ASSESSMENT OF SOLID WASTE MANAGEMENT PRACTICES, CHALLENGES AND IMPROVEMENT STRATEGIES FOR HOUSEHOLDS AND WASTE MANAGERS IN SOUTH-SOUTH NIGERIA

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ABSTRACT

Studies have shown that poor solid waste management has remained a major threat to public health as well as a causal risk factor for environmental degradation. This study assessed solid waste management practices, challenges and improvement strategies for households and waste managers in South-South Nigeria. A cross-sectional study was conducted from November, 2020 through April, 2021 at the households and environmental sanitation agencies in the six States that make up South South Nigeria. Data were collected in the process using structured questionnaires. The final sample was 469 participants, of which 392 responded to questions pertaining to households while 77 responded to questions pertaining to waste managers. Findings reveal that more than half of households adopted good solid waste management practices. Majority of the respondents experienced serious challenges in managing solid waste at the household level. Majority of waste managers experience challenges in solid waste management in South South Nigeria. Majority of waste managers agreed with the suggested improvement strategies for solid waste management at the household level. Education level and marital status were significantly associated with solid waste management practices at household level. Education level was also significantly associated with challenges of solid waste management practices at household level. Many members of the Zone may be willing to participate in measures aimed at improving solid waste management in their community, thus, government and other stakeholders in the scheme need to continue to organize community-integrated programmes and awareness campaigns on solid waste storage, separation, collection, transportation and final disposal.

INTRODUCTION

Proper management of solid waste is an important step in the war against pollution, global warming and climate change. Poor solid waste management (SWM) is a serious public health problem due to its health and environmental sustainability implications. Every human activity creates waste, and it is the way these wastes are handled, stored, collected, disposed and managed that poses risk to the environment and public health. According to World Bank (2019), in 2016, the world's cities generated tons of solid waste, amounting to a footprint of 0.74 kilograms per person per day. With rapid population growth and urbanization, annual waste generation is expected to increase by 70 per

cent from 2016 levels of tons to 3.40 billion tons in 2050 (World Bank, 2019). Managing waste properly is therefore essential for building sustainable and liveable cities. However, it remains a challenge for many developing countries and cities.

The problem of solid waste management remains a challenge in Africa. Africa is known to be the least developed region in the world with 38 per cent urbanization (Muzenda *et al.,* 2011). The authors added that although this is low compared to many other countries in the world, African countries are experiencing rapid development with growth rate of four per cent per annum. Therefore, Africa is facing a growing waste management crisis. Available data showed that 125 million tons per annum of municipal solid waste (MSW) was generated in Africa in 2012, of which 81 million tons (65%) was from sub-Saharan Africa (Scarlat *et al.,* 2015). This is expected to grow to 244 million tons per year by 2025. However, with an average waste collection rate of only 55 per cent (68 million tons), nearly half of all MSW generated in Africa, remains within the cities and towns, dumped onto sidewalks, open fields, storm water drains and rivers. The average MSW collection rate in sub-Sahara Africa is lower at only 44 per cent. Although the coverage varies considerably between cities, from less than 20 per cent to well above 90 per cent. The average MSW collection rate for the continent is expected to increase to only 69 per cent by 2025 (Scarlat *et al.*, 2015).

Nigeria is one of the nations in sub-Saharan Africa that encounters challenges of solid waste management. Nigeria, with a population exceeding 170 million, is one of the largest producers of solid waste in Africa (Bakare, 2019). Despite a host of policies and regulations, solid waste management in Nigeria seems to be assuming alarming proportions with each passing day. According to Bakare (2019), Nigeria generates more than 32 million tons of solid waste annually, out of which only 20-30 per cent is collected. Reckless disposal of MSW has led to blockage of sewers and drainage networks, and choking of water bodies. Most of the wastes is generated by households and in some cases, by local industries, artisans and traders which litters the immediate surroundings. Bakare further posited that improper collection and disposal of municipal wastes is leading to an environmental catastrophe as Nigeria currently lacks adequate budgetary provisions for the implementation of integrated waste management programmes across the States.

