ANALYSIS OF HOUSEHOLD SOLID WASTES GENERATION WITHIN SOKOTO METROPOLIS

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ABSTRACT
Solid waste management has been given a serious attention in recent times in the City of Sokoto; however, there still exist heaps of solid wastes littering some important areas within the city. This therefore calls for a study into the solid waste generation in the metropolis with a view to identify the model which will represent the solid waste generation for the city. In this study a total of 100 (one hundred) households were randomly selected within four housing estates in the city. Average five days wastes generation were tabulated for each housing estate and scatter graphs were plotted for each estate using regression analysis. Regression equations generated were tested and only one equation shown a positive correlation between population and waste generation for Sokoto city. This model ***'Yest = 1.622x + 8.9063'*** *with the correlation coefficient of 0.67 is therefore adopted as the equation to be used in the determination of daily waste generation for Sokoto metropolis. With this, it is concluded that adequate planning can be made for solid waste management in the metropolis since total daily solid waste can be calculated from the equation obtained.*

Keywords: Correlation coefficient, Model, Regression analysis, Sokoto, Solid waste

1. INTRODUCTION

Wastes are inevitable part of human activity, they are either a by-product of initial production process or they arise when objects or materials are discarded after being used (Buhari, 2009). It is also defined as any substance, solid ,liquid or gaseous that remain as residue or incidental by-product of the processing of a substance and for which no use can be found by organisms or system that produce it. Ayuba 2005 defined waste as substances or objects which are disposed off or are required to be disposed off according to the provision of a national law. Bradshaw, 1992 asserted that 'growth is a production system for living organisms which produces waste as a by-product'. What is more significant is that all living organisms, when they die, ultimately become waste.

Solid waste is a fraction of human and environmental waste and it can be defined according to Ukpong, 2006 as all wastes arising from human activities that are normally solid and are discarded as useless or unwanted. To the Environmental Protection Agency, (1972) solid waste is a useless, unwanted or discarded material with insufficient liquid contact to be free flowing. Lawal *et'al* (1995) in Nura, (2010) defined solid wastes as all unwanted or discarded materials from houses, streets, commercial centres, industries and agricultural operation. They consists of various materials such as leaves metals paper, dust, plastic, food wastes, glass, discarded clothing, pathological wastes, garden wastes and construction wastes.

Solid wastes from homes are broadly classified into organic and inorganic. Organic wastes from residential areas include food remnants, animal remains, leaves and fruits (Muhammad, 2006). Adedibu, (1983) and Agunwamba, (2001) grouped solid wastes into eight classes namely domestic, municipal, industrial, agricultural, institutional, pesticides, residential and hazardous waste. Also, solid wastes can be classified as biogradable and non- biogradable. Biogradable wastes are the wastes that decompose by the action of microbes. These include agricultural wastes, paper, leaves etc. non – biogradable includes nylons bags, packaged water sachets, plastic, rubber etc. This category of solid wastes does not decompose under the action of microbes rather they are either recycled or incinerated (Ibrahim, 2006)

It has been proved that 90% of municipal generated solid wastes are from households and inefficient collection, and disposal of such wastes constitute a great health risk to the populace (EPA, 2011). There is therefore a need to intensify a working solid waste management which according to Agunwamba, 2001 is defined as the safe collection, transport and disposal of solid waste in a manner that it becomes harmless to the handlers as well as the environment as a whole.

Various solid wastes disposal method have been identified out of which according to NISER, (1984) includes plasma gasification, landfill which involved the burying of waste, incineration, supercritical water decomposition (hydrothermal monophasic oxidation), recycling which involved the sorting and re-use of waste as raw materials for new product, biological processing and energy recovery.

All these waste disposal methods can only be efficient when the value / amount of waste generated in a particular community is highly understood and known. Agunwamba, 2001 explained

that waste generation can be determined by many methods viz; weight –volume analysis which involved the weighing of solid wastes at the disposal site with respect to the area where it has been collected. Material balance, which is a method that involved the drawing of system boundary around the unit to be studied, identifies all the activities that occur across the boundary and determining the amount of waste generated. Load count analysis is the third method and it involves the recording of individual loads and the corresponding bin characteristics over a specific period of time.

Waste management in Sokoto city and its environ has received a tremendous attention from the Sokoto Environmental Protection Agency in recent times. However, there seems to be a recurring existence of heaps of wastes at every corners of the city. This therefore suggests that there is a problem which needs to be addressed.

Volume / amount of household waste generation is primary to the concept of solid waste management as the determination of individual household waste generation gives the idea of the total waste expected in a place within a certain period of time and on which the collection and final disposal be planned.

