Assessment of the Environmental and Health Effects of Solid Waste Disposal at Ikhueniro Dumpsite in Ikhueniro Community of Uhunmwode LGA, Benin City, Edo State, Nigeria

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Abstract
Compared to those in developed countries, residents in developing countries like Nigeria, especially the urban poor in Benin City, are more severely impacted by unsustainably managed waste. In low-income countries (such as Nigeria), over 90% of waste is often disposed of in unregulated dumps or openly burned. These practices create serious health, safety, and environmental consequences. Thus, there are growing concerns about the effects of indiscriminate disposal of solid waste on the environment and human health. In this study, a cross-sectional descriptive survey method was adopted. Data were collected from household residents close to the dumpsite (<250m-nearby) and household residents far away from the dumpsite (>250m-far away) via questionnaires and interviews. The data were then analyzed using the Statistical Package for the Social Sciences (SPSS Version 26.0). Four hundred and twenty (420) semi-structured questionnaires (210 for nearby and faraway residents, respectively) were administered to household residents in Ikhueniro Community. Four hundred and three (201 nearby and 202 faraway) copies were retrieved and thus analyzed. Results revealed that both nearby and faraway residents were affected by the location of the dumpsite closer to their settlements. However, the residents close to the dumpsite were more affected than those far away from the dumpsite. The environment was polluted as the residents suffered issues like offensive odors and smoke. And this impacted their health due to the fact that the residents were victims of various diseases such as malaria, typhoid, cholera, diarrhea, and cough. It was observed that the solid waste disposal methods used by residents (both nearby and far away) were very unsatisfactory, and this may probably be due to a lack of knowledge on solid waste management options. It was deduced from this study that waste disposed at the dumpsite has an effect on the environment and health of household residents in the community, and as such, it is recommended that operators of the dumpsite (Edo State Waste Management Board) adopt alternative waste management options (eco-friendly options) and educate residents on them so that gradually the dumpsite can be closed.

Keywords: Solid Waste Disposal, Dumpsite, Hazardous Waste, Biodegradable Materials, Ikhueniro Community.

1.0 INTRODUCTION

Solid waste refers to substances or objects (garbage) arising from human or animal activities that are discarded, worthless, unwanted, defective, or of no value from a consumption or manufacturing process or that are required to be disposed of according to the provisions of a national law (Ayuba, 2005). Generally, solid waste is generated from residential, commercial, institutional, and industrial activities (Nathanson, 2023) and may be handled in a variety of ways. Solid waste can be classified in a number of ways on the basis of sources, environmental risks, utility, and physical property. On the basis of source, solid wastes are classified as: municipal solid wastes, industrial solid wastes, and agricultural solid wastes.

Around the world, waste generation rates are rising. In 2020, the world was estimated to generate 2.24 billion metric tons of solid waste, amounting to a footprint of 0.79 kilograms per person per day (World Bank, 2022). With rapid population growth and urbanization, annual waste generation is expected to increase by 73% from 2020 levels to 3.88 billion metric tons in 2050 (World Bank, 2022). Compared to those in developed countries, residents in developing countries like Nigeria, especially the urban poor in Benin City, are more severely impacted by unsustainably managed waste. In low-income countries (Nigeria), over 90% of waste is often disposed of in unregulated dumps or openly burned. These practices create serious health, safety, and environmental consequences.

A dumpsite is a piece of land where waste materials are dumped. An open dumpsite involves the disposal of solid waste in a manner that does not protect the environment, is susceptible to open burning, and is exposed to the elements, vectors, and scavengers. It is an indiscriminate and unscientific disposal method for waste (Ndukwe et al., 2019). Unscientific disposal of solid waste causes an adverse impact on all components of the environment and human health (Jha et al., 2003; Sharholy et al., 2008; Sharme et al., 2018). Dumping huge amounts of garbage drives biodegradable materials to decay and decompose under abnormal, uncontrolled, and unhygienic conditions. After a few days of decomposition, it becomes a breeding ground for different types of disease-causing insects as well as infectious organisms. A foul smell is produced (an unpleasant odor), and it also damages the aesthetic value of the area. These conditions are worse when there is extreme temperature, which speeds up the rate of bacteria action on biodegradable materials. Commonly coupled with open dumping is the waste open-burning practice, which leads to greenhouse gas emissions and negatively affects public health (Dos Muchangos and Tokai, 2020). For instance, the emission of nitrous oxide (N_2O) from the burning of solid waste contributes directly to greenhouse gas emissions. This greenhouse gas has a high global warming potential. Also, the dioxins and poisonous gases produced from the burning of solid waste can cause various diseases, such as chronic disease, skin infections, cancer, etc. Contaminated animals are one of the major mediums through which pollutants deposited on land enter the human body (Medina, 2002; Abul, 2010). Dumpsites closer to residential areas are always feeding places for animals such as dogs and cats, as well as homes for rodents. These animals carry diseases with them to nearby homesteads (Ndukwe et al., 2019). Exposure to hazardous waste in dumpsites can affect human health, with children being the most vulnerable to these pollutants (Yongsi et al., 2008; Olorunlana and Ogunade, 2022). Direct exposure can lead to diseases through chemical exposure, as the release of chemical waste into the environment leads to chemical poisoning (Olorunlana and Ogunade, 2022). Disposal sites can also create health hazards for the neighborhood (Foday et al., 2013; Olorunlana and Ogunade, 2022).

