House hold solid waste in Imo state: A comparative study of the household solid waste generated by household and patterns of household solid waste disposal in Orlu and Owerri Municipalities.

Abstract

Background: Generally, but especially domestic waste has been seen to be the most problematic of all generated waste by households and individuals has employed the habit of just throwing away waste indiscriminately and hence the management of these indiscriminate waste has become both a national and international concern. In Imo State—one of the rapidly urbanizing regions in southeastern Nigeria—municipalities such as Orlu and Owerri face persistent challenges despite relatively high levels of public awareness about proper waste management practices. The disconnect between knowledge and practice poses severe risks to environmental sustainability and public health. hence this study tends to shed light on the solid waste generated by households and patterns of disposal.

Method: The study utilized a comparative descriptive cross-sectional study design. A total of 400 was obtained as the sample size for the study using Taro and Yamane formula and Multistage sampling technique was employed in the selection of households from which respondents were drawn. A structured questionnaire was used as the instrument of data collection. Statistical data analysis was performed using statistical product and solution (SPSS) and the results obtained from the study were expressed in distribution tables, percentages and charts. Chi-square was used to test for associations between data variables (P=0.05).

Result: Assessment of the types waste generated in Orlu showed that the major components was biodegradable (57.5%) and non-biodegradable accounted for (42.5%) while Owerri showed that (60%) of the solid waste generated were biodegradable and (40%) were non-biodegradable, no significant association was found on the categories of household solid waste generated in both cities(P=4.097). While open dumping was found to be the most waste disposal method practiced in both cities (37.5% in Orlu and 42.5% in Owerri) no significant difference was found in this study on household solid waste disposal method in Orlu and Owerri (p=0.445).

Conclusion and Recommendation: The study concluded that the categories of wastes generated in these two cities include both biodegradable and non-biodegradable wastes. On the other hand, people in both cities practice more of open dumping and non-provision of adequate equipment contributed to that. In all, the waste disposal at household level in Orlu and Owerri is quite similar and poor with low capacity. Therefore, organized improvements are required.

Background

In Nigeria, managing Solid waste disposal has become a significant issue despite efforts by government and private sectors in that direction. Hence it is a common sight across the country today to see heaps of waste dumps in almost every area. Residential apartments, markets, waterways, highways, streets and undeveloped plots of land have been turned to waste dumps for many households [3][5]. Consequently, this accumulation not only creates aesthetic and environmental hazards but also contributes to the proliferation of disease vectors. Studies indicate that effective household waste management is heavily reliant on the consistent and efficient operation of collection services, which in many developing countries remain underfunded and poorly coordinated [4]. According to [19], all living organisms produce by-products through their activities. In natural ecosystems like rainforests and coral reefs, sustainability is maintained as different species coexist, utilizing each other's waste as resources. However, in several Nigerian cities, including Lagos, Kano, and Ibadan, many households still rely on unsanitary waste disposal methods such as open dumping and burning, posing serious environmental and health risks [14]. Thus, the intersection of environment, health, and poverty is significant, as many widespread diseases, particularly those affecting the poor, stem from poor environmental conditions [11].

Additionally, the U.S. Environmental Protection Agency [16] defines solid and domestic waste as discarded materials, including garbage, sludge, and semi-solid substances from households. , studies estimate that global municipal waste will increase from 1.3 billion to 2.2 billion tonnes per year by 2025, with significant growth in developing countries 10][5][7][11]. Low-income countries are projected to generate 213 million tonnes of waste daily as their population reaches 676 million, while lower-income countries may produce 956 million tonnes daily with a

population of 2.08 billion [5][7][11]. Besides, by 2025, solid waste generation in upper-middle-income countries is projected to reach 360 million tonnes per day, with a population of 619 million, while high-income nations are expected to produce 686 million tonnes daily with a population of 912 million. The report indicates that municipal waste challenges may surpass those of climate change [10]. Waste disposal often occurs without regard for environmental and human health consequences, leading to accumulation in urban areas and uncontrolled dumps. As a result, the World Health Organization advocates a holistic health approach, emphasizing the need for hygienic solid waste disposal to address environmental factors that could negatively impact public health in Nigeria [12][15].

