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Assessment of Management of Waste Collection and Disposal in Bauchi Metropolis Bauchi State, Nigeria

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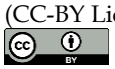

Abstract: Waste management is the process of collecting, transporting, processing or disposing, managing and monitoring of waste materials. Poor waste management has been a major problem to human health and existence, affecting both rural and urban areas. The study used survey research design adopted a quantitative method because of its appropriateness to the topic under investigation. In most low to medium income developing nations like Nigeria, almost 100 percent of generated waste goes to landfills, while wastes are deposited in open dumps in developing nations; these have become obsolete in the developed countries. The educated respondents are significantly more likely than the less educated to dispose of waste through composting ($p < 0.05$) and incineration ($p < 0.025$). However, the less educated are more likely to dispose of refuse by open dumping ($p < 0.05$), burning and burying ($p < 0.05$), and also more likely to hand carry refuse ($p < 0.025$) and transport refuse by wheel barrow ($p < 0.025$) than the more educated would do. Majority of the respondents (75.90%) have a centralized place for dumping solid waste and the commonest means of transports of waste was by wheel barrow (70.20%). The repeated measure regression was used to allow comparisons among the variables under each condition. For finding depicts many factors like current methods, source of information, types of waste generated and waste management practices of waste collection and disposal. The finding shows that if public and private sector provides necessary consideration and utilization of practice of west collection and disposal, and encouragement of awareness on the uses of recycling method and practice to the Bauchi Metropolis. Multiple regressions were conducted to test the above-mentioned assessment.

Keywords: Assessment of management; Disposal in Bauchi Metropolis; Waste collection

Introduction

Waste management is the process of collecting, transporting, processing or disposing, managing and monitoring of waste materials (Yeboah Antwi & Ofori-Nyarko, 2023). The term usually relates to materials produced by human activity and the process is generally undertaken to reduce their effect on health, the environment or aesthetics. The major focus of this research is on waste management practices as obtains in the urban developing nations. Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded and these include: packing items garden waste, old paints containers, vegetables, metals etc. Poor waste management has been a major problem to human health and existence, affecting both rural and urban areas (Adogu et al., 2015). A clean environment influences good health and good health further affects the productivity of man. Therefore, it can be said that a good and clean environment invariably affects the wealth and economic status of the nation. There are various methods of waste disposal including: land filling: which involves burying the waste in abandoned or unused quarries, mining voids or burrow pits and covering it with layers of soil; incineration: involves subjection of solid organic wastes to combustion at a very high temperature of about 10.000 so as to convert them into residue or gaseous products; open dumping: whereby dumping can be done on open land or sea; composting:

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this is an aerobic, biological process of degradation of biodegradable organic matter; hog feeding: this involves feeding animals like pigs with left over materials of waste; mechanical destructor: this involves the use of machines to destroy waste materials (Hossain et al., 2024).

Recycling of waste which means taking waste materials and transforming them into raw products, results in saving natural resources, saving energy (Jassim, 2017; Nallapaneni et al., 2023), reducing disposal costs, reducing harmful emission to air and water, saving money and creating jobs (Massoud et al., 2023). Wastes are any discarded materials, which can be solid, liquid, semi-solid or containerized gaseous materials Solid waste is defined as discarded material which has no consumer value to the person abandoning it. This can be generated by either domestic commercial, industrial healthcare agricultural mineral places, etc. The words "garbage" "trash", "refuses" and "rubbish" is used to refer to some forms of solid waste. The solid waste being generated in Jimeta, from each household is approximately 1 ton of domestic waste per year. The incidence of much garbage lying uncollected in the streets, dustbins, causing inconvenience and environmental pollution, and being a risk for public health in the study area is the main thrust of this study (Beyuo et al., 2023; Petropoulou et al., 2023). Although, government authorities are trying to control this, hence the piles of wastes only seem to grow from day to day. The average per capital waste generation is 0.8kg per person per day. The problem is likely to intensify unless alternate approaches are developed.

Recyclable materials are divided into sub materials, which depend on industrialization rate and packaging in food industry. Sub materials for plastic, paper, glass and Aluminum presented by Soni et al. (2022). According to Söderholm et al. (2020), the least expensive of the policies for waste disposal (aluminum, paper plastic and steel) is deposit/refund. Recyclable Plastic Materials Plastics are widely used in humankind's life. Furthermore, plastic production in society is higher than steel, and is increasing year by year. Percentage of plastic solid waste in MSW is also increasing. Recycling is the best method for treatment of plastic materials considering stable chemical and physical characteristic. Specially assessment case study in Spain shows that high-density polyethylene (HDPE), low density polyethylene (LDPE), polyethylene terephthalate (PET), polyvinylchloride (PVC), expanded polystyrene (EPS), polystyrene (PS), liquid packaging board (LPB), and material recover facility(MRF) are detected in MSW. Major plastic sources are PVC and PET. According to Lazzarotto et al. (2020), steam separation method in municipal solid waste recycling have higher efficiency in recycling of plastic materials.