Poor health can have a negative impact on the economy of a country as well as education. Without good health conditions, an economy loses its ability to develop competitive productivity, which might subsequently hinder economic growth (Ridhwan et al., 2022). Poor health is not only more likely to cause lower educational attainment, but it can also cause educational setbacks and interfere with schooling. Health conditions, disabilities, and unhealthy behaviours can all have a negative effect on education outcomes. For example, children with chronic illnesses may experience recurrent absences and difficulty concentrating in class, which directly affect their academic performance (Quynh Vo, 2019).

Managing waste properly is essential for building sustainable and liveable cities; thus, it allows improvement in sustainable development. Therefore, there is a need to examine the environmental and health effects of solid waste disposal in order to promote awareness among the government and the public so as to practice proper waste disposal methods.

Solid waste disposal at dumpsites poses a serious threat to environmental quality and human health (Snigdha and Prasenjit, 2003). Therefore, access to sanitation services and clean, adequate water are regarded as paramount to the health and well-being of people (WHO, 2023). As Benin City becomes more populated and industrialized, the congenital problem of solid waste management comes along with it. This study seeks to fill the gap by looking at the environmental and health effects of solid waste disposal at the Ikhueniro dumpsite in the Ikhueniro community of Uhunmwode Local Government Area (LGA), Benin City, Edo State, and what the Edo State government needs to do to improve the solid waste disposal method in the Ikhueniro community. This study will provide the Edo state government with information on ways to improve solid waste disposal methods in the Ikhueniro community.

2.0 MATERIALS AND METHODS

2.1 Study Area

Ikhueniro community (see Figure 1) is a suburb situated in Uhunmwode L.G.A., which is in the south senatorial district of Edo State (Omorogieva et al., 2016). Uhunmwode LGA has its headquarters in Ehor town, and it has a total area of 2,033 square kilometers (Okuo and Ighodaro, 2018; Manpower, 2023). It is bounded by latitude 6.29**°** north and longitude 5.95**°** east (Elevator Map, 2023) of the central province of Edo State. The LGA has a number of rivers and streams with an average humidity level of about 52% (Manpower, 2023). Uhnunmwonde has a population of about 121,749 people with a population density of 59.89/km^2 (NPC, 2006).

The Ikhueniro community shares a common boundary with Okhuahe and other neighbouring communities. The topography of the terrain is characterized by a gentle slope plunging towards the southeastern portion of the community and gradually increasing steepness towards Okhuahe community (Omorogieva et al., 2016). The distance of the community from the center of Benin City is about 14 km. Most of the vegetation in the community has been removed by urbanization, while the rest of the vegetation remains a mosaic of farmlands. Ikhueniro lies within latitude 06°19’38.1’’ north and longitude 005°44’5.2’’ east (Omorogieva et al., 2016; Okuo and Ighodaro, 2018). Ikhueniro is underlain by the sedimentary formation of the south sedimentary basin, and it constitutes part of the Benin formation, which is made up of massive, highly porous, fresh water-bearing sandstone with local thin shale inter-beds that are thought to be of braided stream origin (Rayment, 1965; Omorogieva et al., 2016). The climate of the area is a moist tropical rainforest with mean monthly rainfall and a temperature of 50 mm and 27 °C (Ojo et al., 1999; Omorogieva et al., 2016). The area has two distinct seasons. These are the wet (rainy) season and the dry season. The rainy season occurs between the months of March and October, with a short break in August. The dry season, on the other hand, lasts from November to February with dry harmattan winds between December and February, but with the effect of global warming and climate change, rains have been observed to fall

irregularly almost every month of the year, with double peak periods in July and September (Rawlings and Ikediashi, 2020). One major feature of the community is the dumpsite (Ikhueniro dumpsite), which is now almost at the center of the community. This dumpsite is one of the largest and major open dumpsites in the Benin metropolis, which belongs to the Edo state government (Omorogieva et al., 2016; Okuo and Ighodaro, 2018); thus, it is operated by the Edo State Waste Management Board (EDSMA). The dumpsite consists of waste from different sources, such as domestic, market, commercial buildings, industries, and institutions (Ibezute and Erhunmwunse, 2018).

