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CONTENTS

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AN ASSESSMENT OF SOLID WASTE DISPOSAL AND MANAGEMENT TECHNIQUES IN BENIN CITY, NIGERIA

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Abstract
The research examined solid waste disposal and management techniques encountered by residents and environmental waste managers in the management of solid waste in Benin City. Waste disposal had been a menace in recent times in most cities in Nigeria and Benin City and this calls for urgent attention. The challenge of waste disposal has been the consistent use of rudimentary methods against modern techniques. For this study, the objective was that examined solid waste disposal and management techniques in Benin City while the hypothesis is no significant variation in the techniques of waste management on quality of environment among the 3 Local Government Areas of Oredo, Egor and Ikpoba-Okha that constitute the City of Benin was tested. Data for this study were obtained from primary and secondary sources. Primary data were obtained from 25 selected wards and communities from 110 settlements in the study area through systematic sampling technique from the selected streets and houses in each of the 3 Local Government Areas. In each of the streets, the 2nd, middle and 2nd to the last households were administered with the questionnaire. A total of 1,781questionnaires were administered in 768 polling units and 192,250 numbers of registered voters were used for this study. Secondary data were sourced from published and documentary materials. Descriptive and statistical analyses were used for the study. Findings from the objective of the study revealed that the use of sack-bag constitutes the highest storage facilities, this accounts for 55.3% of the total storage facilities. Block-setting is 21.7%, polythene bag represents 9.4%, the use of basket represents 6.7% and metal drums represents 1.7%. The use of other facilities constitutes the remains of 5.2%. It was recommended that there should be a change of the methods of waste disposal and management techniques to curtail the menace of solid waste in Benin City owing to population increase and urban growth and development. In addition, human attitude should be curtailed while Waste Management Board should compel Local Government Council areas, private sector practitioners and Environmental Free-Lancers to provide a clear plan on effective waste management which will involve waste resource recovery, re-use, recycling and conservation processes.

Keywords: Assessment, Global methods, Solid waste disposal, Management techniques, Benin City, Nigeria.

Introduction

Among other environmental challenges as population growth, pollution, environmental degradation, epidemic, global warming and climate change in recent times, the menace of solid waste management has been one of the leading global environmental challenges (Wright and Boorse, 2011; WHO, 2018; Agbebaku, 2021). Towns and Cities across the globe mainly in Europe American, Asia and Africa have witnessed increasing indiscriminate solid waste disposal, especially in the last two decades. The factors leading to this threat according to Agunwanba, (1998), Babayemi and Dauda (2009), Sridhar (2012) as cited by Agbebaku (2019) and WHO (2015), indicates that the practice and habits of poor techniques of waste management, technology and innovation, increased waste generation, increase urban growth and development, increase in human population, dwindling financial resources of urban council institutions, the inability of the government to implement laws and policies, inadequate solid waste services and human attitudes

of which these indices are mainly observed in the continent of Africa and Asia if a comparison is to be made (Kadam and Sarawade, 2016). The situation with most of these towns and cities is such that waste materials are dumped anywhere and anyhow mostly in open spaces, in public facilities like schools, along major and minor roads and junctions, abandoned projects, into streams, rivers and in markets places without timely evacuation. For instance, in most of the developing countries like Nigeria, on daily basis, the menace of solid waste materials of different types, nature and components are deposited as heaps in places where they are dumped and these have constituted a major concern for residents, researchers, government agencies and environmental stakeholders. Waste disposal constitutes the same as methods or techniques of waste management. It connotes the act of getting rid of the waste or discarded materials through the different methods of waste management. This practice signals the final stage of waste management. However, before these functional stages, it is expected that sorting and segregation of waste items would have been carried out but these practices are limited to the advanced nations of the world having the right technology and where these waste items are recycled for further uses and a potential avenue for creating job opportunities, income generation and raw materials generation for further uses (UNDP, 2004; Sridhar, 2012; LAWMA, 2017; Cunningham and Cunningham, 2015; Imafidon, 2016: Edward and Ogubazghi, 2016; Agbebaku, 2021).

