Knowledge, Practice and Perceived Problems of Solid Waste Generated in an Institutional Complex, University of Ibadan, Nigeria

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Abstract: Developing integrated solutions to Waste Management (WM) problems in an area requires generators' knowledge and perceptions on existing WM practices. This study assessed nature of waste and people's knowledge and practices of managing waste at Oladele Ajose building (within the University Teaching Hospital, Ibadan, Nigeria) as a way of identifying the most environment-friendly and cost-effective WM strategy for the complex. A semi-structured self-administered questionnaire was used to elicit information on the socio-demographic characteristics of 58 staff and all the consented students that have been in the complex for at least five years as well as their knowledge, practices and perception of WM problems. Participants' knowledge was evaluated using an 8-point scale. Scores less or equal to four were categorized as poor knowledge. Appropriate tools were also used to characterize components of solid waste generated in the complex. Age of the respondents was 31.4 ± 8.9 years; 52 % were males and 76 % were students. The knowledge score was 6.2 ± 1.2 and 87.9 % had good knowledge of WM. Majority (82.8 %) did not know the waste disposal methods in Ajose building. Almost all (96.6 %) knew that improper waste disposal can cause disease outbreak while 77.6 % believed that it could cause air, water and soil pollution. Almost all the participants (93.1 %) did not recycle or reuse their waste. Many (67.2 %) perceived waste disposal facilities as being adequate and 69.0 % claimed there were no management problems and felt comfortable. A total of 112.9 ± 1.2 kg of solid waste was generated in the complex per day, with paper making up the major component (39.3 ± 0.1 kg) followed by organic waste (24.5 ± 0.2 kg). Respondents had good knowledge of waste and could not perceive WM in the complex as problem. However, since the waste stream had a lot of recyclables, waste re-use and recycling should be promoted as an integral part of WM option in the complex.
[Hammed T. B, Ana G. R. E. E., Morakinyo O.M., Adejumo M. and Okareh O. T.. **Knowledge, Practice and Perceived Problems of Solid Waste Generated in an Institutional Complex, University of Ibadan, Nigeria.** *Nat Sci* 2017;15(9):48-53]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 8. doi:10.7537/marsnsj150917.08.

Keywords: Waste management problem, Recyclables, Re-use, Disposal facilities

1. Introduction

Understanding the characteristics of an institution's solid waste stream is the first step towards identifying a suitable, effective and sustainable waste management system for an Institution. Effective SWM requires a complete understanding of the composition of a waste stream as well as activities that determine its generation (Farmer et al., 1997), including the knowledge and perception of people that generate the waste. Considering this, SWM programs that are based on the reality of the generating source, are far more successful than mimicked programs that have been implemented elsewhere (Armijo et al., 2008). Hence, investigating the characteristics of wastes is a critical first step in successful waste management programme that would be sustainable in any higher institution of learning (Danielle et al., 2010).

According to Keniry (Keniry, 1995) and Creighton (Creighton, 1998), waste characterization studies at colleges and universities identify campus specific and regionally relevant opportunities for waste reduction and recycling. It also offer the most effective process for examining the various wastes generated and identifying opportunities for waste reduction, reuse, recycling, and composting (Thompson and Wilson, 1994; Thompson and van Bakel, 1995). Only a small number of studies have assessed the composition of solid waste within institutions of higher education (Felder et al., 2001; Mason and Oberender, 2004; Armijo de Vega et al., 2008).

Amori et al. (2013) carried out an assessment of the generation and management of solid wastes in residential areas of some selected tertiary institutions in Southwest Nigeria. The results revealed that high income earners generate more wastes than low income earners. The high composition of non-biodegradable wastes from these results bears implication of the requirement for alternative waste management solutions for sustainable and environmental friendly waste management system in the university community. Also, the results of the study showed that waste management in any environment has a direct relationship to the generator demographic

characteristics and that students have negative waste disposed habits. In another study carried at a college of education in Nigeria (Orajekwe, 2011), significant difference was found to exist between male and female students in their waste disposal habits. Likewise, students of various ages differed significantly in their waste disposal habits.

It was estimated that in 2006 the total amount of municipal solid waste (MSW) generated globally reached 2.02 billion tones, representing a 7 % annual increase since 2003 (USEPA 2009). It was further estimated that between 2007 and 2011, global generation of municipal waste would rise by 37.3 %, equivalent to roughly 8 % increase per year. If most of the waste could be diverted for material and resource recovery, then as substantial reduction in final volumes of waste could be achieved and the recovered material and resources could be utilized to generate revenue to fund waste management. This forms the premise for Integrated Solid Waste Management (ISWM) system which is based on Reduce, Reuse and Recycle (3Rs) principle (United Nations Environment Programme, 2009). Jibril et al. (2012) determined the practice of 3Rs approach amongst waste generators within an institute of higher learning to minimize the solid waste generated and reduce the running cost of the waste management system in the institute.

