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Assessment of Solid Waste Generation and Management in Eziobodo Community, Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author NEI designed the study, performed the statistical analysis, and wrote the first draft of the manuscript. Authors NMA and AOI managed the the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Solid wastes management is a major problem that has reached alarming proportions requiring drastic measures. The increasing difficulty in managing wastes in Nigeria has become one of the most intractable environmental issues. There is unprecedented increase in the rate of wastes generated by the residents. The cardinal aim of the study is to "ascertain the assessment of solid waste management generated in Eziobodo community, Owerri west, Imo state, Nigeria". To achieve this aim, 140 copies of questionnaires were administered to the residents of Eziobodo community selected at random sampling. Of these, 112 copies of the questionnaire (80.0%) were returned and analyzed using descriptive statistics. Data from the questionnaires were analyzed by simple frequency and presented by percentage. The study revealed among others that: residential buildings accounts for the highest generation source of solid wastes in the community and the solid wastes were predominantly nylon/nylon bags/ nylon sachets; food waste, plastic can/rubbers arranged in their order of severity. Consequently, the effect of the solid waste in the community were; wide and easy spread of disease vectors, soil pollution and easy breed of flies, rats and mosquitoes. Hence the study recommends, sorting of solid waste before dumping, provision of

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adequate skips and dustbins and ensuring regular collection of wastes. Finally, potential for a sustainable approach to management of solid wastes such as recycling, reuse, energy recovery and waste reduction.

Keywords: Solid wastes; random sampling; sources and management of solid wastes.

1. INTRODUCTION

Most human activities naturally result in the generation of wastes. As this is an unavoidable event in day to day living, there is a need for waste generated to be managed. How this may be efficiently done poses a problem in many societies today. Another natural process, population growth, makes waste management even more challenging; more people in a specific geographic location would imply higher level of waste generation, hence more waste be contended within that area. As poorly managed wastes are perceived as environmental hazards of high significance, the inabilities of societies to manage waste generation effectively play a high role in increasing extant environmental pressures [1]. The challenge derived from the generation of waste is not just coping with the volume, but also its composition and having the ability to design and accomplish its management in an efficient and sustainable manner; waste should be disposed of in a safe way which takes into cognizance the health of environment and that of the public, while ensuring non detrimental effects on generations to come [2]. While in the developed parts of the world, sustainability encompasses ensuring that future generations are not negatively affected by environmental choices made today; for the most developing countries, attention rather lies on what can be currently gained from such choices, especially from the socio- economic standpoint [3]. Dumping of solid wastes in highly inappropriate places like middle of roads and unauthorized disposal sites are common practices in many developing countries [4]. The solid waste management scenario in most developing countries are similar, Nigeria inclusive.

1.1 Objectives

The aim of this solid waste management project was to assess solid waste management generated in Eziobodo community.
To achieve this aim, the following objectives are clearly outlined:

I. To identify the source of generation of solid waste in the community
II. To identify the types of solid waste generated in the community
III. Assessing the occupant's opinion on the effects of poor waste management and existing methods of solid waste disposal.
IV. Suggest sustainable management methods for solid waste in Eziobodo community.

1.2 Scope

The scope of this work is focused on assessing the occupants' perception on the effectiveness of management of solid waste generated. Eziobodo community was chosen because it is a fast growing community just like any other towns such as Owerri municipal and as such is facing a bigger problem of managing its solid wastes generated efficiently and effectively Contextually, the study focused on domestic solid wastes management such as food wastes, damaged furniture, nylon bags and sachets, damaged electronics/appliance, tins and cans from processed foods and drinks, leaves from trees and flowers within the premise, waste from condemned clothing, papers from packets of used products . This is because about 80 per cent of solid wastes generated in the community come from the domestic sources. For the purpose of the research work, the study covers the entirety of Eziobodo community of Imo state, Nigeria.

1.3 Solid Wastes Management in Nigeria

Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. Solid wastes could be defined as non-liquid and non-gaseous products of human activities, regarded as being useless. It could take the forms of refuse, garbage and sludge [5]. Cities in Nigeria, being among the fast growing cities in the world [6] are faced with the problem of solid waste generation. The implication is serious when a country is growing rapidly and the wastes are not efficiently managed. Waste generation scenario in Nigeria has been of great concern both globally and locally and of the different categories of wastes being generated, solid

wastes had posed a hydra-headed problem in solid waste management systems in Nigeria [7], as the streets experience continual presence of solid wastes from commercial and domestic activities. The term solid waste as used in this text is all-inclusive, encompassing the heterogeneous mass of throwaways from the urban community as well as the more homogeneous accumulation of agricultural, industrial, and mineral wastes.