A view of waste management across the globe shows that waste disposal techniques include the methods of (a) rudimentary such as open burning, open dumping, dug-pit, ocean dump, (b) semi-modern such as incinerator, composite, landfill and (c) modern such as ploughing in the field, hog feed, grindings and discharging have been identified but not fully in operations owing to variance in science and technology. For instance, while there has been a paradigm shift in the advanced nations from rudimentary methods to semi-modern and modern techniques, the majority of the countries in Africa e.g., Nigeria, Togo, Cameroun, Eritrea and Sudan and Asia e.g. India, Philippines, Haiti, Pakistan and Bangladesh are still in dark aged of the used of rudimentary methods of waste disposal and less potential of the innovation of revenue generation (Monday and Danieles, 2011; Oseghale, 2011; Sridhar, 2012; Enahoro, 2016; Egbenoma, 2016; Edward and Ogubazghi, 2016; Agbebaku, 2021). To this end, there is the need for effective consideration of the model of locational theory before the choice of dumpsite location. This is to avoid the relocation of dumpsites resulting from urban spread and development. In addition, the choice of the methods of waste disposal is governed by factors such as; site location, types, nature and components of waste materials, cost implication, availability of land and labour. In view of these, the methods of waste disposal were examined from the perspective of; (a) rudimentary methods such as; open dumping, open burning, dug a pit and ocean dump (b) semi-modern methods such as; incinerator, sanitary landfill and composite and (c)modern methods such as; ploughing in the field, hog feeding and grinding and discharging (Cunningham and Cunningham, 2012; Ibrahim, 2016; Agbebaku, 2018, 2021). Waste management in Benin City is managed by the Edo State Waste Management Board (ESWMB), through the tripartite bodies of Local Government Area Councils, Private Section Practitioners and Environmental Free Lancers. The Board was established in 2000 to manage, monitor, regulate and appoint waste service operators and this is done through the Department of Sanitation and Safety Services via the units of; (a) waste managers and utility services (b) environmental health, and (c) volunteers "*task force*". Facilities for waste disposal in Benin City include the use of basket, sack bag, block sets, polythene bag metal drum and others while the equipment used for waste collection and disposal are open truck vehicle, compactor truck, closed top non-compactor vehicle, open vehicle, head-pan, rake and others. To achieve the aim of this research, the main objective of this paper will be to ascertain solid waste disposal and management techniques in Benin City. This informed the reason for this research as the research gap is meant to ascertain the methods of solid waste disposal and management techniques in the City of Benin. The research is meant to examine the global practices of solid waste disposal and management techniques of waste solid management. To this end, the specific objective of this study is to examine solid waste disposal and management techniques of residents and environmental waste managers in Benin City.

Conceptual Issues

Solid waste management: Solid waste management is the systematic process of waste generation, collection, storage, transportation, treatment, utilization and disposal of unused or waste items. This involves all the administrative processes, financial and legal implications and planning

functions as well as the physical aspect of waste handling. Furthermore, solid waste management involves the activities and actions required to manage waste from inception to its final disposal. This includes among other things waste generation, collection, storage, transportation, treatment and disposal (Gilpin, 1976; Mishra, 2008; Ibrahim, 2016; Agbebaku, 2019, 2021). The studies of Wright and Boorse (2011) Cunningham and Cunningham (2015), Ibrahim (2016) and Agbebaku (2021) observed that over 1000 metric tonnes of solid waste materials are evacuated from indiscriminate dumps in public places every month in China, in England and the United States of America over 900 metric tonnes were evacuated in public places every month while in South Africa and Sweden over 600 metric tonnes are evacuated in public places every month. In Nigeria, over 200 metric tonnes of solid waste are evacuated from indiscriminate dumps in public places every month in Ibadan. This assertion was also corroborated by Ayo (2015), Imafidon, (2016) and Agbebaku (2021) in their studies in Lagos Island, Abuja and Benin Cities respectively where they identified that 30, 25 and 20 metric tonnes of waste items were evacuated from residential places and in associate areas in every quarter of the metropolitan areas. To this end, the situation varies in degree and is typical in most towns and cities in developed and developing countries. Furthermore, studies have shown that majorities of the dumpsites in urban areas in Nigeria are temporal in transits to permanent dumpsites unlike in the developed nations where the theory of locational model was considered before establishment if comparative studies are to be carried out. However, in most of these towns and cities centres, urban growth, spread and development have engulfed such dumpsites as observed in major towns and cities in Lagos, Ibadan, Port Harcourt, Kaduna, Benin, Kano and Abeokuta (Agunwanba, 1988; Igbinomwanhia and Ohwovoriole, 2011; Edward and Ogubazghi, 2016; Egbenoma, 2016; Ibrahim, 2016; Agbebaku, 2021).

Solid waste disposal: Disposal of waste items is done with allots of methods, equipment and storage facilities. Disposal of waste items is the ultimate desire for all types, compositions and classification of waste items. The techniques of waste disposal at the global level are open burning, open dumping, sanitary landfills, incineration, composting, ploughing in fields, hog feeding, salvaging and grinding and discharging into sewers and these can be termed as: (a) rudimentary, (b) semi-modern, and (c) modern methods (Cunningham and Cunningham, 2015; Ibrahim, 2016; Enahoro, 2016; Agbebaku, 2019, 2021). For instance, the methods of open dump and open burning technique under the rudimentary methods of waste management is where waste materials are dumped and burned anywhere and anyhow. These methods are the cheapest among other methods of waste management and their dumpsites have increased in geometric form across developing nations.

This may be partly because of increased population, urban growth and development, transforming technology and increase in production of goods and services by the concentrated population or a combination of the above. Advantages of these methods of waste disposal according to Medupin and Adedoyin, (2015) is that the methods are easy to establish and its location is everywhere but that these practices portrait an unpleasant and unsanitary to the environment, its ill-disposed environment causes diverse breed of insects and offensive odour and air pollution all through the season. The methods of dug-pit and ocean dumps have negative challenges to man and ecosystem and also negate the standard of the World Health Organization if compared to modern methods of waste management above (Osagie, 2011; Sridhar, 2012; WHO, 2015; Cunningham and Cunningham, 2015).

