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SOCIO-ECONOMIC CORRELATES OF HOUSEHOLD SOLID WASTE GENERATION: EVIDENCE FROM LAGOS METROPOLIS, NIGERIA

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Abstract
The study analyzed the determinants of household solid waste generation among residents of Lagos metropolis, Nigeria. Primary data for the study were obtained through questionnaire administered on residents in Eti-osa, Ikeja and Mushin Local Government Areas (LGAs) representing the low, medium and high densities respectively into which the sixteen LGAs in Lagos metropolis were stratified. From a total of 15,275 residential buildings in ten electoral wards, one out of every forty buildings (2.5%) was selected using systematic random sampling where a household head was sampled. The actual measurement of the quantity of household solid waste generated was determined in 1% of the sample frame for this study. Data obtained were analyzed using both descriptive and inferential statistics. 59.9% of the residents were high income earners, 34.9% and 5.2% were middle and low income earners respectively. Through multiple regression, the study concluded that income, education, age, length of stay and household size of residents explained 54.9% of the variation in the household solid waste generation in Lagos metropolis. The policy implication of this study is that these determinants should be considered as essential factors in the design of solid-waste management programme in urban settlements that share similar residential characteristics with Lagos metropolis especially in Nigeria.
Keywords: Household Solid Waste generation, Socio-economic correlatess, Multiple Regression.

1. INTRODUCTION

As a result of rapid urbanization taking place within the cities of the world, plethora of environmental challenges has been noted within the different residential spheres. These problems include urban sprawl, decaying inner-city, inadequate housing, crime and congestion among others. Of particular interest and attention is the problem associated with waste management that has taken unprecedented complex dimension in the cities of developed and developing nations (Afon 2007; Hassan et al., 2007; Contreras et al., 2009; Kayode and Omole 2011).

According to Gilpin (1996) and Oresanya (1998) an elaborate definition of the term waste embraces all unwanted and economically unusable by-products or residuals at any given place and time, and any other matter that is discarded into the environment. This definition suggested that what constitutes

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waste must occur in such a volume, concentration, constituency or manner as to cause a significant alteration in the environment. Thus, apart from waste being an unwanted substance that is discarded, the amount of it and the impact it makes on the environment also become important considerations in defining waste. Events of the late 20th and early 21st centuries indicate that waste, in whatever form or classification: solid, liquid, or toxic, has become a major consequence of modernization and economic development (Tsiboe, and Marbell 2004). Notably, the solid form of waste, is fast becoming a menace in both developed and developing nations (Contreras et al., 2009; and Musademba et al., 2011).

As observed by Pacione (2005), in countries around the world, one major environmental problem that confronts municipal authorities is solid waste management. Pacione (2005) articulated that most city governments are confronted by mounting problems regarding the solid waste generation. The observation is in tandem with the assertion of Johan and Obirih-Opareh (2003) and UNHABITAT (2010) that, in third World cities, between one-third and one-half of the solid waste generated remain uncollected. In high-income countries, the problems associated with solid waste usually centre on the difficulties and high cost of disposing the large quantity of solid waste generated from different sources. According to Nwachukwu (2009), of particular concern are the management problems associated with the solid waste emanating from households.

The management of household solid waste is one of the huge challenges of the urban areas of all sizes. From mega-cities to the small towns, it is always in the top five of the most challenging problems for city managers (UNHABITAT 2010). In an earlier study, Girling (2005) concluded that the collection and disposal of household solid waste generated are particularly problematic in cities of developing countries. In this regard, Nigeria is not exempted as evidences abound that the problems associated with household solid waste generation are daily realities in most Nigerian cities.

Household solid waste generation constitutes a growing problem and has gained increased research focus in recent years. The amount of solid waste generated in the world is steadily increasing and every government is currently focusing on methods to approach the challenge (UNHABITAT, 2010). Despite this growing concern, (UNEP 2009; Ezeah, 2010; Kayode and Omole, 2011) posited that the problems associated with household solid waste still persist in the urban settlements of Nigeria and other developing nations.

Studies by Afon (2007) and Nwachukwu (2009) investigated solid waste generation in two different traditional cities in Nigeria. The work of Afon (2007) focused on four residential attributes (education, occupation, income and household size) influencing household solid waste generation. The findings indicated; there is a relationship between solid waste generated and educational and income status, as

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well as household size and occupation of the residents. On the other hand, Nwachukwu (2009), through the use of secondary source of data examined the relationship between population growth and the quantity of solid waste generated. The study established a linear relationship between quantity of solid waste generated and population increase.

The work of Afon (2007) did not consider other factors such as: age of residents and years they have lived in their neighbourhood (length of stay). Thus, this study is different, as it attempts to examine the effect of these factors in addition to education, income and household size as identified by Afon (2007) on household solid waste generation. Also, contrary to the methodology employed by Nwachukwu, this study shall utilize primary data to examine the factors influencing household solid waste management at source.

