

Public Sector Management of Municipal Solid Waste in an Emerging Metropolitan Setting

^aBabatunde, I. O. and ^bOjetunde, I.

^aDepartment of Estate Management and Valuation, Niger State Polytechnic, Zungeru, Nigeria

^bDepartment of Estate Management and Valuation, Federal University of Technology, Minna, Nigeria

*Corresponding email: babatundeiyijide@yahoo.co.uk

Abstract

This study examined issues in municipal waste management as varied as sources of waste, level of compliance with waste management policies and the extent of public satisfaction with waste management service in an emerging metropolitan setting in Nigeria. Utilizing a cross-sectional approach, data were collected through structured questionnaires, backed up with interviews from 42 senior staff of Niger State Environmental Protection Agency, 19 sanitary inspectors, 527 household-heads and 210 commercial business operators in Minna metropolis – the case study area. For the purpose of analysis, the data were analysed by the use of frequency count, 5-point Likert scale, mean score, relative importance index and the Spearman rank correlation test. The empirical findings from this paper revealed that markets, residential properties in high density areas and commercial properties were the three topmost ranked sources of solid waste generation, while residential properties in high density areas, schools and hotels respectively were the least generating sources of waste in the study area. Based on the perception of the households, the study also showed a high proportion of dissatisfaction with the public waste management services in the study area. This study concluded that some of the existing waste management practices must be further strengthened by the appropriate authorities. For example, our study was indicative of the lack of enforcement of waste management standards by the appropriate authority, poor quality of services provided, and the carefree attitude of the public towards waste management as severe bottlenecks to waste management services in Minna. As a recommendation, these challenges merit consideration from policy makers and the state waste management agency so as to evolve a sustainable waste management practice for Minna metropolis.

Keywords: Municipal Waste, NISEPA, Solid Waste, Waste Management, Minna

INTRODUCTION

As hazardous as municipal solid waste may seem to human health, it can be beneficial to the society if it is well processed and managed (Singh *et al.*, 2018). Waste management has however become a grave sanitation and economic challenge in many Nigerian cities as a result of its colossal level of generation and poor management standards (Ejaz *et al.*, 2010; Adeoye *et al.*, 2011; Ike *et al.*, 2018). Grounds articulated for improper waste management by related studies included poor methods of collection and disposal; management deficiencies; and lack of appropriate legislations and policies, which often lack proper waste-source articulation, strategies on waste management, poor implementation strategies and inadequate funding. People that lived near waste dumps had also been said to be infected by epidemic diseases such as gastrointestinal virus, diarrhea and cholera among others (Giusti, 2009). Poor waste management had also caused environmental disasters such as land and water pollution (Alam & Ahmade, 2013; Ogundele *et al.*, 2018). The implication of the emergence of these diseases and disasters was that the resources which ought to have been used to develop infrastructure, education and the economy were used for treatment, palliatives and repairs.

Sources and types of waste, legislations, management policies, implementation strategies and public satisfaction with waste management service had been observed to be fundamental to effective waste

management practice (Adebayo, 2000; Adewole, 2009; Oyeniya, 2011; Onyenekenwa *et al.*, 2011; Afangideh & Atu, 2012; Agwu, 2012; Fafioye & John-Dewole, 2013). Majority of these studies were conducted in southern part of Nigeria. The few of them which were carried out in an emerging city - Minna - such as Aderemi *et al.* (2011) and Ogunbode *et al.* (2013) did not sufficiently discuss the solid waste management service of Niger State Environmental Protection Agency (NISEPA) on the aforementioned grounds.

Arising from the foregoing, this present study seeks to examine the sources of municipal solid waste in Minna; the policies and strategies of NISEPA adopts in waste collection and disposal; and the satisfaction of the public with its waste management service in the metropolis.

Theoretical Framework

A necessity for a waste management agency is to identify and recognize all the types and sources of waste in its domain and thereafter factor them into formulating policies that could appropriately deal with them (Sridhar *et al.*, 2017). This suggests that sources and types of waste in any urban or metropolitan setting should be adequately identified and factored into policy formulation if the aim of waste management is to be achieved. The theoretical approach herein articulated in this study therefore hinges on waste management issues such as sources of waste, effective management policies and sustainable implementation strategies for proper waste management service.