The methods of sanitary landfill, incinerator and composite technique under the semi-modern methods of waste management is more to the advanced nations than developing. These methods are where waste materials are better managed with improved techniques if compared with the rudimentary methods but still with some negative effects on the quality of the environment. For instance, the technique of sanitary landfills involves burying refuse items into constructed landfills. The method also involves pitching refuse into a depression, closed mining sites or burrowed pits. This method is mostly in operation in urban areas of the developed world. This technique is one of the semi-modern methods of disposing of solid waste without creating or causing nuisance and hazards to public health. The choice for this method is governed by the unavailability of land space in urban areas, due to urban growth and development. The advantage of this technique is that; it minimizes pets and aesthetic loss, air and water pollution problems while the disadvantage is that if the site is not well managed, it can degenerate into an open dump and there might be no space for a landfill site because of human activities and other developmental projects. In Nigeria, the practice of this method of waste disposal is yet to be

operational except in the Federal Capital Territory, Abuja where most of the approved dumpsites are termed as landfills (Ekpoh, 2003; Iman, Mohammed, Wilson and Cheeseman, 2008; Segynola and Ofuokwu, 2011; Kumar and Sarawade, 2016; Imafidon, 2016; Agbebaku, 2021).

The method of composting is where organic wastes are decomposed naturally under oxygen-rich conditions. This method helps to turn waste materials into useful solid manure such as agricultural fertilizers for home gardens, commercial farms and process into fuels for motor vehicles. The process of composting helps to speed up the aerobic degradation of organic matter in refuse. Furthermore, the methods allow for metals, glass, inorganic or their non-bio-degradable materials to be sorted out from fixed refuse and the remainder converted to a peat-like organic fertilizer and soil conditioners. However, the method reduces the volume of waste that must be landfilled and its end product can potentially be used as agricultural fertilizer or processed into fuel to power vehicles, but the process is too expensive for poor communities and is not practised in Nigeria. In the same vein, the method of incineration is where waste dumps are subjected to high temperatures as thermal treatment. Incineration is the process of destroying waste materials by burning them through intensive heat. Incineration is often alternatively named energy from waste and waste to energy. This process can be carried out both on small scale by individuals and on large scale by industries. Studies have revealed that 89% of solid wastes collected in the United States of America are disposed of in this way (Monday and Daniel, 2011; Igbinomwanhia and Ohwovoriole, 2011; Egbenoma, 2016; Ruth, 2016).

This method of waste disposal is not practicable in most developing countries including Nigeria due to cost implications. Benefits of incineration include reduction in the volume of waste materials and production of energy in the form of electricity, heat and gas generation but the major constraints of this method apart from being capital intensive, is that it contributes to air pollution by adding to foul odour, noxious gases and gritty smoke into the atmosphere which repeal environmental quality (Wright and Nebel, 2002; UNEPA, 2006; Wright and Boorse, 2011; Egbenoma, 2016; Agbebaku, 2021). Furthermore, the modern methods of solid waste management such as ploughing in the field, hog feeding and grinding and discharging are also more to the advanced nations than developing. For instance, the methods of ploughing in the field are where dumpsite fields are ploughed into farmlands in preparation for the sowing of seeds or for planting purposes. The ploughed field is typically left to dry out and then harrowed before planting. However, environmental quality in areas where this method is practised could be a threat only if the method is not well managed. In the same vein, the method of hog feeding is where refuse dumpsites are used for feeding of animals, but in this case, the dumpsites area will constitute more garbage items while the method of grinding and discharging is where waste items are blinded into articles before discharge to reduce its bulkiness and process into other uses. Ideally, sorting of refuse components is crucial in this modern method of waste disposal (Wright and Nebel, 2002; Wright and Boorse, 2011; Cunningham and Cunningham, 2015; Ibrahim, 2016; Egbenoma, 2016; Agbebaku, 2021).

Material and Methods

This paper is purely an empirical study. Benin City is administered mainly by 3 Local Government areas of Oredo, Egor and Ikpoba-Okha and parts of Ovia South-West, Uhunwonde and Orhionmwon Local Government areas. Benin City lies within Latitude 6^0 20' and 6^0 58' North of the Equator and Longitude $5^0$35' and $5^0$44' East of the Greenwich Meridian. Figure 1 shows the 3 Local Government areas used for the study while Figure 2 shows the Benin City metropolitan area respectively. The study area is the 3 Local Government areas of Oredo, Egor and Ikpoba-Okha Local Government in Benin City. These 3 Local Government Areas are made up of several settlements some of which were used for this study. Each of these Local Government areas is made up of political wards and the wards are made up of settlements.

To get primary data, wards and settlements of the study area were used as the frame. For this study, 60% of the wards of each Local Government area were randomly selected for the study. In doing this, 12 wards were selected in Oredo, 03 wards in Egor and also10 wards in Ikpoba-Okha Local Government areas respectively. The selection of settlements was based on the number of Polling Units.

Therefore, settlements with Polling Units of 20 and above were selected for questionnaire administration. For the purposed of determining the population size for primary data collection, the number of registered voters in the Polling Units of each settlement was used. Voter registrations of 250 were used per polling unit. The use of the number of

