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Modelling of The Effect of Waste Management in Ikeja Area of Lags State Nigeria

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Abstract
There is no doubt that waste in all ramifications disturbs the balance of nature. As a result of this, it will be of great importance to mankind if a way is devised to foretell how the effectiveness or otherwise of waste management can affect the lives of those living in an area. This work considers waste management in a holistic view and attempts to develop a model for the relationship between waste management/disposal method and its effect on the people living within a defined geographical location. Lagos which has a relatively high daily per capital domestic waste generation rate in Nigeria has not yet established a comprehensive waste management system. A municipal solid waste management is designed based on Nigerian situations at the end of which a model y=-0.6228x + 56.31 was obtained. This predicts that as waste disposal method becomes appropriate and adequate, the occurrence of different types of diseases decreases rapidly. This may be a very useful tool of waste management for the Government and an easier means of ensuring a healthier living environment for the masses.
Keywords: *Environment; modeling; waste; disposal*

Abstrak
Limbah dengan berbagai macam jenisnya merupakan salah satu hal yang dapat mengganggu keseimbangan alam. Cara untuk memperkirakan efektivitas dan pengelolaan limbah di suatu daerah yang mempengaruhi kehidupan masyarakat yang tinggal di suatu daerah menjadi sangat penting. Penelitian ini mengembangkan pengelolaan limbah dalam pandangan holistik dan model hubugan antara metode pengelolaan limbah dan pengaruhnya dengan masyarakat yang tinggal di lokasi geografis tertentu. Lagos merupakan daerah di Nigeria dengan timbunan limbah domestik harian tertinggi dan belum memiliki sistem pengelolaan limbah yang komprehensif. Berdsarakan hasil penelitian diperoleh model y=0.6228x+56.31. Hal ini menandakan bahw dengan metode pembuangan limbah yang memadai, kasus adanya penyakit dapat menurun dengan cepat. Hal ini dapat menjadi sebuah prediksi yang bermanfaat bagi pemerintah dalam pemilihan metode pengelolaan sampah dan menjadi sarana untuk memastikan lingkungan yang lebih sehat bagi masyarakat.

Kata Kunci: Lingkungan; pemodelan; limbah; pembuangan

1. Introduction

Environmentalism was in response to the era of industrial revolution in the late 19th and early 20th century brought about the destruction and uncontrolled exploitation of natural resources. Today, there are many Non-Governmental Organizations (NGO's) fighting the cause of the environment (both national and international). These include Wildlife Federation, the Isaac Walton League of Conservation, Zero Population. Environmental Defence Fund. Friends of the Environmental Action, etc (Omokwale, 2003). In the month of June 1992 in Rio de Janeiro, Brazil, the first United Nations Conference on Environment and Development (UNCED) popularly billed as the earth summit, was held. The most far reaching outcome of UNCED was a 600-page agreement called agenda 21 which set guidelines for how under UN leadership, the governments and business of the world should attempt to achieve economic growth, while maintaining environmental quality. Two years prior to the earth summit on April 22, 1990, 200 million people in 140 countries around the world participated in a variety of activities to celebrate "Earth Day". An achievement of this summit is the drastic reduction of pollutants that threaten stratospheric ozone, but has not reduced spread of "green-house gases" that threaten global climatic stability. The recent environmental trade fair exhibition in Hanover, Germany is an attestation to growing environmental consciousness and one of the highlights of the fair is the cleaning of the rivers Thames- London –one of the dirtiest rivers in the world as exhibited by British participants to the fair. Many researchers have proposed different models to solve problems associated with municipal solid wastes in different parts of the world. Lee et al (2016) developed a mathematical model for municipal solid waste in Hong Kong. Shirazi et al (2016) also developed a model for municipal solid waste management in Tehran. A model for the optimization of municipal solid waste management was proposed by Barma et al (2022). Hoang et al (2021) also developed a novel mathematical modeling for simulating the spread of heavy metals in solid waste landfills. A mathematical model of municipal solid waste management system for Aba metropolis was developed by Kalu et al (2017). Due to the prevailing poor economic situation in Nigeria, most areas have been indiscriminately turned into waste dump sites by inhabitants of these areas. This has been acting as a catalyst to the quick spread of various diseases and sickness (Ibatereh, 2002). The authorities concerned with waste management have put in place certain measures to effectively address the problem of waste disposal. But the question is how effective has this been? The purpose therefore of this research work is to look for means of actually assessing the effectiveness of waste management and its effect on the lives of the inhabitants living in an area with a view of checking how one affects the other. This work applies mathematical principles on modeling as used by Berry and Houstin, 1995, and Oroge and Rizevi, 1990 to evolve the relationship between waste management and its effects on lives of people and to use the model to plan how best to manage waste.