Sources of Waste and Policy Framework

Amasuomo and Baird (2016) reported that households, industrial houses, farms, commercial buildings, hospitals, eateries, markets, construction and mining sites among others as the sources of waste in developing countries. Sridhar *et al.* (2017) also quoted several Nigerian national legislations on waste management such as the Federal Environmental Protection Act, State Environmental Protection edicts, National Environmental Standards and Regulations Enforcement Agency Act and National Oil Spill Detection and Response Agency Act to articulate waste sources and their appropriate management policy regulations. Table 1 is an adapted compilation from Sridhar *et al.* (2017).

Sustainable Public Policies for Solid Waste Management

As aptly noted by the Department for Environmental Food and Rural Affairs, DEFRA (2011), policies on solid waste management should follow a hierarchy of preference from prevention, reduction, reuse, recycling to energy recovery and disposal in that order. To start with, the prevention of waste or zero waste should be premised on sustainable behaviour and consumption with product stewardship and absolute resource recovery without landfill and incineration (Zaman & Lehmann, 2011). The research conducted by Zaman (2014) showed that waste reduction connotes the system of using less material and energy to curtail waste generation in order to conserve natural resources. The author further noted that waste reduction could be done by the application of reusable bags for shopping; buying food that could be eaten completely; composting organic waste instead of throwing it into thrash bin and later returning it to the garden; and learning to repair damaged items rather than discarding them where necessary.

Unlike waste reduction, reuse of waste connotes the act of using a waste product again for the same or a different purpose without further processing (SA-EPA, 2019). Under this concept, people are advised to only buy what they could effectively use so as to save costs, conserve resources and satisfy human urge to be creative (SA-EPA, 2019). The recent study by Abdul-rahman (2014) cited instances of reuse of waste to include containers being reused at home and for school projects or giving of outgrown clothing to friends or charity or offering old furniture and household items to people in need.

Recycling of waste represents the process of collecting and processing waste into new products with the aim of reducing the amount of waste sent to landfills and incinerators (US-EPA, 2017). The exercise usually increases economic activities, conserves resources and saves energy (US-EPA, 2017).

Table 1: Nigerian National Policies on the Management of Various Types of Waste

S/N	Waste type	Sources	Management policy
1	Municipal solid waste, semi-solids and liquids (residential, commercial, government offices)	Human activities	Reduce, reuse, recycle, dispose
2	Non-living nutrient runoffs	Fertilizers	Reduce, recycle
3	Demolition waste, quarry rejects	Construction sites, quarries	Reuse, recycle, dispose
4	Hazardous expired drugs, chemical toxins, contaminated sludge, incineration ash, corrosive, reactive toxins	Industries, healthcare facilities, households, waste disposal facilities	Reduce, dispose; for healthcare wastes incineration is adopted
5	Radioactive waste	Spent fuel from reactors, tailings from the mining /refining of uranium, medical/academic	Reduce, reuse, dispose
6	Electronic waste (e- waste)	Cell phones, computers, etc.	Reduce, recycle
7	Mixed wastes from livestock	Livestock	Recycle
8	Synthetic chemical wastes	Pesticides, biocides, fuel additives, cosmetics, etc.	Reduce, dispose
9	Waste products from combustion (greenhouse gases)	Vehicle engines, sea craft, energy production	Reduce, alternate fuel use

Source: Adapted from Sridhar et al. (2017).

Energy recovery emanating from non-recyclable waste is done through combustion which is described by US- EPA (2017) as entailing burning such waste to boil water which powers steam generators that subsequently produces electric energy and heat to be used in homes, businesses, institutions and industries. Disposal of waste, the final stage of its management, comprised of waste treatment prior to disposal; incineration of waste with or without energy recovery; depositing of waste to land or water; discharge of liquid waste to sewer permanently and indefinite or long-term storage of waste (US-EPA, 2017).

