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ASSESSMENT OF SOLID WASTE MANAGEMENT IN SOKOTO METROPOLIS

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ABSTRACT

This study was designed to assess the methods of solid waste management in Sokoto metropolis, Sokoto state North-Western Nigeria. The research gathered data from two main sources (Primary and secondary). The primary data were collected through the use of structured questionnaires administered to 120 households, while secondary data were sourced from ministerial documents. Descriptive statistics and chi square test of association were employed to analyze the data. The findings revealed that domestic source accounts for 55.8% of waste generated in the metropolis, commercial source accounts for 32.5% and agricultural waste accounts for 11.7% of waste generation in the study area. Majority (81.7%) of the respondents are reported using waste bin as the means of waste collection which is usually dumped at the nearby dumpsites or drainages. The relationships between socio-demographic characteristics of the respondents and the method of waste disposal were examined using chi-square test of association. Among the variables compared, only educational level showed a significant relationship (X^2 = 18.446, $P<0.05$). Based on physical observations, the result revealed that there is high unauthorized waste disposal point in the study areas than authorized, which is an indication that majority of respondents dumped their waste illegally in resident areas, the study concluded that there is lack of waste disposal points in the metropolis and recommended based on findings that government should increase the number of waste collection points, waste collection vehicles and waste management staff.

Keywords: Solid waste; Waste management; Sokoto metropolis

INTRODUCTION

Waste may be defined as substances or objects discarded, worthless, unwanted, and defective or of no value from a consumption or manufacturing process (Ayuba, 2005). They may also be defined as substances or objects which are disposed of, or are required to be disposed of according to the provision of a national law (Ayuba, 2005). Sustainable waste management practices include reuse, recycle, recovery and treatment. Reuse is using again items that can be disposed as waste such as glass jars, bottles, and plastic bags. Recycle is the creation of new things from used items such as paper, broken glass, some form of plastics, and bottles. Recovery is the regaining of items which were disposed as waste in waste dumps. Treatment is the handling of waste to minimize its negative impact on the

environment which is mostly applied to liquid wastes such as industrial effluents and household sewage (Enete, 2010).

According to Mansoor *et al.* (2005), proper solid waste disposal is an important component of environmental sanitation and sustainability. A sustainable environment and improved waste management offer opportunities for income generation, health improvements and reduced vulnerability. This could hardly be attained in some of the developing countries, most especially in Nigeria because of non- readiness, uncoordinated and laissez faire attitude toward better ways of solid waste disposal methods in spite of their high rate of urbanization and growth in commercial and industrial activities (Afangideh *et al.*, 2012).

According to Nwigwe (2008), refuse disposal is one of the major environmental problems that developing countries are faced with. Health hazard, traffic congestion, unsightliness, unpleasantness and blockage of drainages are some of the problems caused by lack of efficient waste management practice in Nigeria. Solid waste disposal is treated with levity in developing countries of the world, most especially in Nigeria which has experienced high rate of urbanization within the last four decades. The nonchalant attitude of people in African countries toward modern methods of waste disposal has posed serious environmental health challenge to human existence in their natural environment (Afangideh *et al.,* 2012). Meanwhile, one of the aspirations of the western world is to achieve sustainable environment.

Solid wastes comprise all the wastes arising from human and animal activities that are normally solid, discarded as useless or unwanted (Okecha, 2000). Solid waste can be classified in a number of ways, on the basis of sources, environmental risks, utility and physical property, solid wastes are also classified as: Municipal Solid Wastes (MSW), Industrial Solid Wastes (ISW) and Agricultural Solid Wastes (ASW) (Okecha, 2000). Nigeria's major urban centers are today fighting to clear mounting heaps of solid waste from their environments. These strategic centers of beauty, peace and security are being over taken by the messy nature of over flowing dumps unattended heaps of solid wastes emanating from household or domestic or kitchen sources, markets, shopping and business centers (Okecha, 2000). City officials appear unable to combat unlawful and haphazard dumping of hazardous commercial and industrial wastes which are clear violation of the clean Air and Health Edicts in our environmental sanitation laws, rules and regulation (Okebukala, 2001).