In South South Nigeria, there appears to be a marked imbalance between waste production and controlled waste disposal. According to Adeniji and Ogu (2008), inadequate solid waste management seems to be currently posing a serious health problem for urban areas where solid wastes clog drainage systems, increasing flooding and water related diseases such as cholera. Given the high social costs of improper disposal of municipal solid wastes, the health effects are devastating (Elenwo, 2015). According to Eludoyin *et al.* (2016), the residential land use constitutes the single most important generator of solid waste, and it is very difficult to manage because of indiscriminate litters all around the neighbourhoods. The residential land use is the most obnoxious because solid waste commonly accumulates near communities where it constitutes health hazards. This, therefore, avers to the socio-economic spatial structure of the city (Eludoyin *et al.,* 2016).

Solid waste (SW) is any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and from community activities (Resource Conservation and Recovery Acts [RCRA], 2018). The major categories of solid wastes have been identified by authors. These include: municipal waste (household waste, commercial waste and demolition waste); hazardous waste (industrial waste); biomedical waste (clinical waste); and special hazardous waste (radioactive waste, explosive waste, and electronic waste) (Ray, 2008). Solid waste can be categorized based on material, such as: plastic, paper, glass, metal, and organic waste (Leblanc, 2018). Categorization may also be based on hazard potential, including radioactive, flammable, infectious, toxic, or non-toxic. Categories may also pertain to the origin of waste, such as industrial, domestic (household), commercial, institutional or construction and demolition. Various categories of SW are managed accordingly.

According to UNSD Glossary of Environment Statistics (2017), solid waste management is the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of solid waste materials in a way that best addresses the range of public health, conservation, economics, aesthetic, engineering and other environmental considerations. In its scope, solid waste management includes: planning,

administrative, financial, engineering and legal functions (UNSD Glossary of Environment Statistics, 2017). To develop a sustainable solid waste management, households need to adopt proper solid waste management practices.

The adoption of proper solid waste management practices at the household level is critical to the development of a sustainable solid waste management system. According to Tchobanoglous and Kreith (2002), these practices include waste handling and separation which involves the activities associated with managing wastes until they are placed in communal storage containers for collection. Also, these practices involve household willingness to pay for waste disposal. Although, the prevention of disease spread and environmental hazards caused by improper waste management practices is a general responsibility, various individuals may experience different challenges and problems while managing household waste. Weerasundara (2014) stated that lack of waste collection service coverage, untimely waste collection, absence of door to door collection, unexpected stoppage of waste collection and disposal, deteriorated waste collection service quality, inadequate number of community bins, distance to collection point/community bin, inadequacy and insufficiency of waste collection equipment among others are the problems faced by the public due to improper waste disposal. Gathering data on solid waste management practices and challenges encountered at the household level could provide information to help authorities design and incorporate effective plans for sustainable solid waste management and implementation. For a solid waste management system to be sustainable, it must be regularly enhanced through the use of properly selected improvement strategies.

Improvement strategy refers to the vision, goals and set of steps that will enable an organization's processes to achieve a sustainable competitive advantage by addressing inefficiencies, waste, plant and asset condition, and culture within the process and its stakeholders (Delgado *et al.,* 2014). Improvement strategies for solid waste management may include door to door campaigning, rallies, use of mass communication methods, insisting on waste segregation at generation level, provision of secondary storage bins, involvement of private sector in solid waste management in the municipality and allocation of better fund to solid waste management agencies and privatization of area-wise integrated programme which include street sweeping, drain cleaning, waste collection and transportation (Yousuf, 2001). These improvement strategies aimed at improving solid waste management system cannot be carried out as an end to themselves but their results should be used to initiate and design specific programmes directed towards a target population.

The need to address the challenges of solid waste management practices cannot be over emphasized. This is because proper solid waste management not only serves as a mitigating strategy against global warming, environmental pollution and degradation, but also as the first level in the prevention of diseases, morbidity and mortality. However, there is limited data on solid waste management practices, challenges and improvement strategies among households in South South Nigeria. Thus, the need for this study which was poised to assess solid waste management practices, challenges and improvement strategies for households and waste managers in South South Nigeria. The study findings would help environmental health officers, public health educators, government, researchers and the general public in designing community based environmental promotion activities as an avenue for individuals to participate in healthy waste management practices.