2. Method

A total of 200 questionnaires were distributed (see appendix for sample) to the members of the public in Ikeja area of Lagos State in Nigeria out of which 150 were returned. The questionnaire were distributed from house to house capturing the area of study and collected after completion from respondents. The scope of this research is the application of mathematical modeling using

regression analysis to find the relationship that exists between waste disposal and its effect on the health of people. The limitation in the work is the use of two variables per time in the construction of the model.

2.1. Model Assumptions

The following assumptions were made to formulate regression model in for municipal solid waste in Ikeja metropolis: (i) All generated solid wastes in Ikeja metropolis are collected from the sources to the collection centres and then transferred to the landfills, (ii) Industrial and institutional wastes generated in Ikeja metropolis are transferred to the nearest collection centres at the expense of the generators, (iii) Transportation cost is proportional to both the distance travelled and quantity of the load, (iv) There is no waste separation at the collection centres where the scavengers are allowed to do the separation in Ikeja metropolis.

The procedure used was that the data collected were arranged and analysed by converting them to percentages, tabulating them, displaying them graphically using bar and pie charts. The model was then formulated using statistical method- Correlation and Regression analysis.

The variables consist of bio-data, types of waste, waste disposal method and physiological effects of waste management. These variables are tabulated in Table 1.

The developed model is formulated taking into consideration of the flow in Ikeja metropolis. The residential, commercial and municipal service sources will dispose their wastes in the collection bins located in front of them. The various households are expected to take the collection bins to the nearest waste sources to them. The waste source is defined as a point where a big waste container is placed for onward delivery to the collection centres. The collection centre is a centroid waste from which closer sources are deposited for scavenging before taken to the landfills. A transfer vehicle is used to transfer waste from the sources to the collection centres and then to the landfills. This study also revealed that all solid wastes in Ikeja metropolis are either buried or burnt at the landfill. They are not decomposed or recycled. Hence there is need to minimize the cost of transporting waste from their sources to the landfill centres.

3. Result ad Discussion

From the analysis of the sample questionnaire, the following facts can be drawn: (i) Type of waste/ waste Disposal Frequency, (ii) The waste disposed in the area are mainly rubbish and dust/fumes and none measured up to 50% of the total waste dispose in the area, (iii) The waste vehicle truck disposed method happened to be most frequently used method of waste disposal in the area. Figure 1 depicts types of wastes in the study area. It can be observed that rubbish wastes are the highest with more than 80%, dust/fumes are next to rubbish about 70% and the least being noise which is less than 50%. Figure 2 also shows the frequency of waste disposal in the study area. Weekly waste disposal being the highest, this followed daily and then monthly.

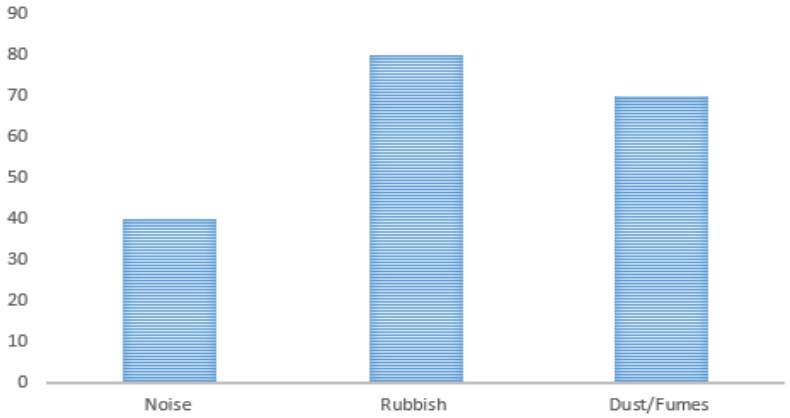

Figure 1. Types of waste in the study area.