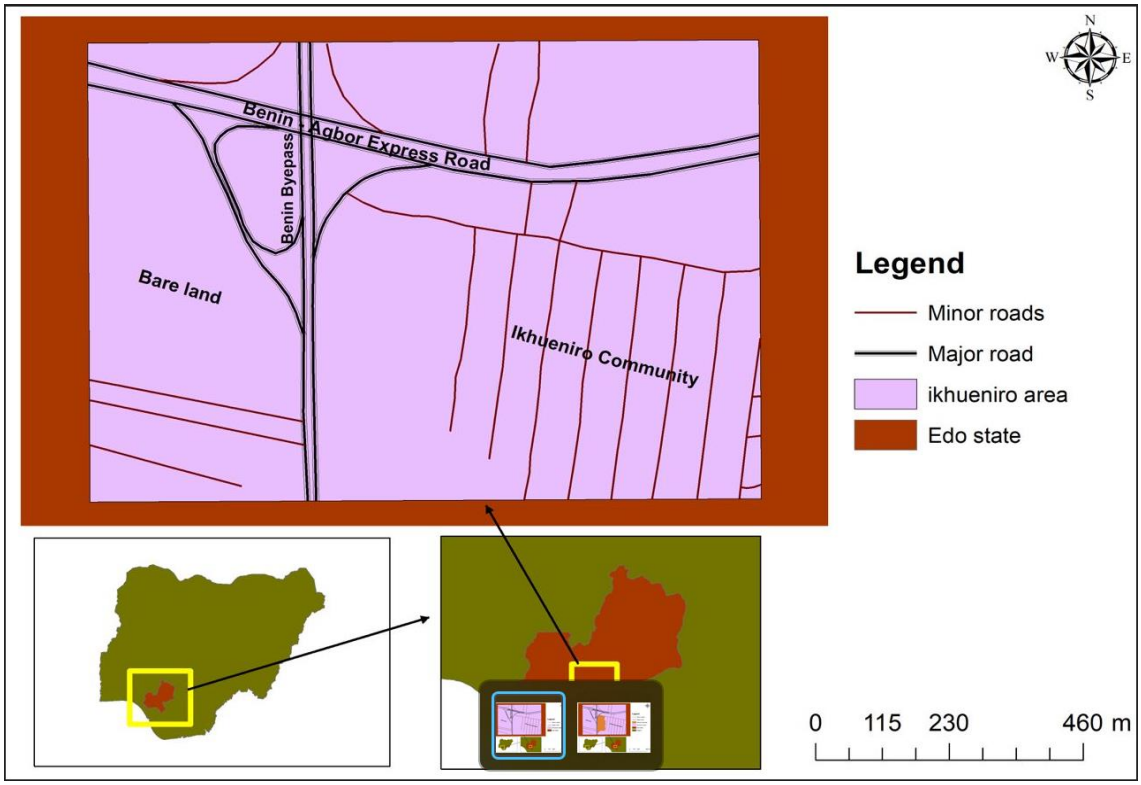

Figure 1: Map Showing Ikhueniro Community (Source: Ibezute and Erhunmwunse, 2018- Modified by the Authors, 2023)

2.2 Data Collection and Analysis

The data used for this study were collected via questionnaires using a cross-sectional descriptive survey method and interviews with household residents (both nearby and far away from the dumpsite). A multi-stage sampling technique was used to constructively administer a total of 420 technically designed, pre-tested, semi-structured questionnaires to households in the Ikhueniro community. These questionnaires were administered to two categories (each category = 210 questionnaires) of household respondents (Babs-Shomoye and Kabir, 2016): household residents close to the dumpsite (<250 m) and household residents far away from the dumpsite (> 250 m). Google Maps was used to determine the streets and houses located within the specified distances from the dumpsite prior to data collection (Babs-Shomoye and Kabir, 2016). About 10% of the questionnaire was ascertained for validity using the Face Validity Method and reliability (using Cronbach's alpha statistics). Cronbach's alpha is a measure used to assess the reliability, or internal consistency, of a set of scales or test items, and it normally ranges between 0 and 1 (Goforth, 2022). The

questionnaires obtained data on socio-demographic characteristics of residents, residents' views on the surroundings of their community, solid waste disposal methods used by residents, implications of the dumpsite on the health of the community, and measures employed to protect residents from dumpsite effects. The sample size used for the study was determined using the formula (Yamane, 1967):

$$n = \frac{N}{1 + N(e^2)} \quad (1)$$

where,
$n =$ Sample size
$N =$Population under study
$e =$ Margin error = 0.05

Household residents (both nearby and far away from the dumpsite) were interviewed to obtain information on residents' views on the location of the dump site and their surroundings.

Four hundred and three (403; 201 from nearby residents and 202 from faraway residents) completed copies of questionnaires were retrieved (estimated sample size). Hence, four hundred and three (403) copies of questionnaires were analyzed. The retrieved questionnaires and Cronbach's alpha reliability were analyzed using Statistical Package for the Social Sciences (SPSS, version 26.0, 2018), and results were presented using descriptive tables and charts (bar charts).

3.0 RESULTS AND DISCUSSION

The results obtained from the study are presented in Tables 1 to 4 and Figures 2 to 3. Table 1 shows Cronbach's alpha for the reliability of the questionnaire; Table 2 shows the socio-demographic characteristics of respondents; Table 3 shows the implications of the dump site on the health of the community; and Table 4 indicates the measures employed to protect residents from dumpsite effects. Residents' views on the surroundings of their community and solid waste disposal methods used by residents are indicated in Figures 2 and 3.

Table 1: Cronbach's Alpha for Reliability of Questionnaire

Cronbach's Alpha	No. of Items
0.709	18

From Table 1, a Cronbach Alpha of 70.9% indicates an acceptable questionnaire (Glen, 2023) and implies that the questions in the questionnaire are all similar and relevant to the subject matter of the survey. Of the 420 questionnaires administered to households, 403 were retrieved (201 from nearby residents and 202 from faraway residents) for analysis, giving a response rate of 100%.