MATERIALS AND METHODS

Study design, setting and population

A cross-sectional study was conducted from November, 2020 through April, 2021 at the households and environmental sanitation agencies in the six States that make up South South Nigeria. South South Nigeria is one of the six geopolitical zones in Nigeria, consisting of six States. The six States are: Akwa Ibom, Bayelsa, Cross River, Delta, Edo and Rivers. Each of these States has three Senatorial Districts otherwise referred to as Geopolitical Zones, and the senatorial districts are made up of Local Governments Areas (LGAs). In the various LGAs, there are autonomous communities and villages. The area is one of the most populous regions in Nigeria.

The study population comprised households and waste managers. Only adult household representatives (18 years and above) were included in the study. Households with younger

representatives (less than 18 years) were excluded from the study.

Sample size determination and procedure

The sample size for the study was 500 respondents, comprising 420 households and 80 waste managers. This was in line with the suggestion of Cohen, Manion, and Morrison (2011), that when a population size is 10,000 and above at 95 per cent confidence level (5% interval), the sample size should be 370 and above. Also, when a population size is 100 and above at 95 per cent confidence level (5% interval), the sample size should be 79 and above.

Purposive sampling method was adopted in selecting 420 participants. Purposive in the sense that only heads of households were used. Hence, 70 households were selected from each of the six States that make up South South Nigeria, which gave a total of 420 households.

On the part of the waste managers, the convenience sampling method was used to draw the 80 waste managers for the study. Convenience in the sense that only waste managers, who had time and expressed their consent in responding to the questionnaires, were used.

Data collection tools

Two researcher-designed structured questionnaires were utilized for data collection in this study. These are Solid Waste Management Practices, Challenges and Improvement Strategies Questionnaire for households (SWMPCISQ), and Challenges and Improvement Strategies for Solid Waste Management Questionnaire (CISSWMQ). The SWMPCISQ was developed based on a detailed literature review of previous studies that had determined solid waste management practices. The SWMPCISQ for households consisted of four parts. Part A consisted of four items on the socio-demographic characteristics of the respondents (gender, education, marital status and household size). Part B consisted of seven questions on solid waste management practices of households with dichotomous response options of yes and no. Part C consisted of 14 questions on the challenges of solid waste management practices at household level with dichotomous response options of yes and no. Part D consisted of 10 questions on the improvement strategies for solid waste management with non-dichotomous response options of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD).

The CISSWMQ was administered to waste managers and consisted of two parts. Part A consisted of 15 questions on the challenges of solid waste management practices by waste management workers with dichotomous response options of yes and no. Part B consisted of 12 questions on the improvement strategies for solid waste management with non-dichotomous response options of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD).

The face and content validity of the questionnaires were evaluated by a professional board of five specialists in health education and environmental health and as well was tested for internal consistency. The internal consistency of the questionnaires (SWMPCISQ and CISSWMQ) was determined using Split half (Spearman-Brown Coefficient Correlation) with indices of .774 and .735 respectively.

Ethical consideration and consent to participate

The ethical approval was obtained prior to commencing research. The Ethics Committee of the Faculty of Education, University of Nigeria, Nsukka approved the study. The researchers explained the objectives of research for the participants and the latter were assured about the privacy of their personal data. After their consent was gotten, head of households were contacted in their homes while waste managers were contacted at the environmental sanitation agencies where they work.

Data collection procedure

A total of 500 questionnaires were filled out in the process. Out of the 420 questionnaires administered at the households, 411 were returned, which gave a return rate of 97.9 per cent. Out of the returned questionnaires, 19 copies were not duly filled out, thus discarded. Only 392 copies of the questionnaire duly filled out were used for analyses at household level.

On the part of waste managers, 80 questionnaires were filled out. Out of the 80 questionnaires administered to waste managers, 77 were returned, which gave a return rate of 96.3 per cent. The 77 returned questionnaires were duly filled out and used for data analyses.