This study seek to find out the individual waste generation value so as to be able to evaluate the amount of total household solid waste to be generated in Sokoto per day for effective collection and final disposal.

2. METHODOLOGY

Prior to the commencement of the study, all the three methods of evaluating wastes generation were studied and found to be inadequate for the study area in question. This therefore led to the use of an indigenous method that involved daily measurement of individual household wastes generated per day.

A total number of 100 (one hundred) households were randomly selected from 4(four) housing estates within the city of Sokoto. These are;

(i). federal low - cost housing, Arkilla (2- bedrooms)
(ii). Federal low – cost housing estate, Arkilla (3- bedrooms)
(iii). Old Airport housing estate, Gusau road. Sokoto
(iv). Police quarters, diplomat area .Sokoto.

In each of these selected housing estates, a number of 25(twenty – five) homes were selected randomly and the population of inhabitant of each homes were taken accordingly. Measurements of collected waste in each of these homes were carried out with the use of a standard waste bucket and a weighing machine with each housing estate covered by different researching groups. Averages of five days records obtained for each homes and were tabulated against the household population.

Regression analysis was adopted in the analysis of data collected as the numbers of inhabitants were plotted against the average solid waste generation in scatter graph of the form $Y = AX + C$, with values of their correlation coefficients (R's). Confirmation was made on the influence of population on the amount of waste generation and test was carried out on the equations generated in order to be able to adopt the equation with best relation. Further analyses were carried out on the data used in generation of the equation with best fit.

3. RESULTS AND DISCUSSION

Graphs developed from the collected data are presented as shown in figures 1-4 as follows. As already stated, the average weekly solid waste generated by each household was plotted against each household's population. Models generated for each of the graphs were also stated accordingly.

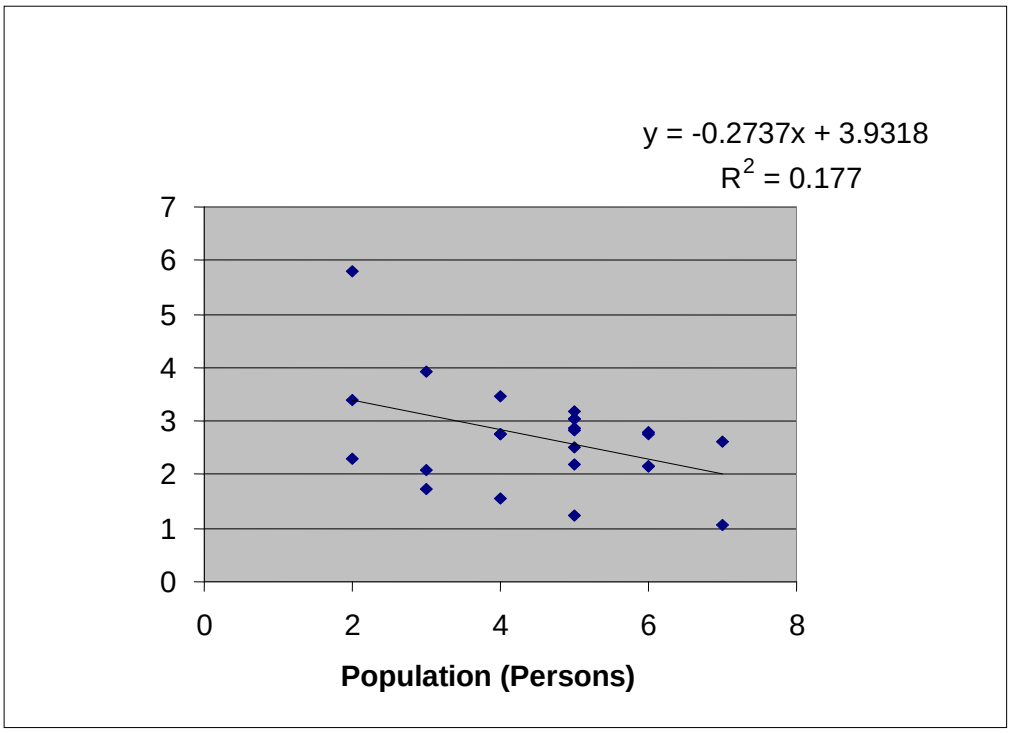

Figure 3.1: Average Household waste generation Vs population For Federal low-cost Arkilla 2-Bedrooms

