American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-13, Issue-5, pp-71-95
www.ajer.org
Research Paper Open Access

Assessment of Municipal Solid Waste Management in Nigeria For Sustainable Environment

Awara, Biokpomabo Festus[1,a],Ebieto, Celestine Ebieto[2],and Omorogiuwa, Eseosa[1,3]

1, Institute of Engineering Technology and Innovation Management, University of Port Harcourt
2, Department of Mechanical Engineering, University of Port Harcourt, Nigeria
3, Department of Electrical Engineering, University of Port Harcourt, Nigeria

ABSTRACT
This study seeks to assess municipal solid waste management in Nigeria for sustainable environment. The current waste management system and practices in the Rivers State municipal areas was described, the factors that influence waste management in the Rivers State were identified, the waste management system being adopted by Rivers State management agencies were assessed, and recommendations for development of a sustainable solid waste management system and the law governing waste dumpsite management through the National Assembly were proposed. Descriptive survey and quantitative research method were employed to analyze the responses generated from the 100 structured questionnaires completed by stakeholders in Rivers State, Nigeria. Broad based results revealed that the highest-ranking waste management system practice in the Rivers State, Nigeria was 'Open Dumping (A1)'. The highest-ranking factor that influences waste management in Nigeria was 'Environmental Sanitation (B1)'. The highest-ranking factors that affect access to waste management in Rivers State, Nigeria were 'Obsolete and Insufficient Operational Equipment. (C4)' 'Weak Waste Management Institutions. (C2)' and 'Availability of Dumping Grounds Discourages Investment in Alternative Disposal Methods. (C3)'. The highest-ranking factor that affects access to waste management in Nigeria was 'Waste Workers are not properly trained and paid. (D2)'. The result showed that the respondents' opinion, behaviors, attitude, the dilapidated infrastructure, weak institution, ineffective policies, inadequate public education on waste management, obsolete and inefficient equipment, inadequate training, poor pay and lack of motivation contributed greatly to the current state of solid waste management in the Rivers State, Nigeria. Conclusion and recommendation were made that the transformation of crude dumping into sanitary landfill for the installation of biogas waste plant is a sustainable technical solution for the economic analysis and management of dumpsites waste based on this study.

Keywords: Disposal, Environment, Solid Waste Management, Sustainable, Waste, Nigeria.

Date of Submission: 05-05-2024 Date of acceptance: 17-05-2024

I. INTRODUCTION

Waste is any matter or material that needs to be disposed of because it is damaged, worn out, contaminated, or has undergone other degradation, losing its value (Anifowose *et al.*, 2011). Waste generated contained a range of materials such as fragmented glass, raw steel metal, food residue and human waste, which are dangerous to human health. Additionally, waste can be categorized as municipal waste and industrial waste (Adewole, 2009). Any apparent, non-free-flowing unwanted thing or material that arises from activity by humans is potentially harmful and could exist in liquid or solid form could be often referred to as Municipal Solid Waste (MSW) since it is produced by human settlements, industrial, commercial, and agricultural activities (Singh *et al.*, 2011). Municipal Solid Waste (MSW) is often disposed of in landfills, and dumpsites. In urban areas, the generation of solid waste is significantly influenced by population expansion and economic development (The World Bank, 2019). Municipal Solid Waste (MSW), which is expanding faster than the pace of urbanization, is an issue in metropolitan areas all over the world, according to Hoornweg and Bhada-Tata (2012). Cities, towns, and surrounding areas in Africa are under tremendous pressure due to the continent's fast urban growth (Aliyu & Amadu, 2017; Saghir & Santoro, 2018). As a result of the growing urban waste

production, there are now health risks, water pollution in the ground, and decreased air quality (Mazhindu et al., 2012).

Waste management includes the handling of waste during its collection, transportation, treatment, and disposal, as well as oversight and regulation. Waste has been a problem for people as long as they have lived in settled communities, and modern society produces significantly more solid waste than did prehistoric ones (Mondal, 2014). Public health concerns have been the motivation driving improvements in waste treatment and disposal (Williams, 1998; Lane and Peto, 1995). Municipal Solid Waste (MSW) is the result of combining various kinds of household waste which includes food leftover, broken glass, human waste, organic pollutants, heavy metals, pathogenic microorganisms that can contaminate ground and surface waters. Improper waste disposal has far-reaching consequences, which leave the environment dirty and has the potential to change the environment in a way that attracts flies and other insects, serving as a breeding ground for vectors like rats, cockroaches, and mosquitoes, which can pose a threat to public health by spreading disease (Ndubuisi-Okolo *et al.*, 2016). Presently, the management of waste has reached alarming levels throughout the world, and nations including Nigeria are battling to deal with waste.

Nigeria is one of the continent's top producers of solid waste, with a population of about 180 million people. Nigeria is said to produce more than 32 million tons of solid garbage annually, although only a small portion of it is collected (Bakare, 2020). The vast majority of these wastes are produced by households, though occasionally small businesses, craftspeople, and traders also contribute to the local waste problem. Amasuomo and Baird (2016) state that it is quite worrisome that these wastes produced in developing nations like Nigeria cannot be appropriately managed. Besides this, rapid urbanization means speedy growth of shanty dwelling units in Nigeria that are largely unplanned for, and add to the waste, health, and hygiene problems. This will worsen the waste management problem as developing nations like Nigeria, which have inadequacies in terms of technological advancement and socio-political setting to overcome such condition. An additional significant factor that contributes to the problem of solid wastes in a developing nation is the lack of proper collection and transportation facilities, and the waste disposal workers and other employees in dumpsite facilities are at a greater risk from exposure to improperly handling of wastes and inappropriate use of Personal Protection Equipment (PPE) (Beatrice & Jussi 2013). The improper planning coupled with rapid growth of population and urbanization serves to add congestion in streets, and as a result waste collection vehicles are inaccessible to some places, thus allowing filth to build up over time and produce unfriendly smells (Afon, 2005). Inadequacy of financial resources, at times, results in inadequate or no transportation vehicles for waste disposal adding another dimension to the ever-rising cycle of problems (Jain 1994; Zerboc 2003). The management of Solid Waste (SW) in Nigeria is still a major concern for the government, stakeholders, and the general populace despite a number of legislation and regulations. Solid Waste (SW) collection and disposal inefficiencies have resulted in a range of environmental problems, including the suffocation of aquatic bodies and the obstruction of sewer and drain networks (George, 2010). Despite the fact that the nation lacks a well-coordinated waste management system, established laws and regulations regarding waste management, solid waste management (SWM) is the responsibility of the Ministry of Environment at the Federal and State levels, and the Environmental Health Department at the Local Government level. The regulations include the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the Harmful Waste Act (Federal Ministry of Environment, 2019).

Recent literatures show that a lot of attention has been paid to the problem of municipal solid waste management in Nigeria for sustainable environment. Many authors are professionally engaged in solid waste management in Nigeria, waste disposal site selection using remote sensing and GIS: a study of Akure and its environs, southwest-Nigeria and municipal solid waste characteristics and management in Nigeria (Bakare, 2016; Anifowose *et al*., 2011; Ogwueleka, 2009). Somorin *et al.* (2017) conducted state-level assessment of the waste-to-energy potential (via incineration) of municipal solid wastes in Nigeria while Ibrahim *et al.* (2014) studied municipal household solid waste collection strategies in an African megacity: analysis of public private partnership performance in Lagos and Binion and Gutberlet (2012) investigated the effects of handling solid waste on the wellbeing of informal and organized recyclers: a review of the literature. Edoho and Dibie (2000) carried out executing environmental policy and waste management in Ghana and Nigeria. Zerbock (2003) studied urban solid waste management: waste reduction in developing nations while Amuda *et al.* (2014) examined challenges and possible panacea to the municipal solid wastes management in Nigeria and Henry *et al.* (2006) studied municipal solid waste management challenges in developing countries - Kenyan case study. Amasuomo and Baird (2016) assessed solid waste management trends in Nigeria. Nuwematsiko *et al.* (2021) studied knowledge, perceptions, and practices of electronic waste management among consumers in Kampala, Bartone (2000) studied strategies for improving municipal solid waste management: lessons from world bank lending and CWG activities.