Data analysis

The IBM Statistical Package for Social Sciences (SPSS) version 23.0 was used for all the statistical

analyses. The standard descriptive statistics were applied to describe data pattern. Frequency counts and percentages were generated to compute solid waste management practices, challenges and improvement strategies. Multivariable logistic Regression was used to identify socio-demographic factors associated with solid waste management practices and challenges at household level. All the tests were 2-tailed and the probability values less than .05 (p < .05) were considered significant.

RESULTS

The final sample for households was 392; comprising of 197 (50.3%) male and 195 (49.7%) female. The vast majority of the respondents had attained at least secondary education 376 (95.9%). Most of the respondents were single 203 (51.8%). Most of the households had at least 5 persons 206 (52.6%) as contained in Table 1.

Table 2 shows that overall, more than half (52.8%) of households adopt good solid waste management practices while 47.2 per cent adopt poor solid waste management practices. Also, the table show that more than two-thirds (73.7%) of households do not separate solid waste into reusable and non-reusable and only 24.5 per cent pay for solid waste management.

Table 3 shows that majority (91.8%) of the respondents encounter several challenges while managing solid waste at the household level, while only 8.2 per cent did not encounter challenges while managing solid waste at the household level.

Table 4 shows that overall, majority of waste managers (97.4%) encounter several challenges while managing solid waste in South South Nigeria, while only 2.6 per cent do not encounter challenges while managing solid waste.

Table 5 shows the improvement strategies for solid waste management agreed to by waste managers. Overall, majority (98.7%) of waste managers agreed with the suggested improvement strategies for solid waste management.

Table 6 shows that the Wald criterion demonstrated that only education level and marital status (p < .05) made significant contributions to the study prediction. In the multivariable analysis, respondents with tertiary education were 8.5 times more likely to adopt good solid waste management practices than those with no formal education (OR = 8.531, 95% CI [1,017-71.583], p = .048 < .05). Respondents who are married were 60.8 per cent less likely to adopt good solid waste management practices than those who are single (OR = .392, 95% CI [.250-.615], p = .000 < .05). Respondents who are divorced/separated were 58.2 per cent less likely to adopt good solid waste management practices than those who are single (OR = .418, 95% CI [.187-.932], p = .033 < .05). Respondents who are widowed were 82.2 per cent less likely to adopt good solid waste

Table 1. Socio-demographic Characteristics of Households (*n*=392)

Sl.N	Socio-demographic characteristics	Frequency	Percentages
1.	Gender		
	Male	197	50.3
	Female	195	49.7
	Total	**392**	**100.0**
2.	Education level		
	No formal education	8	2.0
	Primary education	8	2.0
	Secondary education	131	33.4
	Tertiary education	245	62.5
	Total	**392**	**100.0**
3.	Marital status		
	Single	203	51.8
	Married	151	38.5
	Divorced/separated	30	7.7
	Widowed	8	2.0
	Total	**392**	**100.0**
4.	Household size		
	Less than 5 persons	186	47.4
	5 persons and above	206	52.6
	Total	**392**	**100.0**

Table 2. Solid Waste Management Practices at Household Level (*n*=392)

Sl.N	Solid waste management practices	Yesn(%)	Non(%)
1.	Do you generate waste daily?	295(75.3)	97(24.7)
2.	Do you use closed container to store your waste in your household?	236(60.2)	156(39.8)
3.	Do you dispose your solid waste at the designated dump stand?	230(58.7)	162(41.3)
4.	Do you dispose waste by yourself?	294(75.0)	98(25.0)
5.	Do you separate solid waste into reusable and non-reusable at the household level?	103(26.3)	289(73.7)
6.	Do you differentiate the containers where you keep waste that can easily decompose and those that cannot decompose easily?	124(31.6)	268(68.4)
7.	Do you pay for solid waste management in your municipality?	96(24.5)	296(75.5)
	Overall %	**52.8**	**47.2**

Table 3. Challenges of Solid Waste Management Practices at Household Level (*n*=392)