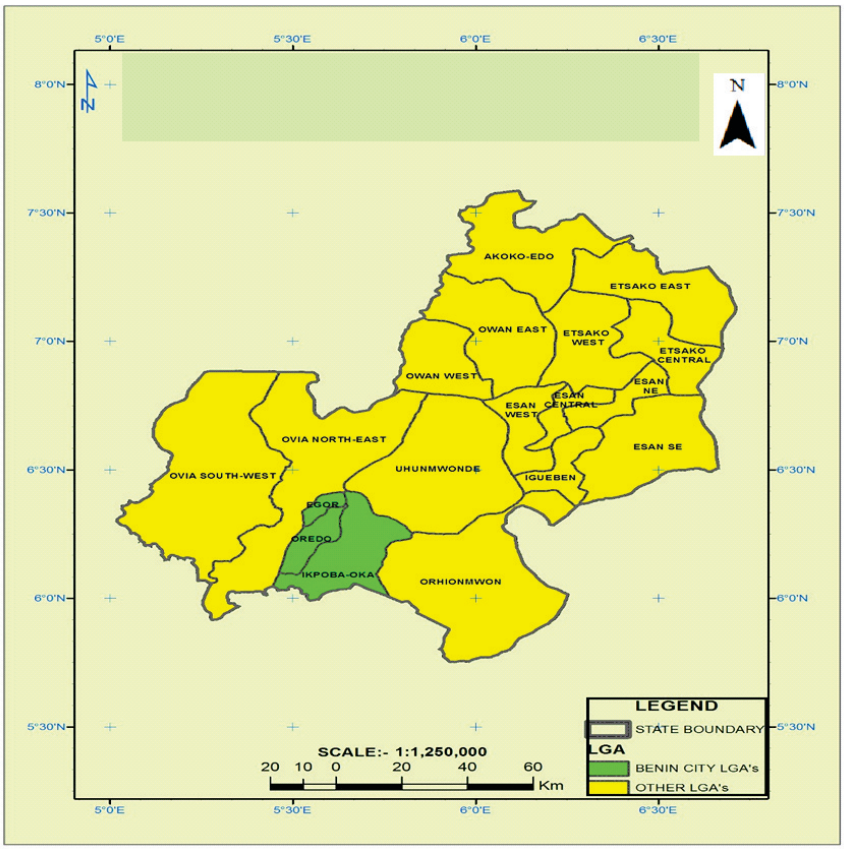

Figure 1: Edo State; Local Government Areas of the Location of Benin City.
Source: Cartography Studio, A.A.U Ekpoma, 2019.

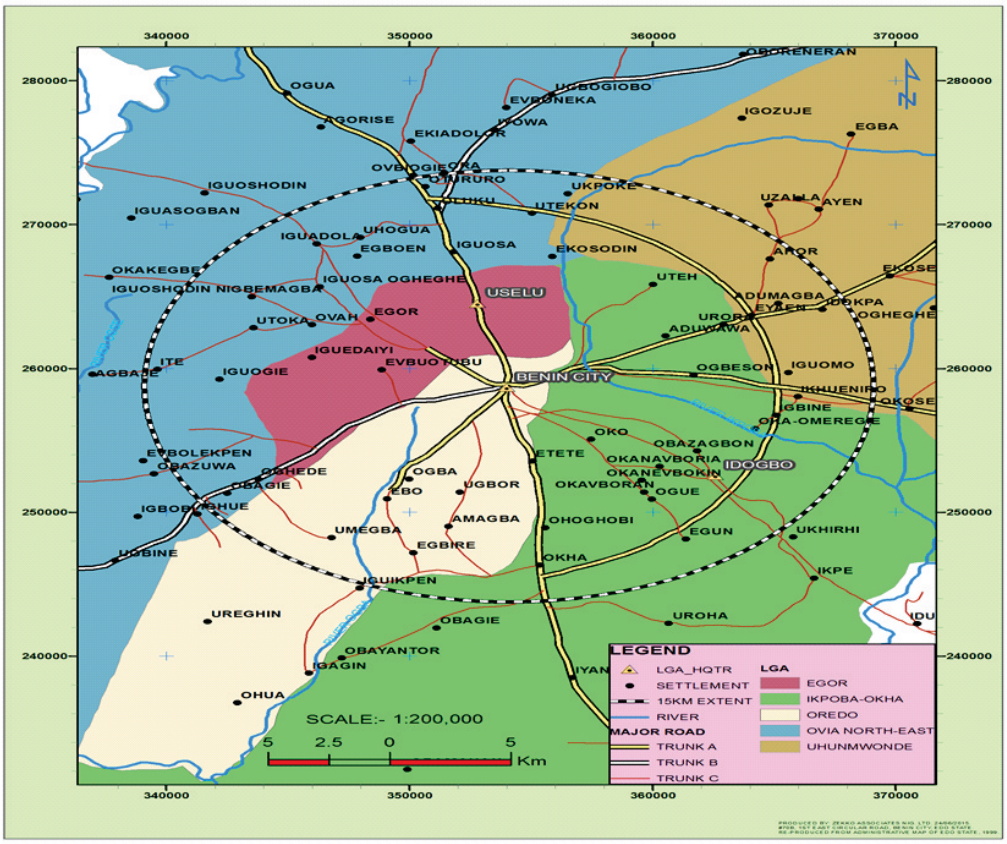

Figure 2: Benin City: The Benin Metropolis.
Source: Ministry of Land and Survey, Benin City, Edo State (2019)

registered voters is predicated upon the unavailability of the 2006 Population Census figure for settlements. For the Oredo Local Government Area, the number of registered voters from the selected polling units were 89, 250 while in Egor and Ikpoba-Okha, they are 15, 750 and 87,250 respectively. In all 192,250 populations were registered. Distributions of the questionnaire were administered in each ward of the Local Government areas. To this end, wards with 20 and above polling unit stations (PUS) were selected in each of the three Local Government areas. That is, in the Oredo Local Government area with 28 communities, which constitutes 12 wards; all the communities in the 12 wards were used for questionnaire administration going by the benchmark of 20 and above polling unit station used for this study.