Urban land use becomes complex as the city grows in population and physical size and so does the solid waste generation increase in volume and types. Urban land uses vary from residential, commercial, industrial, institutional; and others, with each category generating its own peculiar type of solid waste. However, residential land use constitutes the single most important generator of solid waste in Nigeria urban areas (Adegoke, 1990). Because of the complexity of the household wastes, the socio-economic structure of the urban population becomes a major determinant of the spatial structure of solid waste problems in our cities. Uwadiegwu *et al* (2013) in a study noted that the quantity of municipal solid waste produced depends upon the living standard of the residents, urbanization and industrialization.

Okoye (2004) identified household size, income level, level of technological advancement and socio-economic status as factors that affect the quantity of solid waste generation, but, noted that, a single factor may not on its own constitutes a difference in the quantity of waste generated by a household.

There are different techniques of municipal solid waste disposal but the common techniques are landfill, incineration, composting and anaerobic digestion and recycling (Igbinomwanhia, 2011). Although presently in Nigeria the prominently practiced municipal waste management technique is open dumping, land fill, followed by open burning while incineration method is seldom put to practice. Incineration is a cost effective municipal waste disposal option which is seldom applied in Nigeria hospitals where medical waste are incinerated at a minimal scale (Ogwueleka, 2009). The cheapest and simplest method of waste disposal is landfill. The resulting environmental impact of landfills is enormous but could be mitigated provided sanitary precautions are undertaken and waste reduction is advocated. Landfills were responsible for 49 percent of England's methane emissions in 2007 (Burney & Rampling, 2011). Moreover, recycling which is an environmentally friendly option is not fully adopted. There is no formal recycling sector in Nigeria. Wastes are recycled informally by scavengers who buy un-used valuables from people and also go to legal and illegal dumpsites in search of materials that can be re-used and recycled. This study is therefore, designed to identify methods of solid waste disposal within the metropolis; classify and establish relationship between socioeconomic status and methods of disposal adopted by the inhabitants; and to evaluate the level of efficiency in the control and management of urban waste in Sokoto metropolis.

MATERIALS AND METHODS

The Study Area

Sokoto metropolis was the study area, which is currently the capital city of Sokoto State, which is located in the North-West geo-political zone of Nigeria within latitude $13^0 05$- $13.083^{0'}$N and longitude $05^0 15$- 5.250^0E and at an average elevation of 272 m above sea level. Sokoto metropolis comprised of a number of local administrative units (local governments): Sokoto North and South as well as some parts of Kware, Dange-Shuni and Wamakko local government areas.

In terms of climate, the vegetation of the state falls within the savannah zone. This is open tsetse fly grassland suitable for cultivation of grain crops, savannah trees and animals husbandry. Rainfall starts late and ends early with mean annual ranging between 500 to 1,300 mm. There are two major seasons in the state, namely the wet and dry seasons. The dry season starts from October to April, while the wet season starts in most part of the state in May and lasts up to September or October. The Harmattan, a dry cool and fairly dusty wind is experienced in the state between November to February. Heat is more severe in the state in March and April but the weather in the state is always cool in the morning and hot in the afternoon.

Sokoto is also one of such cities that attract several visitors from within and outside Nigeria particularly to the famous *Hubbare* of Shehu Usmanu bin Fodio. The political history of the city as the center of the then caliphate also attracted the attention of a number of historical writers.

Preliminary Survey and Sampling Techniques

Prior to the commencement of this study, survey of the residential and commercial areas was conducted with the view to classifying the areas into different strata. Information

on the designated waste collection centers as well as town planning information was obtained from the relevant authorities. Stratified random sampling was used in this study. The metropolis of Sokoto city is organized into different residential as well as commercial areas. Different residential areas are categorized based on the income level of the households as low, medium, and high income earners. Each residential category was considered as a stratum. Commercial areas (market and plazas) also constitute strata. Proportional allocation of strata was adopted to select 120 respondents for this study.