In addition, environmental education needed to be integrated into the school curriculum right from primary school level, especially concerning recycling, reuse and waste disposal. Finally, ecological funds strictly monitored and used to remediate or restore damaged environment strict sanitation and waste management, reforestation, and oil spills clean up. Moreover, Environmental education has been infused into basic and secondary schooling as cross cutting concepts. These efforts by the Nigerian government do not seem to have yielded the much-desired results as solid wastes are still seen in dumps in urban and rural regions. Trushna et al. (2024), show that most of the studies on solid waste management concentrate on household and communities with only a few on secondary school students as participants. Therefore, much still needs to be done to ensure environmental protection in Nigeria, particularly, with regard to solid waste management. Wastes are any discarded materials, which can be solid, liquid, and semi-solid or containerized gaseous materials. Solid waste is defined as discarded material which has no consumer value to the person abandoning it.

This can be generated by either domestic commercial, industrial healthcare agricultural mineral places, etc. The words "garbage" "trash", "refuses" and "rubbish" is used to refer to some forms of solid waste. The solid waste being generated in Jimeta, from each household is approximately 1 ton of domestic waste per year (Phuong et al., 2021). The incidence of much garbage lying uncollected in the streets, dustbins, causing inconvenience and environmental pollution, and being a risk for public health in the study area is the main thrust of this study. Although, government authorities are trying to control this, hence the piles of wastes only seem to grow from day to day. The average per capital waste generation is 0.8kg per person per day. The problem is likely to intensify unless alternate approaches are developed. Waste management is the process of collecting, transporting, processing or disposing, managing and monitoring of waste materials. The term usually relates to materials produced by human activity and the process is generally undertaken to reduce their effect on health, the environment or aesthetics (Chen et al., 2024). The major focus of this research is on waste management practices as obtains in the urban developing nations. Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded and these include: packing items garden waste, old paints containers, vegetables, metals etc.

Poor waste management has been a major problem to human health and existence, affecting both rural and urban areas. A clean environment influences good health and good health further affects the productivity

of man. Therefore, it can be said that a good and clean environment invariably affects the wealth and economic status of the nation (Kaiser & Urban, 2024; Hariram et al., 2023). There are various methods of waste disposal including: land filling: which involves burying the waste in abandoned or unused quarries, mining voids or burrow pits and covering it with layers of soil; incineration: involves subjection of solid organic wastes to combustion at a very high temperature of about 10,000 so as to convert them into residue or gaseous products; open dumping: whereby dumping can be done on open land or sea; composting: this is an aerobic, biological process of degradation of biodegradable organic matter; hog feeding: this involves feeding animals like pigs with left over materials of waste; mechanical destructor: this involves the use of machines to destroy waste materials (Chew et al., 2019; Sahoo et al., 2023). Recycling of waste which means taking waste materials and transforming them into raw products, results in saving natural resources, saving energy, reducing disposal costs, reducing harmful emission to air and water, saving money and creating jobs (Li et al., 2023; Yang et al., 2023).

Method

Study Design

The research used survey research design adopted a quantitative method because of its appropriateness to the topic under investigation. Survey design is a scientific method which involves observing and describing the behavior of the subjects without influencing of data for the purpose of answering research question under study (Cheong et al., 2023). The study is based on assessing the management of waste collection and disposal in Bauchi metropolis Bauchi state. It is based on an in-depth investigation of individual group, or even to explore causation in order to find the underlying principles.

Population of the Study

The population of the study comprises of the entire households that in Bauchi metropolis Makama (A) and Dan Amar wards of the Bauchi metropolis Bauchi state. The study adopted two wards in Bauchi LGAs Bauchi state as five (5) years 2020 - 2023. Censuses sampling will be adopted where the entire wards of Bauchi LGAs. The target population comprised of Bauchi LGAs wards of Bauchi state as retrieve from the five (5) years 2020 - 2023. Censuses sampling 2023.

Sampling Design

Simple random sampling techniques will be used by the researcher to collect the sample data from the population. Due to the nature of this research project, it appropriated to use simple random sampling techniques because of its feature of flexibility.