Sl. No.	Challenges of solid waste management practices In the course of managing waste at your household, did you encounter:	Yes n (%)	Non (%)
1.	Lack of waste collection service coverage?	214(54.6)	178(45.4)
2.	Untimely waste collection by state waste management workers?	280(71.4)	112(28.6)
3.	Absence of door to door collection of waste?	220(56.1)	172(43.9)
4.	Unexpected stoppage of waste collection and disposal?	288(73.5)	104(26.5)
5.	Deteriorated waste collection service quality?	304(77.6)	88(22.4)
6.	Inadequate number of community waste collection bins?	298(76.0)	94(24.0)
7.	Distance to waste collection/ disposal points or bin?	327(83.4)	65(16.6)
8.	Lack of pollution control (water, air, etc)?	341(87.0)	51(13.0)
9.	Lack of vectors, insects and rodent control?	352(89.8)	40(10.2)
10.	Bad odour from the waste dumps/landfills/bins?	315(80.4)	77(19.6)
11.	Outbreak of diseases and other environmental health problems?	332(84.7)	60(15.3)
12.	Blockage of drainage systems with solid waste?	313(79.8)	79(20.2)
13.	Environmental degradation?	333(84.9)	59(15.1)
14.	Soil quality deterioration and possibility of erosion due to improper waste disposal?	336(85.7)	56(14.3)
	Overall %	91.8	8.2

Table 4. Challenges of Solid Waste Management Practices by Waste Managers (n=77)

Sl. No.	Challenges of solid waste management practices In the course of managing waste, did you encounter:	Yes n (%)	Non (%)
1.	Lack of authority to make financial and administrative decision?	12(15.6)	65(84.4)
2.	Lack of financial resources?	13(16.9)	64(83.1)
3.	Lack of trained personnel?	37(48.1)	40(51.9)
4.	Lack of standard vehicles and equipment?	74(96.1)	3(3.9)
5.	Old vehicles/equipment frequent breakdown and difficult to obtain spare parts?	72(93.5)	5(6.5)
6.	Lack of capability to maintain/repair vehicles/equipment?	75(97.4)	2(2.6)
7.	Lack of planning (short, medium and long term plan) and institutional set-up for solid waste management service?	47(61.0)	30(39.0)
8.	Rapid urbanization undermining service capacity?	68(88.3)	9(11.7)
9.	Difficulty to locate and acquire landfill site?	69(89.6)	8(10.4)
10.	Poor cooperation by Government agencies with regards to waste management.?	53(68.8)	24(31.2)
11.	Poor public cooperation?	68(88.3)	9(11.7)
12.	Uncontrolled use of packaging material?	65(84.4)	12(15.6)
13.	Poor response to waste minimization (reuse/recycling)?	70(90.9)	7(9.1)
14.	Lack of qualified private contractors?	18(23.4)	59(76.6)
15.	Lack of control policies on hazardous waste?	21(27.3)	56(72.7)
	Overall %	**97.4**	**2.6**

Table 5. Improvement Strategies for Solid Waste Management in South South Nigeria for Waste Managers (*n*=77)

Sl.No.	Improvement strategies for solid waste management	Agreen(%)	Disagreen(%)
1.	Introduction and improvement of the 3R principles (reduce, reuse and recycle)	76(98.7)	1 (1.3)
2.	Insisting on waste separation at generation level by the local authorities	74(96.1)	3 (3.9)
3.	Inclusion of individuals and households in recycling activities.	71(92.2)	6 (7.8)
4.	Introduction of economic benefits associated with high recycling rate and increased use of tax incentives by the authorities involved	73(94.8)	4 (5.2)
5.	Provision of appropriate opportunities and facilities for recycling	75(97.4)	2(2.6)
6.	Public health education on the dangers of indiscriminate disposal of waste.	77(100.0)	0(0.0)
7.	Introduction of awareness campaigns on the need for recycling which may include: door to door campaigns, rallies, etc.	73(94.8)	4(5.2)
8.	Privatization of waste collection and transportation to various communities.	67(87.0)	10(13.0)
9.	Introduction of feedback mechanism to increase user inclusivity and provide useful indication of solid waste management	73(94.8)	4(5.2)
10.	Involvement of private sector in solid waste management in the municipality by the state and local government authorities.	73(94.8)	4(5.2)
11.	Introduction of community-wise integrated programme, such as; street sweeping, drain cleaning, etc. by the local government authorities	68(88.3)	9(11.7)
12.	Funding and empowerment of the public on waste management, control, transportation and disposal.	21(27.3)	56(72.7)
	Overall %	98.7	1.3

