could be serious to the traders' health and to people resident within the market perimeter (Obayelu, 2012). According to Nwankwo (2004), improper disposal of solid waste constitutes a serious threat to human health and to the achievement of sound environmental sanitation.

VI. CONCLUSION

The findings of this study have shown that enormous amount of different types of waste is generated in the markets investigated in Akure, Ondo State, Nigeria**.** The quantity of waste generated varied significantly depending on the size of the markets, sections of the markets and type of waste involved. Generally, more waste was generated in Oja-oba than in Odopetu. It was also concluded that waste management was very poor in the two markets investigated. Open dumping and burning of waste which are the two worst waste treatment options are adopted with no plan of improvement. It is concluded that unless these methods of waste treatment are updated, waste management in the markets will remain poor and unacceptable.

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