Sample Size

The sample size which to be used for the purpose of this research Yamane Formula for sample size, in which the sample size is (282) represented through the total population of (1285) as at 1st February 2023.

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

Where;

n	=	Sample size
N	=	Total population
e	=	Error margin (5%)
1	=	Constant

Therefore using the above formula

N = sample size

N = the total population of the entire households that in Bauchi metropolis Makama (A) and Dan Amar wards of the Bauchi metropolis Bauchi state.

Therefore:

$$N = \frac{1285}{1 + 1285\ (5\%)^2}$$

$$n = \frac{1285}{1 + 1285\ (0.05)^2}$$

$$n = \frac{1285}{1 + 3.2}$$

$$n = \frac{1285}{4.2}$$

$$n = 282$$

The researcher will used stratify random sampling techniques to draw sample of 282 from the population of 1285 entire households that in Bauchi metropolis Makama (A) and Dan Amar wards of the Bauchi metropolis Bauchi state.

Sampling Technique

The researcher made use of the stratified sampling technique to obtain data and relevant information for the study

Data Collection

The researcher will administer the instrument to the entire households Bauchi metropolis Makama (A) and Dan Amar wards of the Bauchi metropolis Bauchi state some explanations on how to respond to the questions but allow independent responses. However, the questionnaires have been administer each, face to face method of administration of the instrument will be use, each respondent will be given a considerate time to answer the questions, after which the researcher collect the questionnaire from the households Bauchi metropolis of Bauchi state.

Data Collection Instrument

The researcher developed the instrument used in this thesis in order to obtain the required information. The four (4) point's likert's scale was scored as follows: Strongly agree, 1 points; Agree, 2 points; Disagree, 3 points; and Strongly Disagree, 4 point. From the questionnaire consisted of four sections A to E. Section A, demographic information of the respondents; section B contains information on the 1. To determine the current methods of collection waste disposal in Bauchi metropolis Bauchi state; section C, concern with the 2. To assess of the role of management waste collection and disposal in Bauchi metropolis Bauchi state concern with D, contains information on the 3. To examine the Major types of waste generated in households of respondents for waste collection and disposal in Bauchi metropolis Bauchi state, while, section E. contains information on the 4. To determine the waste management practices for waste collection and disposal in Bauchi metropolis Bauchi state.

Instrument Reliability and Validity

In order to ensure the face and content validity of the instrument, the researcher structured questionnaire will be submitted to supervisor for vetting so as to ensure their appropriateness, relevance and clarity. Test-re-test reliability method will be employed to establish the reliability of this research instrument. According to (Watson & Petrie, 2010), in test-re-test reliability, the same measuring instrument was used to obtain two separate measurements on the same population at different times. The higher the degree of correlation between the two measurements, the higher the reliability of the instrument.

Data Analysis

The data will be collected and analyzed using descriptive statistics of frequency in data analysis. This entails the used of frequency curves and percentages to and presented into table. Descriptive statistics of frequencies, percentages, means and standard deviations. Inferential statistics of Pearson Product Moment Correlation Coefficient analysis was used to test the hypotheses. All tests were carried out at 0.05 alpha level of significance. This statistic is suitable for this study, this is because, and the study is on assessing the management of waste collection and disposal in Bauchi metropolis Bauchi state. The purpose of correlation analysis to establish the association between the dependent and independent variables. Regression analysis will also be conducted to determine the relationship between independents variable and independent variable. The process of determining which independent the current methods of collection waste disposal, the role of management waste collection, the Major types of waste generated in households of respondents of waste collection and the Waste management practices of waste collection dependent variable ware disposal on the role of management waste collection and disposal however the statistics intuitive consist of graphs basics, questions testing using regression ANOVA probability time series model.

Result and Discussion

The chapter presents the results of the study based on the data collected using the methodology espoused in the previous chapter. The data was analyzed using the Statistical Package for Solutions and Services (SPSS). This chapter is organized into two main sections. The first sections consist of the demographic information of respondents and management of waste collection and disposal in the study. In the second section, the main findings on the current methods of collection waste disposal, the role of management waste collection and disposal, Major types of waste generated in households of respondents for waste collection and disposal, Waste management practices of waste collection and disposal in Bauchi metropolis management of waste collection are presented. This is followed by the measurement of the gap between current methods of collection, role of management waste collection, Major types of waste generated in households of respondents, waste management practices of waste collection and disposal of the using the regression analysis for measure. The final section entails the discussion of the results on management of waste collection and disposal to overcoming the current methods of collection, role of management waste collection, Major types of waste generated in households of respondents, Waste management practices and stability for management waste collection.

