



Solid Waste Collection and Disposal Practices in Bekwarra Local Government Area: Environmental Impacts and Community Awareness

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Waste poses a threat to public health and the environment if it is not stored, collected and disposed of properly. This study investigates the different solid waste collection and disposal practices and its effect on the environment in Bekwarra Local Government of Cross River State.

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Methods: This study utilized a cross sectional descriptive approach where a self-developed questionnaire and an observation checklist to gather relevant information on solid waste disposal practices were used to collect data. A total of 400 female adults were interviewed in this study.

Results: A total of 400 participants completed and returned the questionnaires giving a response rate of 99.2%. Results from the study showed that majority of the respondents produced vegetable waste (15%) while a few of the respondents produced food waste (3%). The study also showed that the use of open containers by the indigenes was the most common method practice with 61.8% while the least method practice was the use of sack bags (2.5%). It was observed that majority of the respondents 364 (91%) had knowledge of solid waste disposal while 36 (9.6%) had no knowledge of solid waste disposal. Results from the observation checklist showed that only 163 (41%) of respondents had storage containers for waste compared to 235 (59%) without storage containers.

Conclusions: It is investigated during the research that due to rapid growth in population, increments in solid waste generation rate, management deficiencies, lack of legislative implementation and funding, the solid waste management systems in Bekwarra are not working effectively. Thus, an inefficient municipal solid waste management system may create serious negative environmental impacts like infectious diseases, land and water pollution, obstruction of drains and loss of biodiversity.

Keywords: Solid waste; environmental impacts; land pollution; Bekwarra; population increase.

1. INTRODUCTION

“Solid waste management systems cover all actions that seek to reduce the negative impacts on health, environment and economy. Developing countries are seriously facing the associated problems in collection, transportation and disposal of communal solid waste. In Bekwarra LGA, due to unplanned communities and developments in major cities, environmental and sanitary conditions are becoming very complex. Due to a lack of awareness and low income sources, dwellers are forced to live with unhealthy and unhygienic conditions” (Omang and Bisong, 2020). “An improper solid waste management system may contribute to a worsening environmental degradation of the community. Illegal dumping of communal solid waste is responsible for a number of diseases in developing countries” (Ejaz et al., 2010).

“Globally, millions of tons of municipal solid waste are generated every day. Urban waste management is drawing increasing attention, as it can easily be observed that too much garbage is lying uncollected in the streets, causing inconvenience, environmental pollution and posing public health risk” (Zia and Devadas, 2008; Yoda et al., 2014).

“The storage, collection, transportation and final treatment/disposal of wastes are reported to have become a major problem in urban centres” (ADB 2002; Kaseva and Mbuligwe, 2005; Rotich et al., 2006; Okot-Okumu and Nyenje, 2011). “The composition of wastes generated by the

people of Bekwarra Local Government is mainly decomposable organic materials based on the urban community consumption that generates much kitchen wastes, compound wastes and floor sweepings” (Oberlin, 2011; Okot-Okumu and Nyenje, 2011; Scheinberg, 2011; Simon, 2008). “This calls for efficient collection system to avoid health, aesthetics and environmental impacts. The collection, treatment and disposal of municipal solid waste and similar wastes provides a benefit to communities by removing wastes which would otherwise decompose and become a source of disease, pests and nuisance” (Rai et al., 2021; Fadhullah et al., 2022). The major causes for the inefficient municipal solid waste management systems in Bekwarra Local Government Area are severe weather conditions, lack of social awareness/ community involvement, improper resources including improper equipment, and lack of funds. An inefficient municipal solid waste management system may create serious negative environmental impacts like infectious diseases, land and water pollution, obstruction of drains, and loss of biodiversity. Thus, this study was carried out to investigate the different solid waste disposal practices in Bekwarra Local Government Area as well as its environmental impacts.