Data Collection

This study used both primary and secondary data. The primary data constitute information on the types of waste generated, methods of disposal, identification of authorized and unauthorized refuse disposal points, as well as the socio-economic information of the residents. The secondary data were obtained from the relevant authorities (Sokoto Environmental Protection Agency and Sokoto Urban and Regional Planning Board) to include data on the designated disposal centers, methods and frequency of refuse collection.

Data Analysis

Descriptive statistics (frequencies and percentage) were used to summarize the data generated. The socio-economic information of the respondents was measured as categorical variables tested in relation to the methods and procedures of waste disposal using chi-square test of association.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Demographic characteristics of the respondents are presented in Table 1. The variables identified and analyzed include age, sex (gender), marital status, occupation, education attainment, and household size.

Majority (48.3%) of the respondents fell within of 21-30 years, followed by 31-40 years (31.7%), and the age range of 51-60 years (0.8%) recorded the least occurrence. This shows that majority of the respondents are within the active youthful age. Similar results were reported by Adogu *et al.* (2015). Male respondents represent 95% of the respondents with over 50% married. This is so because male folks participate more in outdoor activities than female due to the religious and traditional background of the study area, it is difficult to get the response of female especially house wives except older and mostly in the market.

More than 50% of the respondents had tertiary education, followed by secondary school education with 25% while primary and Qur'an education recorded the least responses. Since the respondents are educated there is likelihood that they will accept modern ways of waste management whenever introduced. The finding is not in line with the report of Banga (2013) on household knowledge of solid waste segregation in Urban Kampala which showed that only 17.5% of the respondents had attained tertiary level education and 43.8% attained secondary level education, while 30.5% had primary education. Furthermore, this result is in line with the findings of Adeyemo and Gboyesola

(2013) on knowledge, attitude, and practices on waste management of people living in the university area of Ogbomoso which indicated that the respondents were knowledgeable in refuse management.

Table 1: Socioeconomic characteristics (n=120)

Variable	Frequency	Percentage (%)
Age class		
15-20	3	2.5
21-30	58	48.3
31-40	38	31.7
41-50	20	16.7
51-60	1	0.8
Gender		
Male	114	95
Female	6	5
Marital status		
Single	50	41.7
Married	69	57.5
Divorce	1	0.8
Widow	0	0
Occupation		
Civil servant	26	21.7
Business	60	50.0
Student	34	28.3
Others	0	0
Educational attainment		
Primary	5	4.2
Secondary	30	25
Tertiary	66	55
Qur'an	19	15.8
Household size		
1-10	88	73.3
11-20	27	22.5
21-30	5	4.2

Source: field survey, 2016

Household size is another important factor that determines the amount of waste generation by households. In this study more than 70% of the respondents reported to have household size of 1-10, which will invariably lead to more waste generation per capita. Household generation of solid waste in the metropolis was found to be a function of the type and income levels of households, the larger the households therefore, the more waste is generated; so also the higher the income level of individuals, the more waste they generated in their respective households.

Waste Generation and Management

Three major sources of waste generation were identified as presented in Table 2. Domestic waste constitutes the greater percentage amongst the sources. Different methods of waste collection were as well identified in the course of this study (Table 3). Majority (81.7%) of the respondents uses waste bin within their compounds for waste collection and using trash bags/poly bags recorded the least responses.

Table 2: Source of waste generation

Sources of waste generation	Frequency	Percentage
Domestic	67	55.8
Commercial	39	32.5
Agricultural	14	11.7
Total	120	100

Source: field survey, 2016.

Table 3: Household waste collection

Collection medium	Frequency	Percentage (%)
Waste bin	98	81.7
Polybag	7	5.8
Refuse heap in your compound	15	12.5
Total	120	100

Source: field survey, 2016

It is evident that domestic activities with increasing number of households can lead to higher waste generation within the metropolis. The higher proportion of the domestic waste generation compared with other sources could be due to the fact that the large portion of the study is made of residential houses. This is similar to the findings of Modebe *et al.* (2011) on household solid waste management in Awka, Anambara State, Nigeria.