In this study, the current waste management system and practices in the Rivers State municipal areas was described, the factors that influence waste management in the Rivers State were identified, the waste management system being adopted by Rivers State management agencies were assessed, and recommendations for development of a sustainable solid waste management system and the law governing waste dumpsite management through the National Assembly were proposed.

II. METHODOLOGY

This study assessed municipal solid waste management in Nigeria for sustainable environment, examining the current waste management system and practices in the Rivers State municipal areas as well as the factors that influence waste management in the Rivers State. The study relied on secondary data, with a focus on extant publications and peer-reviewed journals and reports. This study employed the survey approach which focuses mostly on gathering data using semi-structured questionnaires and interviews. However, the study applied both numerical and qualitative data best served by the mix method approach, and research involving numerical data is better served by the quantitative approach. The results of the 5-Point Likert Scale questionnaire that was conducted in Rivers State, Nigeria were analyzed in order to give answers to the research questions. A series of statistical test and analytical study was conducted for the economic analysis and management of dumpsites wastes in Rivers State, Nigeria. The questionnaire comprising of Section A, Section B and Section C and Section D was designed based on 5-point Likert Scale, which measures from 1- 5 according to the level of contribution and impact of each factor (Jackson, 2012). The agreement scale (1-5) was coded accordingly as (1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, and 5- Strongly Agree) to determine the respondent's opinion on the research questions which are (1)What are the current waste management system and practices adopted in the municipal areas of Rivers State? (2) What are the factors that influence waste management in Rivers State, Nigeria? (3) How do you assess the solid waste management system being adopted by the states management agencies? (4) What are the recommendations for the development of a sustainable solid waste management system? In other to achieve the aim of this study, the current survey only included respondents who filled out the questionnaire whose content analysis was performed with Microsoft Excel and Statistical Package for Social Scientist (SPSS). The data was statistically analyzed to confirm the consistency and dependability of the data to reveal the respondent ideas, analyzed using an array of descriptive and inferential statistical analyses. The results were presented using tables and descriptive statistics such as bar charts, pie charts.

III. RESULTS

The questionnaire served as the main instrument used in the collection of data in this study. A total of three hundred (100) copies of the questionnaire consisting of Sections A, B, C and D were distributed in Rivers State, Nigeria. The bio-data of the respondents consisted of their sex, education, age and area of residence of their respective states. The bio-data of respondents in Rivers state consisted of their sex, age; education and area of residence are shown in Table 1, 2, 3, and 4.

Table 1: Distribution of Respondents in Rivers State According to Sex.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	55	55.0	55.0	55.0
	Female	45	45.0	45.0	100.0
	Total	100	100.0	100.0	

Table 2: Distribution of Respondents in Rivers State According to Age.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10-20	6	6.0	6.0	6.0
	21-30	14	14.0	14.0	20.0
	31-40	23	23.0	23.0	43.0
	41-50	34	34.0	34.0	77.0
	51-60	17	17.0	17.0	94.0
	Above 60	6	6.0	6.0	100.0
	Total	100	100.0	100.0	

Table 3: Distribution of Respondents in Rivers State According to Education.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	1	1.0	1.0	1.0
	Primary	26	26.0	26.0	27.0
	Secondary	34	34.0	34.0	61.0
	Graduate	25	25.0	25.0	86.0
	Postgraduate	14	14.0	14.0	100.0
	Total	100	100.0	100.0	

Table 4: Distribution of Respondents in Rivers State According to Area of Residence.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Town	11	11.0	11.0	11.0
	Ogbunabali	5	5.0	5.0	16.0
	Abonnema	5	5.0	5.0	21.0
	Isiokpo	9	9.0	9.0	30.0
	Borokiri	15	15.0	15.0	45.0
	Rumuola	8	8.0	8.0	53.0
	Ahoada	8	8.0	8.0	61.0
	Choba	6	6.0	6.0	67.0
	Diobu	9	9.0	9.0	76.0
	Bori	16	16.0	16.0	92.0
	Omoku	4	4.0	4.0	96.0
	Rumuolumeni	4	4.0	4.0	100.0
	Total	100	100.0	100.0	

3.1 Research Question (A)

What is the current waste management system and practice in Rivers State, Nigeria? The research question was simplified as Section A for respondents as what is the current waste management system and practices in your area? The sub questions under Section-A are as follows:

A1: Open dumping is the most current waste management practice in your area.
A2: Open burning is the most current waste management practice in your area.
A3: Dumping into drain channel, stream and river is the most current waste management practice in your area.
A4: Composting is the most current waste management practice in your area.
A5: Incineration is the most current waste management practice in your area.

This research questions sought to draw out information from the respondents on the current waste management system and practice in their respective areas in Rivers State: Borokiri, Diobu, Ogbunabali, Rumuola, Bori, Abonnema, Ahoada, Omoku, Isiokpo, Choba and Rumuolumeni.

3.1.1 Rivers State Research Question (A)

A breakdown of the Rivers state respondents' to the five items of the Research Question (A)- A1, A2, A3, A4 and A5 are shown in Table 5, 6, 7, 8, 9 and 10.

Table 5: Rivers State Frequency Table for Research Question-A1: Open Dumping is the most Current Waste Management Practice in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	89	89.0	89.0	90.0
	Strongly Agree	10	10.0	10.0	100.0
	Total	100	100.0	100.0	

Table 6: Rivers State Frequency Table for Research Question-A2: Open Burning is the most Current Waste Management Practice in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.0	2.0	2.0
	Neutral	89	89.0	89.0	91.0
	Agree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 7: Rivers State Frequency Table for Research Question-A3: Dumping into Drain Channel, Stream and River is the most Current Waste Management Practice in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	4	4.0	4.0	4.0
	Neutral	87	87.0	87.0	91.0
	Agree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 8: Rivers State Frequency Table for Research Question-A4: Composting is the most Current Waste Management Practice in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	2.0	2.0	2.0
	Disagree	87	87.0	87.0	89.0
	Neutral	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

Table 9: Rivers State Frequency Table for Research Question-A5: Incineration is the most Current Waste Management Practice in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.0	1.0	1.0
	Disagree	87	87.0	87.0	88.0
	Neutral	12	12.0	12.0	100.0
	Total	100	100.0	100.0	

It is observed for Rivers State (Table 10 and Figure 1) that the highest-ranking waste management system practices in Rivers State is 'Open Dumping (A1)' (mean = 4.09), while the lowest ranking cause is 'Composting (A4)' (mean = 2.09).

Table 10: Rivers State Statistical Frequency for Research Question-A: What is the Current Waste Management System and Practices in your Area?