Table 2: Socio-demographic Characteristics of Respondents (n=403)

Variables	No of Respondents	Percentage
Gender		
Male	229	56.8
Female	174	43.2
Total	**403**	**100**
Age		
Below 26	56	13.9
26 to 35	101	25.1
36 to 45	77	19.1
46 to 55	72	17.9
Above 55	97	24.1
Total	403	100
Marital status		
Single	149	37
Married	166	41.2
Divorced	32	7.9
Widow/Widower	56	13.9
Total	**403**	**100**
Education level		
No formal education	52	12.9
Primary education	22	5.5
Secondary education	109	27
Tertiary education	153	38
Adult education	67	16.6
Total	**403**	**100**
Length of stay in area		
Less than a year	89	22.1
1 to 3 years	141	35
4 to 6 years	76	18.9
7 to 10 years	69	17.1
Above 10 years	28	6.9
Total	**403**	**100**
Employment status		
Self-employed	149	37
Employed	85	21.1
Unemployed	117	29
Retired	52	12.9
Total	**403**	**100**
Type of household		
Family	245	60.8
Non-Family	158	39.2
Total	**403**	**100**
Household head		
Male head	334	82.9
Female head	69	17.1
Total	**403**	**100**
Household size		
Below 5	262	65
5 to 12	109	27
Above 12	32	7.9
Total	**403**	**100**

Table 2 revealed that the majority of the respondents (56.8%) were male, 44.2% were within the economically active age range of 26–45 years (Babs-Shomoye and Kabir, 2016), and 41.2% were married. Quite a large number (87.1%) of respondents were educated, with

38% educated to tertiary level; this corresponds with previous findings (Olusosun, 2014; Babs-Shomoye and Kabir, 2016), where most residents within a dumpsite vicinity were found to be educated. Most of the respondents (35%) had lived in the study area for 1 to 3 years, and 37% claimed that they were self-employed. A large proportion (60.8%) of the households were family households, with 82.9% having male household heads and a household size of less than 5 members.

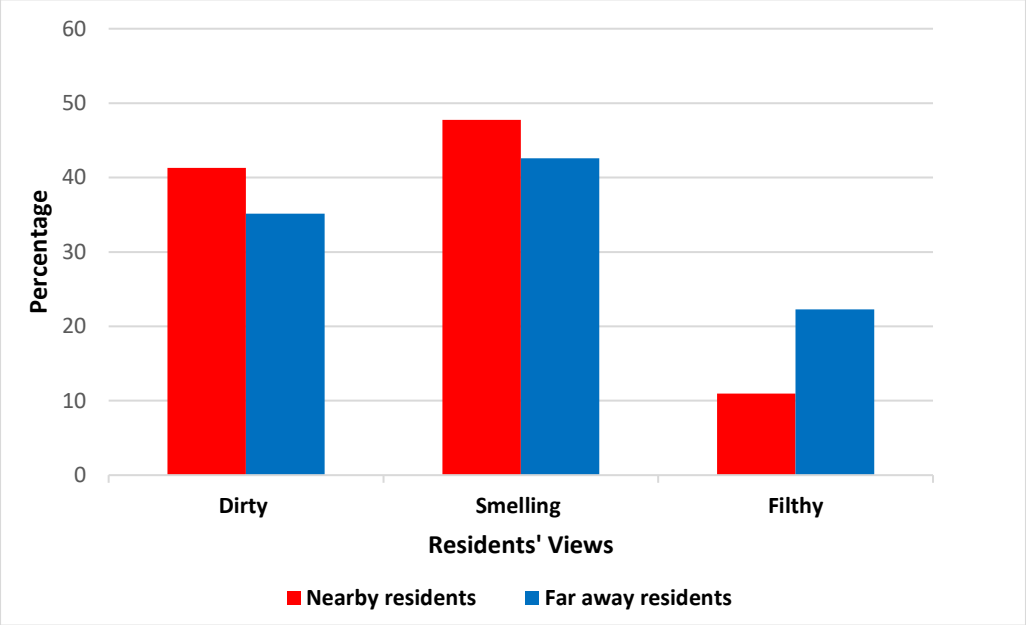

Figure 2: Residents' View on the Surrounding of their Community

Results from Figure 2 show that 41.3% and 35.2% of residents near the dumpsite and far from the dumpsite reported that their surroundings are dirty; 47.8% and 42.6% of residents near the dumpsite and far from the dumpsite indicated that their surroundings are smelling; and only 11% and 22.3% of residents near the dumpsite and far from the dumpsite claimed that their surroundings are filthy. The interview found that the majority of the residents (particularly those living close to the dumpsite) are not happy about the location of the dumpsite. They complained that the dumpsite is too close to their houses and, as such, impacts their health. Also, they reported that their surroundings are smelling and dirty, and from visual inspection, it was observed that some of the waste from the dumpsite overlaps with their houses and, as such, pollutes the environment. These issues reported by the residents close to the dumpsite are consistent with many studies in developing countries (Abul, 2010; Sankoh et al., 2013; Babs-Shomoye et al., 2016; Ndukwe et al., 2019). The interview also found that waste is burned at the dumpsite twice a year, and the residents (particularly those near the dumpsite) complained about the smoke engulfing the community as a result of burning the waste. Smoke from the burning of waste contains harmful chemicals and particulate matter that affect human health and the environment. Residents far away from the dumpsite complained that the dumpsite is at the entrance of the community and that it makes their surroundings smell bad and dirty. They argued that waste such as plastic, nylon, rags, paper, etc. is mostly dispersed into their surroundings by

wind and rain. Further, household residents (both close to the dumpsite and far away from the dumpsite) complained about the unpleasant odour from the dumpsite as a major problem in the area and that it makes them feel nauseous. Waste left unattended to for a long time constitutes a serious hazard and produces an offensive odour, which can cause serious health challenges to those living around the site (Ohwo, 2011). Dirty areas are breeding grounds for bacteria and other germs and aid in their spread; thus, staying in a dirty environment poses a serious threat to residents' wellbeing.