Table 6. Multivariable Logistic Regression Identifying Socio-demographic Factors Associated with Solid Waste Management Practices at Household Level (*n*=392)

Factors	B	S.E	Wald	Df	Sig.	Exp(B)	95% C.I. for Exp(B) Lower	Upper
Gender								
Male[a]								
Female	.292	.216	1.826	1	.177	1.339	.877	2.046
Education level			12.651	3	.005			
No formal education[b]								
Primary education	2.443	1.337	3.339	1	.068	11.510	.837	158.222
Secondary education	1.452	1.092	1,768	1	.184	4.272	.502	36.324
Tertiary education	2.144	1.085	3.902	1	.048*	8.531	1.017	71.583
Marital Status			20.151	3	.000			
Single[c]								
Married	-.936	.229	16.680	1	.000*	.392	.250	.615
Divorced/separated	-.873	.409	4.545	1	.033*	.418	.187	.932
Widowed	-1.726	.866	3.969	1	.046*	.178	.033	.972
Household size								
Less than 5 persons[d]								
5 persons and above	.395	.217	3.305	1	.069	1.485	.970	2.274
Constant	-1.650	1.088	2.299	1	.129	.192		

Nagelkerke R^2 = .133   CI= confidence Interval

$\chi^2 (8)$ = 21.712, p = .005 < .05

Odd Ratio (OR) = Exp(B)

Ref Groups: Gender = Male[a]; Education Level = No Formal Education[b]; Marital Status = Single[c]; Household Size = Less Than 5 Persons[d]

management practices than those who are single (OR = .178, 95% CI [.033-.972], p = .046 < .05).

Table 7 shows that the Wald criterion demonstrated that only education level (p < .05) made a significant contribution to the study

prediction. In the multivariable analysis, respondents with tertiary education were 10.8 times more likely to encounter challenges in solid waste management practices at the household level than those with no formal education (OR = 10.784, 95%

CI [1.785-65.138], p = .010 < .05).

DISCUSSION

The findings in Table 2 show that overall; more than half of households adopt good solid waste management practices while 47.2 per cent adopt poor solid waste management practices. Also, the table show that more than two-thirds of households do not separate solid waste into reusable and non-reusable and only 24.5 per cent pay for solid waste management The result was expected and therefore, not surprising because people through television broadcast or other means have been informed of the environmental and health implications of poor solid waste management and so are expected to adopt good solid waste management practices. Individuals may also be very unwilling to pay for solid waste management due to the poor economic status of the entire country. The findings were inconsistent with the findings of Alemayehu *et al.* (2017) in Dire Dawa City, Eastern Ethiopia, who found that majority of the households, 352 (69%) disposed solid wastes in improper manner. The findings also disagreed with the findings of Birara and Kassahuṅ (2018) in Bahir Dar City, Ethiopia

who found 66.6 per cent of the participants practice illegal solid waste disposals with the remaining 33.4 per cent waiting until solid waste collectors evacuate the wastes. The reason for this disagreement in findings may be because households in South South Nigeria might have seen and experienced first-hand the negative implications of improper solid waste management with regards to health, general wellbeing and the environment. This may have been possible because of the yearly floods experienced in the geopolitical zone due to clogged drainages, erosion, accidents among others.