		Open dumping is the most current waste management practice in your area.	Open burning is the most current waste management practice in your area.	Dumping into drain channel, stream and river is the most current waste management practice in your area.	Composting is the most current waste management practice in your area.	Incineration is the most current waste management practice in your area.
N	Valid	100	100	100	100	100
	Missing	0	0	0	0	0
Mean		4.09	3.07	3.05	2.09	2.11
Std. Error of Mean		.032	.033	.036	.035	.035
Median		4.00	3.00	3.00	2.00	2.00
Mode		4	3	3	2	2
Std. Deviation		.321	.326	.359	.351	.345
Variance		.103	.106	.129	.123	.119
Range		2	2	2	2	2
Minimum		3	2	2	1	1
Maximum		5	4	4	3	3
Sum		409	307	305	209	211

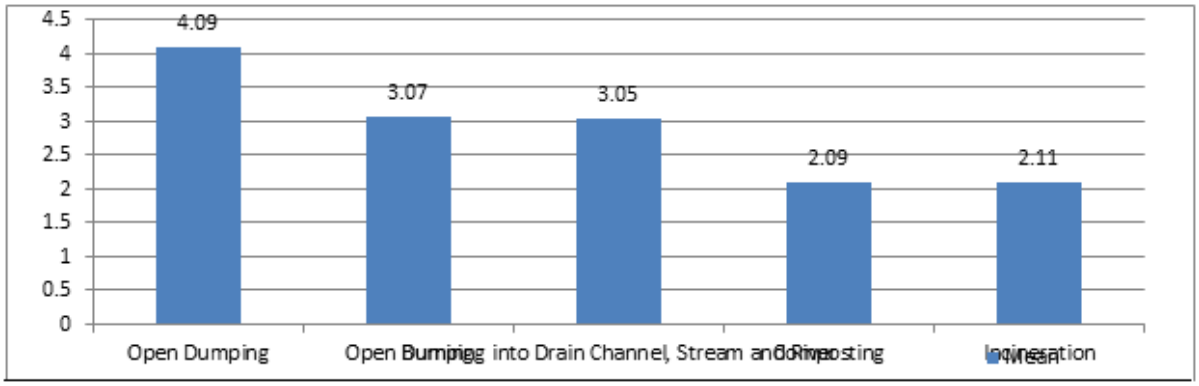

Figure 1: Mean Bar-Chart Showing Rivers State Statistical Frequency for Research

Question-A: What is the Current Waste Management System and Practices in your Area?
Rivers State Test of Hypothesis and Significance for Research Question (A)

The One-Sample t-test of the IBM SPSS Statistics, Version 23 was used to determine whether the sample comes from a population with a specific mean. The 95% confidence interval is used as the confident interval percentage, by declaring statistical significance at the p-value, $p<0.05$ level. The table of output interpreted the result for the one sample t-test. The value of the known population mean used in comparing the sample data is the test value of 3 (i.e. the mean score (5+4+3+2+1)/5). Where t is the t-distribution (t-test), the observed t-value; the degree of freedom, df= N-1= 100-1=99; N is the number of valid (non-missing) observations; p is the probability of obtaining the observed t-value, the statistical significance p-value, sig. (2-tailed), this actually means that $p<0.05$ for 95% confidence value.

Table 11: Rivers State One-Sample Test of Hypothesis and Significance Research Question-A1: Open Dumping is the most Current Waste Management Practice in your Area.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Open dumping is the most current waste management practice in your area.	33.975	99	.000	1.090	1.03	1.15

From Table 11, the t-statistics is 33.975 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t (99)=33.975, p=0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.090 and at 95% confidence intervals of the difference are 1.03 to 1.15 (lower to upper columns). The depression score was statistically significantly higher by 1.090 (95% CI, 1.03 to 1.15) than a normal depression score of 3.0, t(99)=33.975, p=0.000.

Rivers State Null Hypothesis and Significance Testing for A1

The p-value reported from the test (sig. (2-tailed) p=0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 12: Rivers State One-Sample Test of Hypothesis and Significance Research Question-A2: Open Burning is the most Current Waste Management Practice in your Area.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Open burning is the most current waste management practice in your area.	2.148	99	.034	.070	.01	.13

From Table 12, the t-statistics is 2.148 with 99 degree of freedom; the corresponding two-tailed p-value is 0.034, which is less than 0.05. The population normal distribution score t(99)=2.148, p=0.034 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 0.070 and at 95% confidence intervals of the difference are 0.01 to 0.13 (lower to upper columns). The depression score was statistically significantly higher by 0.070 (95% CI, 0.01 to 0.13) than a normal depression score of 3.0, t(99)= 2.148, p= 0.034.

Rivers State Null Hypothesis and Significance Testing for A2

The p-value reported from the test (sig. (2-tailed) p= 0.034) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 13 Rivers State One-Sample Test of Hypothesis and Significance Research Question-A3: Dumping into Drain Channel, Stream and River is the most Current Waste Management Practice in your Area.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Dumping into drain channel, stream and river is the most current waste management practice in your area.	1.393	99	.167	.050	-.02	.12

From Table 13, the t-statistics is 1.393 with 99 degree of freedom; the corresponding two-tailed p-value is 0.167, which is greater than 0.05. The population normal distribution score t(99)= 1.393, p=0.167 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 0.050 and at 95% confidence intervals of the difference are 0.02 to 0.12 (lower to upper columns). The depression score was statistically significantly higher by 0.050 (95% CI, 0.02 to 0.12) than a normal depression score of 3.0, t(99)= 1.393, p= 0.167.

Rivers State Null Hypothesis and Significance Testing for A3

The p-value reported from the test (sig. (2-tailed) p= 0.167) is greater than p<0.05, then the result is said to be statistically not significant. Therefore, we accept the null hypothesis and reject the alternative hypothesis.

Table 14: Rivers State One-Sample Test of Hypothesis and Significance Research Question-A4: Composting is the most Current Waste Management Practice in your Area.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Composting is the most current waste management practice in your area.	-25.933	99	.000	-.910	-.98	-.84

From Table 14, the t-statistics is -25.933 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= -23.933, p=0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 0.910 and at 95% confidence intervals of the difference are 1.03 to 1.15 (lower to upper columns). The depression score was statistically significantly lower by 0.910 (95% CI, 0.98 to 0.84) than a normal depression score of 3.0, t(99)= -25.933, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for A4

The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 15: Rivers State One-Sample Test of Hypothesis and Significance Research Question-A5: Incineration is the most Current Waste Management Practice in your Area.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Incineration is the most current waste management practice in your area.	-25.790	99	.000	-.890	-.96	-.82

From Table 15, the t-statistics is -25.790 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= -25.790, p=0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 0.890 and at 95% confidence intervals of the difference are 1.03 to 1.15 (lower to upper columns). The depression score was statistically significantly lower by 0.890 (95% CI, 0.96 to 0.82) than a normal depression score of 3.0, t(99)= -25.790, p=0.000.

Rivers State Null Hypothesis and Significance Testing for A5

The p-value reported from the test (sig. (2-tailed) p=0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

3.2 Research Question (B)

What are the factors that influence waste management in the in Niger Delta region? The research question was simplified as Section B for respondents as what are the factors that influence waste management in your area? The sub questions under Section-B are as follows:

B1: Enhanced partnership has a great influence on waste management in your area.
B2: Environmental sanitation has a great influence on waste management in your area.
B3: Composting has a great influence on waste management in your area.
B4: Energy generation from solid waste has a great influence on waste management in your area.
B5: Recycling of solid waste has influence on waste management.

This research questions sought to draw out information from the respondents on factors that influences waste management system and practice in their respective areas in:

Rivers State: Borokiri, Diobu, Ogbunabali, Rumuola, Bori, Abonnema, Ahoada, Omoku, Isiokpo, Choba and Rumuolumeni.

3.2.1 Rivers State Research Question (B)

A breakdown of the Rivers state respondents' to the five items of the Research Question (B)- B1, B2, B3, B4 and B5 are shown in Table 16, 17, 18, 19, 20 and 21.

Table 16: Rivers State Frequency Table for Research Question-B1: Enhanced Partnership has a Great Influence on Waste Management in your area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.0	2.0	2.0
	Neutral	89	89.0	89.0	91.0
	Agree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 17: Rivers State Frequency Table for Research Question-B2: Environmental Sanitation has a Great Influence on Waste Management in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	2.0	2.0	2.0
	Agree	89	89.0	89.0	91.0
	Strongly Agree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 18: Rivers State Frequency Table for Research Question-B3: Composting has a Great Influence on Waste Management in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	2.0	2.0	2.0
	Disagree	87	87.0	87.0	89.0
	Neutral	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

Table 19: Rivers State Frequency Table for Research Question-B4: Energy Generation from Solid Waste has a Great Influence on Waste Management in your Area.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	87	87.0	87.0	87.0
	Disagree	12	12.0	12.0	99.0
	Neutral	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Table 20: Rivers State Frequency Table for Research Question-B5: Recycling of Solid Waste has Influence on Waste Management.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	3.0	3.0	3.0
	Neutral	2	2.0	2.0	5.0
	Agree	86	86.0	86.0	91.0
	Strongly Agree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

It is observed for Rivers State (Table 21 and Figure 2) that the highest-ranking factors that influence waste management in Rivers State is 'Environmental Sanitation (B1)' with a (mean = 4.09), while the lowest ranking cause is 'Energy Generation (B4)' with a (mean = 1.14).