Demographic Information

The questionnaire was designed to firstly seek information about the respondents' gender, age, university educational level, and their account type. This is to give a brief idea of the kind of respondents that were available for the research. Three hundred and eight questionnaires were distributed but only 282 were collected and analyzed giving a response rate of 92%.

Data Analysis

Information on Demographic Characteristic of the Respondents

Less than 20 years. Females were made up of 63.8% (180) of the respondents while 36.2 (102) were males. Also 97.2% (274) while 60.3% (170) had tertiary education. In Table 2, majority of the respondents 90.1%, (254) were aware of waste management. Open dumping

was the most popular method of waste disposal known to the respondents 279 (98.9%), followed by Burning 94.7% (267). Incineration recorded the least known waste disposal method. Majority of the respondents 97.5% (275) agreed that proper waste disposal can better their health and 98.9 agreed that the practice of waste management is of great importance. Also 99.3% (280) of respondents specified that waste management promotes good health and healthy environment Majority of the respondents 91.5% (258) do not have licensed waste management firm in their area while only 5% (14) reported the presence of waste management policy in their local government. On overall attitude rating, 79.8% (225) had excellent attitude while 18.4% (52) had good attitude towards waste management.

Table 1. Demographic Information

S/N	Items	Category	Frequency	Percentage (%)
1	Gender	Male	102	36.2
		Female	180	63.8
		Total	282	100
2	Age (years) in Range	Less than 20	11	3.9
		21 - 30	124	43.9
		31 - 40	97	34.4
		41 - 50	34	12.1
		Above 50	16	5.7
		Total	282	100
3	Educational Level	SSCE	21	7.4
		Diploma	86	30.5
		HND/Degree	137	48.6
		Master	31	11
		PhD	7	2.5
		Total	282	100
4	Do you have awareness of waste management services	Yes	195	69.1
		No	87	30.9
		Total	282	100

Source: Research Survey (2024)

Table 2. Current Methods of Waste Collection and Disposal

S/N	Items	Category	Frequency	Percentage (%)
1	Method of Waste Collection	Bags	121	42.9
		Containers with covers	73	25.9
		Containers without covers	43	15.3
		Hand carrying	114	40.4
		Wheel barrow	61	21.6
		Open truck	45	16
		Closed trucks	38	13.5
		Others	24	8.5
		Total	282	1000
2	Waste Disposal Methods	Open dumping	185	65.6
		Burning	202	71.6
		Burying	55	19.5
		Composting	43	15.3
		Land filling	31	11
		Incineration	9	3.2
		Burning and Burying	81	28.7
		Hog feeding	19	6.7
		Others	12	4.3
		Total	282	100
3	Waste Separation Before Disposal	Yes	68	24.1
		No	214	75.9
		Total	282	100
4	Frequency of Waste Disposal	Every day	112	39.7
		Every alternate day	89	31.6
		Once a week	81	28.7
		Total	282	100

Source: research survey (2024)

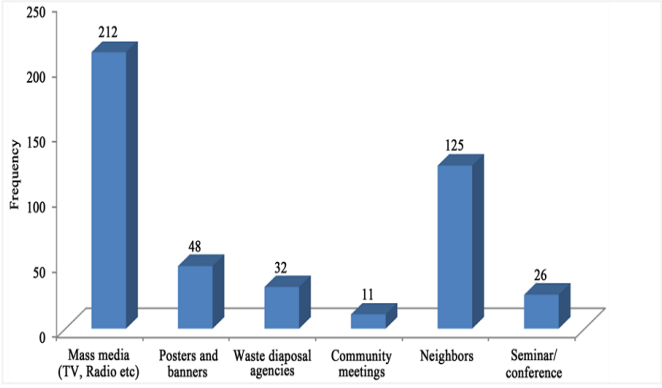

Figure 1. Depicts that the mass media (TV, radio, newspaper)

Was the commonest source of information 75.2% (212) on waste management, followed by neighbors' 44.3% (125) community meetings recorded the least common means 3.9% (11). Table 3 shows that majority of respondents collect their waste in containers with covers 51.4% (145) and 88.3% (249) do not separate their waste before disposal. About 50.4% (142) dispose their waste every alternate day. The commonest methods of solid and liquid waste disposal include open dumping 66.3% (187) and water carriage 86.2% (243) and water closet 95.4% (269) respectively. Majority of respondents 75.9% (214) said they had a centralized place for dumping solid waste while 28% (198) used the wheel barrow for transportation of waste to final dump site.