However, domestic waste is particularly problematic due to the widespread habit of indiscriminate disposal [1]. Waste management is a significant national and international concern, with studies indicating that the issue lies not in waste volume but in the capacity of governments, individuals, and waste disposal firms to effectively manage it [13]3][5]. Although, previous studies conducted in Owerri have shown that although up to 90% of residents are aware of proper waste management [2], the overwhelming majority continue to dispose of waste through unapproved methods such as open dumping (approximately 99%) and burning (over 94%). Similar findings have been reported in Orlu, where residents in communities like Umuowa exhibit high awareness yet practice poor waste management, with a predominant reliance on open dumping and burning [17]. This disconnects between knowledge and practice poses severe risks to environmental sustainability and public health. Open dumping and burning contribute to air and soil pollution, create breeding grounds for disease vectors, and can lead to respiratory ailments, gastrointestinal infections, and other health complications among the populace [9]. Therefore, considering the potential influence of Household Solid Waste Disposal

on health, this study investigated from a larger body of work as an excerpt the categories of household solid waste generated by households and the patterns of household solid waste disposals in Orlu and Owerri municipalities.

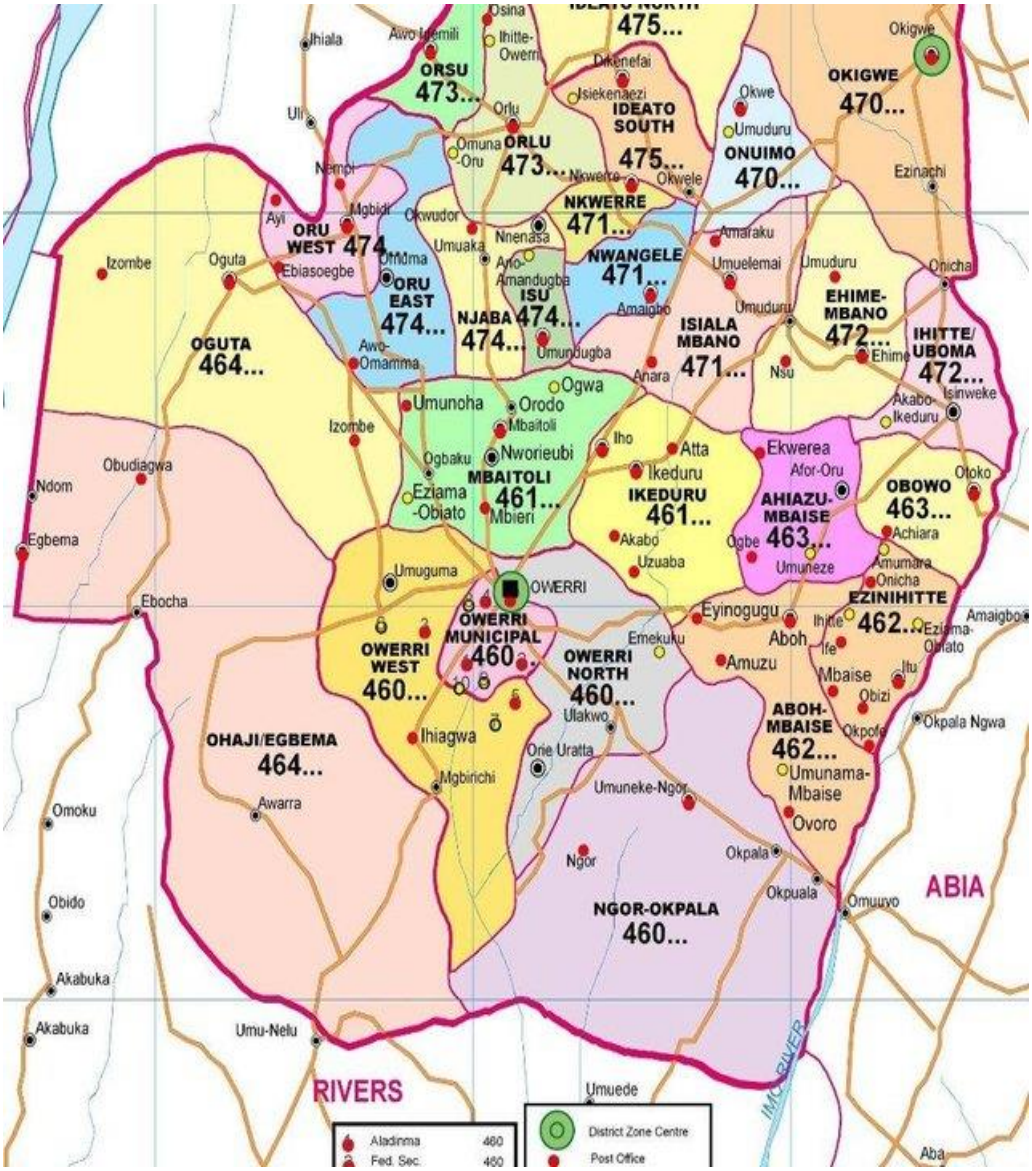
Methods

Study area

Owerri municipal council is one of the 27 local government areas of Imo state. It is located on the South Eastern part of Nigeria. It is also inhabited by Ibos. Owerri Municipal council is located on latitudes: 5°25"50.23'N and longitude 7°2"149°.33'E. It is traditionally called Owerri Nchi-ise revealing that Owerri has five communities which are Umuororonjo, Amawom, Umuonyeche, Umuodu and Umuoyima in the order of seniority. Owerri municipal a local government area in Imo State with headquarters in Owerri city, sitting on approximately 40 square miles (100km) in area and bordered by Otamiri River to the east and Nwaorie River to the south.According to the 2006 National census, Owerri municipal has a population of 127,213 inhabitants, 62,990 males, 64, 223 females with over 1,000 households, including shops and offices. It is bounded on the North by Amakohia on the North East by Uratta, on the East by Egbu, on the South East by Naze, on the South by Nekede and on the North West by Irete. In February 3, 1976, Owerri was declared the capital of Imo State by the Late Head of State, Gen. Murtalla Muhammed. It has two geological regions, namely a coastal plain and a plateau portion. The vegetation is typical rainforest, although some parts consist of Guinea Savanna due to poor environmental management and pollution. It has a mean annual rainfall of about 2.250-2500 mm. The mean temperature is 25-27°C. The relative humidity is 80%. Owerri Municipal inhabitants are mainly traders, few artisans, civil servants and farmers who are predominantly natives. The main environmental sanitation scope given attention in Owerri Municipal is waste disposal.