Using waste bin is a common practice among the respondents within the metropolis. This is largely because majority of the respondents for this study acquired one form of education or the other and there is strong correlation between educational status of a people and waste management. Using trash bags/poly bags recorded the least responses as a means of waste collection and this could be attributed the cost of acquiring the bags in relation to economic realities of the residents. It was observed that some of the waste bins had no cover, hence causing overflow and littering of the area. It was observed that children and housemaids do normally dispose of the waste (either in bins or trash bags) mostly in drainages and illegal dumpsites close to the area in which the house is located. Omambiaa and Ogonya (2015) reported similar findings stating that most of the people use communal bin as a method of their household solid waste collection. It is in accord with a research done on solid waste transportation, which reported that many households will want a communal bin outside their houses and the location of the communal bin or pit done in conjunction with the residents (Mabel, 2008).

Table 4: Waste disposal and management by households

Frequency of disposal	Frequency	Percentage
Daily	49	40.8
Twice a week	42	35.0
One a week	29	24.2
	Method of disposal	
Dumping in near- by dumpsite	40	33.3
Dumping in near-by drainage	18	15.0
Use of private waste managers	4	3.4
House help/housemaid	58	48.3

Frequency of disposing waste as well as methods of disposal were assessed and results presented in Table 4. Daily waste disposal recorded the highest proportion among the responses (40.8%). This could be due to the fact that the household size of the respondents is relatively large enough to accelerate per capita waste generation on daily basis. Preliminary survey suggests that four different methods of disposal are commonly adopted by the residents. From the result it was observed that indiscriminate dumping of waste either at the nearby dumping site or drainages are very common practices with few individuals patronizing the services of private waste managers. Different results were reported by Abdullahi *et al.* (2014*)* who revealed that, 52.1% of respondent reported weekly collection intervals while 35.4% of respondent reported daily collection. The findings of this study are in line with the work Adeniyi (2013) who reported 52.5% of the respondents using houseboys/housemaids to dispose of their waste, 33% dump their waste in nearby dumpsites while 22.5% use private sanitation agencies and 2.5% dispose of their waste in nearby drainages.

Physical observation of 92 different waste disposal points was carried out with a view to ascertain efficiency of the government's effort in waste management. Majority (64.2%) of the places visited dispose refuse in unauthorized points, this show that, unauthorized number of waste disposal points have a higher percentage among the resident areas in the metropolis. According to Medina (2002), improper handling and disposal of solid waste has contributed to the high level of mortality and morbidity witnessed in most urban cities in developing countries of the world. In addition, urban cities in developing countries face challenges in solid waste management in terms of their non-sustainability status in solid waste management.

Table 5: Status of waste disposal points

Variable	Frequency	Percentage
Authorized	33	35.8
Unauthorized	59	64.2
Total	92	100

Relationship between Socio-economic Characteristic and Method of Waste Disposal

Chi square test of association was carried out in order to establish relationship between socioeconomic characteristics of the respondents and the methods adopted for

waste disposal. Results of the test revealed non-significant relationship with all the variables except educational status as presented in Table 6.

The present finding therefore, is in line with finding work done by Ibanga (2015) who reported that there is significant association between methods the respondents used in disposing refuse and their sex, with their educational level. Association between their occupation and the method they used in disposing refuse was not significant (P<0.05).

Table 6: Chi square result

Variable	X^2	P-value
Gender	0.670	0.880
Age	13.360	0.343
Marital status	2.768	0.837
Occupation	6.679	0.352
Educational status	18.446	0.030*
Household size	6.134	0.408

*significant (P<0.05)

CONCLUSION

The study revealed that domestic waste constitutes the major source of waste within the metropolis with the majority of residence using landfill as their methods of waste disposal. Similarly, based on physical observation of the waste dumping sites, there are high unauthorized waste disposal points in the study area than authorized. Indiscriminate dumping of waste causes problems like environmental pollution, blockage of drainages, unpleasant odor, littering of the street, epidemic, ground water pollution. There was a strong relationship between educational level of the inhabitants and the methods of waste management.

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