The findings in Table 3 show that majority of the respondents encounter several challenges while managing solid waste at the household level. The findings were expected and not surprising. This is because the obvious environmental hazards identified in the Geopolitical Zone due to improper solid waste management reveal that there is a problem in the handling of solid waste. Disregard on the part of members of the Zone is also obvious in the components of the waste generated as individuals seem not to care about waste separation. The finding is in line with Warunasinghe and Yapa (2015) in Kottawa Colombo, who found that 54 per

Table 7. Multivariable Logistic Regression Identifying Socio-demographic Factors Associated with Challenges of Solid Waste Management Practices at Household Level (*n*=392)

Factors	B	S.E	Wald	Df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Gender								
Male[a]								
Female	-.639	.398	2.571	1	.109	.528	.242	1.153
Education level			19.402	3	.000			
No formal Education[b]								
Primary education	-.655	1.170	.313	1	.576	.520	.052	5.148
Secondary education	1.053	.891	1.395	1	.237	2.866	.499	16.450
Tertiary education	2.378	.918	6.717	1	.010*	10.784	1.785	65.138
Marital Status			.386	3	.943			
Single[c]								
Married	.246	.416	.349	1	.555	1.279	.566	2.891
Divorced/separated	.234	.799	.086	1	.769	1.264	.264	6.050
Widowed	19.679	13292.692	.000	1	.999	351959948.9	.000	
Household size								
Less than 5 persons[d]								
5 persons and above	-.217	.394	.304	1	.581	.805	.372	1.742
Constant	1.159	.912	1.615	1	.204	3.186		

Nagelkerke R^2 = .134   CI= confidence Interval
χ^2 (8) = 9.141, p = .331 > .05
Odd Ratio (OR) = Exp(B)
Ref Groups: Gender = Male[a]; Education Level = No Formal Education[b]; Marital Status = Single[c]; Household Size = Less Than 5 Persons[d]

cent of the households were unsatisfied with the prevailing waste management practices and 70 per cent of them expect more involvement by the government to correct the problem. The authors also reported that 26 per cent of the households were not aware of waste recycling, reuse and reduction. The findings also agreed with that of that Douti *et al.* (2017) in Bawku Municipality, Ghana, who reported that lack of public awareness on issues regarding waste and lack of a participatory approach were solid waste management challenges. The challenges of solid waste management are very evident in the Municipality. These challenges include: poor waste collection coverage; inadequate and deteriorated waste collection service; lack of pollution, vector and pest control; absence of door to door collection of waste among others. All these contribute to the challenges faced by households when managing waste in the municipality.

The findings in Table 4 show that majority of waste managers encountered several challenges while managing solid waste. The findings were expected because waste managers have been seen to go extra lengths to carry out their duties but are limited due to lacking resources, finances, public cooperation, among others. This finding is in agreement with the findings of Douti *et al.* (2017) in Bawku Municipality, Ghana, who found that waste management institutions were faced with financial difficulties, understaffing and poor logistics and poor nature of roads, and social constraints. The findings also agree with the findings of Alemayehu *et al.* (2017) in Dire Dawa City, Eastern Ethiopia, who reported that manpower, budget, and facilities such as inadequate vehicles were the reasons for low performance of solid waste collectors. The government and private sector have a lot of job to do with reference to reforming the status of solid waste management as the implications of poor sold waste management continues to increase and many waste management workers find it difficult to do their jobs well.

The findings in Table 5 show that majority of waste managers agree with the suggested improvement strategies for solid waste management. The findings were expected because the waste managers are obviously tired of the poor working condition of things in their area of work, and are ready for positive improvements which will make their jobs easier and less stressful. The findings agreed with Sankoh *et al.* (2014) in Freetown, Sierra Leone, who opined that there was

need for support from government, private sector and Non-governmental Organizations for a rehabilitation of the entire solid waste management system, first on an emergency basis, followed by development and implementation of long-term sustainable measures.

Table 6 show that education level was significantly associated with solid waste management practices at household level. The Table also show that respondents with tertiary education were more likely to adopt good solid waste management practices than those with no formal education. The findings were not surprising but expected because with increase in education level, it is assumed that one receives knowledge on the need for environmental sanitation and the right practices to adopt especially in the area of solid waste management. Hence, it is not surprising that individuals with no formal education were the least to adopt good solid waste management practices. The findings agree with the findings of Brown (2015) in Mwanza City, Northern Tanzania, who reported that the level of education attained by the head of household had association (p=0.04) with relation to practice of better methods of solid waste disposal. The findings were also in line with the findings of Abegaz *et al.* (2021) in Woldia Town, Northeastern Ethiopia, who reported that educational status was a major factor associated with solid waste management practices.