Characterization of municipal solid waste (MSW) is a waste stream analysis which involves a logical and systematic approach to obtaining and analyzing data on one or more waste streams or sub-streams. The analysis usually provides - the composition of the waste stream and an estimate of the quantity of the waste stream (Danielle et al., 2010). There is currently no agreed international standard for waste stream analysis or waste characterization although many countries have national procedures. However there are two basic approaches to estimating quantities of municipal solid waste - site-specific study and material flow approach (McCauley-Bell et al., 1997). This study examined the current status of municipal solid waste management within an institutional complex in the University of Ibadan, Nigeria the outcome of which is intended to improve the existing scheme.

2. Materials and Methods

Study area

The Oladele Ajose building complex was formerly known as Department of Preventive and Social Medicine. It was one of the four foundation clinical Departments of the Faculty of Medicine established for the training of medical doctors in 1948. Thereafter it was upgraded to the present Faculty of Public Health. Professor Oladele Ajose, after whom the Faculty of Public Health building was named, was the Head of Department of Preventive and Social Medicine (1948 -1962) as well as the Director of the Institute of Public Health one of the pioneer faculties of the University College Hospital that was established in 1957. The entire complex comprises 3 stories, ground floor and basement that have shared offices, lecture rooms for students, library and laboratories. At specific points in the quadrangles and entrances are located movable refuse bins for solid waste collection (Figure 1).

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Figure 1. Refuse storage points at Oladele Ajose building: 1- outside the building; 2- inside the building

Study design

Cross-sectional study design comprising questionnaire administration and solid waste assessment was adopted for this study.

Data collection procedures

A semi-structured self-administered questionnaire was used to elicit information on the socio-demographic characteristics of all 58 staff and students that have been in in the complex for at least five years as well as their knowledge, practices and perception of WM problems. Participants' knowledge was evaluated using 8-point scale. Scores less or equal to four were categorised as poor knowledge. Characterization of raw waste generated in the complex was carried out in order to classify the waste into nylon, plastic, metal, organic material, glass, rubber and so on. The 'output method' that involves sorting and weighing of individual category of the waste stream (Tchobanoglouse et al., 1993) was adopted for characterization exercise. Appropriate tools including: pickers, rakes and spades were used to segregate the waste into various components prior to weighing on a top-loading scale. Statistical analyses were performed on the data obtained to provide descriptive statistics such as sample mean and standard deviation. Data were also subjected to Chi-square test.

3. Results and Discussion

Table 1 summarizes the demographic information of the respondents. Majority (58.6 %) were aged 34 years and the mean age was 31.4 ± 8.9 years; 52 % were males and 76 % were students.

Respondents knowledge score

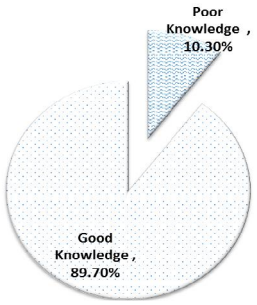

Figure 2. Respondent knowledge of solid waste management

The mean knowledge score was 6.2 ± 1.2 and 87.9 % of the respondents had good knowledge of Waste Management (WM) (Figure 2). Many (53.4 %) reported that solid waste could be useful while 27 (46.6 %) said otherwise. Also, 96.6 % knew that lack of refuse collection and disposal could cause disease outbreak. Almost all (96.6 %) said that lack of refuse collection and disposal could cause disease outbreak against 23.4 % that said otherwise. Forty-five (77.6 %) knew that poor waste management could not cause air, water and soil pollution. Fifty (86.2 %) also believed that segregation of waste at source is necessary prior to waste recycling against 3.4 % and 10.3 % that did not know and those that did not respond respectively. However, majority (82.80 %) were not conversant with the waste disposal methods in Oladele Ajose building.

Table 1. Demographic information of the respondent

Respondents characteristics	Frequency	Percent
Age category		
Equal to 30 years	34	58.6
31-40 years	16	27.6
41-50 years	5	8.6
51 years and above	3	5.2
Total	58	100.0
Gender		
Male	30	51.7
Female	28	48.3
Total	58	100.0
Level of Education		
Primary	3	5.2
Secondary	9	15.5
Tertiary	46	79.3
Total	58	100.0
Status of Occupation		
Teaching	4	6.9
Non-teaching	10	17.2
Students	44	75.9
Total	58	100.0
Hours Spent in Office Daily		
<8 h	1	1.7
8 h	3	5.2
> 8h	10	17.2
Total	14	24.1

Waste management practices in the building

More than half of the respondent (54.0 %) stored their waste in the refuse bin provided for them (Figure 3) and many disposed their waste early in the morning (Figure 4). Most of the respondents did not recycle or reuse their waste (93.1 %) while only 6.9 % reuse some components of their waste. The reason for not reusing waste could be due to lack of technical knowledge on how to recycle waste. Fifty (86.2 %) segregated their waste before disposal and 8(13.8 %) did not. If a sustainable solid waste management must be achieved, recycling which ensure financial returns at the end point of the waste must be included in the waste management scheme. The first step in solid waste management which will include recycling is segregation or sorting. If solid waste is sorted about 30 % of the work is done.