These areas constituted of the high and moderate human population. In Egor Local Government area with 20 communities, which constitutes 10 wards; 3 ward areas were used for questionnaire administration going by the benchmark, while in Ikpoba-Okha Local Government area with 62 communities, which constitutes 10 wards; all the communities in the 10 ward areas were used for questionnaire administration going by the benchmark. The selections were done by systematic random sampling techniques. In this case, in each of the streets for questionnaire administration, the 2nd houses, the middle houses and 2nd to the last houses were used. In addition, the first 2 most populous wards, the first 2 medium populated wards and the least 2 populated communities in each of the wards were chosen. The total number of communities to cover therefore were 25. That is 12 wards in Oredo, 3 wards in Egor and 10 in Ikpoba-Okha Local Government respectively. Furthermore, 5% of the total numbers of questionnaires per Local Government area were administered to staff of Edo State Waste Management Board (ESWMB) and managers of Private Sector Practitioners (PSP). That is, 5% of 616 questionnaires for Oredo Local Government Area 31. 5% of 559 questionnaires for Egor Local Government are 28 and 5% of 606 questionnaires for Ikpoba-Okha Local Government is 30 respectively. The random systematic sampling technique was used for the study. Both descriptive and 2-way ANOVA statistical analyses were used for the study. Secondary data were sourced from documentary materials and established sources from academic journals, conference papers, theses, textbooks, and maps. In essence, secondary data were sourced from documentary materials.

Results and Discussion

The results from questionnaires administration and tests carried out on the assessment on solid waste disposal and management techniques for the study were summarized and presented in Tables 1 to 14 respectively. Table 1 to 14 shows the results and discussion of findings from the study respectively.

Table 1: Storage Facility Used by Residents

Storage Facility	Frequency	Percent
Basket	109	6.7
Sack Bag	899	55.3
Block Setting	353	21.7
Polythene Bag	153	9.4
Metal Drum	28	1.7
Others	85	5.2
Total	**1627**	**100.0**

Source: Fieldwork, 2019.

Results from Table 1 revealed that the use of sack-bag constitutes the highest storage facilities, this accounts for 55.3% of the total storage facilities. This is followed by the use of block-setting 21.7%. The use of polythene bags represents 9.4%, while the use of baskets represents 6.7% and metal drums represent 1.7%. The use of other facilities constitutes the remains of 5.2%. However, findings from the pilot survey revealed that there is a high frequency of the use of sack-bag for waste storage in Benin City and these storage facilities are used mainly in markets places. This could be due to the nature and texture of materials, durability, size, affordability and ability to infiltrate water into the soil. Table 2 shows the comparative analyses of storage facilities used by residents of the 3 Local Government that constitutes the study area.

Table 2: Comparative Analysis of Storage Facility Used by Residents by the 3 Local Government Areas

Local Government Area	Basket	Sack Bag	Block Setting	Polythene Bag	Metal Drum	Others
Oredo	39	303	209	61	13	29
Egor	27	206	105	53	09	33
Ikpoba-Okha	43	390	39	39	06	23
Total	**109**	**889**	**353**	**153**	**28**	**85**

Source: Fieldwork, 2019

Results of the comparative analysis on responses of the most used storage facilities by residents in the 3 Local Government areas revealed that residents from Ikpoba-Okha used more of the facilities of basket and sack bags than residents from any other Local Government Area. This is followed by residents from Oredo and Egor Local Government areas respectively. The used of block settings were frequently used by residents from Oredo than any other Local Government. This is followed by residents from Egor and Ikpoba-Okha respectively. Findings also revealed that the frequent users of basket and sack bags by residents from Ikpoba-Okha are due to ease of purchase, carriage and evacuation of these storage facilities. On the other hand, the use of block setting by residents of Oredo is to help curtain aesthetics and sanitation level of the area being the seat of power and coordination of administrative duties in Benin City. Other's storage facilities used in the study area were facilities from polyethene, metal drum and others storage materials. Furthermore, the study revealed that waste storage facilities were emptied mostly every fortnight than weekly and in sequential order of; whenever they like, once a month, once in two months and daily.

Results from Table 3, shows that waste collection from every fortnight represents 39.5%, this is followed by weekly 37.7%. The collection once a month represents 10.4% while collection, whenever they like, represents 7.5%. Once in two months represents 3.8% and that on daily evacuation represents 1.1% respectively. Findings from personal interviews revealed that there are major anomalies and selective service providers in some quarters and communities in the study area. This results in cases of overflows of storage facilities and poor sanitary conditions as observed in strategic places in Benin City. For instance, the period of August 2018 – March 2019 witnessed the ban of service operatives in the study area.

The study further revealed that delay in collection of storage facility could be part of the reasons for the threat and poor aesthetics of refuse matters in Benin City. Table 4 shows the comparative analyses of waste collection by environmental waste managers of the 3 Local Government that constitutes the study area.