Table 3. Source of Information on Waste Management

S/N	Items	Category	Frequency	Percentage (%)
1	Awareness	Yes	254	90.1
		No	28	9.9
		Total	282	100
2	Knowledge of Waste Management Methods	Open dumping	267	94.7
		Burning	202	71.6
		Burying	55	19.5
		Composting	43	15.3
		Land filling	15	5.3
		Incineration	5	1.8
		Total	282	100
3	Attitude towards Waste Management	Poor	275	97.5
		Average/fair	2	0.7
		Good	5	1.8
		Excellent	0	0
		Has effect on health	279	98.9
		Has no effect on health	3	1.1
		Total	282	100
4	Waste Management is Important	I don't know	211	74.8
		Specific attitude	14	5
		I do not know if it's important or not	24	8.5
		Waste management leads to good health	258	91.5
		Waste management leads to healthy environment	11	3.9
		Total	282	100
5	Government Policy on Waste Management	Have waste management plan/policy by the LGA	130	46.1
		Have licensed waste management firm	72	25.5
		Do not have licensed waste management firm	51	18.1
		Had any form of training on waste management	29	10.3
		Total	282	100

Source: Research survey (2024)

Table 4: shows the effect of gender and education on knowledge, attitude and practice of waste management. Females are significantly more aware of waste management than males ($p = 0.025$). Females are also significantly more knowledgeable than males about open dumping ($p < 0.05$) while males know more about composting ($p < 0.05$) and land filling ($p < 0.05$).

Females displayed better attitude to waste management than males with gradations, "good" ($p < 0.05$) and "excellent" ($p < 0.05$) significantly tilting in favor of the females. Males are more likely to carry waste with wheel barrow than females while the reverse is the case for hand carrying of waste, $p < 0.05$ each.

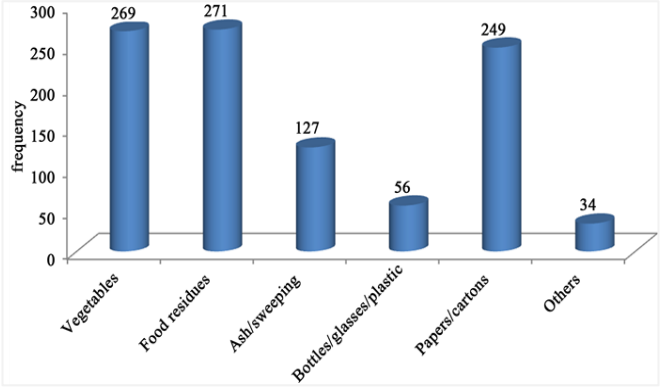

Figure 2. Awareness, knowledge and attitude towards waste management

Figure 2 shows that the major type of waste generated from household is food residues (279), followed by vegetable (269) and papers/cartons (249). This study also showed that the major type of waste generated from households was food residues 271 (97.1%), followed by vegetable 269 (95.4%). This is similar to findings of the work done by Modebe et al. on household solid waste management in Awka in which the commonest type of waste generated was garbage (100%), followed by cellophane bags (99%). It is however different and higher than the household waste generated in the City of Johannesburg, South Africa in which 67% were household wastes, 23% from commercial activities and 10% industrial activities. A good number of our respondents 145 (51.4%) collect their waste in containers with covers and majority do not separate their waste before disposal; 249 (88.3%). This is in line with outcome of study done by Modebe et al., which reported that 85% of households in Awka stored their waste in closed containers outside the house and majority of the respondents (87.8) did not sort their waste prior to disposal. A study in South Africa recorded a similar finding that waste collected is not sorted into recyclables or non-recyclables and is all disposed of at the final dumpsite with no sorting. A recycling programme could be introduced by the authorities as studies have shown that 60% of waste generated in the households can be recycled, if proper waste recycling system is put into place.