Owerri Municipal, which is an Urban center is known for its commercial activities. Owerri Municipal like many other cities in Nigeria is faced with perennial ecological problems favorable to the survival of parasites causing diseases. The major sanitation facilities include: refuse bins, evacuating tanks and occasionally, fumigation of the markets.

Orlu is the third largest city in Southeast Nigeria's Imo State with an estimated population of 220,000. It has a long history and has played a critical role as the headquarters for humanitarian relief agencies during the Nigerian_civil_war. Orlu is located on latitudes 05º 47′47”N and longitude 07º 02′20”E. It is a home for enterprise and many successful Nigerian businessmen have been born in the town. The permanent site for the Imo State University Teaching Hospital, an international market and various industries are located in Umuna which is one of the towns that make up the Orlu Urban area. Orlu is one of the oldest and biggest city in Imo State, Nigeria. The town is in the Local Government of Orlu which consists of other towns like Umuna, Eziachi, Umuzike, Umutanze, Umudioka . Old Orlu (Orlu Zuru Mee) is made up Orlu LGA, Orsu LGA, Ideato North LGA, Ideato South LGA, Nkwerre LGA, Nwangele LGA, Isu LGA, Njaba LGA, Oru West LGA, Oru East LGA, Oguta LGA and Ohaji/Egbema LGA. Orlu Zone is endowed with tourists' attractions such Oguta Lake, Orashi River, Abadaba Lake, Mgbee Valley, Rain forest Vegetation, etc. The cultural activities and festivals are Iri ji, Mmanwu, Okonko, Elekele, Iwa akwa, etc. Orlu people are very hospitable and friendly.



Map of Imo State (NPC, 2019).

Study design and sampling

The study adopted a comparative descriptive cross-sectional design to compare solid waste disposal in Owerri municipal and Orlu. It was carried out by obtaining and comparing data in the two areas of study with of the study population comprises of the households in Owerri municipal and Orlu. In Owerri municipal, it comprises of households from five communities which are Umuororonjo, Amawom, Umuonyeche, Umuodu and Umuoyima. Orlu comprises of all the communities in the local government area. There were a total of 30524 households in Owerri Municipal and 26754 households in Orlu town, which altogether gives a study population of 57278 households. (National Bureau of statistics, 2006). A sample size of 400 was estimated using Taro Yamane formula. A multi stage sampling technique was used in sampling of households for the study. In the first stage, out of the 80 residential areas in Owerri which was obtained from the evaluation unit of the Council the list comprising 80 areas written serially was divided into 8 groups labelled A-H with a group consisting of Nos 1-10, B, 11-20 and so on.. In the second stage, 1 residential area was randomly selected from each of the 8 clusters which makes it 8 residential areas. They were Douglas, Tetlow, Wethedral, Ikenegbu, orji, Akwakuma, Aladinma, and Egbu. In the third stage, the households were enumerated and using systematic random sampling 14 households were each selected from the residential areas giving us a total of 112 households. In the fifth stage, 2 adult respondents were randomly selected from the selected household which gave rise to 224 respondents out of which 213 administered questionnaires were returned and that was the sample size of Owerri.