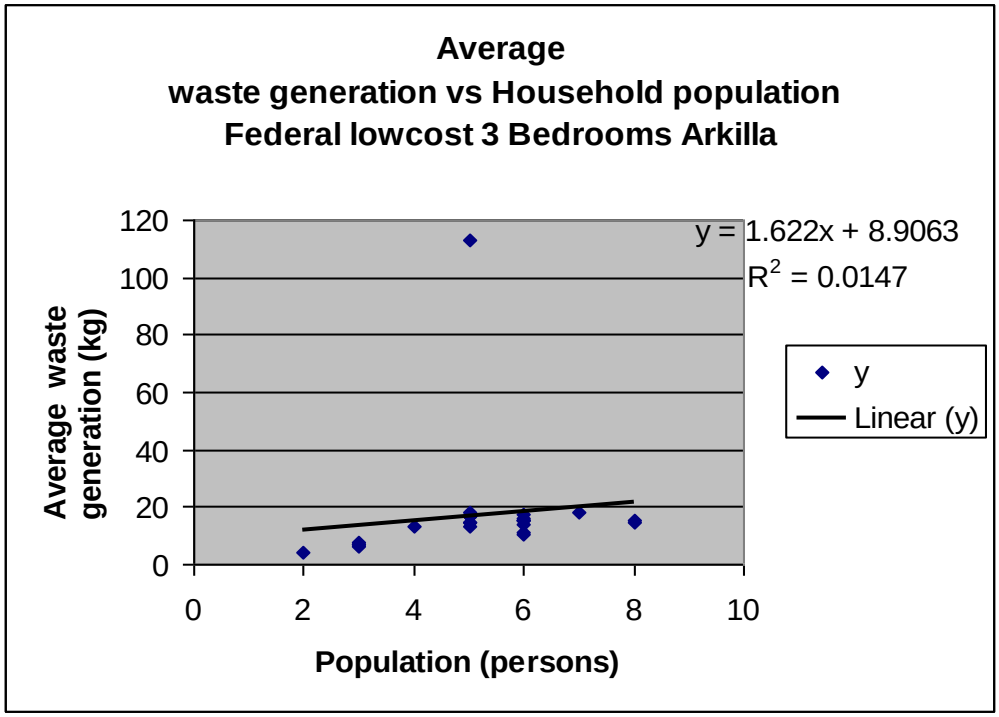

Figure 3.1: Average Household waste generation Vs population For Federal low-cost Arkilla 3-Bedrooms Arkilla

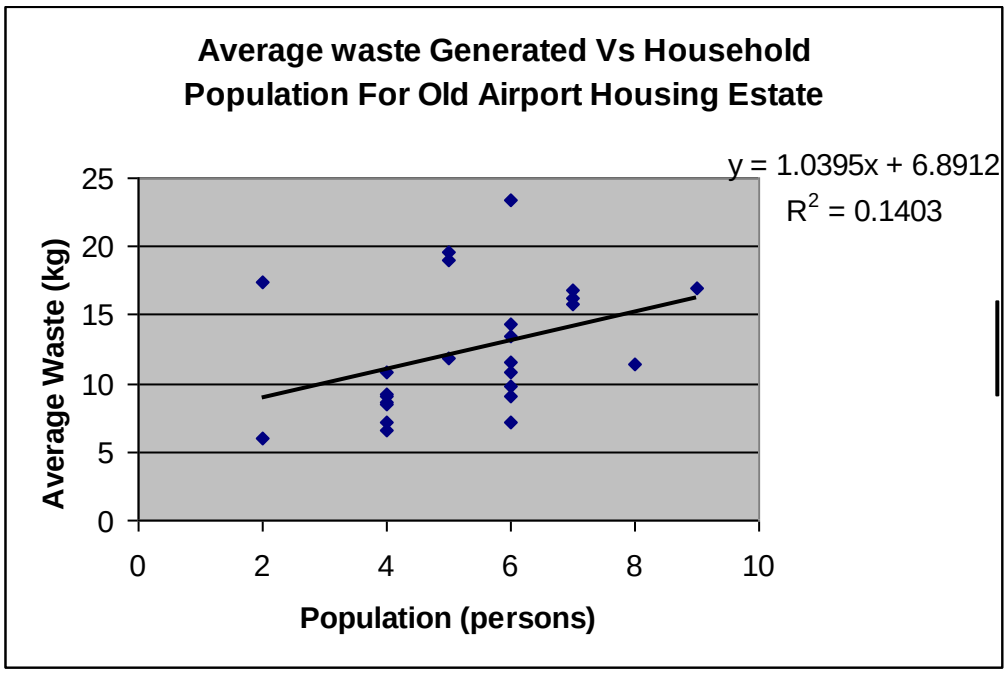

Figure 3.2: Average Household waste generation Vs population ForOld Airport Housing estate