The relation between public health and improper storage, collection, and disposal of solid wastes is quite clear. Public health authorities have shown that rats, flies, and other disease vectors breed in open dumps, as well as in poorly constructed or poorly maintained housing, in food storage facilities, and in many other places where food and harborage are available for rats and the insects associated with them. Ecological phenomena such as water and air pollution have also been attributed to improper management of solid wastes. For instance, leachate from dumps and poorly engineered landfills has contaminated surface water from waste dumps and may contain toxic elements, such as copper, arsenic, uranium, or it may contaminate water supplies with unwanted salts of calcium and magnesium. Although nature has the capacity to dilute, disperse, degrade, absorb, or otherwise reduce the impact of unwanted residues in the atmosphere, in the waterways, and on the land, ecological imbalances have occurred where the natural assimilative capacity has been exceeded.

1.4 Solid Wastes Management Hierarchy

Municipal Solid Wastes Management (MSWM) practices between countries are distinct; in most however, relevant services are rendered by the (local) government or private service providers and may be carried out by employing the hierarchy of waste management [8]. The hierarchy is regarded as one of the important foundations of contemporary MSWM systems and has been popularly adopted for the development of policies related to waste management both on regional and national level, especially in developed countries [9]. The hierarchy of waste management - defined by the 3Rs - reduce, reuse and recycle- stratifies options of waste management and focuses on maximum utilization of resources with minimum generation of resultant waste [8]. The 3Rs refer to the reduction in the amount of waste being generated, the reuse of items prior to their being commissioned as waste, and the recycling of items once they become waste. An expounded version of this in the waste management hierarchy includes- waste prevention/reduction, reuse, recycling &composting, energy recovery, and finally landfilling. The hierarchy's function is to aid in the management of waste whilst ensuring little impact on the environment.

2. METHODOLOGY

With the aim of achieving the above objectives, this project was carried out via an appraisal of literature in the areas of interest; and, with the use of a well-structured questionnaire in view, to obtain the opinion of residents of Eziobodo community on the assessment of solid waste management generated in Eziobodo community in Imo state, Nigeria.

Voluntary random sampling was adopted so that all her residents had equal opportunity to participate. With regards to the sampling size in the distribution of the questionnaire, the sampling size was determined based on the formula below considering the fact that the targeted population was unknown.

$$n= (z^2pq)/d^2$$

Where:
n = the desired sample size
z = the ordinate on the Normal curve corresponding to α or the standard normal deviate, usually any of the following determined based on the 'margin error formula.

1) A 90% level of confidence has α = 0.10 and critical value of zα/2 = 1.64.
2) A 95% level of confidence has α = 0.05 and critical value of zα/2 = 1.97.
3) A 99% level of confidence has α = 0.01 and critical value of zα/2 = 2.58.
4) A 99.5% level of confidence has α = 0.005 and critical value of zα/2 = 2.81.

p = the proportion in the target population estimated to have particular characteristic (normally between the range of 0.1 -0.5)
q = 1.0-p
d = degree of accuracy corresponding to the confidence level and z selected.

For the purpose of this study, a confidence level of 95% was adopted in an attempt to gain a reliable data collection. The sample size was thus determined as,

z = 1.97, d = 0.05, where p = 0.1, q = 0.9
$n = (1.97^2 * 0.1 * 0.9) / (0.05)^2 = 139.7$
n = ~ 140

It therefore means that a total of 140 questionnaires (respondents) were sampled in the area using random sampling technique. A well-structured questionnaire was employed and administered to the residents to ascertain their assessment on the solid waste management generated in the community. The questions were a mixture of open-ended and close-ended questions that allowed for either Nil (N), Low (L), Moderate (M), High (H) or Very High (VH) responses from respondents, especially where the opinion of the respondents were to be ranked. The questionnaires were self-administered, i.e. they were hand delivered to the respondents, who were instructed to complete the questionnaires themselves.