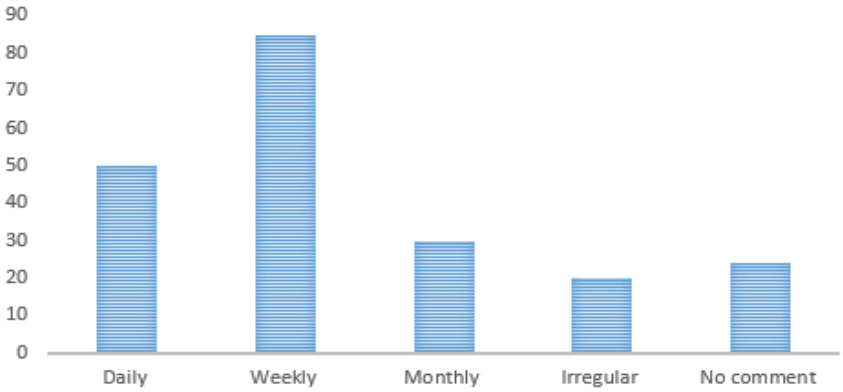

Figure 2. Frequency of waste disposal.

Table 1 presents the response of the residents of the study area to the waste disposal methods commonly used in the area. Use of waste vehicle truck (WVT) being about 44%, Filling I of swamp, 12.5%, Empty into canal stream (EIC), 19% , thrown in street (TIS), 14% and others, 10.5%.

Table 1. Waste disposal methods in the area.

Method	Sample	Percentage (%)
Waste Vehicle Truck (WVT)	88	44
Filling in of Swamp	25	12.5
Empty into canal Stream (EIC)	38	19
Thrown in Streets (TIS)	28	14
Others, burning etc	21	10.5

3.1. Physiological Effects of Waste Management

a. Sickness

Table 2 depicts the effects of wastes on diseases/sickness in the area. Malaria represents 40.9% of the common types of diseases in the area. Typhoid represents 18.7% while cholera and dysentery both represent a total of 11% of the common types of diseases.

Table 2. Effects of wastes on Sickness/ Diseases in the area.

Sickness	Typhoid	Malaria	Cholera	Dysentery	No Comment	Others
Sample opinion	32	70	11	8	36	14
Percentage (%)	18.7	40.9	6.4	4.6	21.1	8.3

b. Visibility

Figure 3 shows response of the residents to the effect of wastes on the visibility in the area. 23.5% of the area is given to be misty, indicating that the area is clear enough for good visibility.

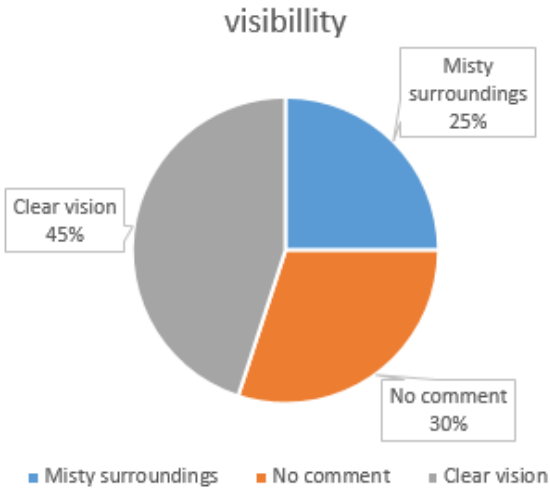

Figure 3. Effect of waste to the visibility in the area .

c. Audibility

Figure 4 depicts the effect of waste on the audibility of the study area. Over 90% of the sampled respondents submitted that indiscriminate dumping of refuse may cause accidents.

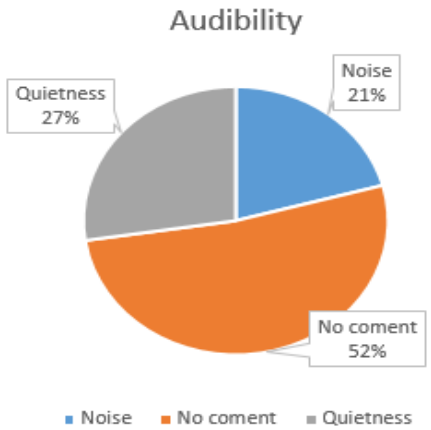

Figure 4. Effect of waste on the audibility of the study area.

d. Odour

Figure 5 shows the response of the residents to the effect of waste on the nature of odour in the area. About 20% of the sampled respondents admitted that indiscriminate dumping of refuse may lead to foul odour.