2. MATERIALS AND METHODS

2.1 Study Setting

Bekwarra Local Government Area is located in the Northern Senatorial district of Cross River

State of Nigeria and was created out of the former Ogoja Local Government Area on 1st October 1996. The Local Government is bounded on the north by Vandekya Local Government of Benue State, on the South by Ogoja Local Government, on the east by Obudu and west by Yala. The Local Government has a projected population of 105,822 and Area of 306km² (118sqmi) with ten political wards¹². Most inhabitants of the area are traders, rural farmers and fisherman. Majority of the populace are Christians with few Muslims and traditional religious groups

2.2 Study Design

The design for this study was a cross sectional descriptive study using a self-developed questionnaire and an observation checklist to gather relevant information on solid waste disposal practices in Bekwarra Local Government Area of Cross River State.

2.3 Study Population

The study population included all adult females and males of 18 years and above living in the study area.

2.4 Sample Size Determination

The sample size for this study was determined by using Cochran's formula¹¹.

$$n_o = \frac{(t)^2 \times (p) \times (1 - p)}{d^2}$$

Where:

t= value of selected alpha level of 0.025 (e.g. 1.96 for 95% confidence level)

p = proportion of solid waste disposal= 0.7(70% being the prevalence for Calabar)

q = (1 - p) = 0.3

d=acceptable margin of error for proportion being estimated = 0.05

$$n_o = \frac{(1.96)^2 \times (0.7) (0.3)}{(0.05)^2} = 322$$

To account for the possible attrition and non-response, the sample size was increased by 25% giving a sample size of 400 which was used as the actual sample size for the study.

2.5 Sampling Procedure

Multi-stage sampling technique was adopted in the selection of study participant and are describes:

Stage 1: Selection of Wards: Out of the ten wards in Bekwarra Local Government Area, five wards were selected using simple random technique (balloting). This was done by writing the names of all the council wards in the Local Government in a sheet of paper and folded. From the folded papers only five (5) were picked without replacement representing five wards for the study after mixing and shuffling in a basket.

Stage 2: Selection of Houses and Households: In each selected ward, the total number of houses was obtained from the Primary Health Care Department from house numbering used by the Primary Health Care Department for immunization. Conservative recruitment sampling of households starting from the village square, the chief house respectively was then applied to select the required number of houses/ households from the wards.

Stage 3: Selection of Respondents: In each household, an adult female/males was selected. In households with many adult females/males, simple random technique (balloting) was carried out. Yes and No were written in a piece of paper and folded. Thereafter, these were placed in a basket and shaken to mix thoroughly, then the adult females/males were asked to pick, the one with the yes was selected for the interview.

2.6 Data Collection

Data was collected from respondents at the household level using the semi-structured questionnaire. The questionnaire comprised of section A - socio-demographic data while section B comprised types of waste generated, methods of waste collection and disposal and self-reported health problems associated with solid waste disposal by respondents. The questionnaire was pre-tested among 5% of the sample population in Yala Local Government Area having similar characteristics with the study area. This was to ensure that the questions were appropriate for the study. Three research assistants with tertiary education were recruited and trained for one week to assist in data collection by the research coordinator. The questionnaire was administered to each respondent after seeking her verbal consent. Proper explanations were given by the researcher when required, and it took about 8 – 15 minutes to administer the questionnaire to each respondent. In all, a period of four (4) weeks was used, from June 2016 to July 2016 to complete the study. The observational check list

was also used by the researcher to provide additional information such as services and conveniences, ventilation, waste disposal facility and refuse collection on premises that was not captured in the questionnaire.

2.7 Methods of Data Analysis

Data was analysed using the Microsoft Excel 2007 and Statistical Package for Social Sciences (SPSS) software version 20. The association between variables was tested using the Chi-square. Scores were assigned to each response accordingly and later summed up to get the total score for each individual. Score range 0 – 3 represented low knowledge of waste disposal, score range 4 – 7 represented average knowledge of waste disposal while score range of 8 – 10 represented high knowledge of waste disposal. The minimum score was 0 while the maximum score was 10 out of a possible total of 10.