Table 21: Rivers State Statistical Frequency for Research Question-B: What are the Factors that Influence Waste Management in your Area?

		Enhanced Partnership has a great influence on waste management in your area.	Environmental sanitation has a great influence on waste management in your area.	Composting has a great influence on waste management in your area.	Energy generation from solid waste has a great influence on waste management in your area.	Recycling of solid waste has influence on waste management.
N	Valid	100	100	100	100	100

Missing	0	0	0	0	0
Mean	3.07	4.07	2.09	1.14	4.01
Std. Error of Mean	.033	.033	.035	.038	.048
Median	3.00	4.00	2.00	1.00	4.00
Mode	3	4	2	1	4
Std. Deviation	.326	.326	.351	.377	.482
Variance	.106	.106	.123	.142	.232
Range	2	2	2	2	3
Minimum	2	3	1	1	2
Maximum	4	5	3	3	5
Sum	307	407	209	114	401

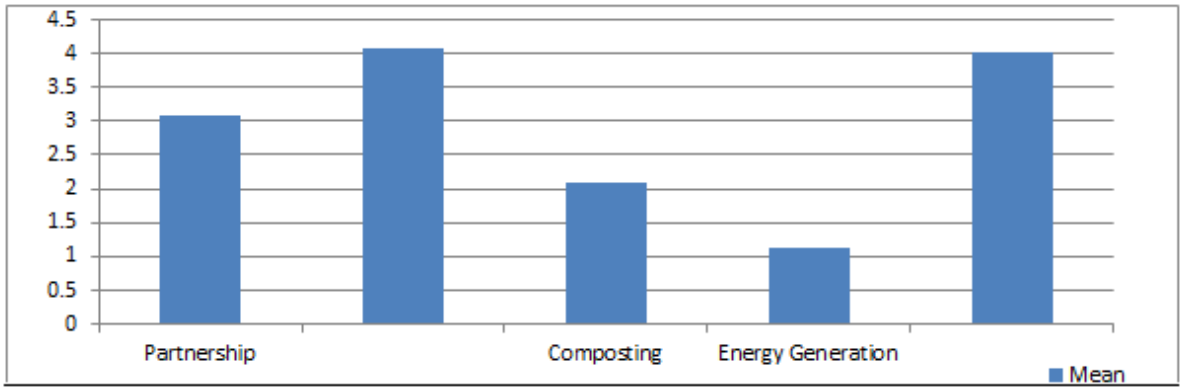

Figure 2: Mean Bar-Chart Showing Rivers State Statistical Frequency for Research

Question-B: What are the Factors that Influence Waste Management in your Area?
Rivers State Test of Hypothesis and Significance for Research Question (B)
The One-Sample t-test of the IBM SPSS Statistics, Version 23 was used to determine whether the sample comes from a population with a specific mean. The 95% confidence interval is used as the confident interval percentage, by declaring statistical significance at the p-value, $p<0.05$ level. The table of output interpreted the result for the one sample t-test. The value of the known population mean used in comparing the sample data is the test value of 3 (i.e. the mean score (5+4+3+2+1)/5). Where t is the t-distribution (t-test), the observed t-value; the degree of freedom, df= N-1= 100-1=99; N is the number of valid (non-missing) observations; p is the probability of obtaining the observed t-value, the statistical significance p-value, sig. (2-tailed), this actually means that $p<0.05$ for 95% confidence value.

Table 22: Rivers State One-Sample Test of Hypothesis and Significance Research Question-B1:

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Enhanced Partnership has a great influence on waste management in your area.	2.148	99	.034	.070	.01	.13

From Table 22, the t-statistics is 2.148 with 99 degree of freedom; the corresponding two-tailed p-value is 0.034, which is less than 0.05. The population normal distribution score t(99)= 2.148, p= 0.034 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 0.070 and at 95% confidence intervals of the difference are 0.01 to 0.13 (lower to upper columns). The depression score was statistically significantly higher by 0.070 (95% CI, 0.01 to 0.13) than a normal depression score of 3.0, t(99)= 2.148, p= 0.034.
Rivers State Null Hypothesis and Significance Testing for Research Question B1
The p-value reported from the test (sig. (2-tailed) p= 0.034) is less than $p<0.05$, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 23: Rivers State One-Sample Test of Hypothesis and Significance Research Question-B2:

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Environmental sanitation has a great influence on waste management in your area.	32.840	99	.000	1.070	1.01	1.13

From Table 23, the t-statistics is 32.840 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 32.840, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.070 and at 95% confidence intervals of the difference are 1.01 to 1.13 (lower to upper columns). The depression score was statistically significantly higher by 1.070 (95% CI, 1.01 to 1.13) than a normal depression score of 3.0, t(99)= 32.840, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question B2

The p-value reported from the test (sig. (2-tailed) p=0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 24: Rivers State One-Sample Test of Hypothesis and Significance Research Question-B3:

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Composting has a great influence on waste management in your area.	-25.933	99	.000	-.910	-.98	-.84

From Table 34, the t-statistics is -25.933 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= -25.933, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is -0.910 and at 95% confidence intervals of the difference are 0.98 to 0.84 (lower to upper columns). The depression score was statistically significantly lower by 0.910 (95% CI, 0.98 to 0.84) than a normal depression score of 3.0, t(99)= -25.933, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question B3

The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 25: Rivers State One-Sample Test of Hypothesis and Significance Research Question-B4:

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Energy generation from solid waste has a great influence on waste management in your area.	-49.391	99	.000	-1.860	-1.93	-1.79

From Table 25, the t-statistics is -49.391 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= -49.391, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is -1.860 and at 95% confidence intervals of the difference are 1.93 to 1.79 (lower to upper columns). The depression score was statistically significantly lower by 1.860 (95% CI, 0.97 to 0.83) than a normal depression score of 3.0, t(99)= -49.391, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question B4

The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 26: Rivers State One-Sample Test of Hypothesis and Significance Research Question-B5:

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Recycling of solid waste has influence on waste management.	20.959	99	.000	1.010	.91	1.11

From Table 26, the t-statistics is 20.959 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 20.959, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.010 and at 95% confidence intervals of the difference are 0.91 to 1.11 (lower to upper columns). The depression score was statistically significantly higher by 1.010 (95% CI, 0.91 to 1.11) than a normal depression score of 3.0, t(99)= 20.959, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question B5

The p-value reported from the test (sig. (2-tailed) p=0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

3.3 Research Question (C)

How do you assess the solid waste management system being adopted by the states management agencies? The research question was simplified as Section C for respondents as how do you assess solid waste management system been adopted in your area? The sub questions under Section-C are as follows:

C1: Waste policies lack clear strategies for action.
C2: Waste management institutions are weak.
C3: Availability of dumping grounds discourages investment in alternative disposal methods.
C4: Operational equipment are obsolete and insufficient.
C5: Public education on waste management is low.

This research questions sought to draw out information from the respondents on how waste management system is been accessed in their respective areas in:

Rivers State: Borokiri, Diobu, Ogbunabali, Rumuola, Bori, Abonnema, Ahoada, Omoku, Isiokpo, Choba and Rumuolumeni.

3.3.1 Rivers State Research Question (C)

A breakdown of the Rivers state respondents' to the five items of the Research Question (C)- C1, C2, C3, C4 and C5 are shown in Table 27, 28, 29, 30 and 31.