Enduring Implementation Strategies

A sustainable strategy stemmed from organizational desire to design a practicable model that would set targets of attainment in waste prevention, minimization, reuse, treatment and eventual disposal (UOW, 2014). Consenting with the latter, NEMA (2015) instituted a solid waste management implementation strategy which emphasized the following:

- a) Legislations and economic policies reforms which harmonize national and sub- national laws with enforcement of standards;
- b) Public education the suitable options of managing waste through well designed sensitization materials in media houses;
- c) Mounting waste segregation campaigns with government agencies providing segregation equipment and transport support arrangement;
- d) Encouraging public private partnership for the purpose of establishing modern energy recovery plants;
- e) Promoting modern technologies in waste recycling and composting with attendant exploration of markets for recovered materials;

- f) Installation of waste infrastructure such as collection facilities, transport support system for segregated items, transfer stations, standard incinerators with energy recovery facilities; establishment of composting and recycling facilities and sanitary landfills; and
- g) Phasing out waste burning and illegal dump sites by linking up the activities of the informal sector with the formal recycling industries through the establishment of operational zones

Firdaus (2010) and Oyedele (2016) also suggested the following measures as sound implementation strategies for solid waste management:

- a) Participation of the poorest social groups in the society as scrap pickers;
- b) Involvement of non-governmental organizations that have more labour-market background such as working with street children and women; informal rag-pickers and scrap dealers for collection, segregation and transportation of waste to recycling points.
- c) Customers enumeration and mapping;
- d) Distribution of waste bags, bins and carts by waste managers; and
- e) Monitoring and evaluation of waste management by neutral body (consultants) or government (project-owner) where government is not the waste collector.

Public Satisfaction with Waste Management

Firdaus (2010) and Oyedele (2016) argued that for any waste management policy and strategy to be successful, the populace should not only be involved but must be satisfied with its output. Shriwas *et al.* (2018) discovered that for the public to be satisfied with the policies and strategies of waste management in developing countries, such practices must ensure transparency and high quality of services; adequacy of vehicles and equipment used; cleanliness of the city/ neighborhoods; regularity of waste collection services; moderate and affordable fees for purchase of bins and collection services; neatness and good conduct of collection crew; proper and efficient handling of waste; level of response to complaint; periodic education of the public on waste management; adequacy of legal provisions on waste management; treatment of employees by waste management authorities; availability of resources; availability of recycling facilities; attitude of households to waste management and adequacy of waste dumps. The public should also be made to benefit economically from the services of the waste managers.

MATERIALS AND METHODS

Study Area

The data for this study were drawn from Minna, the administrative and capital city of Niger State in Nigeria. The city is located in the North-Central geopolitical zone of Nigeria and covers an approximate land area of 88 square kilometers. As shown in Figure 1, it lies on latitude 9° 25' N and 9° 40' N of the equator and longitude 6° 24' E and 6°36' E of the meridian. It is connected to major neighbouring cities. By road, Minna is approximately 150km apart from the Federal Capital City (Abuja), 90km from Bida, 100km from Suleja and 300km from Kaduna (Sanusi, 2006). Minna is connected by rail to both Kano state in the north and Lagos state in the south. It also has an airport. Minna city is home to 541,672 people based on the NPC (2006) population projection at 3.41% annual population growth rate.

Research Design and Study Population

A case study method with focus on Minna metropolis was adopted. The study population comprised of NISEPA senior staff, sanitary inspectors, household heads in residential areas of F-layout; Tunga and Bosso Estates; Barkin Sale, Tudun Wada North, Angwan Daji, Jikpan, Dutsen Kura and Bosso Town (as low, medium and high-density residential neighbourhoods) and business operators in commercial districts of Bosso Road, Paiko Road and Minna CBD (the most prominent business locations in the city).