2.8 Ethical Consideration

A letter of introduction was obtained from the Department of Public Health, University of Calabar, to enable the researcher obtain ethical clearance from the Cross River State Research Ethics Committee, Ministry of Health to facilitate access in the Community. Verbal consent was sought from the community heads in Bekwarra

Local Government Area where the research was carried out. Informed verbal consent was also obtained from the study participants. The Participants were informed that participation in the study was voluntary and assured of anonymity of their identity before commencement of the survey. In addition, they were also told that at any point in time they could withdraw from the study without consequences.

3. RESULTS

A total of 400 participants completed and returned the questionnaires giving a response rate of 99.2%. From Fig. 1, the study showed that majority of the respondents produced vegetable waste (15%), ash waste (14%), wood waste (13%) and plastic rubber waste (13%), while a few of the respondents produced clothing/rag waste (5%) and food waste (3%). Fig. 2 presents the different methods used for the collection of solid waste in Bekwarra Local Government Area. The use of open containers by the indigenes was observed to be the most common method practice with 61.8% while the least method practice was the use of sack bags (2.5%).

Result of the study on the level of knowledge of solid waste disposal as presented on Fig. 3 showed that majority of the respondents 364 (91%) had knowledge (average or high) of solid

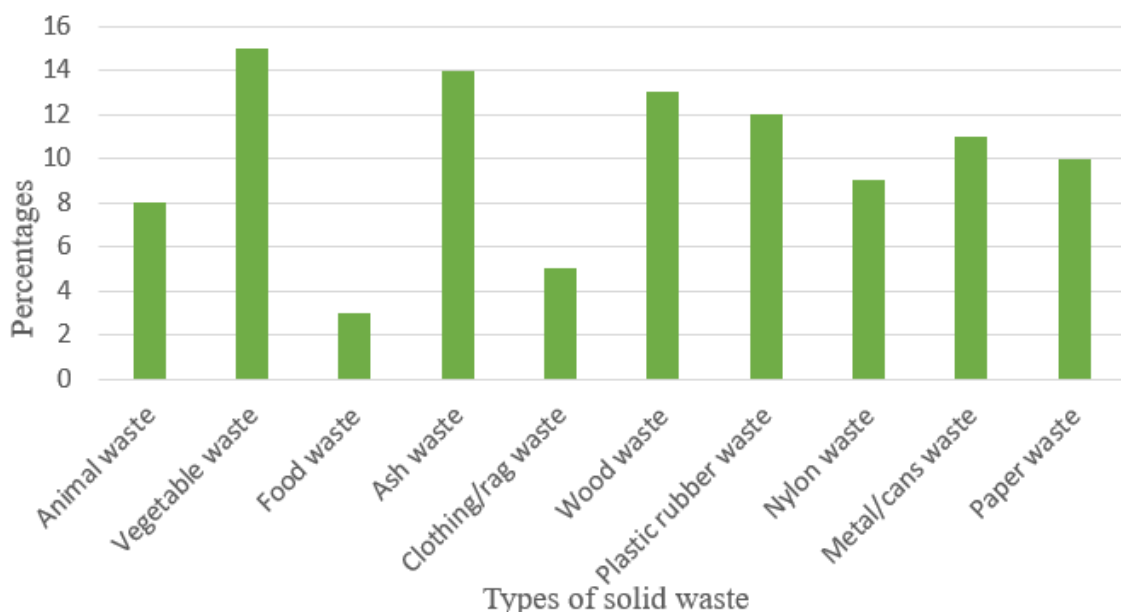


Fig. 1. Types of solid waste generated by households in Bekwarra

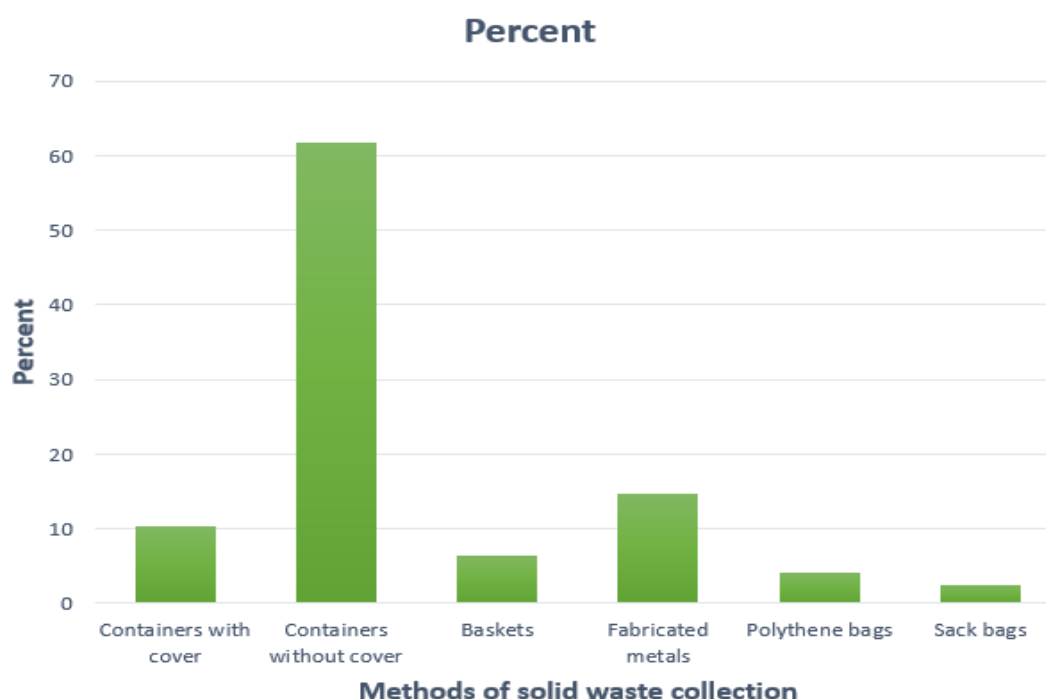


Fig. 2. Methods of solid waste collection by households in Bekwarra

waste disposal while 36 (9.6%) had no knowledge of solid waste disposal. The source of information as reported by respondents on solid waste disposal (Table 1), 163 (45.2%) knew about solid waste disposal through health worker, 34 (9.4%) knew about solid waste disposal through radio/television stations, 16 (4.4%) of the respondent knew about solid waste disposal through awareness creation in the market, 59 (16.3%) knew about solid waste disposal in the church, 29 (8%) acquired knowledge of solid waste disposal through age grade meetings and 60 (16.6%) had knowledge of about waste disposal through town criers. Assessment of health effect of solid waste indicated that 312 (80.2%) of respondents agreed solid waste could cause illness, 45 (11.6%) disagreed with this statement, while 32 (8.2%) did not know. However, 349 (87.9%) of respondents thought something could be done about problems of waste in their community while 8 (2%) thought otherwise while 40 (10.1%) did not know.

Results from the observation checklist showed as shown in Table 2 that only 163 (41%) of respondents had storage containers for waste compared to 235 (59%) without storage containers. The number of respondents who had sanitary refuse collection bin on premises was 91 (22.9%) while 307 (77.1%) used unsanitary