Table 27: Rivers State Frequency Table for Research Question-C1: Waste Policies Lack Clear Strategies for Action.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	2.0	2.0	2.0
	Agree	89	89.0	89.0	91.0
	Strongly Agree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 28: Rivers State Frequency Table for Research Question-C2: Waste Management Institutions are Weak.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	2.0	2.0	2.0
	Agree	87	87.0	87.0	89.0
	Strongly Agree	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

Table 29: Rivers State Frequency Table for Research Question-C3: Availability of Dumping Grounds Discourages Investment in Alternative Disposal Methods.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	89	89.0	89.0	90.0
	Strongly Agree	10	10.0	10.0	100.0
	Total	100	100.0	100.0	

Table 30: Rivers State Frequency Table for Research Question-C4: Operational Equipment are Obsolete and Insufficient.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	70	70.0	70.0	71.0
	Strongly Agree	29	29.0	29.0	100.0
	Total	100	100.0	100.0	

Table 31: Rivers State Frequency Table for Research Question-C5: Public Education on Waste Management is Low.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	86	86.0	86.0	86.0
	Disagree	10	10.0	10.0	96.0
	Neutral	1	1.0	1.0	97.0
	Agree	3	3.0	3.0	100.0
	Total	100	100.0	100.0	

It is observed for Rivers State (Table 32 and Figure 3) that the highest-ranking factors that affect access to waste management in the Rivers State is ‘Operational Equipment are Obsolete and Insufficient. (C4)’ with a (mean = 4.28), while the lowest ranking cause is ‘Public Education on Waste Management is Low. (C5)’ with a (mean = 1.21).

Table 32: Rivers State Statistical Frequency for Research Question-C: How do you Assess Solid Waste Management System been Adopted in your Area?

		Waste policies lack clear strategies for action.	Waste management institutions are weak.	Availability of dumping grounds discourages investment in alternative disposal methods.	Operational equipment are obsolete and insufficient.	Public education on waste management is low.
N	Valid	100	100	100	100	100
	Missing	0	0	0	0	0
Mean		4.07	4.09	4.09	4.28	1.21
Std. Error of Mean		.033	.035	.032	.047	.061
Median		4.00	4.00	4.00	4.00	1.00
Mode		4	4	4	4	1
Std. Deviation		.326	.351	.321	.473	.608
Variance		.106	.123	.103	.224	.370
Range		2	2	2	2	3
Minimum		3	3	3	3	1
Maximum		5	5	5	5	4
Sum		407	409	409	428	121

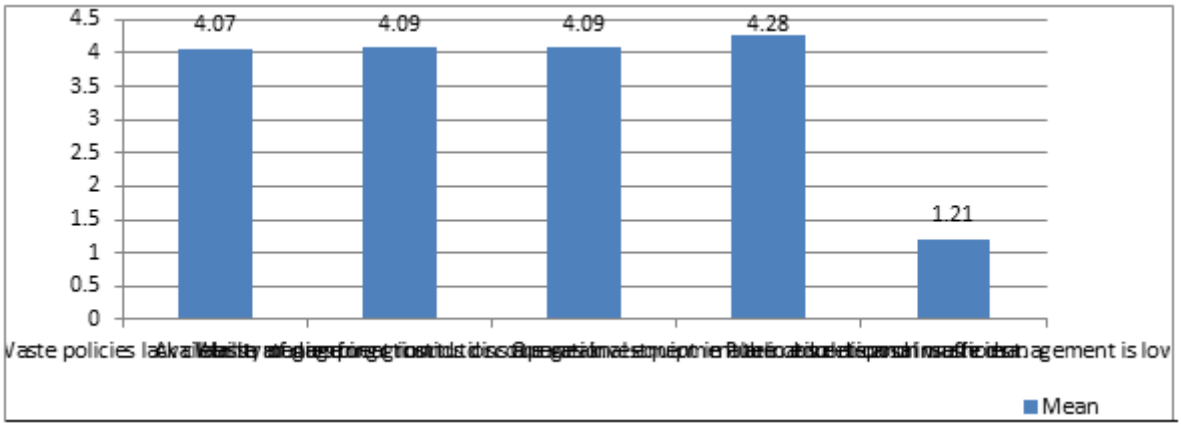

Figure 3: Mean Bar-Chart Showing Rivers State Statistical Frequency for Research Question-C: How do you Assess Solid Waste Management System been Adopted in your Area?

Rivers State Test of Hypothesis and Significance for Research Question (C)

The One-Sample t-test of the IBM SPSS Statistics, Version 23 was used to determine whether the sample comes from a population with a specific mean. The 95% confidence interval is used as the confident interval percentage, by declaring statistical significance at the p-value, $p<0.05$ level. The table of output interpreted the result for the one sample t-test.

The value of the known population mean used in comparing the sample data is the test value of 3 (i.e. the mean score (5+4+3+2+1)/5). Where t is the t-distribution (t-test), the observed t-value; the degree of freedom, df= N-1= 100-1=99; N is the number of valid (non-missing) observations; p is the probability of obtaining the observed t-value, the statistical significance p-value, sig. (2-tailed), this actually means that $p<0.05$ for 95% confidence value.

Table 33: Rivers State One-Sample Test of Hypothesis and Significance Research Question-C1: Waste Policies Lack Clear Strategies for Action.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Waste policies lack clear strategies for action.	32.840	99	.000	1.070	1.01	1.13

From Table 33, the t-statistics is 32.840 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 32.840, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.070 and at 95% confidence intervals of the difference are 1.01 to 1.13 (lower to upper columns). The depression score was statistically significantly higher by 1.070 (95% CI, 1.01 to 1.13) than a normal depression score of 3.0, t(99)= 32.840, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question C1
The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 34: Rivers State One-Sample Test of Hypothesis and Significance Research Question-C2: Waste Management Institutions are Weak.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Waste management institutions are weak.	31.063	99	.000	1.090	1.02	1.16

From Table 34, the t-statistics is 31.063 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 2.148, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.090 and at 95% confidence intervals of the difference are 1.02 to 1.16 (lower to upper columns). The depression score was statistically significantly higher by 1.090 (95% CI, 1.02 to 1.16) than a normal depression score of 3.0, t(99)= 31.063, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question C2
The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 35: Rivers State One-Sample Test of Hypothesis and Significance Research Question-C3: Availability of Dumping Grounds Discourages Investment in Alternative Disposal Methods.

	Test Value = 3					
	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Availability of dumping grounds discourages investment in alternative disposal methods.	33.975	99	.000	1.090	1.03	1.15

From Table 35, the t-statistics is 33.975 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 33.975, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.090 and at 95% confidence intervals of the difference are 1.03 to 1.15 (lower to upper columns). The depression score was statistically significantly higher by 1.090 (95% CI, 1.03 to 1.15) than a normal depression score of 3.0, t (99)= 33.975, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question C3

The p-value reported from the test (sig. (2-tailed) p=0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 36: Rivers State One-Sample Test of Hypothesis and Significance Research Question-C4: Operational Equipment are Obsolete and Insufficient.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Operational equipment are obsolete and insufficient.	27.055	99	.000	1.280	1.19	1.37

From Table 36, the t-statistics is 27.055 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 27.055, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.280 and at 95% confidence intervals of the difference are 1.19 to 1.37 (lower to upper columns). The depression score was statistically significantly higher by 1.070 (95% CI, 1.19 to 1.37) than a normal depression score of 3.0, t(99)= 27.055, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question C4

The p-value reported from the test (sig. (2-tailed) p=0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 37: Rivers State One-Sample Test of Hypothesis and Significance Research Question-C5: Public Education on Waste Management is Low.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Public education on waste management is low.	-29.443	99	.000	-1.790	-1.91	-1.67

From Table 37, the t-statistics is -29.443 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t (99)= -29.443, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is -1.790 and at 95% confidence intervals of the difference are 1.91 to 1.67 (lower to upper columns). The depression score was statistically significantly lower by 1.790 (95% CI, 1.91 to 1.67) than a normal depression score of 3.0, t(99)= -29.443, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question C5

The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

3.4 Research Question (D)

What are the recommendations for the development of a sustainable solid waste management system? The research question was simplified as Section D for respondents as what are the recommendations for the development of a sustainable waste management system? The sub questions under Section-D are as follows:
D1: Waste items should be sorted for recycling/ composting.
D2: Waste workers should be properly trained and paid.
D3: There should be public education on waste management.
D4: Compost as fertilizer can be extracted from the dumpsites.
D5: Biogas can be extracted from dumpsites for useful purposes.
This research questions sought to draw out information from the respondents on what are the recommendations for the development of a sustainable waste management system in their respective areas in:
Rivers State: Borokiri, Diobu, Ogbunabali, Rumuola, Bori, Abonnema, Ahoada, Omoku, Isiokpo, Choba and Rumuolumeni.