UNHABITAT (2010) established that one of the main reasons for difficulties in the field of solid waste management is the failure to take account of the important differences between geographical regions, between nations, between cities and even within a city. Hence, the study examined the socio-economic determinants of household solid waste generation in Lagos metropolis, Nigeria. This was with a view to providing information that can enhance solid waste management. The study is apposite because it can also provide information to waste management stakeholders on feasible measures to address problems associated with household solid waste management even in other urban settings that have similar residential characteristics with Lagos metropolis; a city regarded as one of the fastest growing megacities in the world.

2. STUDY AREA, MATERIALS AND METHODS

Lagos is situated within latitudes 6° 23'N and 6° 41'N and longitudes 2° 42'E and 3° 42'E. The physical growth and development of Lagos are tied to its expanding economic and political roles, which aided by its rapid and explosive population growth has been phenomenal. The state has a population of 17 million with approximately 85% living in the city of Lagos making it one of the most urbanized regions in Nigeria. The population density of the State is about 4,193 persons per square km. However, in the built-up areas of Metropolitan Lagos, the average density is over 20,000 persons per square km. The rate of population growth is about 600,000 per annum, which is ten times faster than that of New York and Los Angeles (Canadian International Development Agency, 2012).

According to Aderogba et al., (2012), Lagos Metropolis is the economic and financial capital of Nigeria. With a total of 999.6km2 in Land Area, the metropolis is made up of 16 Local Government Areas (LGAs). According to Lagos State Government Digest of Statistics (2011), Eti-Osa LGA has the largest

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land area of 299.10 km2, the second and the third largest are: Ojo and Alimosho LGAs with 182 km2 and 137.8km2 respectively. The total population that made up the metropolis has the largest concentration at Alimosho LGA, (2,047,026) while the second and third in terms of population size are: Ajeromi – Ifelodun LGA (1,435,295) and Mushin LGA (1,321,517).

Data for this study were from primary and secondary sources. The primary data was sourced through questionnaire administration and actual measurement of household solid waste generated in the study area. Through multi-stage sampling technique, the 16 Local Government Areas (LGAs) within Lagos Metropolis were stratified into low, medium and high density areas. In this study, a LGA with a population of 20 – 10,000 persons/km2 was regarded as low density; while medium and high density have 10,001 – 20,000 persons/km2 and above 20,000 persons/km2 respectively.

Simple random sampling technique was used to select Eti-osa, Ikeja and Mushin areas from the low, medium and high density areas respectively. The three selected LGAs were further stratified into existing electoral wards as recognized by the Independent National Electoral Commission (INEC).

Information obtained from INEC showed that there were fourteen electoral wards in Mushin LGA, while Ikeja and Eti-osa LGAs has ten (10) wards each. One out of every four (4) wards in each LGA was selected through simple random sampling without replacement.

Thus, ten (10) political wards were surveyed. There were 15,275 residential buildings in the selected political wards, with 8996, 3780 and 2499 in the high, medium and low densities respectively. Systematic random sampling technique was adopted in selecting one out of every forty buildings (2.5%). Using this method, a total of 384 buildings were sampled with a household head targeted in each building for questionnaire administration. Information obtained from residents includes: their residential characteristics and the per capita waste generation.

The actual measurement of the quantity and composition of household solid waste generated was determined in 1% of the sample frame (15,275 buildings) for this study in each of the selected LGAs.

3. RESULTS AND DISCUSSIONS

The research findings are discussed under the various headings below. Except otherwise stated, all the tables through which information are summarized below emanated from the author's field survey of 2014.

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TABLE 1 -AGE DISTRIBUTION OF RESIDENTS

Age	High		Medium		Low		Total	
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
19 – 30	32	14.0	5	5.3	12	19.7	49	12.8
31 – 55	167	72.9	69	73.4	35	57.4	271	70.6
56 – 65	30	13.1	20	21.3	14	23.0	64	16.7
Total	**229**	**100**	**94**	**100**	**61**	**100**	**384**	**100**

(i) Age Distribution of Respondents in Lagos Metropolis

The age of the household head in the three identified residential densities of Lagos Metropolis were grouped into three according to World Health Organization (2011). These were: 19-30 years (the youths), 31-55 years (the young adults) and 56-65 (the adults). Age is expected to play a significant role as maturity could affect level of awareness on solid waste management. As shown on Table 1, it was evident that 70.6% of respondents in Lagos metropolis were young adults. The youth and adult respondents accounted for 12.8% and 16.7% respectively. However, the age distribution of residents within the identified residential densities of Lagos metropolis revealed that young adults were dominant in the three residential densities. This age group constituted 72.9%, 73.4% and 57.4% respectively in the high, medium and low residential densities of the Lagos metropolis. Next in descending order were the adults. This group accounted for 13.1%, 21.3% and 23.0% in the high, medium and low residential densities respectively.