refuse collection bins. Few respondents 41 (10.4%) used refuse bins with cover to store their waste compared to those who did not have refuse bins with cover. Also 25 (6.4%) of the respondents used baskets as waste bins, 58 (14.8%) used fabricated metals as waste bins, 16 (4.1%) used polythene bags and 10 (2.5%) used sack bag as waste bins. Results of the observation checklist indicated that only 95 (24.3%) of the respondents had adequate waste disposal facilities while 296 (75.7%) did not have. When these waste are collected, majority of respondents 160 (40.4%) incinerated the waste in their surroundings, 43 (10.9%) convert their waste into compost, 100 (25.3%) practised dumping as a means of waste disposal, 73 (18.4%) disposed their waste in nearby bushes around them, while 20 (5.1%) dumped their waste at the community dumpsites. The general conditions of the surrounding around refuse storage site of 128 (32.3%) of the respondents were sanitary, compared to the insanitary or filthy situation of the premises of 268 (67.7%) respondents around their refuse storage site. The respondents reported various means of transporting. A larger proportion of respondent 332 (84.1%) carried wastes by themselves to the disposal site, 37 (9.4%), used wheel barrow 17 (.4.3%) paid someone else to move the waste 8 (2%), used open trucks while 1 (0.3%) transport their waste with open van.

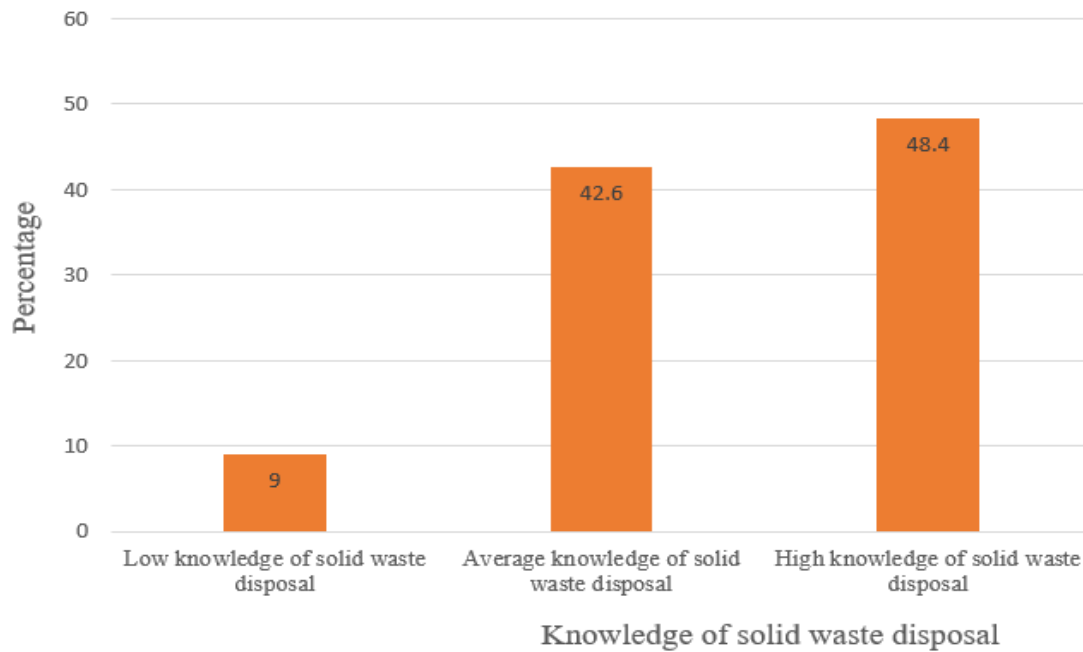


Fig. 3. Respondents' knowledge level of solid waste disposal

Table 1. Respondents view on Solid Waste Disposal

Variables		Frequency	Percentage
Familiar with waste disposal	Familiar	359	90.4
	Non familiar	38	9.6
Source of information on waste disposal	Health workers	163	45.2
	Radio/TV station	34	9.4
	Market square	16	4.4
	Church	59	16.3
	Age grade meetings	29	8
	Town announcers	60	16.6
Waste collectors	Covered containers	41	10.4
	Uncovered containers	243	61.8
	Baskets	25	6.4
	Fabricated metals	58	14.8
	Polythene bags	16	4.1
	Sack bags	10	2.5
Place for dumping waste	Place for dumping waste	359	93.5
	No place for dumping waste	25	6.5
Where waste is mostly disposed	Composting	43	10.9
	Direct dumping	100	25.3
	Bush around	73	18.4
	Community dumpsites	20	5.1
	Burning	160	40.4
How waste is transported	Hand/head carrying	332	84.1
	Wheel barrow	37	9.4
	Open trucks	8	2
	Vans	1	0.3
	Pay somebody	17	4.3
Can anything be done about waste problems in this community	Something can be done	349	87.9
	Nothing can be done	8	2
	Don't know	40	10.1