Forty (69.0 %), 5(8.6 %), 4(6.9 %), 9(15.5 %) disposed of their waste everyday, every other day, every week and at any convenient time. Majority

disposed their wastes daily due to the fact they were aware of environmental health problems that are associated with delayed waste disposal. Mostly, cleaners (87.9 %) who were employed by the university removed waste from the offices at the start of every working day; 8.6 % evacuated waste from offices themselves in the absence of the cleaners and 3.4 % relied on anybody, precisely students, to do it for them.

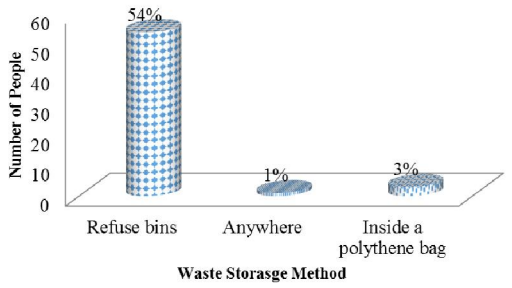

Figure 3. Method of waste storage before disposal

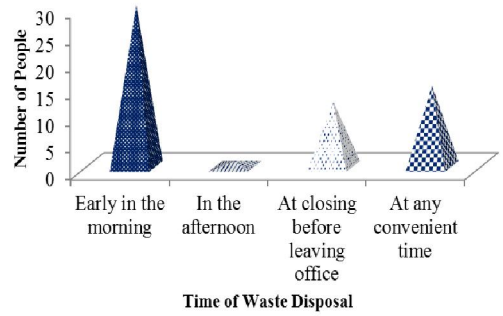

Figure 4. Time of waste disposal in the building

Perception about solid waste management in the building

In general, method of solid waste management within the building was rated to be very good (17.2 %); good (46.6 %); fair (34.5 %) and poor (1.7 %). Many (67.2 %) perceived waste disposal facilities as being adequate; 15 % rated it as not adequate while 6.9 % could not decide. In addition, many of the respondents (69.0 %) claimed there were no management problems and many (69.0 %) were comfortable with the management of waste in the building. It was evident in the building that the entire complex was very clean and devoid of any waste related problem like odour and fly infestation due to constant removal of waste. This is an advantage of hiring the cleaners, though with an additional cost to the total budget of waste disposal. Part of this expense could be off-set if waste is recycled to generate more funds. More than half (55.2 %) were satisfied with the way cleaners disposed wastes while 15.5 % were not satisfied. Suggestions made on how to improve waste management in the building included: education and enlightenment (6.9 %) and introduction of waste recycling programmes (44.8 %).

Physical Characteristics of Solid waste

A total of 112.9 ± 1.2 kg of solid waste was generated in the building per day, with paper made up the major component (39.3 ± 0.1 kg) followed by organic waste (24.5 ± 0.2 kg). Also, the highest density was found in disposable food packs (233.4 ± 1.0 kg·m-3) followed by nylon (214.1 ± 0.7 kg·m-3) and plastics (145.6 ± 0.5 kg·m-3) as shown in the Tables 2 and 3. The results of solid waste generated in the building was far higher than that obtained in another country (Danielle et al., 2010) who reported that during the 2007–2008 academic year, the Prince George campus produced between 1,200 kg and 2,200 kg of waste per week, of which more than 70 % could have been diverted through waste reduction, recycling and composting activities. The reason could be attributed to the fact that paper is no more a major waste component generated in institutions in advanced countries where virtually all academic work is based on electronic and internet facilities. Nigeria is yet to embrace the paper-less system in a typical academic environment.