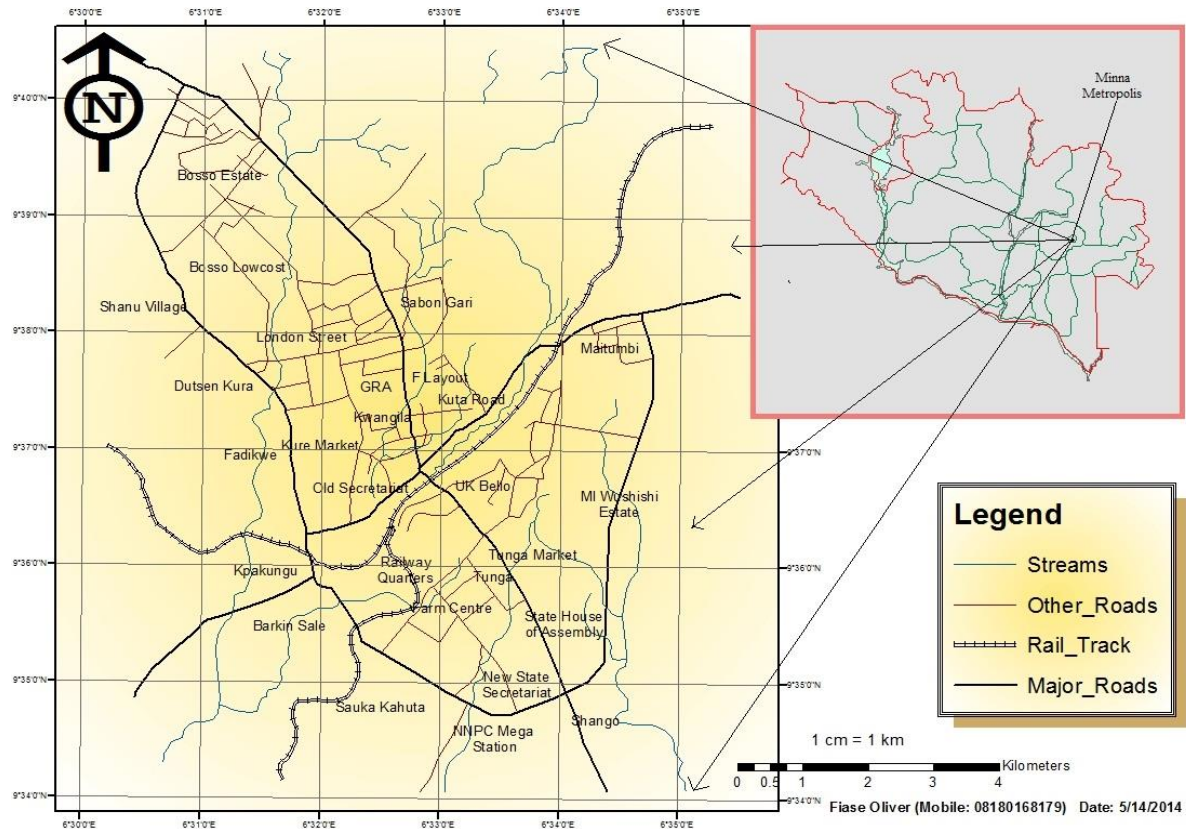


Figure 1: Map of Minna Metropolis

Sample Frame and Sample Size

The sample frame comprised the lists of the senior staff of NISEPA and sanitary inspectors which were obtained from their Director of Personnel and Area Officer respectively. The number of households was extracted from National Population Commission (2006) census of households and complemented with that employed in Owoye *et al.* (2018), while the number of plazas where business owners operate in the city was obtained through the researcher’s field enumeration.

In view of the small number of the 42 NISEPA senior staff and the 29 sanitary inspectors, all of them were purposively enumerated for the study. Using convenience sampling, our study sample also included 210 business operators domiciled in 21 commercial plazas around the Minna CBD, Bosso and Paiko road.

In sampling the households, only 9 of the 25 residential neighbourhoods where formal statistics of households were available were sampled. Stratified random sampling technique was however used to select both the medium and high density residential neighbourhoods. One medium density residential neighbourhood each was selected from Minna West and Minna East districts. Tunga Estate in the West and Bosso Estate in the East were selected through balloting. Two high density residential areas were also sampled, each from the western, central and eastern residential districts. One high density residential area in the extreme north and one in the extreme south of the districts were selected. This resulted in the selection of Tudun Wada North and Barkin Sale (in the west); Angwan Daji and Jikpan (in the central); Dutsen Kura and Bosso Town (in the east). Since F-layout was the only low-density residential neighbourhood with formal record, it was automatically selected.