In Orlu the residential areas sampled include Osuigwe, Amaigbo, Umuezeala, Ebenato and Ubuzor, The same step was followed to get the sample size in Orlu which was 187 respondents. Firstly, out of the 22 autonomous towns and residential areas, it was divided into 5 clusters with each cluster having at least 4-5 residential areas from each of the cluster, 1 residential area was

selected using simple random sampling method, from the selected residential areas one street was each selected using the random sampling method, from each selected street, using the systematic random sampling method, 10 households were each selected and from the 10 households using the convience sampling method, 4 respondents each was used for the study. Which gave rise to 200 respondents and Hence 200 questionnaires were administered to the respondents and 187 was returned which was the sample size for Orlu.

Observation checklisk was also used to observe and record the availability of some of the solid waste disposal equipment.

Data Collection

A structured questionnaire designed based on the research topic and objectives was used in the data collection process. The questionnaire was validated using content and face validation. Forty questionnaires were pretested outside the study area among participants who were not part of the actual study respondents but shared Similar Characteristics with the study area. The questionnaire was tested for reliability using Crombach Alpha test and a reliability coefficient of 0.821 was obtained. Data was collected over a period of one month with the help of three field assistants who were trained on how to administer the data collection instruments to respondents, questionnaires were administered to the selected households and the literate ones among the respondents were allowed to fill the questionnaire themselves but for the non-literate ones, the questionnaire was elicited to them in a translated local language. Each questionnaire took about 3-7 minutes to be completed. Besides, observers conducted site visits to waste disposal management sites to assess service availability and quality using a standardized checklist.

Data Analysis

Statistical data analysis was performed using IBM-SPSS Statistics version 23 (IBM-*SPSS Corp, Chicago, III, USA*). At preliminary analysis, descriptive method was used to describe the distributional characteristics of the data. These include distribution tables and charts, which were all expressed as the percentage of the distribution. Chi-square test method was conducted to test for association between data variables in the study at 5% level of significant.

RESULTS

Socio-demographic Characteristics of Waste Disposal Persons

The result in Table 4.1 shows the socio-demographic characteristics of the household solid waste disposal persons studied in Orlu and Owerri. There were a total of 400 respondents 187 and 213 respectively from Orlu and Owerri urban towns. For the Gender or sex variable in Orlu, there were 54.5% females and 45.5% males, while Owerri had 56.3% female and 43.7% males. For the Age variable in Orlu 67.9% were above 17 years and 32.8% were below 17 while 65.7% were above 17years and 34.3 were below 17 in Owerri. The marital status of the participants in the two cities indicates that 59.8% and 57.3% were married respectively in Orlu and Owerri towns. There were also 40.1% and 42.7% single in Orlu and Owerri respectively. The education level variable showed that 50.7% of the studied respondents from Owerri had first degree compared to 25.1% in Orlu. Only 3.8% did not have formal education among Owerri participants compared to 5.9% in Orlu. The Occupation variable showed that 38.9% public servants 24.4% private sector 22.1% self-employed 10.8% student and 3.8% non-response among Owerri participants, compared to 23.0% public servant, 39.6% private sector, 25.1% self-employed, 5.3% student and 7.0% none respectively for each of the 5 sectors among participants from Orlu town (Table 4.1).

The less than 10 years old were mostly used in household solid waste disposal in both Orlu and Owerri towns in Orlu, the less than 10 were made up of 65.2% of household domestic solid waste disposal persons. Whereas they comprised of 56.3% of waste disposal persons in Owerri