Table 4. Types of Waste Generated in Households for Waste Collection and Disposal

S/N	Items	Category	Frequency	Percentage (%)
1	Organic Waste (Biodegradable Waste)	Burning	202	71.6
		Burying	55	19.5
		Composting	43	15.3
		Land filling	15	5.3
		Incineration	5	1.8
		Total	282	100
2	Plastic Waste	Poor	275	97.5
		Average/fair	2	0.7
		Good	5	1.8
		Excellent	0	0
		Has effect on health	279	98.9
		Has no effect on health	3	1.1
		Total	282	1000
3	Paper and Cardboard Waste	Hand carrying	114	40.4
		Closed trucks	38	13.5
		Open truck	45	16
		Wheel barrow	61	21.6
		Others	24	8.5
		Total	282	100
4	Glass Waste	Bags	121	42.9
		Containers with covers	73	25.9
		Containers without covers	43	15.3
		Waste separation before disposal	68	24.1
		No waste separation before disposal	214	75.9
		Total	282	100
5	Electronic Waste (E-waste)	Open dumping	267	94.7
		Burning	202	71.6
		Burying	55	19.5
		Composting	43	15.3
		Land filling	15	5.3
		Incineration	5	1.8
		Total	282	100

Source: Research Survey (2024)

These modern landfills are often under strict federal and state regulations and are therefore specially sited, designed and operationalized to ensure environmental performance (Mihai et al., 2021). However, it is different in some parts of Nigeria, where the unsanitary landfills are not subject to regulations, and are usually sited for convenience, such as the presence of a pre-existing hole (created from sand mining activities) into which waste could be deposited (Agboola et al., 2020). In Lagos, Nigeria, some of these open pits are located near residential housing and therefore represent a threat to human health and the environment. Also a South African study has found that out of the 5 million tons of waste produced every year, only 5% is disposed of in designated sites, which implies that most of the waste in that country is deposited in environmentally unsafe sites (Ng et al., 2023).

Table 5. Waste Management Practices

S/N	Item	Category	Frequency	Percentage (%)
1	Knowledge of Waste Management Methods	Burning	102	71.60
		Burying	55	19.50
		Composting	43	15.30
		Land filling	15	5.30
		Incineration Total	282	100
2	Overall Attitude towards Waste Management	Burning	102	71.60
		Poor	275	97.50
		Average/fair	2	0.70
		Good	5	1.80
		Excellent	0	0
		Has effect on health	279	98.90
		Has no effect on health	3	1.10
		Total	282	100
3	Method of Waste Transport to Final Disposal Site	Hand carrying	114	40.40
		Closed trucks	38	13.50
		Open truck	45	16
		Wheel barrow	61	21.60
		Others	24	8.50
		Total	282	100
4	Method of Waste Collection	Bags	121	42.90
		Containers with covers	73	25.90
		Containers without covers	43	15.30
		Waste separation before disposal	68	24.10
		No waste separation before disposal	214	75.90
		Total	282	100
5	Knowledge of Waste Management Methods	Open dumping	267	94.70
		Burning	202	71.60
		Burying	55	19.50
		Composting	43	15.30
		Land filling	15	5.30
		Incineration	5	1.80
		Total	282	100

The most popular methods of waste disposal known to the respondents were open dumping (27.9) (98.94%) followed by burning 267 (94.68) while the least known method was incineration. This scenario is not very different from findings in other studies. Open dumping remains the simplest and the most commonly used method for disposing municipal solid waste (Thaiyal Nayahi et al., 2022). In most low to medium income developing nations like Nigeria, almost 100 percent of generated waste goes to landfills (Alao et al., 2022). In spite of the recycling and composting of greater amounts of municipal solid waste in the United States in the last couple of years, the majority of waste generated still end up in landfills (Kaur et al., 2021; Ramadan & Sembiring, 2023). While wastes are deposited in open dumps in developing nations; these have become obsolete in the developed countries. Sanitary landfills which are well engineered facilities (with liners, leachate collection/ treatment system, and gas collection system) are now used to ensure the protection of human health and the environment.

Table 6. ANOVA[a] Respondent on Current Methods, Information on Waste Management, Major Types of Waste Generated in Households, Waste Management Practices, Waste Collection and Disposal

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.346	3	6.115	35.078	.000[b]
	Residual	52.650	302	.174		
	Total	70.997	305			

Source: Data gathered from the field

Socio-demographic variables current methods, attitude and practice of waste management *Significant in information on waste management* *Significant in major types of waste generated in households. Significant in waste collection and disposal. The educated respondents are significantly more likely than the less educated to dispose of waste through composting ($p < 0.05$) and incineration ($p < 0.025$). However, the less educated are more likely to dispose of refuse by open dumping ($p < 0.05$), burning and burying ($p < 0.05$), and also more likely to hand carry refuse ($p < 0.025$) and transport refuse by wheel barrow ($p < 0.025$) than the more educated would do. In this study, females were found to be more aware and knowledgeable about waste management than males. A Togolese study on the intersection of gender, education and health, recognizes the pivotal role of women in household cleanliness and sanitation. It is therefore not surprising that the female respondents knew so much about basic waste management principles. A large number of the respondents had a positive attitude towards waste management as 275 (97.50%) of the respondents agreed that proper waste disposal can better their health and 279 (98.90%) believed that the practices of waste management is of great importance.