TABLE 2 - INCOME GROUP OF RESIDENTS

Income classification	High		Medium		Low		Total	
	Freq.	(%)	Freq.	(%)	Freq.	(%)	Freq.	(%)
₦18, 780 – ₦50, 000 (LI)	12	5.2	8	8.5	–	–	20	5.2
₦50,001 - ₦100,000 (MI)	88	38.4	46	48.9	–	–	134	34.9
Above ₦100,000 (HI)	129	56.3	40	42.6	61	100	230	59.9
Total	**229**	**100**	**94**	**100**	**61**	**100**	**384**	**100**

(ii) Income Status of Residents

One of the most influential factors in determining waste generation rate is the affluence or income level of a particular household or a person. In this study, the income group for household heads were based on the income classification adapted from Ezeah (2010) using the Lagos State Civil Service minimum wage as the benchmark (Vanguard Newspaper, 2011). Therefore, household heads who earn N18, 780 – N50, 000 were regarded as low income earners (LI), N50,001 – N100,000 were referred to as middle income earners (MI), while the high income earners (HI) earn above N100,000 (exchange rate: US $1.00 N162) (Central Bank of Nigeria, 2014). The study established that 59.9% of the residents in Lagos metropolis were high income earners, while 34.9% and 5.2% were middle and low income earners respectively.

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TABLE 3- HOUSEHOLD SIZE

Household size	High		Medium		Low		Total	
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
Small	147	64.2	74	78.7	55	90.2	276	71.9
Medium	65	28.4	20	21.3	6	9.8	91	23.7
Large	17	7.4	–	–	–	–	17	4.4
Total	**229**	**100**	**94**	**100**	**61**	**100**	**384**	**100**

(iii) Household Size

Household size was measured by the number of family members living together under one roof and maintaining a unique eating arrangement (World Health Organization, 2011). In this regard, the Afon (2005) household size classification was adopted and categorized into three. Household with 6 members and below, household that contained 7 to 10 members and household with more than 10 members. These were respectively regarded as the small, medium and large sized household size. From the summary presented in Table 3, low residential density had the largest proportion of respondents with small sized household. This group accounted for 90.2% of the households within Lagos metropolis. Small sized households in the high and medium residential densities were 64.2% and 78.7% respectively. Also, the analysis revealed that households that were of medium size were largely domiciled in the high density residential area. This group accounted for 28.4% in metropolitan Lagos. However, 7.4% of the respondents in the high residential density were of medium sized household.

TABLE 4 - RESIDENTS' LENGTH OF STAY

Statistics	High	Medium	Low	The Study Area
Mean	8.1	6.8	6.2	7.5
Standard deviation	6.6	5.1	4.1	6.2
Minimum	2	1	1	1
Maximum	42	26	14	42

(iv) Length of Stay

This refers to the number of year(s) a resident has lived in an area. As presented in Table 4, the study adopted Faniran (2012) classification in this regard. The number of years residents have lived in an area was categorized into four. That is, 1 - 10 years, 11 – 25 years, 26 – 40 years and above 40 years. The descriptive statistics of the residents' length of stay in the study area revealed that the minimum length of stay was 1 year, while the maximum was 42 years. The mean and standard deviation of residents' length of stay in the study area were 7.5 and 6.2 years respectively. The average length of stay was respectively 8.1, 6.8 and 6.2 years for the high, medium and low densities. The standard deviations of length of stay for the high, medium and low residential densities were 6.6, 5.1 and 4.1 years respectively.

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(v) Education Status of Residents

This variable captured the number of years the respondent spent in pursuit of formal education. The literacy level of household heads was viewed through the number of years spent in attending school by the respondents. The study established that the minimum number of years was 6 years, while the maximum was 23 years. In the high density residential density of the metropolis, the minimum number of years spent on the pursuit of formal education was 12 years, while the maximum was 17 years. While respondents in the medium density residential area had spent a minimum and maximum of 6 and 23 years respectively, those in low density residential area had spent a minimum and maximum of 12 and 18 years respectively. The average number of years spent by residents of Lagos metropolis in the pursuit of formal education was 15 with a standard deviation of 2.1. This low standard deviation shows that the data are clustered closely around the mean and more reliable. The study established that the average years spent by respondents in the pursuit of educational qualifications in each residential density differed. While it was 15 in the high density, it was 14 and 16 respectively in the medium and low densities.