Table 2. Observation checklist results

Variables		Frequency	Percentage
Storage Containers	Available	163	41
	Not available	235	59
Refuse collection on premises	Sanitary refuse collection on premises wastebin	91	22.9
	Unsanitary refuse collection on premises wastebin	307	77.1
General surrounding around refuse storage site	Sanitary Condition (Clean)	91	22.9
	unsanitary Condition (Dirty/Filthy)	307	77.1
Waste disposal facility	Adequate disposal facility	95	24.3
	Non adequate disposal facility	296	95.7

4. DISCUSSION

Adequate solid waste management entails the collection, storage and final disposal of waste in an appropriate and effective manner to avoid posing risk to the health of the populace and cause damage to resources (Kwamitse, 2009). Communities and towns are struggling to get rid of solid waste heaps from their environments which are being overtaken by solid waste emanating from household or domestic sources, markets, shopping and business centers. In this study, a significant proportion of the respondents.

Respondents with secondary education 167 (42.2%) were more and this influenced their knowledge of proper solid waste disposal or solid waste management. Out of the number of respondents who had low knowledge scores, 48.6% also had a secondary level of education. The association of educational status with knowledge of solid waste disposal was statistically significant ($p = 0.012 < 0.05$). In this study, 359 (90.4%) of respondents were already familiar with solid waste disposal while 38 (9.6%) were not and the main source of information on solid waste disposal as reported by respondents was through a health worker 163 (45.2%), town carrier or 60 (16.6%) and through churches 59 (16.3%). Ideally, the first point of call for health information to the public should be the health worker. Television and radio stations can also serve as a means of reaching the general public faster, just as same as campaigns organized in market squares. Town carriers can also be employed to reach out to a wider population, while age-grade meetings involving fewer individuals can serve as a means of outreach. A good number of the respondents 349 (87.9%) thought something could be done about the problems of waste in their community as 312 (80.2%) agreed that solid waste could pose or

cause illness to members of the community. This finding corroborates the study in Gaborone, Botswana which revealed that the citizens had high level of knowledge of waste management yet this did not translate to proper waste disposal practice (Bolaane, 2006).

Data on Nigerian municipal waste generation rate at about 25 million tons annually and daily rate of 0.44-0.66 kg/capital/day (Ogwueleka, 2009). The low-income earners and compound dwelling units or low householders generate an average of about five kilograms of waste, items like vegetables and tuber remains constitute 0.5 kilograms (Mukisa, 2009). In this study, 381 (95.5%) of respondents agreed that they produced vegetable waste from household activities which is supported by Almedon et al. (2007), who reported that about 70% to 90% of the total household waste produced, comprised of organic waste while about 5% to 10% of the total household wastes produced were made up of tins, cans, and paper. Other wastes produced by households in the study area include food waste 98 (24.6%), ashes 376 (94%), clothing/rags waste 376 (94.2%), wood 379 (95%), plastic/rubber 358 (89.7%), nylon w 360 (90.2%), metal/cans 336 (84.4%), bottle/glass waste 318 (79.9%), paper waste 353 (88.7%), animal waste 343 (86.2%) and electrical/electronics 17 (4.3%) (See Fig. 4).