2.1 Data Analysis Procedure

Responses from community residents were collected and analyzed using descriptive statistical methods. The results of the analysis were presented in simple percentages and tables. The descriptive statistics method was used to evaluate the relative ranking of the sources of solid waste generated and adequate management approach. The results were transformed to relative importance indices based on the Likert Scale. To determine the relative ranking, these scores were then transformed to a Relative Importance Index (RII).

$$R11 = \sum w/AN = 5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1 /5N$$

Where;
n1 = number of respondents for option designated as 1
n2 = number of respondents for option designated as 2
n3 = number of respondents for option designated as 3
n4 = number of respondents for option designated as 4
n5 = number of respondents for option designated as
5 N = total number of samples

3. DATA PRESENTATION AND ANALYSIS

This section presents and analyzes the data collected from the questionnaires in a statistical form on the assessment of solid waste management generated in Eziobodo community, Imo state, Nigeria. The analysis of the responses from the questionnaire is presented in simple percentages to represent the opinion of the respondents to the questions asked.

3.1 Percentage Responses

Table 1 shows a summary of the percentage responses to the administered questionnaires. 112 questionnaires were appropriately filled and returned which is 80.00% of a total of 140 questionnaires distributed. 28 questionnaires were not returned by the respondents which is 20.00%. Based on the assertion of Moser and Kalton (2006), the result of a survey could be considered significant if the response rate is not lower than 30 – 40%.

Table 1. Percentage response

Responses	Frequency	Percentage (%)
Returned	112	80.00
Not-returned	28	20.00
Total	140	100

Source: Survey (2017)

Table 2 shows the profile of the respondents to whom questionnaires were administered; indicating that 58.04% of the respondents were male compared with 41.970% female. Also, the respondents aged 24-34 years, corresponding to 48.21% as the highest one, followed by aged 13-23 years of 36.61% and 15.19% has age 35 years and above . The educational qualification shows that greater percentage (77.68%) of the respondents are in tertiary institution, 14.29% of the respondents are in secondary schools, 8.04% are in primary schools.

Table 3 identifies the sources of solid wastes generated. Revealing that the highest sources of solid waste generation came from the residential areas with a relative importance index of 0.673(RII 0.673), followed by market with a relative important index of 0.672(RII 0.672) and lastly schools with a relative importance index of 0.62(RII 0.62). In summary, residential areas generate the highest amount of solid wastes in Eziobodo community.

3.2 Types of Solid Waste Generated

Table 4 shows the ranking of the types of solid waste generated in the community.

Presenting that the three most important types of solid waste generated ranking as follows: nylon/nylon bags/nylon sachets, food wastage

Table 2. Respondent's profile

SN	Option	Option	Frequency	Percentage
1	Gender	A-Male	65	58.04
		B-Female	47	41.97
		Total	112	100
2	Age	A- 13-23 years	41	36.61
		B- 24-34 years	54	48.21
		C- 35 years and above	17	15.19
		Total	112	100
3	Level of Education	Primary level	9	8.04
		Secondary level	16	14.29
		Tertiary level	87	77.68
		Never went to school	0	0
		Total	112	100

Source: Survey (2017); Sources of Solid Wastes Generated

Table 3. Sources of solid wastes generated

S/N	Sources of solid waste generated	1	2	3	4	5	∑F	∑FX	Mean	RII	Rank
1	Residential areas.	35	25	10	17	25	112	377	3.37	0.673	1st
2	Schools	39	31	12	10	20	112	347	3.10	0.62	3rd
3	Health care centre(clinic)	25	20	16	21	30	112	308	2.75	0.55	4th
4	Market	15	19	21	24	33	112	376	3.36	0.672	2nd
5	Open area	49	29	12	7	15	112	246	2.20	0.44	5th
6	Agricultural waste	57	33	7	5	10	112	214	1.91	0.38	6th

Source: Survey (2017)

and plastic can and rubbers. In the opinion of the respondents, the three least types of solid waste generated were: condemned cloths/rags, metals/cans and broken bottle and glass.