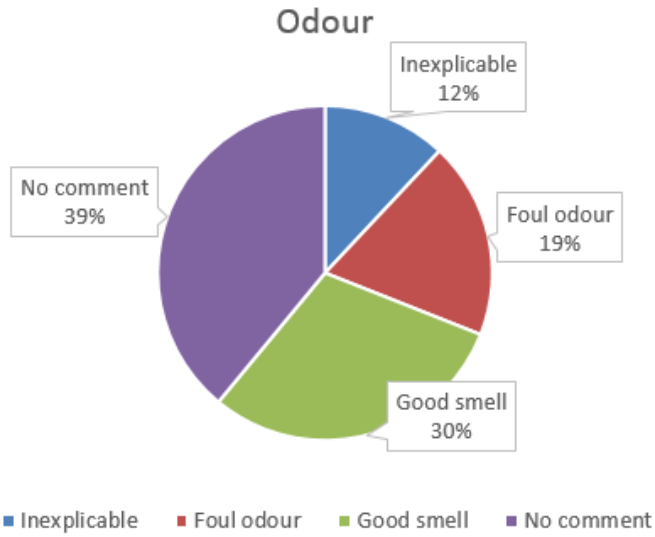

Figure 5. Effect of waste on the nature odour.

3.2. Physiological Effects of Waste Management

Table 3 shows the response of the respondents to the effect of waste disposal methods in the area. The given percentage below indicate the number of respondents who submitted that improper waste disposal methods affect accordingly the categories mentioned: (i) 51.4% of housing in the are is affected by waste disposal method, (ii) 64.4% of food supply to the area is affected by waste disposal method, (iii) 76.1% of water supplied to the area is affected by waste disposal method , (iv) 48.4% of road network is also affected by improper waste disposal method, (v) 48.3% of drainage are affected by waste disposal method, (vi) 87% of fresh air circulation in the area is also affected by waste disposal practiced dusty, misty vision and foul odours and some are due to carelessness of the people.

Table 3. Effects of waste disposal method

ITEM	CONTACTS		Percentage (%)	
	YES	NO	YES	NO
Housing	91	86	51.4	48.6
Food supply	112	62	64.4	35.6
Water Supply	124	39	76.1	23.9
Road network	92	98	48.4	51.1
Drainage	86	92	48.3	51.7
Fresh air circulation	106	80	57	43

Table 4 gives the relationship between the sickness/diseases in the area to the effects of waste disposal method in the area.

Table 4. Relationship between the sickness/diseases and waste disposal method

X	21	25	28	38	88
Y	70	36	32	11	8

X= Waste disposal method in the area

Y= Frequency of types of disease in the area

Table 5: Predicted and observed values of frequency of types of diseases due to waste in the area

X	**y (Predicted)**	**y_o(Observed)**	**$(y- y_o)$**	**$s= (y-y_o)^2$**
21	21m+c	70	21m+c-70	$(21m+c-70)^2$
25	25m+c	36	25m+c-36	$(25m+c-36)^2$
28	28m+c	32	28m+c-32	$(28m+c-32)^2$
38	38m+c	11	38m+c-11	$(38m+c-11)^2$
88	88m+c	08	88m+c-08	$(88m+c-08)^2$

Hence, it can be deduced that the regression line is given by the equation (1).

$$y = 0.6228x + 56.31 \quad (1)$$

4. Conclusion

From the improved regression analysis, the obtained model, y = 0.6228x + 56.31. It represents the developed mathematical relationship between the frequency of types of disease in the area and the waste disposal method in the area. From the mathematical model, it can be projected that if the variable x (which is the frequency of types of diseases in the area) decreases. This can be interpreted to imply that. If proper methods are adopted to ensure regular disposal of waste in the area, the frequency of the effect of the attendant's diseases will be minimized.

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