Waste collection is defined as the collection of solid waste at source from the point of production (residential, industrial commercial, institutional) and movement to the point of treatment or disposal with the ultimate goal of promoting the quality of the environment, generating employment and income, and protecting the environment (Davidson, 2011). Among the respondents sampled in the present study, 359 (93.5%) had places for dumping of



Fig. 4. Different waste disposal methods practice in Bekwarra LGA

waste and used different containers to collect waste. The breakdown showed 41 (10.4%), waste bins without cover 243 (61.8%) used baskets, 25 (6.4%) used fabricated metals 58 (14.8%) used polythene bags, 16 (4.1%) and 10 (2.5%) collected wastes in sack bags. Results from the observational checklist showed that only 163 (41%) of the respondents had storage containers for waste while 95 (24.3%) of them deposit their waste at approved dumpsite. Improper waste disposal methods deface the cities and semi-urban and rural areas thereby constituting health hazards due to the spread of diseases (Eja, 2014). A study conducted in Cross River State which revealed that only about 70% households in the metropolis had appropriate waste bins for waste storage collaborate the above findings. The disposal of solid waste in the Ikot Effanga Area of Cross River State which the poor solid waste disposal practices further agreed with the study (Bassey et al., 2015).

In the present study it was also revealed that 332 (84.1%) carried their waste on the head or by

hand to the central collection point, followed by wheel barrows 37 (9.4%), paying someone else to dispose their waste, 17 (4.3%), open trucks 8 (2%) or van 1 (0.3%). In this study, 160 (40.4%) of respondents the study further showed that majority of them practiced burning of waste. It agrees with the study conducted in Lagos which respondent 160 (40.4%) practice burying of waste with 16.7% of the respondents practiced open burning. (Adetokunbo and Herbert, 2005). According to Agwu (2012) open burning of waste, exhaust fumes from waste collection vehicles and dust from disposal practices contribute to the overall health problems in an area. Also uncontrolled burning of solid waste and improper incineration greatly contributes to air pollution and formation of greenhouse gases, while contaminants from decomposition of organic wastes in landfills, and untreated leachate pollute the surrounding soil and water bodies (Akpovi, 2005). "The present study also showed that 100 (25.3%) of the respondents practiced open dumping as a means of waste disposal. This is lower than the Figure. reported

in a study conducted in Abeokuta, whereby 57.9% of the respondents reported that they disposed of their waste in open dump sites to be collected later, probably by a garbage truck" (Mary, 2014).

"Other methods of waste disposal practiced by respondents in this study include composting 43 (10.9%), dumping in bushes around 73 (18.4%), and community dumpsites 20 (5.1%). Similarly, a study conducted in Lagos revealed that the majority of the households used the communal system of waste collection (45%) or throwing waste into the bush (12.5%) as a means of waste disposal" (Adetokunbo, & Herbert, 2003).

5. CONCLUSION

Despite the efforts and enormous resources being channeled towards environmental management, the disposal of solid waste still poses a serious challenge to the health and wellbeing of the citizenry. It can be concluded from the finding of the study that the poor system of solid waste in the area studied contributed significantly to the reported cases of diseases transmission. These issues can be addressed through health education and enlightenment of the people on waste disposal systems and community mobilization to achieve this objective.

The management of waste is very pertinent and imperative for the protection of public health and the safeguarding of resources because failure to properly manage waste in any community exposes people to an increased risk of infectious diseases (Adetokunbo & Herbert, 2003). This study which was conducted in Bekwarra Local Government Area of Cross River State, Nigeria described the types of solid waste generated by households in the area, determined the methods of waste collection and disposal by households, level of knowledge of respondents concerning waste, as well as the perceived public health problems associated with waste in the study area. Four hundred (400) household respondents were all proportionately selected for this study. The association between age, income, occupational level and educational level with method of waste disposal was tested using a chi-square statistical tool and the results revealed that age, income occupation and educational level of respondents were statistically significant with the method of waste disposal.

Results from the test to ascertain respondents' knowledge concerning waste disposal revealed

that the majority of the respondents' 193 (48.4%) had a high level of knowledge of waste disposal in the study area. Respondents' level of knowledge influenced the method of waste disposal practiced in the study area ($p = 0.011$). The waste disposal practices were not consistent with sanitary standards and could be responsible for the disease cases reported by the respondents in the study area.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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