3.3 Effects of Poor Management of Solid Waste

Table 5 shows various ranking effects of poor management of solid waste generated in the community; indicating that the respondents' three most crucial effects of poor management of solid wastes were: spread and causes of disease, air, water and soil pollution, breed of flies, rats and mosquitoes. Similarly, economic effects of municipal wellbeing, unhygienic condition and poses danger particularly to children and people who were engaged in sorting and handling the dangerous items such as broken glass, razor blades etc., are the third least effects of poor management of solid wastes.

Table 4. Types of solid waste generated

S/N	Types of solid waste generated	1	2	3	4	5	∑F	∑FX	MEAN	RII
1	Food waste	70	25	8	18	19	122	420	3.75	0.75
2	Condemned clothes/Rags	25	9	13	21	44	122	207	1.84	0.37
3	Others	50	33	6	7	16	122	242	2.16	0.43
4	Plastic can and rubbers	20	24	19	22	30	122	399	3.56	0.71
5	Papers	64	25	5	6	12	122	386	3.44	0.69
6	Broken bottles and glass	11	15	16	19	51	122	163	1.45	0.29
7	Wood and damaged furniture	86	15	15	3	4	122	354	3.16	0.63
8	Nylon/Nylon bags/Nylon sachets	6	9	9	17	23	122	462	4.125	0.83
9	Metal/ cans	7	20	15	23	47	122	193	1.72	0.34

Source: Survey (2017)

Table 5. Effects of poor management of solid wastes

S/N	Effects of poor solid waste	1	2	3	4	5	∑F	∑FX	MEAN	RII	RANK
1	Air, water and soil pollution.	19	17	25	20	31	112	363	3.24	0.65	2nd
2	Attraction of rodents and vector insects.	36	29	18	16	13	112	277	2.47	0.49	5th
3	Breed of flies, rats and mosquitoes.	22	30	16	23	21	112	327	2.92	0.58	3rd
4	Spread and causes of disease.	14	21	13	27	37	112	388	3.46	0.69	1st
5	Creates aesthetic nuisance.	25	31	21	18	17	112	307	2.74	0.55	4th
6	Unhygienic condition.	54	27	17	10	4	112	219	1.96	0.39	8th
7	Degradation of the built environment.	42	27	19	15	9	112	258	2.30	0.46	6th
8	Economic effects of municipal wellbeing.	40	37	17	12	6	112	243	2.17	0.43	7th
9	Poses danger particularly to children and people who are engaged in sorting and handling the dangerous items such as broken glass, razor blades etc.	66	19	16	10	1	112	197	1.76	0.35	9th

Source: Survey (2017)

Table 6. Various methods of solid waste disposal in residential area

S/N	Methods of disposal	1	2	3	4	5	∑F	∑FX	MEAN	RII	RANK
1	Direct dumping.	35	25	10	17	25	112	377	3.37	0.673	1st
2	Storing in waste bin.	39	31	12	10	20	112	347	3.10	0.62	3rd
3	Dumping in streets/road sides	25	20	16	21	30	112	308	2.75	0.55	4th
4	Burning in open air	15	19	21	24	33	112	376	3.36	0.672	2nd
5	Composting	49	29	12	7	15	112	246	2.20	0.44	5th
6	Dumping in drains	57	33	7	5	10	112	214	1.91	0.38	6th

Source: Survey(2017); Legend: 1- Strongly Disagree; 2- Disagree; 3- Indecisive; 4- Agree; 5- Strongly Agree

Table 7. Frequency of respondent's opinion

Who Takes the waste from your home	Frequency	Percentage (%)
a) Myself	65	54.46
b) House keeper	22	19.64
c) Someone else in the home	14	12.5
d) Private waste collector	4	3.57
e) Town council	7	9.83
Total	112	100

Source: Survey(2017)

Table 8. Where is the waste taken for disposal

Where is the waste taken for disposal	Frequency	Percentage (%)
a) Landfill	65	54.46
b) Collecting center	21	18.47
c) Site for burning	12	10.71
d) I don't know	14	12.50
Total	112	100

Source: Survey(2017)

3.4 Various Methods of Solid Waste Disposal in Residential Area

Table 6 shows the ranking, according to the perception of the respondents, of various methods of solid waste disposal in the residential area of Eziobodo community. The ranking based on the Relative Importance Index establishes that the three most practiced methods for solid waste disposal of the residential area are: direct dumping, burning in the open air and storage in the waste bin. The two least ranking methods of waste solid wastes disposal in the community are: composting and dumping in drains.