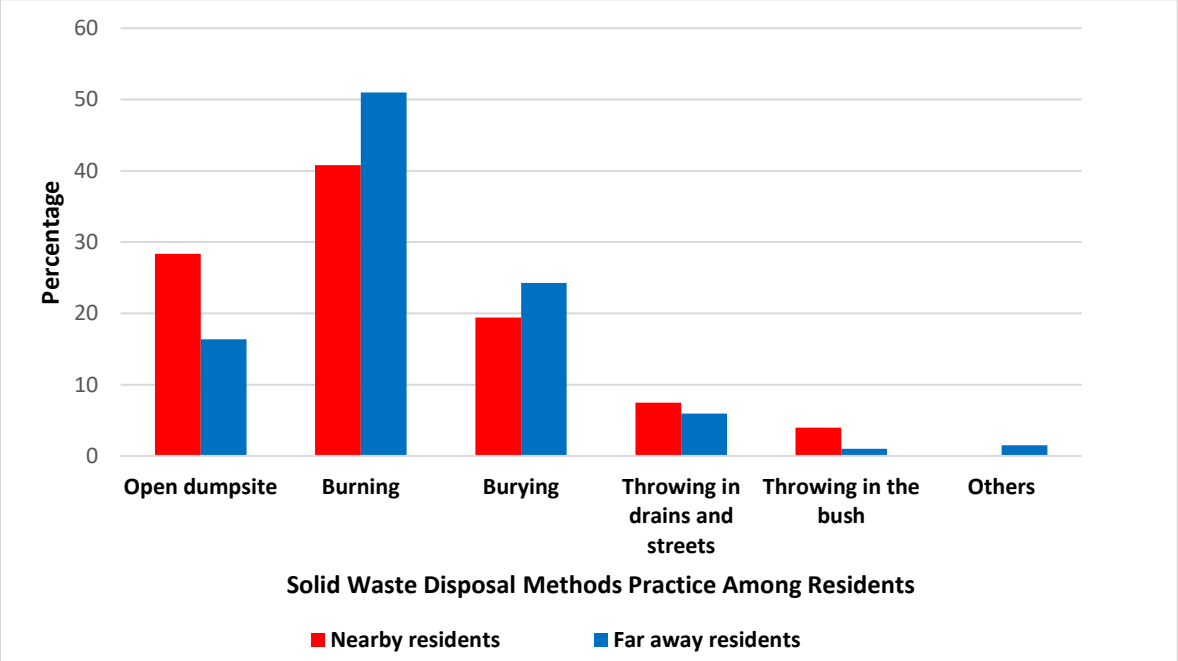

Figure 3: Solid Waste Disposal Methods Used by Residents

From Figure 3, results showed that the majority of the residents near the dumpsite (40.8%) and far from the dumpsite (51.0%) burn their waste; 28.4% of residents near the dumpsite and 16.3% of residents far from the dumpsite dispose of their waste at the dumpsite (open dumpsite); 19.4% of residents near the dumpsite and 24.3% of residents far from the dumpsite bury their waste; 7.5% of residents near the dumpsite and 5.9% of residents far from the dumpsite throw their waste in drains and on the streets; only a small proportion of residents near the dumpsite (4.0%) and far from the dumpsite (1.0%) throw their waste into the bush. These results indicate that the solid waste disposal methods used by residents (both near and far from dumpsites) were very unsatisfactory, and this may be due to a lack of knowledge on solid waste management options. They correspond with the practices that have been reported in many developing countries (Sankoh et al., 2013; Ndukwe et al., 2019; Olorunlana and Ogunade, 2022). These methods pose various threats to public health and adversely affect the environment (Asuma, 2013; Liu et al., 2017; Olorunlana and Ogunade, 2022). The highest way in which residents disposed of their waste (burning) may be attributed to the common practice of uncontrolled burning of waste in the dumpsite as a way of managing the waste. This practice could lead to environmental pollution as well as

the depletion of the ozone layer, which in turn leads to climate change (Babs-Shomoye et al., 2016; Olorunlana and Ogunade, 2022). Burning waste is an environmentally poor waste management option that releases a hazardous mixture of cancer-causing compounds and other toxic substances into the environment (UNEPA, 2006).