TABLE 5 - RESIDENTS' EDUCATIONAL STATUS

Statistics	High	Medium	Low	The Study Area
Mean	15	14	16	15
Standard deviation	1.7	2.5	1.5	2.1
Minimum	12	6	12	6
Maximum	17	23	18	23

TABLE 6 - CORRELATION COEFFICIENT OF THE ASSOCIATION BETWEEN RESIDENTS' SOCIO-ECONOMIC CHARACTERISTICS AND HOUSEHOLD SOLID WASTE GENERATION

	x_1	x_2	x_3	x_4	x_5	x_6
x_1	1`					
	384					
x_2	-.158**	1				
	.002					
	384	384				
x_3	.185**	.385**	1			
	.000	.000				
	384	384	384			
x_4	.660**	-.251**	.000	1		
	.000	.000	.997			
	384	384	384	384		
x_5	.480**	-.160**	.069	.326**	1	
	.000	.002	.176	000		
	384	384	384	384	384	
x_6	.042	.180*	.708**	-.124	-.083	1
	.605	.025	.000	.125	.305	
	155	155	155	155	155	155

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Age (x_1), Years spent in pursuit of formal education (x_2), Average monthly income (x_3), Length of stay in the neighbourhood (x_4), Household size (x_5), Total quantity of household solid waste generation (x_6).

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TABLE 7[a] - MODEL SUMMARY

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.741[a]	.549	.524	.24413

a. *Predictors: (Constant), Predictors: (Constant), Age of residents, Years spent in pursuit of formal education, Average monthly income, , Length of stay in the neighbourhood and Household size of residents*

TABLE 7B: ANOVAB

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	10.580	8	1.323	22.189	.000[a]
	Residual	8.702	146	.060		
	Total	19.282	154			

b. *Predictors: (Constant), Age of residents, Years spent in pursuit of formal education, Average monthly income, , Length of stay in the neighbourhood and Household size of residents*
c. *Dependent Variable: Total quantity of household solid waste generation*

TABLE 7C - REGRESSION COEFFICIENT OF FACTORS EXPLAINING THE QUANTITY OF WASTE GENERATION IN LAGOS METROPOLIS

Model	Un-standardized Coefficient		Standard Coefficient	T	Sig.
	B	Standard error	Beta		
Constant	.586	.214		2.744	.007
x_1	.002	.003	.071	.853	.395
x_2	-.025	.011	-.153	-2.218	.028
x_3	3.022E-6	.000	.702	11.165	.000
x_4	-.005	.004	-.095	-1.308	.193
x_5	-.010	.005	.058	-1.998	.048

(vi) Household Solid Waste Generation and Residents' Socio-economic Characteristics

As presented on Table 6, the pearson correlation coefficient was performed to check collinearity between the predictors and the dependent variable (quantity of household solid waste generation). Correlation coefficient computed indicated that each of the variables representing age, years spent in pursuit of formal education, average monthly income, length of stay in the neighbourhood, and household size was strongly correlated to the total quantity of household solid waste generation. The coefficient of each of the variables with quantity of household solid waste generation were: .042, .180, .708, -.124, -.109, .031, -.301 and -.083 significant at the 0.01 level (2-tailed). These 5 independent variables used in the regression model were tagged thus: Age (x1), Years spent in pursuit of formal education (x2), Average monthly income (x3), Length of stay in the neighbourhood (x4), Household size (x5), and total quantity of household solid waste generation (x6, dependent variable).

The multiple regression coefficient R2 = 0.549 (see Table 7a), significant at 0.001, confirmed that 54.9% of the variance in the quantity of household solid generation in Lagos metropolis was explained by the model. From Table 6.2c, the regression equation is Y = 0.586 + .002x1 – .025x2 + 3.022E-6x3 – .005x4

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– .010x5. The ANOVA table (see Table 7b) which assesses the overall significance of a regression model confirmed the model was significant as p □ 0.05. The final model that emerged from the stepwise regression contained two predictor variables (average monthly income and household size). The combination of these two variables after others were excluded indicated that these two predictors both explained 52.1% of the variation in the household solid waste generation. However, Average monthly income was the dominant variable that contributed 50.2% of the variance in the model. This study therefore, established that household income and family size are the most significant factors affecting the quantity of solid waste generation.

4. CONCLUSIONS

The study examined the determinants of household solid waste generation in Lagos metropolis. Analyses of correlation coefficient computed indicated that each of the variables representing age, years spent in pursuit of formal education, average monthly income, length of stay in the neighbourhood, and household size was correlated to the total quantity of household solid waste generation. However, through stepwise regression, the study revealed that income and household size were the significant determinants of household solid waste generation. These two variables explained 52.1% of the variation in the household solid waste generation in Lagos metropolis. This implies a linear relationship between quantity of household solid waste generation and income with household size in Lagos metropolis. The policy implication of this study is that residents' income and population increase (household size) should be considered as essential factors in the design of solid-waste management programme in Lagos metropolis and other urban settlements that have similar residential characteristics with Lagos metropolis especially in Nigeria.

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