Table 3: Responses of Residents on Waste Collection by Environmental Waste Managers

Wastes Collection	Frequency	Percent
Daily	18	1.1
Weekly	613	37.7
Every Fortnight	643	39.5
Once a Month	169	10.4
Once in Two Months	62	3.8
Whenever they Like	122	7.5
Total	**1627**	**100.0**

Source: Fieldwork, 2019

Results from Table 4 showed the comparative analysis of the responses on waste collection by Environmental Waste Managers in the study area revealed that wastes collection on weekly, every fortnight and once a month were common in Oredo than in any other Local Government Area. This is followed by a collection from Egor and Ikpoba-Okha Local Governments respectively. The reasons for this could be due to the level of sensitization, functionality and administrative and coordinating services at Oredo than in any other councils of the study area. Furthermore, findings from the study revealed that the collection of wastes by Environmental Waste Managers in Egor and Ikpoba-Okha were not as effective if compared to that of Oredo Local Government. The reasons could be the low level of patronage and poor service provider in these Local Government areas by Environmental Waste Managers if compared to the Oredo council area. Others order waste materials collected from the study area are wastes collected from whenever they like, once in two months and daily collection with Oredo having the highest collected. This is followed by waste from Egor and Ikpoba-Okha Local Government areas respectively.

Table 4: Comparative Analysis of Residents Responses on Waste Collection by Environmental Waste Managers

Local Government Area	Weekly Collection	Every Fortnight Collection	Once a Month Collection	When Ever They Like	Once in two Months	Daily
Oredo	215	235	66	29	15	8
Egor	201	216	54	30	13	6
Ikpoba-Okha	197	192	49	63	34	4
Total	**613**	**643**	**169**	**122**	**62**	**18**

Source: Fieldwork, 2019

Table 5: Distance of Dumpsite from Residents

Distance	Frequency	Percent
Less than 1Km	266	16.3
2-3Km	512	31.5
3Km Above	849	52.2
Total	**1627**	**100.0**

Source: Fieldwork, 2019

Results from Table 5 revealed that a total of 849 of the residents responded to a distance of 3km and above and this represents 52.2%. 512 responses to a distance of between 2-3km and this represent 31.5% while 266 responses to a distance of less than 1km and represented 16.3%. Though having dumpsites closer to one domain has its advantage and disadvantages, but having to cover a huge distance of 3km and above could be part of the reasons why some residents indulged in the sharp practices of an indiscriminate dump of refuse materials anywhere and anyhow as observed in some wards, quarters and communities within the study area. In addition, the inadequacies of refuse space within the households are another factor for such length of distance covered. On the other hand, residents may be cautious of the menace of refuse within their domains hence the need to travel far and also of the need to adhere to the concept of locational factor of the distance of dumpsite. Where some residents decide to flout sanitary laws by disposing of wastes within a short distance others decides to flaunt the same laws and keep some at arm's length. However, comparative analysis revealed that responses from residents of Oredo Local Government covered more distance than any other council area. This is followed by responses from Egor and Ikpoba-Okha respectively.

Table 6: Comparative Analysis of Responses on Distance of Dumpsite from Residents

LGA	Less than KM	2-3 KM	3KM and Above
Oredo	102	167	315
Egor	85	158	309
Ikpoba-Okha	79	187	225
Total	**266**	**512**	**849**

Source: Fieldwork, 2019

Results from Table 6 showed the comparative analysis on responses on the distance of dumpsite from residents in the study area. From the Table, responses from residents of Oredo Local Government covered more distance than any other council area. This is followed by responses from Egor and Ikpoba-Okha respectively. Findings from questionnaire administration and the pilot survey revealed that this is due to the non-availability of a permanent dumpsite in the study area the variance is distance covered.

Table 7: The Attitude of Persons to Waste Disposal by Environmental Waste Managers

Attitude of Persons	Frequency	Percent
Failure to Abide by Sanitary Rules	9	10.8
Poor Human Attitude	20	24.1
Need Awareness	48	57.8
Failure to Use PSP Operators	5	6.0
Poor Logistics	1	1.2
Total	**83**	**100.0**

Source: Fieldwork, 2019

The results from Table 7 on the attitude of persons to indiscriminate dumps of waste by Environmental Waste Managers revealed the need for awareness and this represents 57.8%. This was followed by poor human attitude, 24.1%. Failure to abide by sanitary rules, represent10.8% while failure to use PSP operators represent 6.0% and poor logistics represent 1.2% respectively. However, findings from personal interviews and pilot surveys revealed that there is a need for more awareness drives in the study area as this sensitization will help to curtail the poor attitude of some persons in Benin City. These poor human relations are observed mainly in Okhoro (Egor L.G) and Idogbo (Ikpoba-Okha L.G) communities where residents indulged in the practice of throwing refuse items into water channels during the rainy season. There is high time for a change in human attitudes on the practice of indiscriminate dumps of refuse materials anywhere and anyhow in this 21st Century. In addition, members of the public should learn how to abide by environmental laws and sanitary rules. Table 8 shows the comparative analyses of the attitude of persons to indiscriminate dumps of waste by environmental waste managers of the study area.

Results of the comparative analyses of responses revealed that poor human attitude, need awareness and failure to abide by sanitary rules were higher with residents from Ikpoba-Okha than in any other council. This is followed by responses from Egor and Oredo Local Government areas respectively. The reasons for this could be due to the low level of sensitization, poor service provider and low patronage of private-sector managers in Ikpoba-Okha if compared to responses from Oredo and Egor Local Government areas respectively. In addition, failure to use PSP operators and poor logistics were higher in Ikpoba-Okha and none in Oredo and Egor Local Government areas.