4. SUMMARY OF FINDINGS

From the extensive literature review and data analysis of the survey results, the responses received from the survey participants were tabulated and analyzed individually. On the basis of responses from the respondents, it was found that the highest sources of solid waste generation came from the residential areas with a relative importance index of 0.673(RII 0.673), followed by market with a relative important index of 0.672(RII 0.672) and lastly schools with a relative importance index of 0.62(RII 0.62). In summary, the residential areas generate the highest amount of solid wastes in Eziobodo community.

It is obvious that nylon/nylon bags/ nylon sachets dominated the highest type of solid waste generated in the community with a relative importance index of 0.83(RII 0.83), followed by food waste with a relative importance index of 0.75(RII 0.75) and thirdly by plastic can/rubbers. This indicated that nylon/nylon bags/nylon sachet constitute the highest type of solid waste generated in the community.

The effects of poor solid waste management are numerous but ranked as the first, second and third ranks were spread and causes of disease with a relative importance index of 0.69(RII 0.69), air, water and soil pollution with a relative importance index of 0.65(RII 0.65) and breeding of flies, rats and mosquitoes with a relative importance index of 0.58(RII 0.58). Explicitly, puts it that diseases and its wide spread is the major effect of poor solid waste management.

It is obvious that direct dumping is common in the community with a relative importance index of 0.673(RII 0.673), burning in the open air ranked second with a relative importance index of 0.672(RII 0.672) and thirdly by storing in waste bin with a relative index of 0.62(RII 0.62).

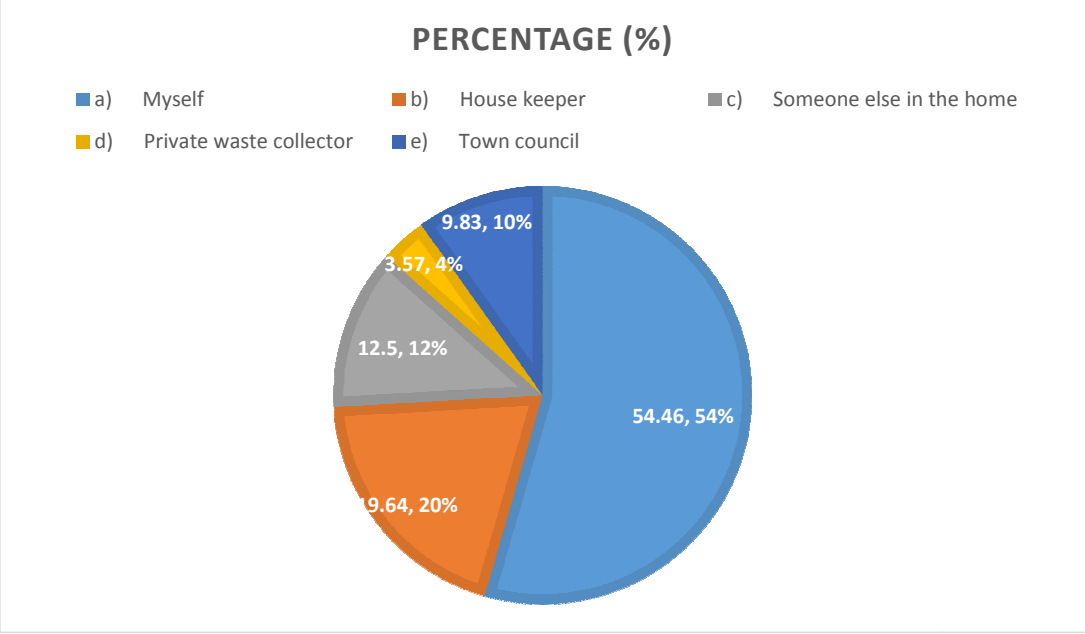

Fig. 1. Who disposes waste from homes
Source: Survey(2017)