3.4.1 Rivers State Research Question (D)

A breakdown of the Rivers state respondents' to the five items of the Research Question (D)- D1, D2, D3, D4 and D5 are shown in Table 38, 39, 40, 41, and 42.

Table 38: Rivers State Frequency Table for Research Question-D1: Waste Items should be sorted for Recycling/ Composting.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	88	88.0	88.0	89.0
	Strongly Agree	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

Table 39: Rivers State Frequency Table for Research Question-D2: Waste Workers should be properly Trained and Paid.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	58	58.0	58.0	59.0
	Strongly Agree	41	41.0	41.0	100.0
	Total	100	100.0	100.0	

Table 40: Rivers State Frequency Table for Research Question-D3: There should be Public Education on Waste Management.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	88	88.0	88.0	89.0
	Strongly Agree	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

Table 41: Rivers State Frequency Table for Research Question-D4: Compost as Fertilizer can be Extracted from the Dumpsites.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	90	90.0	90.0	91.0
	Strongly Agree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 42: Rivers State Frequency Table for Research Question-D5: Biogas can be extracted from Dumpsites for Useful Purposes.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.0	1.0	1.0
	Agree	81	81.0	81.0	82.0
	Strongly Agree	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

It is observed for Rivers State (Table 43 and Figure 4) that the highest-ranking factor that affects access to waste management in Rivers State is 'Waste Workers should be properly Trained and Paid. (D2)' with a (mean = 4.40), while the lowest ranking cause is 'Compost as Fertilizer can be Extracted from the Dumpsites. (D4)' with a (mean = 4.08).

Table 43: Rivers State Statistical Frequency for Research Question-D: What are the Recommendations for the Development of a Sustainable Waste Management System?

		Waste items should be sorted for recycling/ composting.	Waste workers should be properly trained and paid.	There should be public education on waste management.	Compost as fertilizer can be extracted from the dumpsites.	Biogas can be extracted from dumpsites for useful purposes.
N	Valid	100	100	100	100	100
	Missing	0	0	0	0	0
Mean		4.10	4.40	4.10	4.08	4.17
Std. Error of Mean		.033	.051	.033	.031	.040
Median		4.00	4.00	4.00	4.00	4.00
Mode		4	4	4	4	4
Std. Deviation		.333	.512	.333	.307	.403
Variance		.111	.263	.111	.095	.163
Range		2	2	2	2	2
Minimum		3	3	3	3	3
Maximum		5	5	5	5	5
Sum		410	440	410	408	417

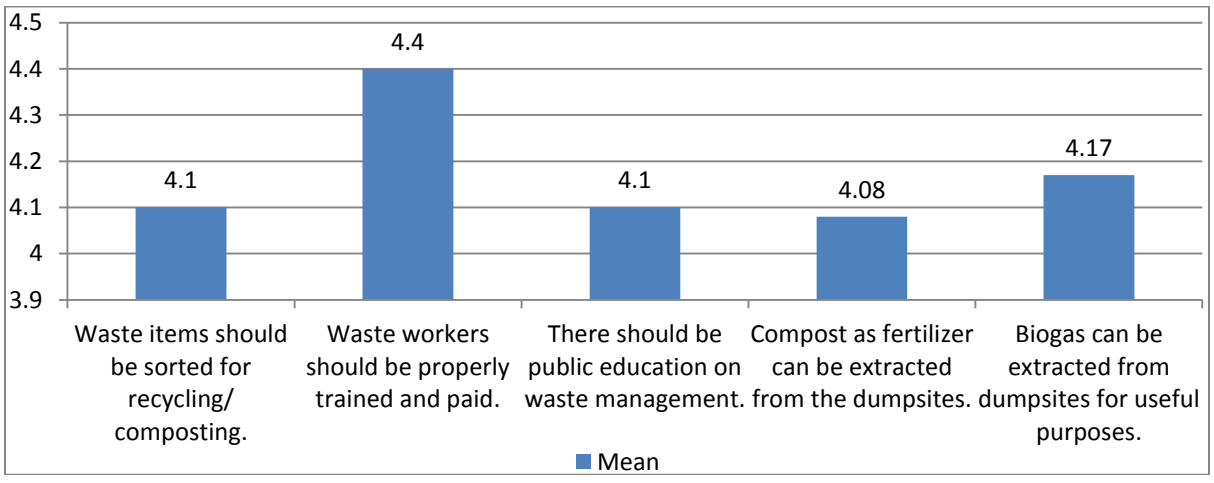

Figure 4: Mean Bar-Chart Showing Rivers State Statistical Frequency for Research Question-D: What are the Recommendations for the Development of a Sustainable Waste Management System?

Rivers State Test of Hypothesis and Significance for Research Question D

The One-Sample t-test of the IBM SPSS Statistics, Version 23 was used to determine whether the sample comes from a population with a specific mean. The 95% confidence interval is used as the confident interval percentage, by declaring statistical significance at the p-value, $p<0.05$ level. The table of output interpreted the result for the one sample t-test. The value of the known population mean used in comparing the sample data is the test value of 3 (i.e. the mean score (5+4+3+2+1)/5). Where t is the t-distribution (t-test), the observed t-value; the degree of freedom, df= N-1= 100-1=99; N is the number of valid (non-missing) observations; p is the probability of obtaining the observed t-value, the statistical significance p-value, sig. (2-tailed), this actually means that $p<0.05$ for 95% confidence value.

Table 44: Rivers State One-Sample Test of Hypothesis and Significance Research Question-D1: Waste Items should be sorted for Recycling/ Composting.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Waste items should be sorted for recycling/ composting.	33.000	99	.000	1.100	1.03	1.17

From Table 44, the t-statistics is 33.000 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 33.000, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.100 and at 95% confidence intervals of the difference are 1.03 to 1.17 (lower to upper columns). The depression score was statistically significantly higher by 1.100 (95% CI, 1.03 to 1.17) than a normal depression score of 3.0, t(99)= 33.000, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question D1

The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than $p<0.05$, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 45: Rivers State One-Sample Test of Hypothesis and Significance Research Question-D2: Waste Workers should be properly Trained and Paid.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Waste workers should be properly trained and paid.	27.319	99	.000	1.400	1.30	1.50

From Table 45, the t-statistics is 27.319 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 27.319, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.400 and at 95% confidence intervals of the difference are 1.30 to 1.50 (lower to upper columns). The depression score was statistically significantly higher by 1.400 (95% CI, 1.30 to 1.50) than a normal depression score of 3.0, t(99)= 27.319, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question D2

The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than $p<0.05$, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 46: Rivers State One-Sample Test of Hypothesis and Significance Research Question-D3: There should be Public Education on Waste Management.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
There should be public education on waste management.	33.000	99	.000	1.100	1.03	1.17

From Table 46, the t-statistics is 33.000 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 33.000, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.100 and at 95% confidence intervals of the difference are 1.03 to 1.17 (lower to upper columns). The depression score was statistically significantly higher by 1.100 (95% CI, 1.03 to 1.17) than a normal depression score of 3.0, t(99)= 33.000, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question D3
The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 47: Rivers State One-Sample Test of Hypothesis and Significance Research Question-D4: Compost as Fertilizer can be extracted from the Dumpsites.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Compost as fertilizer can be extracted from the dumpsites.	35.124	99	.000	1.080	1.02	1.14

From Table 47, the t-statistics is 35.124 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 35.124, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.080 and at 95% confidence intervals of the difference are 1.02 to 1.14 (lower to upper columns). The depression score was statistically significantly higher by 1.080 (95% CI, 1.02 to 1.14) than a normal depression score of 3.0, t(99)= 35.124, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question D4
The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

Table 48: Rivers State One-Sample Test of Hypothesis and Significance Research Question-D5: Biogas can be extracted from Dumpsites for Useful Purposes.