Table 3: Implications of the Dump Site on the Health of the Community

Variable	Nearby Residents		Far away Residents	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Are you aware of the implications of having a dumpsite nearby a community				
Yes	134	66.7	94	46.5
No	67	33.3	108	53.5
Total	201	100	202	100
If yes, implications of the dumpsite				
Breeding place for disease vector	40	29.9	33	35.1
Causes diseases	76	56.7	50	53.2
Makes the area dirty	18	13.4	11	11.7
Total	134	100	94	100
Does location of the dumpsite affect the health of the community				
Yes	153	76.1	89	44.1
No	48	23.9	113	55.9
Total	201	100	202	100
Diseases which have affected the residents				
Malaria	73	56.2	58	51.8
Diarrhoea	10	7.7	6	5.4
Cholera	11	8.5	24	21.4
Typhoid	36	27.7	24	21.4
Total	130	100	112	100

Results from Table 3 revealed that both nearby and faraway residents (66.7% and 46.5%) are aware of the implications of having a dumpsite nearby their community, and as such, they reported that the dumpsite is the breeding place for disease vectors (29.9% of nearby residents and 35.1% of faraway residents), causes diseases (56.6% of nearby residents and 53.2% of faraway residents), and makes the place dirty (13.4% of nearby residents and 11.7% of faraway residents). Results also showed that 76.1% of residents nearby the dumpsite and 44.1% of residents far away from the dumpsite believed that the location of the dumpsite affects the quality of their health, and they claimed to have suffered from various diseases such as malaria (56.2% of nearby residents and 51.8% of faraway residents), typhoid (27.7% of nearby residents and 21.4% of faraway residents), cholera (8.5% of nearby residents and 21.4% of faraway residents), and diarrhea (7.7% of nearby residents and 5.4% of faraway residents). This indicates that residents near the dumpsite experience a higher frequency of these diseases than those far away from the dumpsite.

This is in consonant with previous findings that as distance between a dumpsite and community reduces, the frequency of illness increases (Sankoh et al., 2013; Babs-Shomoye et al., 2016). It was observed that malaria is the most prevalent disease that residents have suffered from, which agrees with previous findings on the effect of the location of a dumpsite nearby a community (Abul, 2010; Sankoh et al., 2013; Ndukwe et al., 2019). Solid waste dumping areas become sources of contamination due to the incubation and proliferation of flies, mosquitoes and rodents (Mahler et al., 2016; Singh et al., 2021). Hence, waste dumps near living areas are detrimental to human health. The interview found that the smoke release from burning of the waste affect the residents (particularly those nearby the dumpsite), they complained of severe cough during the period of burning the waste. Uncontrolled burning of waste at the dumpsite releases toxic chemicals as well as soot particles (that can cause cancer) into the atmosphere, which in turn leads to air pollution and thus impacts human health and the environment.

Table 4: Measures Employed to Protect Residents from Dumpsite Effects

Variable	Nearby Residents		Far away Residents	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Any measure to mitigate the effects of the dumpsite on the community				
Yes	71	35.3	59	29.2
No	130	64.7	143	70.8
Total	201	100	202	100
Residents' knowledge on pollution				
Makes the environment dirty	43	21.4	32	15.8
Adds waste load to the environment	64	31.8	50	24.8
Causes sickness	68	33.8	83	41.1
Don't know about pollution	26	12.9	37	18.3
Total	201	100	202	100
Residents' suggestions on solid waste				
Use sanitary landfill method for waste disposal	17	8.5	22	10.9
Sort waste and recycle	31	15.4	38	18.8
Proper management of the dumpsite	83	41.3	71	35.2
Relocate the dumpsite	58	28.9	62	30.7
Burn the waste	12	6.0	9	4.5
Total	201	100	202	100
Residents' sources of information on solid waste management				
School	57	28.4	32	15.8
Media	82	40.8	104	51.5
Both school and media	38	18.9	52	25.7
Church	16	8.0	12	6.0
Mosque	8	4.0	2	1.0
Total	201	100	202	100

From Table 4, the majority of both nearby and faraway residents (64.7% and 70.8%) reported that no measures are being taken to mitigate the effects of the dumpsite on the community. This may probably be due to the enormous cost associated with solid waste management (Abdel-Shafy and Mansour, 2018), as quite a large proportion of the residents have knowledge of pollution. The majority of the residents near the dumpsite (33.8%) and far from the dumpsite (41.1%) indicated that pollution causes sickness; 31.8% of residents near the dumpsite and 24.8% of residents far from the dumpsite indicated that pollution adds waste to the environment; 24.4% of residents near the dumpsite and 15.8% of residents far from the dumpsite indicated that pollution makes the environment dirty; and only a small proportion of both nearby and far away residents (12.9% and 18.3%) claimed that they knew nothing about pollution. Therefore, the majority of both nearby and faraway residents (41.3% and 35.2%) suggested that the dumpsite should be properly managed since the media, which is the most available source of information on solid waste management, can be easily accessed. A waste dumpsite, if not properly managed, can serve as a breeding ground for animals such as mosquitoes, fly, rodents, and rats, which can transmit diseases to humans either from the waste dump itself or other related sources (Rao et al., 2007; Babs-Shomoye et al., 2016).