Given a total population of 17764 households in all the 9 selected residential neighbourhoods, a sample of 527 households was determined using the Krejcie and Morgan formula for sample size determination (equation 1):

$$n = \frac{X^2 \cdot N \cdot P \cdot (1-P)}{[ME^2 \cdot (N-1)] + [X^2 \cdot P \cdot (1-P)]}$$

1

Where n is sample size to be determined; X^2 has a corresponding value of 1.96 at 95% confidence level; N is the total population (17764 households); P is the standard deviation of the total population (which in this case is 0.5) and ME is the margin of error that can be tolerated (4.5 percent).

Research Instruments

Structured close ended questionnaire and interview guides were the main instruments of data collection from the respondents. Three sets of questionnaires (one each for NISEPA senior staff, sanitary inspectors and household heads/ business operators) were adopted to collect primary data. Where the respondents could not complete them, the research-assistants read the questionnaire to them in the form of interview and completed it for them. Questionnaire designed for the ranking of waste sources and the magnitude of generation were measured by frequency statistics while five level Likert Scale of strongly disagree (SD=1); disagree (D=2); neutral (N=3); agree (A=4) strongly agree (SA=5) was used to measure NISEPA staff’s opinion on sustainable policies and implementation strategies for managing municipal solid waste in the metropolis. Similarly, five level Likert Scale of very dissatisfied (VD=1); dissatisfied (D=2); neutral (N=3); satisfied (S=4) very satisfied (VS=5) was used to measure the level of satisfaction of the public with the waste management service of NISEPA in the city. The questionnaire administered are shown in table 2.

Table 2: Questionnaire distributed and response rate

Respondents	Questionnaire distributed	Freq of response	% of respondents
NISEPA senior staff	42	29	69.00
Sanitary inspectors	19	10	53.00
Households	527	290	55.03
Commercial business operators	210	110	52.24

Out of the 42 NISEPA senior staff and 19 sanitary inspectors that the questionnaire were administered on, only 29 (69 percent) and 10 (53 percent) respectively completed and returned the questionnaire. Also, 110(52.24 percent) out of 210 business operators and 290(55.03 percent) of the 527 household-heads completed and returned them. In all, these response rates achieved were found suitable for further analysis.

Data Analysis

Both descriptive and inferential statistics were applied to analyze the data collected for the study. The descriptive statistics such as frequency counts, weighted scores, mean scores, relative importance index and ranking were employed. While inferential statistics such as Spearman rank correlation (rho) was used as tools of analysis of the collected data. Spearman rank correlation (rho) is computed as shown in eqn 2.

$$rho = 1 - \frac{6 \sum d^2}{(n^2-1)}$$

2

Where rho is the rank order correlation to be calculated and range from -1 to +1, $\sum d^2$ is the summation of the square of the deviation between the ranks and n is the number of observations in the sample. The results and discussions based on the analyses are presented next.

RESULTS AND DISCUSSION

Sources of Waste

The results on sources of waste in the metropolis based on the opinions of both the NISEPA senior staff and sanitary inspectors are shown in Table 3.

Table 3: NISEPA senior staff and sanitary inspectors’ perception on sources of solid waste in Minna

S/N	Sources of waste	W_N	RII_N	$Rank_N$	W_S	RII_S	$Ranks$
1	Residential properties in low density areas	93	0.29	9	26	0.33	9
2	Residential properties in medium density areas	204	0.64	4	62	0.56	6
3	Residential properties in high density areas	300	0.94	2	104	0.95	2
4	Commercial properties (shops & offices)	210	0.66	3	77	0.7	3
5	Markets (central and neighbourhood markets)	309	0.97	1	106	0.96	1
6	Government secretariats (institutional offices)	199	0.62	6	67	0.61	4
7	Factories (sawmills, food processing, plastic etc)	71	0.22	11	21	0.19	11
8	Hotels	112	0.35	8	44	0.4	7
9	Catering houses & eateries	201	0.63	5	65	0.59	5
10	Hospitals	142	0.45	7	41	0.37	8
11	Schools	72	0.23	10	35	0.32	10

Note: W_N and W_S are the weighted scores of NISEPA staff and sanitary inspectors respectively while RII_N and RII_S are their Relative Importance Indices.