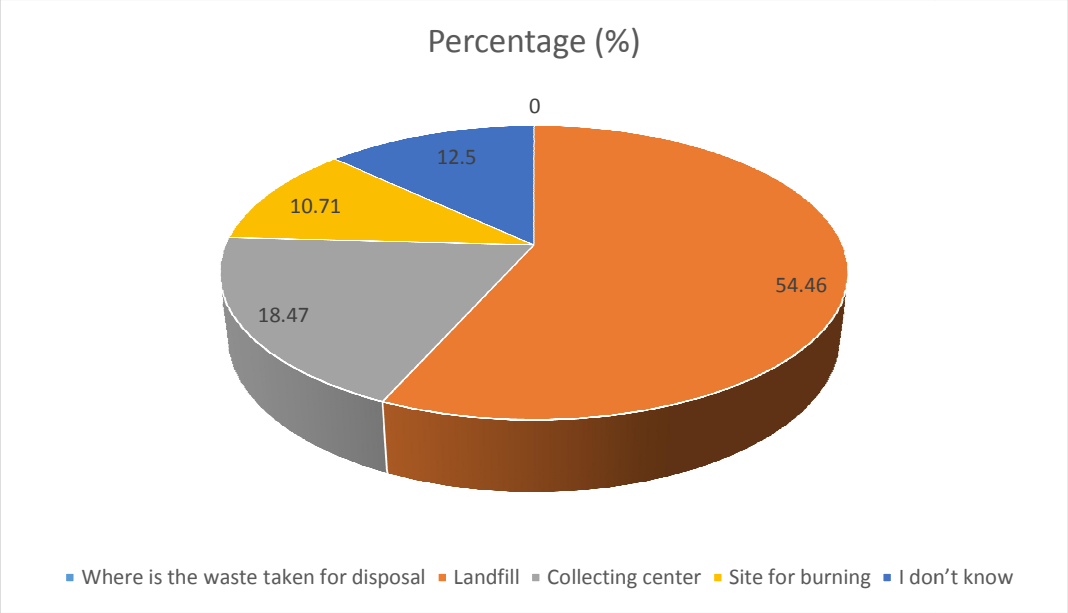

Fig. 2. How the waste taken for disposal are handled
Source: Survey (2017)

From the frequency of the respondent's opinion, 36.61% have waste container at home and 48.24% do not have waste containers in their respective homes. Also, from Table 6, it is clearly seen that 80.36% of the respondents did not sort their wastes at home, 14.29% sometimes sort their waste and 5.36% sort their waste. Furthermore, 54.46% dispose off their waste themselves shown in the first quadrant, followed by house keeper with 19.64% and thirdly by someone else at home with 12.5% in Fig. 1. Fig. 2, shows that 54.46% dispose their waste for site burning as shown in the first quadrant, while 18.47% did not know where their collected waste are disposed as indicated in 2nd quadrant and 10.71% perceived that their collected waste are taken for disposal at collection center.

5. CONCLUSION

In the study, the following objectives were set to be achieved. The first objective was to identify the source of generation of solid waste in the community. Therefore, the survey indicated that the highest amount of solid waste was generated from the residential area. The second objective identify the types of solid wastes generated with nylo/nylon bags/nylon sachets being the highest and lastly to access the occupant's opinion on the effect of poor waste management. The survey revealed that the spread and causing of disease was the commonest effect of poor waste management in the community. Therefore, all the objectives set were achieved and with regard to the main objective of the study, it can be concluded that the following are indeed the key factors affecting management of solid waste generation in the community. These include inadequate skip supply for storing waste; high population to skip ratio; lack of routine collection of waste, poor methods of waste management and inadequate resources for waste management institutions to effectively collect the waste generated.

The time to act is now because if nothing is done immediately, the more time passes, the more complicated the solid waste management problem will get. The population is without doubt increasing day in day out and the impact on the environment is also becoming enormous. The damage on the environment is already noticeable in the community as a result of the solid waste generated in residential buildings and careless disposal practices. The situation calls for an immediate arrest as the only way to reverse the effects in future.

6. RECOMMENDATION

Based on the findings of this research work, the following recommendations are made:

1. Solid wastes should be sorted before dumping. Knowledge about the importance and benefits of sorting waste is one thing,

and having knowledge on the recyclable waste material is another. The intention is to easy the management of the waste by having some of the waste items recycled
2. Provision of adequate skips and dustbins
3. Regular collection of Waste.
4. Potential for a sustainable approach to management of solid waste such as recycling, reuse, energy recovery and waste reduction. If the above recommendations given are well taken and implemented, it will bring about effective management of solid waste generated and hence ensure a clean environment and curb any possible outbreak of disease in Eziobodo community.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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