5.0 CONCLUSION

In this study, the environmental and health effects of solid waste disposal at the Ikhueniro dumpsite in the Ikhueniro community were investigated. Results revealed that the location of the dumpsite nearby the community affected both residents close to the dumpsite (nearby) and residents far away from the dumpsite (far away). However, the residents close to the dumpsite were more affected than those far away from the dumpsite. With regards to the quality of the environment, they complained of an offensive odour emanating from the dumpsite and the smoke released from the open burning of the waste at the dumpsite. This is an indication that the environment has been polluted, and as such, it has impacted the health of the residents, as it was discovered that they were victims of various diseases such as malaria, typhoid, cholera, diarrhea, and cough. It was observed that the solid waste disposal methods used by residents (both nearby and far away) were very unsatisfactory, and this may have resulted from a lack of knowledge on solid waste management options. Further, it was discovered that no measures were taken to mitigate the effects of the dumpsite on the community. Open dumping of waste is an inappropriate and uncontrolled waste disposal method that poses threats to human health, the environment, and aesthetic values. Proper management of waste is essential for building sustainable and liveable cities, including communities. Therefore, it is recommended that operators of the dumpsite (Edo State Waste Management Board) adopt alternative waste management options (eco-friendly options) and educate residents on them so that gradually the dumpsite can be closed.

REFERENCES

Abdel-Shafy, H. I. and Mansour, M. S. M. (2018). Solid Waste Issues: Sources, Composition, Disposal, Recycling and Valorization. Egyptian Journal of Petroleum, 27(4): 1275-1290.

Abul, S. (2010). Environmental and Health Impact of Solid Waste Disposal at Mangwaneni Dumpsite in Manzini: Swaziland. Journal of Sustainable Development in Africa, 12 (7): 64-78.

Abul, S. (2010). Environmental and Health Impact of Solid Waste Disposal at Mangwaneni Dumpsite in Manzini, Swaziland. Journal of Sustainable Development in Africa, 12 (7): 64-78.

Adegbite, J. T., Aigbogun, C. O. and Kuforijimi, O. (2018). Physiochemical Analysis of the Quality of Groundwater in Egbeta, Ovia Northeast Local Government Area of Edo State, Nigeria. Journal of Applied Geology and Geophysics, 6(3): 9-32.

Asuma, O. (2013). Leachate Characterisation and Assessment of Groundwater and Surface Water Qualities near Municipal Solid Waste Dump Site in Effurun, Delta State, Nigeria. Journal of Environmental and Earth Sciences, 3(9): 26-135.

Ayuba, H. K. (2005). Environmental Science: An Introductory Text, Kaduna, Apani Publications.

Babs-Shomoye, F. and Kabir R. (2016). Health Effects of Solid Waste Disposal at a Dumpsite on the Surrounding Human Settlements. Journal of Public Health in Developing Countries, 2(3): 268-275.

Dos-Muchangos, L. S. and Tokai, A., (2020). Greenhouse Gas Emission Analysis of Upgrading from an Open Dump to a Semi-Aerobic Landfill in Mozambique – The Case of Hulene Dumpsite. Scientific African, 10: 1-2.

Elevator Map, (2023). Uvbe, Egbede, Uhunmwonde, Nigeria. Available online from: https://elevationmap.net/uvbe-egbede-uhunmwonde-ng-1001380959, Accessed 28/02/2023.

Foday, P. S., Xiangbin, Y, and Quangyen, T. (2013). Environmental and Health Impact of Solid Waste Disposal in Developing Cities: A Case Study of Granville Brook Dumpsite, Freetown, Sierra Leone. Journal of Environmental Protection, 4: 665-670.

Glen, S. (2023). Cronbach Alpha: Definition, Interpretation, SPSS. Available online from https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/cronbachs-alpha-spss/, Accessed 06/08/2023.

Goforth, C. (2022). Using and Interpreting Cronbach's Alpha. Available online from: https://www.virginia.edu, Accessed 28/04/2022.

Ibezute, A. C. and Erhunmwunse, O. (2018). Assessment of Leachate Characteristics and Pollution Index of Ikhueniro Dumpsite in Benin City, Edo State, Nigeria. IOSR-Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), 12 (6 Ver. I): 38-44.

Ikhile, C. I. (2016). Geomorphology and hydrology of the Benin region, Edo State, Nigeria. International Journal of Geosciences, 7:144-157.

Jha, M. K., Sondhi, O. A. K. and Pansare, M. (2003). Solid Waste Management – A Case Study of Indian. Journal of Environment Protection, 23 (10): 1153-1160.

Liu, Y., Kong, F., Ernesto, D. R. and Gonzalez, S. (2017). Dumping Waste Management and Ecological Security: Evidence from England. Journal of Cleaner Production, 167: 1425-1437.

Manpower, (2023). Uhunmwode Local Government Area. Available online from: https://www.manpower.com.ng/places/lga/279, Accessed 28/02/2023.

Medina, M. (2002). Globalisation, Development and Municipal Solid Waste Management in Third World Cities. Tijuana, Mexico: El Colegio de la Frontera Norte. Available online from: http://www.gdnet.org/pdf/2002AwardsMedalsWinners/outstandingResearchDevelopment/martinmedinaMartinezpa per.pdf.

Nathanson, J. A. (2023). Solid Waste Management. Available from: https://www.britannica.com/technology/solid-waste-management/Solid-waste-collection, Accessed 11/01/2023.