Table 2. Quantity of waste generated per week in the building (kg, Mean ± SD)

Waste Type	Ground Floor	Basement	First Floor	Second Floor	Third Floor	Total
Organic Waste	4.3 ± 0.1	0.4 ±0.0	8.4 ± 0.1	7.2 ± 0.0	4.3 ± 0.0	24.5 ± 0.2
Plastics	1.1 ± 0.0	1.5 ± 0.1	1.5 ± 0.0	0.7 ± 0.0	1.2 ± 0.0	5.9 ± 0.1
Nylon	1.2 ± 0.0	8.4 ± 0.1	6.4 ± 0.0	3.0 ± 0.1	3.5 ± 0.1	23.3 ± 0.2
Metal	0.7 ± 0.0	1.2 ± 0.0	1.2 ± 0.0	1.1 ± 0.0	0.3 ± 0.0	4.7 ± 0.1
Paper	9.7 ± 0.1	7.3 ± 0.0	7.3 ± 0.0	9.7 ± 0.0	5.5 ± 0.0	39.3 ± 0.1
Disposable Food Packs	0.2 ± 0.0	0.7 ± 0.0	0.7 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	1.9 ± 0.1
E-Waste	0.4 ± 0.0	1.2 ± 0.0	0.0 ± 0.0	2.0 ± 0.1	0.5 ± 0.0	4.1 ±0.1
Glass	0.4 ± 0.0	0.4 ±0.0	1.2 ± 0.0	1.6 ± 0.0	0.1 ± 0.0	3.6 ±0.1
Others	1.4 ± 0.0	2.3 ± 0.0	2.3 ± 0.0	1.3 ± 0.0	0.7 ± 0.0	5.7 ±0.1
Total	20.1 ± 0.3	21.0 ± 0.3	28.9 ± 0.2	26.6 ± 0.3	16.3 ± 0.2	112.9 ± 1.2

Table 3. Density of waste generation in the building (kg·m-3)

Waste Type	Ground Floor	Basement	First Floor	Second Floor	Third Floor	Total
Organic	3.4± 0.8	10.6 ± 0.1	1.8 ± 0.3	4.3 ± 0.5	3.4 ± 1.3	23.5 ± 0.6
Plastics	1.0± 0.7	1.5 ± 0.1	1.6 ± 0.7	46.1 ± 0.0	95.4± 1.1	145.6 ± 0.5
Nylon	60.3 ± 0.9	3.4 ± 0.9	1.2 ± 0.4	69.3 ± 1.0	79.8 ± 0.5	214.1 ± 0.7
Metal	79.4 ± 3.1	1.3 ± 0.2	1.1 ± 0.2	10.4 ± 0.4	1.42± 0.8	93.6 ± 0.9
Paper	1.1 ± 0.7	2.0 ± 0.4	1.5 ± 0.2	1. ± 0.33	1.1 ± 0.0	7.1 ± 0.3
Disposable Food Packs	25.0 ± 2.8	85.4 ±1.4	84.0 ± 0.4	2.4 ± 0.1	36.7 ± 0.4	233.42± 1.0
E-Waste	9.6 ± 0.7	-	50.0 ± 0.0	1.4 ± 0.1	1.1 ± 0.5	62.1 ± 1.6
Glass	1.0 ±3.5	4.7 ± 0.8	1.1 ± 0.7	8.5 ± 0.7	1.1 ± 0.9	16.5 ± 1.3
Others	3. ± 1.04	1.7 ± 0.2	1.6 ± 0.6	1.2 ± 0.5	2.8 ± 0.3	10.9 ± 0.5
Total	184.4 ± 2.1	110.6 ± 0.5	143.92± 0.4	145.11± 0.4	222.7 ± 0.7	806.6 ± 0.8

In addition, types of wastes generated in the building including: used paper, discarded cans and bottles food scraps, yard trimmings, and other items were similar to waste generated in households, commercial establishments, and businesses. According to NEED (NEED, 2011), one ton of paper recycled from used papers instead of fresh fibres from wood saves 7,000 gallons of water, 17-31 trees, 4,000 kW·h electricity and 60 lbs of air pollutants. Metals, plastics, bottles and other waste components can also be reused or recycled for value added and the safety of the environment. The study shows that the average waste generated per day in the residential areas of the institutions, food waste had the highest proportion followed by plastic related waste. Other important waste materials identified in the study include e-waste, metals and textiles.

4. Conclusion and Recommendation

Both students and staff of Oladele Ajose building at the University Teaching Hospital, Ibadan, Nigeria had good knowledge of waste and could not perceive waste management in the complex as a problem. Also, method of solid waste management within the building was very good and waste disposal facilities were adequate. However, as recyclables formed the major components of wastes generated in the building and as respondents had good practices of waste storage and segregation, recycling and re-use, considered to be the best management option, was not yet being practiced in the building. The high composition of recyclables therefore bears implication for the requirement of alternative waste management options like waste recycling for sustainable and environmental friendly waste management. It is recommended that capacity building on institutional waste recycling programmes should be encouraged to improve waste management in the building.

Acknowledgements:

The authors wish to express their profound gratitude to MPH students (2013/14 set) of the Department of Environmental Health Sciences who assisted in data collection.

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