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Biogas can be extracted from dumpsites for useful purposes.	29.004	99	.000	1.170	1.09	1.25

From Table 48, the t-statistics is 29.004 with 99 degree of freedom; the corresponding two-tailed p-value is 0.000, which is less than 0.05. The population normal distribution score t(99)= 29.004, p= 0.000 indicate that the probability of obtaining the observed t-value. The mean difference in the population is 1.100 and at 95% confidence intervals of the difference are 1.09 to 1.25 (lower to upper columns). The depression score was statistically significantly higher by 1.170 (95% CI, 1.09 to 1.25) than a normal depression score of 3.0, t(99)= 29.004, p= 0.000.

Rivers State Null Hypothesis and Significance Testing for Research Question D5

The p-value reported from the test (sig. (2-tailed) p= 0.000) is less than p<0.05, then the result is said to be statistically significant. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

IV. CONCLUSION

The solid waste management situation in Rivers State, Nigeria is critical as available data on the amount and types of solid waste generated, and the methods employed in the treatment and disposal of generated waste, are deficient, incompatible and undependable due to poor database and waste reporting records by the agencies. Inadequate infrastructure for effective collection and transport of the waste to dumpsite contributed to open dumping, open burning, dumping into drain channel, stream and river. The economic analysis of dumpsites waste goes beyond the collection and disposal of waste, which it has not even done properly, priority should be on the conversion of dumpsites wastes into useful byproducts. The dumpsites and landfills are not harness in terms of adopting waste to energy technology through thermo-chemical (incineration) and bio-chemical (biogas) technologies to generate energy as a source of fuel. It will also treat dumpsites wastes and reduce the effect of its pollution, as well as generate useful energy for the people, thereby raising their standard of living and reducing their cost of living. The current existence of little or not compost plant is not good for the economy. Government and private sector partnership should setup compost plant where dumpsites wastes can be processed into useful by-products like manure and fertilizers. The highest-ranking waste management system practice in the Rivers State, Nigeria is 'Open Dumping (A1)'. The highest-ranking factors that influence waste management in Nigeria is 'Environmental Sanitation (B1)'. The highest-ranking factors that affect access to waste management in Rivers State, Nigeria are 'Operational Equipment are Obsolete and Insufficient. (C4)' and 'Waste Management Institutions are Weak. (C2)' and 'Availability of Dumping Grounds Discourages Investment in Alternative Disposal Methods. (C3)'. The highest-ranking factor that affects access to waste management in Niger Delta is 'Waste Workers should be properly trained and paid. (D2)'. The transformation of crude dumping into sanitary landfill for the installation of biogas waste plant is a sustainable technical solution for the economic analysis and management of dumpsites waste based on this study. Waste management agencies should partner with private sector technocrats for the establishment of a biogas waste plant in the Rivers State, Nigeria. The findings of the study acknowledged that an effective management of dumpsites wastes in the Rivers State, Nigeria is mandatory. The uncollected waste is dumped indiscriminately on streets, drain channel, stream and river; this waste decomposes with animal and human excreta; thus, serving as breeding grounds for insects and rodent vectors, spreading of diseases and contributing to flooding. The prevalent burning of waste causes pollution to the environment. However, from the data collected, shows that the respondents' opinion, behaviours, attitude, the dilapidated infrastructure, weak institution, ineffective policies, inadequate public education on waste management, obsolete and inefficient equipment, inadequate training, poor pay and lack of motivation contribute greatly to the current state of solid waste management in the Rivers State, Nigeria. Therefore, there is an urgent call for a change in the attitude and behaviours of the people. People are recalcitrant towards management of dumpsites wastes. The people and the authorities need to work hand in hand in other to manage dumpsite wastes in the Nigeria. The major findings of the study are as follows:

1. Dumpsites wastes are indeed a very pressing environmental issue in Nigeria and that a high percentage of the people are conscious of it therefore justifying the respondent opinion on waste management, that people's knowledge about environmental issues can be drawn based on geographic location or scale (Chan, 1998).
2. The dumpsites waste practice adopted by the people of Nigeria is negative as analyzed from the study.
3. Poor disposal attitude such as open dumping, open burning, dumping into drain channel, stream and river is a common practice.
4. The study also observed that the predisposition of the people's attitude towards adopting better dumpsite management practices is hampered by several infrastructural inadequacies and weak waste management institution, poor public education and awareness of waste management, short-staffed personnel, and personnel not properly trained and paid, obsolete and insufficient operational equipment, lack of clear strategies for actions and ineffective policies.

5. In general, the successful management of dumpsites wastes in Nigeria in general is hindered by many factors which can be classified into economic factors, psychological factors, cultural factors, social, educational factors, institutional factors and technical factors.
6. Adequate policies or regulation are not put in place neither are the people enlightened on the benefits and importance of effective management of dumpsites wastes and a clean environment.
7. In Rivers State, Nigeria, there is inadequacy of policies or regulations aimed at minimizing waste generation.
8. The researcher also identified that there is no form of public sensitivity or awareness on waste management in the Nigeria.
9. The people are not motivated effectively to reduce the current waste management practice of open dumping, open burning, dumping into drain channel, stream and river and embrace composting.
10. Summarizing from the management of dumpsites wastes situation in the Rivers State, Nigeria, seriously requires concerted effort to sensitize the public on the need for proper disposal of solid waste.
11. Officials of the waste management agencies should be well trained on professionalism, service delivery and ensure that other states within the country have access to quality waste managers who are within reach and can assist on the best approach to managing their waste before collection (Attah, 2016)
12. Shortage of finance to invest on municipal solid waste treatment plant and sorting waste is a big obstac1es in the implementation of a functional treatment plant.
13. Lack of private-public sector participation or enhanced partnership makes it very difficult to borrow and purchase equipment.
14. Lack of environmental awareness is a big obstac1es. There should be thorough sensitization on waste management and sorting. Officials of waste management agencies should be competent.
15. These findings were validated according to Agunwamba (1998), established that poor waste disposal habit of the people, corruption, weak government regulation, poor work attitude, lack of fund, inadequate facilities such as plants and equipment among others are factors militating against effective waste management towards sustainable development in Nigeria as a whole.

Recommendation

The following recommendation if enforced will go a long way in addressing the current problem facing the management of dumpsites wastes in Nigeria and setting up a better and workable solid waste management system.

(a) Public awareness, enlightenment and campaigns on the need for a better solid waste management system. The public should be enlightened on the dangers of open dumping, open burning and dumping of waste into drain channel, stream and river and the importance of sustainable waste management and health living.
(b) Proper management and transformation of dumpsites and landfills into waste to energy facilities thereby serving as an alternative energy (biogas) source for the people of the Nigeria.
(c) Establishment of compost plant for the processing of dumpsites wastes into manure and fertilizers.
(d) Provision of state-of-the-art operational equipment and sufficient waste management infrastructures.
(e) Establishment of strong waste management laws and the enforcement of penalty to offenders.
(f) The implementation of source sorting of waste.
(g) Motivation of waste workers, they should be trained and well paid.
(h) Promoting the culture of recycling, reuse and reduce of waste.
(i) Establishment of a joint public, private partnership to proffer solution and manage solid waste crises in the Nigeria.
(j) Establishment of the mandatory monthly sanitation exercise.
(k) Creation of vibrant monitoring team for the monitoring and supervision of household, business premises, with respect to adopting better sanitation practices.
(l) Provision of modern waste collection point on every street.
(m) A bill should on waste reforms based on the finding of this study should be sent to the National Assembly for implementation.