The result presented in Table 2 revealed with a RII of 0.97, 0.94 and 0.66; and 0.96, 0.95 and 0.70 respectively that the two groups of respondents perceived that markets, residential properties in high density areas and commercial properties were the three top sources of solid waste. This further implied that these three sources which were ranked as 1st, 2nd and 3rd correspondingly were the biggest generators of municipal solid waste in Minna metropolis. Conversely, the preponderance of opinion based on the RIIs of two groups of respondents showed that residential properties in high density areas, schools and hotels respectively were the least generating sources of waste in the study area.

We further employed spearman rank order correlation (ρ) to examine the association between the level of agreement between the two groups of respondents concerning the sources and proportion of waste generation. The result of the spearman order correlation ($\rho = 0.955$; $p = 0.01$) is shown in Table 4. As the ρ of 0.955 is statistically significant at 99% level of probability, it shows that the level of agreement between the two groups did not occur by mere chance. Based on this finding, we concluded that a significant positive relationship exists between the opinions of NISEPA staff and the sanitary inspectors on the ranking of the magnitude of wastes generated by the accredited sources in the metropolis.

Table 4: Correlation of the opinions of NISEPA staff and sanitary inspectors

Variables	Opinions of NISEPA staff (N=10)	Opinions of Sanitary Inspector
Opinions of NISEPA staff	1.000	.955*
Opinions of Sanitary Inspector	.955*	1.000

*Correlation is significant at the 0.01 level (2-tailed).

Compliance Level with Policies and Implementation Strategies for Solid Waste Management

Table 5 displayed the result of the level of compliance of NISEPA with sustainable national policies and implementation strategies for solid waste management. The result in Table 4 indicated that NISEPA did not satisfactorily comply with the national standards on policy and sustainable implementation strategies on waste management. Based on the consensus opinion of the respondents, there exists some level of agreement with respect to the fact that agency only harmonized its policy with the national laws, reused livestock wastes and adopted mass media jingles as a means of public education on waste management.

Table 5: NISEPA’s level of compliance with the Nigerian sustainable policy

S/N	Managing waste, Types in compliance with sustainable policy and Implementation strategies	Frequency of responses					Weighted Score	Mean Score	Aggregate Opinion
		SD	D	N	A	SA			
1	Solid wastes from residential, commercial and institutional properties are reduced, reused, recycled before disposal	6	15	8	0	0	60	0.41	D
2	Electronic waste such as cell phones, sawmill & construction rejects are reused and recycled	6	15	8	0	0	60	0.41	D
3	National and sub- national laws are harmonized on waste management	0	0	0	25	4	120	0.83	A
4	Mixed wastes from livestock are usually reused	0	0	0	28	1	112	0.81	A
5	Participation of the poorest social groups in the society in SWM	29	0	0	0	0	29	0.20	SD
6	Involvement of NGOS, informal rag-pickers and scrap dealers in SWM	0	4	5	20	0	103	0.71	N
7	Engagement of neutral body (consultants) periodically to monitor waste managers	29	0	0	0	0	29	0.20	SD
8	Engaged in public private partnership for the establishment of modern energy recovery plants	29	0	0	0	0	29	0.20	SD
9	Customers enumeration and mapping	0	4	5	20	0	103	0.71	N
10	Public education through radio and television jingles	0	0	1	26	2	113	0.81	A

Note: SD=Strongly Disagree; D= Disagree; N= Neutral; A =Agree and SA=Strongly Agree

Public Satisfaction with Waste Management Service

The opinions of business operators and house-hold heads on their level of satisfaction with the waste management service of NISEPA in the city are presented in Table 6. Services that were satisfactory to the businessmen in their ranking order comprised of affordable charges of waste bins and collection; cleanliness of the municipal and low density residential areas; road for transporting wastes and public education on the enlightenment on waste management while the ones that were satisfactory to the household-heads in their ranking order comprised of affordable charges of waste bins, road for transporting wastes; and cleanliness of the municipal and low density residential areas. On the other hand, both groups perceived factor such as the enforcement of waste management standards, quality of services provided, the attitude of the public towards waste management as the least factors based on their level of satisfaction.

However, against the background that both groups expressed either neutral or dissatisfactory opinions on 11 out of the 15 services listed in the table 5, the level of association between the opinions of both groups were subjected to spearman coefficient analysis as depicted in Table 7. The result of the spearman correlation analysis ($\rho = 0.977$; $p= 0.01$), implies a significant positive relationship exists between the opinions of business operators and households on the ranking of the satisfaction of the two groups on the

service of NISEPA in the management of municipal solid waste in Minna Metropolis. We therefore conclude that this empirical finding is not due to any oddity in the sample.