Table 8: Comparative Analyses of Responses on Attitude of Persons to Wastes Disposal by Environmental Waste Managers

Local Government Area	Poor Human Attitude	Need Awareness	Failing to Abide by Sanitary Rule	Failure to use PSP Operators	Poor Logistics
Oredo	05	10	2	1	-
Egor	06	15	3	1	-
Ikpoba-Okha	09	23	4	3	1
Total	**20**	**48**	**9**	**5**	**1**

Source: Fieldwork, 2019

Table 9: Agencies of Waste Disposal Identified by Residents

Agencies of Waste Disposal	Frequency	Percent
Self-Service	193	11.9
PSP	1121	68.9
Environmental Free-Lancer	268	16.5
Government Agency	45	2.8
Total	**1627**	**100.0**

Source: Fieldwork, 2019

The results from Table 9 shows agencies in charge of waste management as generated by residents and collected by Environmental Waste Managers in the study area revealed that Environmental Waste Managers mainly from registered and accredited Private Sector Practitioners (PSP) collects and disposed of more of the wastes generated by residents than from any other agencies and self-efforts. Agencies of PSP represent 68.9% and this is followed by the un-registered and un-accredited Environmental Free-Lancer (EFL) and this represents 16.5%. The agencies of Government (State and Local) represent 2.8% while that of self-service represents 11.9% respectively. From personal interviews and pilot surveys, it was revealed that operatives of PSP were more in charge of wastes collection and disposal than any other forms of agencies in Benin City. However, this is due to the collaborative efforts between the State Government, Waste Management Board and Local Government agencies on waste management in Benin City. Table 10 shows the comparative analyses of the attitude of the agencies of waste management by environmental waste managers of the study area.

Results of the comparative analysis of responses on agencies of wastes disposal identified by residents from the study revealed that wastes disposal from the private sector practitioners were higher in Oredo than in any other council area. This is followed by responses from Egor and Ikpoba-Okha respectively. The reasons for this could be the level of awareness, hygiene and effectiveness of service operatives. On the other hand, wastes disposal by self-services is relatively low in Oredo, in-between in Egor and higher in Ikpoba-Okha Local Government areas respectively. Findings from the pilot survey revealed that responses from Ikpoba-Okha believed that they can manage waste in their way even with or without the presence of service agencies. However, waste disposal by a government agency was higher in Oredo than in Egor and low in the Ikpoba-Okha Local Government Area respectively. The majority of responses indicate during the rainy season and this represents 62.3%. This is followed by responses from the dry season and this represents 28.0% while those that indicate all through the season represent 9.6% respectively. From personal interviews on the study, it was revealed that during harvest periods e.g., during corn season which incidentally coincides with the rain season, the menace of wastes from corn leaves and shaves is relatively a challenge. While during the dry season, the non-degradable waste items e.g., bottles and pure water sachets constitute a major menace. In addition, the results on the nature of degradable and non-degradable waste items constitute a threat all through the season. Given

Table 10: Comparative Analyses of Responses on Agencies in Charge of Waste Disposal Identified by Residents

Local Government Area	PSP	Environmental Free-Lancer	Self-Services	Self Service
Oredo	452	101	45	39
Egor	409	96	63	48
Ikpoba-Okha	260	71	85	106
Total	**1121**	**268**	**193**	**193**

Source: Fieldwork, 2019

these, the agencies of Environmental Waste Managers need to put more effort into waste evacuation during the rainy season as observed by residents from the study. The results on the comparative analysis on this revealed that responses of residents on raining, dry season and all through the year were higher in Okpoba-Okha than in any other council area. This is followed by responses from Egor and Oredo respectively. Findings from the study revealed that the reasons for this are that the threats of wastes on seasonal variation were mostly felt in Ikpoba-Okha due to poor management and human attitudes.

The impacts of indiscriminate waste disposal on residents in the study area indicated a negative impact of waste disposal in their domains. The case of offensive odour to their immediate domain constitutes the highest impact and this represents 39.2%. This is followed by poor aesthetics and this represents 23.4%. The impact of environmental pollution represents 17.5%. The impact of environmental degradation represents 8.5%. The impact on the attraction of insects and rodents represents 7.7% while that of epidemic outbreak represents 3.7%. These negatives impact of waste disposal on residents calls for urgent intervention by stakeholders on the need to improve the quality of the environment. Furthermore, a comparative analysis on responses of residents revealed that the causes of offensive odour, poor aesthetics and environmental pollution were higher in Ikpoba-Okha than in any other council area. This is followed by responses from Egor and Oredo Local Government respectively. Findings from the study revealed that reasons for the low impact of waste disposal from residents from Oredo and Egor could be due to the level of awareness of the threats of these indices on human health and the quality of the environment. Other impacts of waste disposal in the study area are those from environmental degradation, the attraction of insects and rodents and epidemic outbreaks and the Ikpoba-Okha Local Government area has the highest responses.

Table 11: Equipment Used by Environmental Waste Managers

Equipment Used	Frequency	Percent
Open Truck Vehicle	50	60.2
Compactor Truck	6	7.2
Closed Top Non-Compactor	12	8.5
Open Vehicle	1	3.3
Head-Pan	2	6.4
Rake	6	7.2
Others	6	7.2
Total	**83**	**100.0**

Source: Fieldwork, 2019

The results from Table 11 shows the equipment used by environmental waste managers (EWM) in the study area revealed that the use of open truck vehicles constitutes the most predominantly used equipment's for waste collection and this represents 60.2%. This is followed by the use of a closed top non-compactor truck and this represents 8.5%. The use of compactor trucks, rake and others represent 7.2% respectively. While the use of a head pan, represents 6.4% and that of open vehicles represent 3.3%. Others equipment's used in the study involve the combination of shovel, nets, hand-gloves and nose cover. The use of others equipment such as a net, sack bag and hand gloves were common with service operators in Benin City. Furthermore, the majority of service operators make use of open truck vehicles against the use of compactor trucks as recommended by World Health Organization standards.