REFERENCES

[1]. Adewole A.T. (2009). Waste management towards sustainable development in Nigeria: A case study of Lagos state. International NGO Journal, vol. 4, no.40, pp. 173-179 3.
[2]. Afon, A.O. (2005). “Solid Waste Management in Selected Cities of Oyo State” Department of Urban and Regional Planning, ObafemiAwolowo University, Ile-Ife, Nigeria.
[3]. Agunwamba, J. C. (1998) Solid waste management in Nigeria: Problems and issues. Environmental Management, 22(6), pp.849-856.

[4]. Aliyu, A. A., and Amadu, L. (2017). Urbanization, cities, and health: The challenges to Nigeria - A review. Annals of African medicine, 16(4), 149–158. https://doi.org/10.4103/aam.aam_1_17

[5]. Amasuomo, E. and Baird, J. (2016). Solid Waste Management Trends in Nigeria. Journal of Management and Sustainability, 6(4), 35–44. https://doi.org/10.5539/jms.v6n4p35. Amuda, O. S., Adebisi, S., Jimoda, L., & Alade, A. (2014). Challenges and possible panacea to the municipal solid wastes management in Nigeria. Journal of Sustainable Development Studies, 6(1), 64–70.

[6]. Amuda, O. S., Adebisi, S., Jimoda, L., & Alade, A. (2014). Challenges and possible panacea to the municipal solid wastes management in Nigeria. Journal of Sustainable Development Studies, 6(1), 64–70.

[7]. Anifowose, Y. B., Omole, K. E. and Akingbade, O. (2011). Waste Disposal Site Selection using Remote Sensing and GIS: A Study of Akure and its Environs, Southwest-Nigeria. Proceedings of the Environmental Management Conference, Federal University of Agriculture, Abeokuta, Nigeria (pp. 2-9). Abeokuta: Federal University of Agriculture, Abeokuta.

[8]. Bakare W (2016) Solid Waste Management in Nigeria. Bio-Energy Newsletter 5: 68-72.

[9]. Bartone, C. 2000: Strategies for Improving Municipal Solid Waste Management: Lessons from World Bank Lending and CWG Activities. Workshop on Planning for Sustainable and Integrated Solid Waste Management, Manila, 18-22 September 2000. Washington, DC: Urban Management Division, World Bank. Available online at . Accessed January 25th 2007.

[10]. Beatrice A. and Jussi K. (2013). Municipal Solid Waste Management Problems in Nigeria: Evolving Knowledge Management Solution. International Journal of Environmental and Ecological Engineering Vol:7, No:6

[11]. Binion,E., & Gutberlet, J. (2012). The effects of handling solid waste on the wellbeing of informal and organized recyclers: a review of the literature. International Journal of Occupational and Environmental Health, 18 (1): 43–52.

[12]. Edoho, F. & Dibie, R. (2000) Executing environmental policy and waste management in Ghana and Nigeria. Journal of Sustainable Development in Africa, 2(2).

[13]. Ezerie H. E., Chima G., N., Ogbonna C., E., & Chibunna J., B. (2017). Municipal solid waste management in Aba, Nigeria: Challenges and prospects. Environmental Engineering Research; 22(3): 231-236.

[14]. Federal Ministry of Environment (2019). Surface Water Quality in Nigeria. [online] Federal Ministry of Environment. Available at: https://environment.gov.ng/surface-water-quality-nigeria/

[15]. George, O. (2010). Social effects of poor sanitation and waste management on poor urban communities: a neighbourhood-specific study of Sabon Zongo, Accra. Journal of Urbanism: International Research on Placemaking and Urban Sustainability, 3:2, 145-160, DOI: 10.1080/17549175.2010.502001

[16]. Henry, R. K., Zhao, Y. S. & Dong, J. (2006) Municipal solid waste management challenges in developing countries - Kenyan case study. Waste Management, 26(1), pp.92-100.

[17]. Hoornweg, D. and Bhada-Tata, P. (2012) What a waste: A global review of solid waste management (Urban Development Series - Knowledge Papers No. 15). Washington, DC, USA: World Bank.

[18]. Ibrahim, R. A., Adeyemi, O. E., & Adebayo, A. (2014). Municipal household solid waste collection strategies in an African megacity: Analysis of public private partnership performance in Lagos. Waste Management and Research.

[19]. Jain A. P. (1994) Solid waste management in India. G.B. Pant Institute of Himalayan Environment and Development, India. Monthly News Letter. 3(1): 229-241.

[20]. Lane, P. and Peto, M. (1995) Blackstone's Guide to the Environment Act. London: Blackstone Press.

[21]. Mondal, P. (2016). Solid Waste Management, Types, Sources, Effect and Methods.

[22]. Mazhindu, E., Gumbo, T. and Gondo, T. (2012). Waste Management Threats to Human Health and Urban Aquatic Habitats – A Case Study of Addis Ababa, Ethiopia, Waste Management - An Integrated Vision, IntechOpen, DOI: 10.5772/48077. Available from: https://www.intechopen.com/books/waste-management-an-integratedvision/waste management-threats-to-human-health-and-urban-aquatic-habitats-a-case-study-of

[23]. Nuwematsiko, R., Oporia, F., Nabirye, J., Halage, A. A., Musoke, D., Buregyeya, E., et al. (2021). Knowledge, Perceptions, and Practices of Electronic Waste Management among Consumers in Kampala, Uganda. J. Environ. Public Health 3846428, 1–11. doi: 10.1155/2021/3846428

[24]. Ndubuisi-Okolo P. U., Anekwe R., I., & Attah E., Y. (2016). Waste Management and Sustainable Development in Nigeria: A Study of Anambra State Waste Management Agency. European Journal of Business and ManagementVol.8, No.17

[25]. Ogwueleka, T. (2009). Municipal solid waste characteriztics and management in Nigeria. Journal of Environmental Health Science & Engineering, 6(3), 173–180

[26]. Ogwueleka, T.C. (2009). Municipal Solid Waste Characteristics and Management in Nigeria. Iran J. Environ. Health Science and Engineering. Vol. 6(3) 173 -180.
[27]. Saghir, J. and Santoro, J. (2018). Urbanization in Sub-Saharan Africa:Meeting Challenges by Bridging. Retrieved from https://csis-prod.s3.amazonaws.com/s3fspublic/publication/180411_Saghir_UrbanizationAfrica_Web.pdf?o02HMOfqh99KtXG6ObTacIKKmRvk0 Owd.
[28]. Singh, R. P., Singh, P., Arouja, A. S. F., Ibrahim, M. H., and Sulaiman, O. (2011). Management of Urban Solid Waste: Vermin composting a sustainable option. Resource. Conserv. Recycl. 55, 719–729.
[29]. Somorin, T. O., Adesola, S., and Kolawole, A. (2017). State-level assessment of the waste-to-energy potential (via incineration) of municipal solid wastes in Nigeria. Journal of Cleaner Production, 164, 804–815. https://doi.org/10.1016/j.jclepro.2017.06.228
[30]. Williams, P. T. (1998) Waste Treatment and Disposal. New York : John Willey and Sons Limited.
[31]. World Bank Technical Paper (2019). "A technical guide to planning, design and preparation," 425, Washington, DC, USA. Rick, L.
[32]. Zerbock, O. (2003) Urban Solid Waste Management: Waste Reduction in Developing Nations. Michigan Technological University. Accessed Online November 15th 2006. http://www.cee.mtu.edu/peacecorps/documents_july03/Waste_reduction_and_i cineration_FINAL.pdf>