Table 6: Satisfaction level of business operators and households on NISEPA’s waste management service

S/N	Efficacy of waste management service of NISEPA	Business Operators		Household Heads		Rating Scale and Rank	
		W_B	M_B	W_H	M_H	R_{GB} R_B	R_{GH} R_H
1	Transparency of waste management service	285	2.59	3.01	N 9	D10	3.01
2	Adequacy of vehicles and equipment used	275	2.50	2.08	D 12	D 11	2.08
3	Skills, behaviour and tidiness of crew	340	3.09	3.55	N 5	N 6	3.55
4	Nearness of waste collection points to disposal site	354	3.22	3.70	N 4	N 5	3.70
5	Response to complaint	312	2.84	2.58	D 10	D 9	2.58
6	Cleanliness of the municipal and low density residential areas	472	4.29	4.24	S 3	S 2	4.24
7	Cleanliness of medium and high density residential areas	275	2,50	2.41	D 11	D 11	2.41
8	Affordable charges of waste bins and collection	486	4.42	4.44	S 1	S 1	4.44
9	Public education and enlightenment on waste management	446	4.06	3.51	N 6	S 4	3.51
10	Quality of services provided	251	2.28	1.94	VD 14	D 13	1.94
11	Adequacy of waste dumps	322	2.93	3.08	N 8	D 8	3.08
12	Road for transporting wastes	454	4.13	4.23	S 2	S 3	4.23
13	Attitude of the public to waste management	220	2.0	1.92	VD 15	D15	1.92
14	Enforcement of waste management standards and regulations	242	2.2	1.96	VD 13	D 14	1.96
15	Monitoring and effective supervision of waste management duties	332	3.02	3.25	N 7	N 7	3.25

Note: W_B and W_H are the respective weighted score of Business Operators and the Household Heads
 M_B and M_H denote the mean scores of Business Operators and the Household Heads
 R_{GB} and R_B denote the rating Scale and rank in the Business Operators Group
 R_{GH} and R_H denote the rating Scale and rank in the Household Group
 D= Dissatisfied; N=Neutral; S= Satisfied and VD= Very Dissatisfied

Table 7: Correlation of the opinions of Business Operators and Households

Variables	Opinions of Business Operators N=15	Opinions of Households
Opinions of Business Operators	1.000	.977*
Opinions of Households	.977*	1.000

*. Correlation is significant at the 0.01 level (2-tailed).

CONCLUSION

This study which was essentially aimed at assessing the level of satisfaction of the public with the policies, strategies and activities of NISEPA in the management of different types of municipal solid waste in Minna metropolis discovered that markets, residential properties in high density areas and commercial properties were the sources that produced greatest magnitude of solid waste in the area. Evidence from the study proved that both NISEPA staff and sanitary inspectors in the city were unanimous on this declaration. It was also clearly shown that NISEPA did not adequately comply with the national standards on policy and implementation strategies on waste management as its efforts only culminated in harmonizing its policy

with the national laws; reusing of livestock wastes and adopting mass media as a means of public education in the city out of several unfulfilled courses of action. The public were generally disenchanted with NISEPA services on waste management in the city. Services that were satisfactory to the populace were affordable charges of waste bins, roads for transporting wastes and cleanliness of the municipal and low-density residential areas.

The study has made both theoretical and practical contributions to the existing literature on municipal solid waste management policies, regulations and implementation strategies in Minna metropolis. The result of this study will practically help stakeholders such as the business operators, households, environmental professionals and scholars, facilities managers, solid waste managers, Niger State Ministry of Environment, NISEPA officials and the Niger State Government on how to effectively treat issues of municipal solid waste management in their jurisdictions. As a recommendation, challenges such as lack of enforcement of waste management standards by the appropriate authority, poor quality of services provided, and the carefree attitude of the public towards waste management merit consideration from policy makers and the state waste management agency so as to evolve a sustainable waste management practice for Minna metropolis. Future research work is required in the area of sewage management in the city.

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