Table 1 Socio-demographic characteristics

	Orlu		Owerri	
Variable	Frequency	%	Frequency	%
Sex				
Male	85	45.5	93	43.7
Female	102	54.5	120	56.3
Total	187	100	213	100
Age				
Above 17 years	127	67.9	140	65.7
17 years and below	60	32.8	73	34.3
Total	187	100	213	100
Marital status				
Single	75	40.1	91	42.7
Married	112	59.8	122	57.3
Total	187	100	213	100
Educational qualification				
FSLC	53	28.3	23	10.7
SSCE/WASC	73	39.1	67	31.5
OND/HND/B.ED/B.SC	47	25.1	108	50.7
M.Sc/Ph.D	3	1.60	7	3.3
NONE	11	5.9	8	3.8
Total	187	100	213	100
Occupation				
Civil/public servant	43	23.0	83	38.9
Private sector	74	39.6	52	24.4
Self-employed	47	25.1	47	22.1
Student	10	5.3	23	10.8
No response	13	7.0	8	3.8
Total	187	100	213	100
Age of people involved in solid waste disposal				
<10	122	65.2	120	56.3
11-20	47	25.1	60	28.2
21-30	11	6.0	27	12.7
31-40	7	3.7	7	3.3

41-50	0	0	0	0
Total	187	100	213	100

Categories of Solid Waste Generated by Households in Orlu and Owerri

Assessment of the types of waste generated showed that the major component was biodegradable (57.5%) while non-biodegradation accounted for 42.5% of generated wastes in Orlu while Owerri showed that 60% of the solid waste generated is biodegradable while 40% shows non-biodegradable. (Table 4.2). At 5% significant level, no significant difference was found on the categories of households' solid waste generated in both cities studied ($p=4.097$, $\chi^2=0.536$).

Table 2 Categories of households Solid Waste generated in Orlu and Owerri

Categories of waste	Cities	Orlu		Owerri	
		no.	%	no.	%
Biodegradable		69	57.5	72	60
Paper		20	16.6	18	15
Glass		10	8.33	11	9.16
Metal		8	6.66	9	7.5
Textile and leather		7	5.83	9	7.5
Inert (earth, ash)		6	5	1	0.83
			χ^2=0.536, p=4.097		

Patterns of Household Solid Waste Disposals in Owerri and Orlu Municipalities

Analysis of the data gathered from the ENTRACO, indicates that there were 3 sanitary sites but these were woefully inadequate. An ideal number of 10 sites were required by the ENTRACO in Owerri and 6 in Orlu. The other equipment is shown in Table 3.Owerri has 5 (6.3%) scavengers, 30 (25%) sweepers and 10 (4%) refuse labourers, Orlu has 4 (5.7%) scavengers, 12 (13.3%) women and 6 (3.0%) refuse labourers which are all inadequate in comparison to the optimum required number.

Table 3 Patterns of Household Solid Waste Disposals in Owerri and Orlu Municipalities (via Labour force of ENTRACO)

Labour Description	Owerri			Orlu		
	Optimum required	Available	Non Available	Optimum required	Available	Non Available
Scavengers (Men)	80	5 (6.3%)	75 (93.7%)	70	4 (5.71%)	66 (93.3%)
Sweepers (Women)	120	30 (25%)	90 (75%)	90	12 (13.3%)	78 (86.7%)
Refuse Labourers	250	10 (4%)	240 (96%)	200	6 (3.0%)	194 (97.0%)

χ^2=0.514, p= 0.773

Discussion

Socio-demographic characteristics of the household solid waste disposal persons indicates that Owerri had more females in solid waste disposals than Orlu but both cities had mostly females and it goes on to show that females are more involved in household solid waste disposals than men. This result also corroborates with the findings of [20] that females are more involved in domestic waste disposals than males.

In both Orlu and Owerri, those below 17 years of age were used in waste disposal, of which the less than 10 years were the most used in both cities. More than half of them were married. This present study findings are consistent with the result in [21], for which it was shown that married people respond more to issues concerning waste disposal than the unmarried. And similar percentage had up to tertiary education in Owerri. To a reasonable extent, the socio-demographic characteristics were similar in both cities

The majority of waste that are disposed in both cities studied was biodegradable (57.5%) while non-biodegradation accounted for 42.5% of generated wastes in Orlu while Owerri showed that 60% of the solid waste generated is biodegradable while 40% shows non-biodegradable. The findings were consistent with [21], who conducted a study on Solid Waste Management in Owerri Municipality and its Immediate Environs which gave the figures of biodegradable and non-biodegradable wastes as 54% and 46% and also based on the study it was seen to be consistent with another Study conducted by [22] on the Determinants of Household Solid Waste Generation and Composition in Homs City, Syria. The study presented factors influencing the waste generation rate and the waste composition. The study was carried out in 300 families from four zones in Homs city, and three sampling stages were conducted during the study duration, which