Also 280 (99.3) of respondents specified that waste management promotes good health and healthy environment. This is line with the study carried out by (Schenk et al., 2023), which showed that respondents in university area of Ogbomso had a positive attitude towards waste management as 82.0% agreed that waste disposal into drains and around the surroundings is unhealthy and can be disastrous to health. This study has created a general picture of poor waste management practices among residents of Bauchi Metropolis because 66.3% of respondents practiced open dumping while 176 (62.4%) preferred to burn their wastes. These are not ideal since they constitute potential sources of infection, air pollution as well as constitute aesthetic blithe. Which showed that majority of the respondents in Awka (73%) disposed their waste through government waste management agency and only 27% dumped theirs in unauthorized area. This is an indication that the residents of Awka enjoy the benefit of existing strong and functional government waste management agency.

The result is a better coordinated waste management practice in Awka than obtains in Bauchi Metropolis. Majority of the respondents (75.9%) have a centralized place for dumping solid waste and the commonest means of transports of waste was by wheel barrow (70.2%). This finding is however at variance with what obtains in South Africa where domestic waste is collected weekly. About 91.4% of our study respondents do not have licensed waste management firm in their area. To worsen an already bad situation, almost all the respondents (96.1%) have not had any formal training on waste management and 95.0% of respondents do not have waste management plan/policy provided by the local government area/council. This unfortunate situation is an indication of the lack of political will and commitment towards such important statutory function and activity of the local governments, aggravated by total absence of plan for storage, collection, transportation and final.

Table 9. Respondent Coefficients[a] (Source: Data gathered from the field)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.723	.207	.221	3.499	.001
	Current methods	.319	.056	.298	5.659	.000
	Source of information	.354	.061	.324	5.830	.000
	Households generated Waste	.004	.064	.003	.058	.957
	management practices	.002	.067	.005	.062	.954

A majority of user satisfaction about significant value on 001 of the females were found to be more aware and knowledgeable about waste management than males. A Togolese study on the intersection of gender, education and health, recognizes the pivotal role of women in household cleanliness and sanitation (Pouramin et al., 2020). It is therefore not surprising that the female respondents knew so much about basic waste management principles.

Discussion

The waste management practices in Bauchi metropolis are generally inadequate, with many residents relying on unsustainable methods. The study

found that there is a lack of structured waste collection systems, and the practice of separating waste before disposal is minimal. Collection practices on waste is mostly collected in bags or containers, with a significant number of residents transporting waste to disposal sites by hand or using wheelbarrows. Separation and recycling on waste separation before disposal is practiced by only 24.1% of respondents, indicating a low level of engagement in recycling or other sustainable practices. Final disposal of waste often involves environmentally harmful methods such as open dumping and burning, which are prevalent due to the absence of formal waste management systems.

Quality of recycled plastic vary widely in terms of color, mixed materials and density meanwhile, through the different types of plastic materials, PET recycling framework can also be considered as an acceptable method for preparation of raw material. High quality recycled PET cab be used as a raw material in different industries (Damayanti & Wu, 2021). According to (Naderi Kalali et al., 2023), higher quality and process of separation in recycling plastic such as tertiary and quaternary treatment scheme following primary and secondary treatment technologies and schedules, could be considered as a robust, worse scientific and traditional investigation. Preliminary researches such as (DuBois et al., 2013), tried chemical treatment for recycling. Manufacturing high quality carbon for phenol adsorption. Recent researches are focused on hydrocyclon is separation froth flotation as recycling technology (Zhang et al., 2025), and using waste PETs as filler in phenolic resin mold (Kunlere & Shah, 2023). Worldwide plastic production and power application for producing in plastic manufactories consumes 8 percent of total oil production. In Europe and USA, plastic recycling has reached to 26% and 9% respectively, which clearly shows that recycling industry have great scope for improvement (Kunlere & Shah, 2023).

Awareness and knowledge of waste disposal is influenced by many factors as pointed out in a work done by Margaret Banga on household knowledge, attitudes and practices in solid waste segregation and recycling in urban Kampala. It indicated that the participation in solid waste separation activities depended on the level of awareness of recycling activities in the area, household income, educational level and gender. Anokye et al. (2024) and Kassab et al. (2023), studied the waste management awareness knowledge and practices of secondary school teachers in Ogun state and it showed that teachers were aware and knowledgeable about waste management even though they possessed negative waste management practices. There seems to be appreciable awareness and knowledge about waste disposal among people in Nigeria but most of them are only aware of the crude and traditional methods and are oblivious of the modern methods such as incineration and recycling. The attitude of people towards waste management can be affected by their level of knowledge and awareness of waste management and it has been reported that homes with waste bins engage more in proper way of storing waste than homes without waste bins. A Nigerian study about attitude towards recycling and waste management showed no significant effect of gender, employment and educational statuses, on willingness to recycle.