The results from Table 12 shows the comparative analysis on responses on equipment used by Environmental Waste Managers revealed that the equipment's used ranges from vehicles, compactor truck, head-pan, rake, sack-bag, net, gloves and nylon. The study also revealed that all the 3 Local Governments made used this equipment, but the use of open truck vehicles was relatively low in Oredo and high in the Ikpoba-Okha Local Government Area. In addition, the use of closed top non-compactor trucks was low in Oredo and high in Ikpoba-Okha. Responses from questionnaire administration revealed that the use of rake was tied

Table 12: Responses on Equipment Used by Environmental Waste Managers

Local Govt. Area	Open Truck Vehicle	Closed top non-Compactor Truck	Rake	Compactor Truck	Others	Head Pan	Open Vehicle
Oredo	12	2	2	3	1	1	0
Egor	17	4	2	2	2	1	0
Ikpoba-Okha	21	6	2	1	3	0	1
Total	**50**	**12**	**6**	**6**	**6**	**1**	**1**

Source: Fieldwork, 2019

Table 13: Variables Used to Test the Hypothesis

Local Government Area	Use of Vehicle	Equipment	Number of Household Covered	Storage Facility	Methods of Waste Disposal
Oredo	19	20	470	654	335
Egor	27	27	537	433	546
Ikpoba-Okha	36	33	600	540	757
Total	**82**	**80**	**1607**	**1627**	**1456**

Source: Fieldwork, 2019

Table 14: Analysis of Variance on the Techniques of Solid Waste Management among Residents

		Sum of Squares	Df	Mean Square	F	Sig.
Type of Waste Storage Facility	Between Groups	496.933	4	124.233	632.778	.000
	Within Groups	318.447	1622	.196		
	Total	**815.380**	**1626**			
Methods of Waste Disposal Commonly Adopted	Between Groups	90.705	4	22.676	578.842	.000
	Within Groups	63.542	1622	.039		
	Total	**154.247**	**1626**			

Source: Fieldwork, 2019

in all the 3 Local Government areas. Findings from the pilot survey revealed that the use of rake equipment is essential to waste management while the use of compactor truck, open vehicle, head pan and other equipment were relatively low among Environmental Waste Managers in the study area. The variables that were used to examine and compute this hypothesis was derived from findings from fieldwork. These variables were the use of the vehicle, the number of sites and households covered, equipment used, storage facility. Table 13 shows the variables used per local government area.

Table 14 shows the 2-Way Analysis of Variance on the techniques of waste management among the three Local Government Areas of Oredo, Egor and Ikpoba-Okha in Benin City. The technique of Analysis of Variance was used to examine the types of waste storage facilities and methods of waste disposal commonly adopted in Benin City. The sum of squares and mean square for the types of waste storage facility Between Groups were 496.933 and 124.233 respectively; and Within Groups were 318.447 and .196 respectively. While that the Sum of Squares and Mean Square for the method of waste disposal commonly adopted among residents Between the Groups were 90.705 and 22.676 respectively and 63.542 and .039 respectively. Standard Deviation (df) were constant Between Groups 4 and Within Groups 1622 for both the types of the wastes storage facility and methods of wastes disposal commonly adopted. Given this, since the F-critical is 6.39 and the F-sta. is 6.32, the test is significant and the same applies to the methods of waste disposal commonly adopted in the study area. Furthermore, since the P-values are less than 0.5 level of significance, there is no significant variation (0.000) in the techniques of waste management among residents of the study area. The variation also reflects on the types of waste materials and wastes storage facilities.

Conclusion

The mediums of storage facilities for waste disposal in more of the use of sack bags and waste disposal methods are more of use of open dumping and open burning; these practices caused over-flow of storage disposal facilities in the area. Waste management collection agencies are more of the services from private sector practitioners than State and Local Government authorities. Collection of waste materials is not satisfactory from these bodies as there are records of ill-services, selective collection and a poor approach to waste collection. These mal-administrative services constitute parts of the threat of poor waste management in Benin City. The poor service provider has been the major problem of solid waste management in recent times in Benin City. The use of rudimentary techniques of waste disposal had become outdated and the practice has been condemned by World Health Organisation. The practice of open burning and open dumping is rudimentary and should be discontinued as it has been banned outrightly in most of the advanced

countries in Europe, Asia, North and South America and Australia for the past two decades.

To this end, the use of modern techniques of waste management mainly the technique of sanitary landfill among other techniques should be embraced. These techniques are not as derogating, offensive, epidemic loose and constitute less environmental menace like the rudimentary methods, but this is subject to how effective they are well managed. Furthermore, there should be an improvement in wastes collection, the establishment of the waste recycling industry and a high level of synergy between state and Local Government. In addition, dumpsites establishments should adhere to the concept of the locational model. Visitors, scavengers and waste managers visiting dumpsites should be well dressed with personal protection equipment (PPE) and protective materials such as; overall dress, safety boots, hand gloves, nose-cover, and eye-glass.

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