Table 6 also show that marital status was significantly associated with solid waste management practices at household level. The Table also revealed that respondents who were married, divorced/separated and widowed were less likely to adopt good solid waste management practices than those who are single. The findings were expected because, it is agreeable that single individuals have more free time to practise proper solid waste management compared to married, divorced or widowed individuals. Single individuals tend to be more conscious about their physical environment and may have more time to do the right thing than those with other marital status. The findings are however in contrast with the findings of Alemayehu *et al.* (2017) in Dire Dawa City, Eastern Ethiopia, who found that marital status of the respondent was associated with improper household solid waste management. Marital status may be associated with solid waste management practices because, being single, an individual may be able to control the amount of waste produced and

hence manage it appropriately. However, being married, divorced/separated or widowed may come with other responsibilities which may lead to reduced attention towards solid waste management.

Table 7 show that education level was statistically associated with challenges of solid waste management practices at household level. The Table also revealed that respondents with tertiary education were more likely to encounter challenges in solid waste management practices at the household level than those with no formal education. The finding was expected because the higher the education level, one begins to see things for what they truly are and so will no longer be comfortable with the proper thing not being done. So also, in solid waste management, it is not surprising that persons with no formal education may encounter little or no challenge in solid waste management as he or she may not even be aware of what the right thing should be. The findings are in line with the findings of Ssemugabo *et al.* (2020) in Kampala, Uganda, who found that gender, age, education level, marital status, religion, and occupation of the household head, were not significantly associated with households solid waste management status, including the challenges. The findings, therefore, signify that ignorance and lack of awareness due to a lower education level may be a limiting factor to individuals with no formal education in adopting the best practices for solid waste management.

The implications are significant for public health. The findings from solid waste management practices at household level have implication for the entire public. This is because solid waste management must be seen as a personal responsibility rather than solely the responsibility of the government or waste workers. The findings also have implications for public health educators and environmental health officers tasked with the responsibility of organizing programmes aimed at sensitizing members of the municipality regardless of education level on the need to improve solid waste management for the benefit of all.

Strengths and Limitations

The strengths of this study include using both households and waste managers as participants. The findings can be used to initiate intensified campaigns which will emphasize the importance of 3R principles (reduce, reuse and recycle), employing the mass media as a way of reaching a vast majority of the community. However, there are some limitations in the study. Firstly, all measures were assessed using only self-report measures (questionnaires) about their solid waste management practices and challenges. Hence, the data are subjected to response and recall biases and limitation inherent in this form of data collection. Also, the study was conducted only among households and waste managers which may not be a representative of the entire Geopolitical Zone. Thus caution should be taken in generalizing the findings of the study. Finally, the study was cross-sectional in nature, limiting the ability of the researcher to infer causality (cause-effect relationship).

CONCLUSION

The findings revealed that more than half of households adopt good solid waste management practices. Majority of the respondents encounter several challenges while managing solid waste at the household level. Majority of waste managers encountered several challenges while managing solid waste. Majority of waste managers agree with the suggested improvement strategies for solid waste management. Education level and marital status were significantly associated with solid waste management practices at household level. Also, education level was statistically associated with challenges of solid waste management practices at household level. It is therefore crucial to immediately intervene in solid waste management in the Geopolitical Zone.

Given that both households and waste managers encounter challenges in solid waste management, the government and solid waste management agencies are confronted with the challenge of improving the solid waste management system and also encouraging people to take responsibility of their own waste by adopting good solid waste management practices. Many members of the Zone may be willing to participate in measures aimed at improving solid waste management in their community, thus, government and other stakeholders in the scheme need to continue to organize community-integrated programmes and awareness campaigns on solid waste storage, separation, collection, transportation and final disposal.

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