Human wastes are great contributors of environmental health hazards. Poor waste practices lead to contamination of edible products thereby increasing the burden of infection and diseases among the citizens. About 1.3 billion tons of waste are generated globally, 0.035% being generated by Nigeria. About 85.8% of Nigerian waste is generated by households. It is estimated that an average Nigerian in the urban or rural areas generates about 0.49 kg of solid waste per day with household and commercial centres contributing almost 10% of total urban waste burden. of this about two thirds of wastes are dumped indiscriminately on the streets and in the drains thus posing serious environmental health hazards (Abubakar et al., 2022). Furthermore, poor waste management and disposal could lead to various diseases, infections and infestation and these include fly transmitted diseases like myiasis, diarrhea, typhoid, cholera; rodent transmitted disease like Lassa fever plague, leptospirosis, murine typhus; mosquito borne diseases such as malaria, yellow fever, filariasis, and dengue hemorrhagic fever. Also gases like methane, carbon dioxide, hydrogen sulphide and mercury vapor emitted from land fill site can constitute air contaminants and pollution.

Another problem people face in proper waste management and disposal is the absence of storage facilities (waste bins with tight fitted covers) in some houses which lead to littering of refuse around the house, worsened by the absence of drainage systems in such houses. Even where the drains are available they are either constructed without a gradient or not properly maintained as they are clogged or blocked with sand or other debris thus preventing se- wage drainage. The waste management sector is facing numerous challenges globally. Huge amounts of municipal and industrial wastes are produced daily worldwide as a consequence of human activities. It is estimated that about 3.4-4 billion tons of municipal and industrial solid wastes and up to 300 million tons of hazardous waste are produced annually worldwide. As the volume and complexity of solid waste increase, the environmental risk posed by the waste products including human health risks, ecosystem degradation, contamination of soils and water, as well as, greenhouse gas emissions, global

warming, and climate change become more seriou). These risks are more obvious in the developing countries of the world where there are greater consumers of industrial materials, a higher percentage of outdated and obsolete technological products than in the developed countries. This is due in part to the waste products being shipped to developing countries, such as used refrigerators, hazardous industrial wastes, second-hand clothes, cars, and shoes among others.

Against the background of these identified problems, this research further assessed waste management practices, factors that influenced these practices and provided solution to avert/prevent the complications which arose from poor waste management. This research helped to ascertain the level of awareness, knowledge and attitude of people towards waste management practices. It also helped in finding out the prevailing methods of household waste collection and disposal system adopted by Bauchi state Council. Globally, the waste management sector is facing numerous challenges. Pheakdey et al. (2022) noted challenges from a lack of a declaration of national environmental emergency to a needed review and popularization of existing laws, regulation and policies. They also highlighted the need to encourage public participation at both the level of formulation and implementation and waste management planning for the entire nation covering all kinds of waste.

Conclusion

The study was carried out in Bauchi Metropolis and considered the waste management practices among the residents. It looked at the level of awareness and knowledge, attitude towards waste management and the methods of waste disposal. The study found that large numbers of the residents were aware of waste management and also knowledgeable about various methods of waste disposal. Majority of the residents had a positive attitude towards proper waste management, even though there was evidence to the contrary considering the discovery that the most prevalent methods of disposal were open dumping and burning. These are inappropriate as they pollute and constitute aesthetic blithe in the environment. Proper waste disposal management is essential to sustain healthy living conditions in any environment. Strict adherence to appropriate waste management practices in any community will insulate the inhabitants from detrimental and hazardous environmental conditions and improve the living standard of the people. The management of waste collection and disposal in Bauchi metropolis is currently insufficient to meet the needs of the growing population. The reliance on traditional methods, such as open dumping and burning, poses significant risks to public health and the environment. The lack of formal waste management services and the low level of awareness regarding sustainable waste management practices contribute to the ongoing challenges in the region. The study concludes that there is an urgent need for improved waste management strategies in Bauchi metropolis. These should include the establishment of formal waste collection services, increased public awareness campaigns, and the promotion of sustainable practices such as waste separation and recycling.

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