National Population Commission (NPC), (2006). Nigeria National Census

Ndukwe, V. A., Uzoegbu, M. U., Ndukwe, O. S, Agibe, A. N. (2019). Environmental and Health Impact of Solid Waste Disposal in Umuahia and Environs, Southeast, Nigeria. Journal of Applied Sciences and Environmental Management, 23 (9): 1615-1620.

Ndukwe, V. A., Uzoegbu, M. U., Ndukwe, O. S., Agibe, A. N. (2019). Environmental and Health Impact of Solid Waste Disposal in Umuahia and Environs, Southeast, Nigeria. Journal of Applied Science and Environmental Management, 23 (9): 1615-1620.

Ohwo, O. (2011). Spatial Analysis of the Quality of Borehole Water Supply in Warri-Effurun Metropolis, Delta State, Nigeria. Ikogho: A Multi-disciplinary Journal, 9: 91-103.

Ojo, S. O., Ologe, K. O. and Ezechukwu, F. C. (1999). Countdown to Senior Secondary School Certificate Examination, Geography. Evans Brothers Nigeria Publisher Limited, pp 421.

Okecha, S. A. (2000). Pollution and Conservation of Nigeria's Environment, T'Afrique International Association (W.A.) Ebenezer Court, Owerri, pp. 16-18, 36.

Okuo, J. M. and Ighodaro, A. (2018). Spatial and Seasonal Variation of Volatile Organic Compounds (VOCs) in Ambient Air of an Open Dumpsite, Benin City, Southern Nigeria. Physical Science International Journal, 20(3): 1-11.

Olorunlana, F. A. and Ogunade, A. O. (2022). Impact of Indiscriminate Solid Waste Disposal on Human Health in Akungba-Akoko, Ondo State, Nigeria. International Journal of Sciences: Basic and Applied Research (IJSBAR), 62(2):468-478.

Olorunlana, F. A. and Ogunade, A. O. (2022). Impact of Indiscriminate Solid Waste Disposal on Human Health in Akungba-Akoko, Ondo State, Nigeria. International Journal of Sciences: Basic and Applied Research (IJSBAR), 62 (2): 468-478

Olusosun, O. O. (2014). Dumpsite: From Waste to Wealth. New Telegraph Newspaper. Available online from: http://new telegraphonline.com/olusosun-dumpsite-from- waste-to-wealth, Accessed 12/09/2015

Omorogieva, O. M., Imasuen, O. I., Isikhueme, M. I., Ehinlaye, O. A., Anegbe, B. and Ikponmwen, O. M. (2016). Hydrogeology and Water Quality Assessment (WQA) of Ikhueniro and Okhuahe Using Water Quality Index (WQI). Journal of Geography, Environment and Earth Science International, 6(3): 1-10.

Rao, C. S. (2007). Environmental pollution control engineering. New Age International.

Rawlings, A. and Ikediashi, A. I. (2020). Impact of Urbanizing Ovia-Northeast on the Quality of Groundwater using Water Quality Index. Nigerian Journal of Environmental Sciences and Technology (NIJEST), 4 (1): 87 – 96.

Rayment, R, A. (1965). Aspects of the Geology of Nigeria. Ibadan University Press.

Ridhwan, M. M., Nijkamp, P., Ismail, A. and Irsyad, L. M. (2022). The Effect of Health on Economic Growth: a Meta-Regression Analysis. Empirical Economics, 63: 3211-3251

Sankoh, F. P., Yan, X. and Tran, Q. (2013). Environmental and Health Impact of Solid Waste Disposal in Developing Cities: A Case Study of Granville Brook Dumpsite, Freetown, Sierra Leone. Journal of Environmental Protection, 4: 665-67

Sharholy, M., Ahmad, K., Mahmood, G. and Trivedi, R. C. (2008). Municipal Solid Waste Management in Indian Cities **–** A Review. Waste Management, 28 (2): 459-467.

Sharme, A., Gupta, A. K. and Ganguly, R. (2018). Impact of Open Dumping of Municipal Solid Waste on Soil Properties in Mountainous Region. Journal of Rock Mechanics and Geotechnical Engineering, 10(4): 725-739

Snigdha, C. and Prasenjit, S. (2003). Economics of Solid Waste Management: A Survey of Existing Literature. Available online: https://www.researchgate.net/publication/285232859_Ec

UNEPA, 2006. Informal Solid Waste Management. Available online from: http://www.unep.org?PDF/kenyawastemngntse ctor/sector/chapter1.pdf, Accessed 12/09/2015

Vo, L. Q. (2019). What Does Education have to do with Health? Available from: https://cohealthinitiative.org/articles/what-does-education-have-to-do-with-health/, Accessed 16/01/2023.

WHO, (2023). Water, Sanitation and Hygiene (WASH), Privacy Legal Notices. Available online: www.who.int/health-topics/water-sanitation, Accessed 22/01/2023

World Bank (2022). Solid Waste Management, Brief, Available online: https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management, Accessed 15/01/2023

Yamane, T., (1967). Statistics, An Introductory Analysis, 2nd Edition, New York: Harper and Row.

Yongsi, H. B. N., Herrmann, T. M., Netu, A. L. and Sietchiping, R. (2008). Environmental Sanitation and Health Risks in Tropical Urban Settings: Case Study of Household Refuse and Diarrheal in Yaounde Cameroon. International Journal of Human and Social Sciences, 3 (3): 220-228.