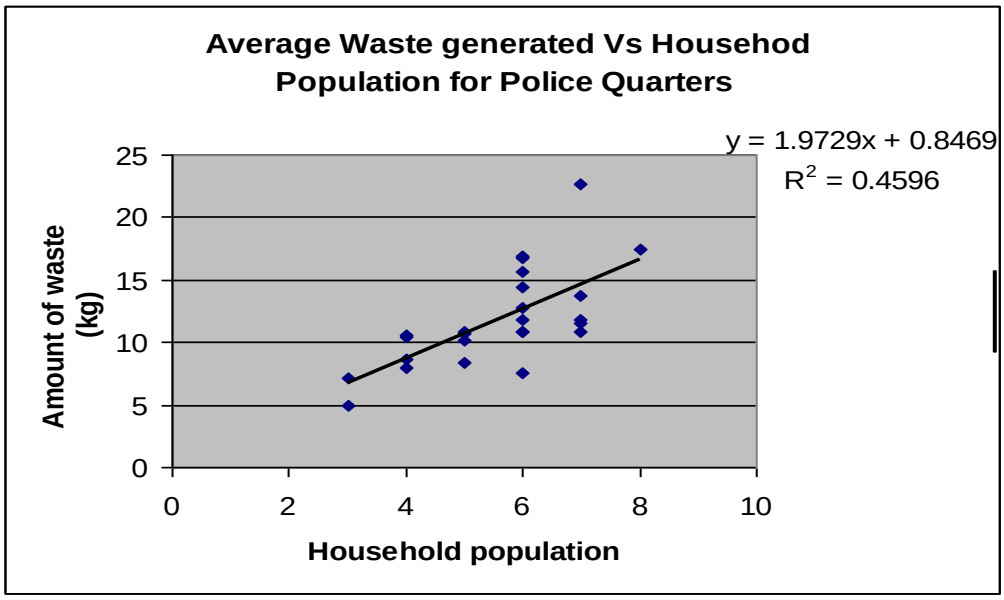

Figure 3.3: Average Household waste generation vs population For Police Headquaters

Table 3.1; Housing Estate, regression equation/models generated with corresponding correlation coefficients

Housing Estate	Generated regression equation	Corresponding correlation coefficient
Federal low - cost Arkilla 2-bedrooms	Yest1 = - 0.273x + 3.9318	Rxy = 0.4207
Federal low - cost Arkilla 3-bedrooms	Yest2 = 1.622x + 8.9063	Rxy = 0.1212
Old Airport Housing estate	Yest3 = 1.0395x + 6.8912	Rxy = 0.3746

Police Headquaters Housing Estate	Yest4 = 1.9729x + 0.8469	Rxy = 0.6779

Using deduction from the charts shown before leave, it is noted that the relationship between average daily waste generations vary with the population of households in various manners.

Figure 3.1 represents the waste generation versus population for Federal low-cost housing estate (2- bedrooms) and the scatter graph indicated the variation in the amount of waste generated from each household and the population were in a downward manner. The generated equation for the combination is Yest1 = - 0.273x + 3.9318, its corresponding correlation coefficient is 0.4207 which mean there is no strong relationship between the two parameters involved.

Figure 3.2 represents the waste generated versus population for the 3-bedroom section of federal low-cost Arkilla. The generated equation is $Yest_2$ = 1.622x + 8.9063, and the correlation coefficient is 0.1212. This means that there is no relationship between the amount of waste generated and household population.

The third chart named 3.3 represents the plot of average amount of waste generated in kg and the population of household. The equation generated is $Yest_3$ = 1.0395x + 6.8912 with correlation coefficient equals 0.3746 which shows a weak relationship between the parameters.

Figure 3.4 represent the plot of solid waste generated and the household population in the police headquaters housing estate diplomat, Sokoto. There, the model/ equation generated is Yest4 = 1.9729x + 0.8469 with 0.6779 as the coefficient. This shows that there is a relation between the amount of waste generated and household population. And therefore this equation shall be adopted for the whole Sokoto city.

4. CONCLUSION

From the study so far the following can be concluded; The average waste generation in Sokoto metropolis is a function of the population of house hold inhabitants; Greater percentage of household wastes are polythene related materials; The model generated for police head quaters , sokoto represent the equation of waste generation for sokoto and can be used for determination of amount of waste to be generated at any particular point in Sokoto city. This is because its correlation coeficient is highest i.e 0.6779 which establish the highest link between amount of solid waste generated and household population.

5. RECOMMENDATIONS

Based on the conclusions from above the following recommendation have been made;

1. Sokoto state government should revive household waste collection services in other to improve waste collection and disposal.
2. Main finding of this research could be used adequately to estimatethe amount of waste generated daily in Sokoto metropolis
3. A study should be initiated and sponsored by the state government on the potential re-usability of solid wastes generated within Sokoto and its environs.

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