started in July 2017 and ended in February 2019. The outcomes showed that an average of 0.68 kg/per/day solid waste generated was calculated for the entire study area in Homs city. Also, the data analysis presents that organic waste constitutes the largest component in the waste mixture (69.1%) followed by plastic (10.6%), inert materials (8.7%), paper (4.6%), textile (2.5%), metal (1.2%), glass (1.1%), wood (0.6%), and hazardous materials (1.6%). The multiple linear regression results showed that the adjusted R2 value was found to be 0.557, 0.839, and 0.709 for the waste generation per capita, the daily household organic waste generation, and the daily household packaging waste generation, respectively. Also, according to Pearson's coefficient values, a positive correlation was found between household waste generation and monthly income ($r = 0.626$), household size ($r = 0.37$), and age of the household head ($r = 0.517$), whereas a negative correlation was found between household waste generation and the education level of the household head ($r = -0.649$). Owerri is an administrative city and residents are mostly civil /public servants. The economic and social status of the city could be the main reason for the huge number of biodegradable wastes generated.

Open dumping was found as the most used method, followed by sanitary landfill and burning. The result agrees with those of Uwakwe, [21], and in a descriptive cross-sectional study conducted by [23] on the Assessment of Waste Management Practices among Residents of Owerri Municipal Imo State Nigeria. A study in which a total of 282 residents of Owerri Municipal were selected by multistage sampling technique and studied using self and interviewer administered questionnaires. The results showed that 90% of respondents were aware of waste management while 97.5% had positive attitude towards it. The major types of waste generated from households were food residues (97.1%) and vegetable products (95.4%). Also poor waste management practices among residents include open dumping, practiced by 66.3% of the residents and burning as practiced by

62.4% of respondents. The commonest means of waste transport to final disposal site was by wheel barrow. Gender and educational status of respondents significantly influenced their knowledge, attitude and practice of waste management ($p < 0.05$). Possible reasons for adopting open dumping as the main waste disposal method could include unavailability of adequate man-power and equipment, inaccessibility to final dumpsites, people's poor attitude towards environmental sanitation as well as the simplicity and non-cost involvements in the dumping pattern.

A major problem that could associate to that is that there are no plans to create new sanitary sites. Some of the designed sanitary sites have been encroached upon by some recalcitrant residents and consequently, the whole area is well packed with houses and other unauthorized structures and has no available unused space, also people's attitude towards waste disposal by their refusal to contribute to waste management issues. Individuals who have available space to be used for sanitary often find it difficult to make it available.

Conclusion

The waste disposal patterns in Orlu and Owerri share similar socio-demographic characteristics. In both cities, women are more involved in household solid waste disposal than men. The waste generated consists of both biodegradable and non-biodegradable materials. However, open dumping is the dominant method of disposal due to a lack of adequate equipment. Overall, household waste management in these cities is inefficient and lacks capacity, highlighting the need for organized improvements

Suggestions

1. That government should make adequate budgetary provision for the procurement and installation of modern equipment and facilities, training and employment of professionals

in waste handling and implementation of public health laws mitigate incessant waste disposal

2. Community base education where hygiene practices will be taught should be promoted by the waste management department on solid waste in order to improve the patterns of household solid waste disposal.
3. The waste management department should make provision for enhance municipal waste management that involves a central waste collection system where inhabitants of these municipalities can dispose their household waste
4. The waste management department should embraces timely removal of all waste disposed in the central waste collection point
5. The chiefs and other opinion leaders must be given additional roles to play in ensuring environmental cleanliness. This can be done by authorizing the chiefs in each area or community to take up the additional job of ensuring clean environmental practices with the youth playing an important role and not to see waste handling as the sole responsibility of ENTRACO
6. Women group in Owerri and Orlu should be encourage to adopt a form of peer education on household waste management during August meeting discussion so as to protect their Health and Environment as it has been realized that women do a greater part of household waste handling and disposal in the community and in training of children who has been discovered to play a great role in waste disposal in this study.

Limitations to the Study

Though this study has been able to highlight the household solid waste disposal patterns, the results of this findings should be interpreted with caution; due to

a.) Geographical Limitation: the study focused on two urban areas Orlu and Owerri which may not be a representative of other urban areas in Nigeria or globally. The findings may not be generalizable to other cities with different demographic, economic and environmental characteristics.

b) Methodological Limitation: the study relied on data collected through questionnaire which can be subject to biases and limitations. For e.g. respondents may not provide accurate information on questions asked.

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