Practice, Pattern and Challenges of Solid Waste Management in Onitsha Metropolis, Nigeria

Obiageli F Emelumadu[1], Obed C Azubike[2], Chinomnso C Nnebue[3,*], Ngozi FAzubike[1], Queencallista N Sidney-Nnebue[4]

[1]Department of Community Medicine, Nnamdi Azikiwe University/University Teaching Hospital NAU/NAUTH, Nnewi Nigeria
[2]Department of Physiotherapy, Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi Nigeria
[3]Department of HIV Care and Department of Community Medicine, Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi Nigeria
[4]National Gallery of Art, Ministry of Tourism, Culture and National Orientation, Igboukwu Nigeria
*Corresponding author: nnebnons@yahoo.com

Abstract **Background:** Despite efforts at making municipal solid waste management (MSWM) effective, one key challenge faced by the state and local environmental protection agencies in Nigeria has been inconsistencies in the pattern of solid waste management by households. **Objective:** To determine the practice, pattern and challenges of solid waste management in Onitsha Metropolis. **Materials and methods:** A cross-sectional study of 425 households in Onitsha Metropolis, selected using multistage sampling technique was done. Quantitative data was collected by interview using a pretested semi-structured questionnaire and analysed using computer Graph Pad Prism version 5.3. Tests of statistical significance were carried out using ANalysis Of Variance followed by multiple comparison done using post hoc Tukey's HSD (honestly significant difference) test. A p value of < 0.05 was considered significant. Qualitative data was obtained using key informant interviews. **Results**: The mean age of the respondents is 36.84 ± 12.21 years. Whereas 244 (57.4%) use government facilities / services, 47 (11.1%) dump theirs on streets and drainages. Two hundred and ninety five (60.90%) practice some form of waste segregation. There were statistically significant differences between the areas of residence and household solid waste disposal personnel ($p<0.05$), patterns of solid waste disposal ($p<0.05$) and solid waste separation ($p<0.05$) respectively. **Conclusions:** The study revealed poor waste management practices as well as some relationship between area of residence and waste disposal personnel, pattern of waste disposal and waste separation respectively. Strategies for improving the MSWM in Onitshaare thus suggested.

Keywords: Solid waste management pattern, challenges, Onitsha metropolis

1. Introduction

The problems of solid waste management dates back to antiquity. In Athens Greece, records between 500-300 BC showed that solid waste posedsuch tremendous challenges that there was promulgation of laws prohibiting littering rubbish in the streets as well as regulations stipulating the minimum distance which haulers are permitted to move beyond the city wall before disposing of solid waste. [1]

The need for proper collection, adequate treatment and sanitary disposal of solid waste by man arose as populations migrated from disperse geographical areas into communal living. Waste generation, both domestic and industrial, continues to increase globally in tandem with growth in population and consumption patterns of towns and cities. Based on available literature it has been confirmed that if current trends continue, the world may see a five-fold increase in waste generation by the year 2025. [2] Rapid urbanization, industrialization, and consequent collapse of solid waste management of cities is a global phenomenon and Nigeria is not left out. [2,3,4]

In Nigeria, solid waste generation ranges from 0.44 to 0.66 kg per capita per day and up to 25 million tonsper annum, with household and commercial centers contributing about 10% of total urban waste burden. [4,5] Municipal waste density in the Country falls within the range 280 to 370 kg/m. [3,4] It has also been reported that roughlytwo thirds of these wastes are dumped indiscriminately on the streets and in the drains thus posing serious environmental health hazards. [5] This scenario is worsened by the report by Nabeguin a study on municipal solid waste in Kano metropolis Nigeria that households are mostly interested in receiving effective and dependable waste collection services within their immediate vicinity, and cared less about the broader environmental solid waste disposal techniques thus disposing waste in unauthorized places. [6]

Efforts bystate and local environmental protection agenciesin Nigeriato completely get streets and neighborhoods rid of indiscriminate wastes have not achieved the much desired success. [4,7] This inefficiency has been linked to inadequacies in the waste management system. Results from the structural time-related model by Nkwocha *et al.,* on evaluating the efficiency of solid waste collection services in Owerri Nigeria reported about 61% efficiency in waste collection in the Municipality. [8] The interpretation is that out of the total quantity of waste generated in Owerri, 39% were left to accumulate in various parts of the town with its attendant negative impacts.

Societal differences has been found to determine who in a household is responsible for disposing household waste as well as pattern of waste management. In Chennai household solid waste is disposed of by maids in one-quarter of the households. [9] Urban slums with their peculiarities and difficult terrain are usually left out of waste management services as was documented by Ononugbo *et al.,* in Enugu Nigeria. [10]

From the foregoing, Municipal Solid Waste Management (MSWM) has remained a public health concern. This underscores the need to dispose waste through an acceptable, systematic and environmental friendly procedure such that man's health is not adversely affected. With this backdrop, this study set out to determine the practice, pattern and challenges of household waste management in Onitsha Metropolis, Nigeria.

2. Materials and Methods

This descriptive cross-sectional study was carried out in Onitsha metropolis in Anambra State, Nigeria. The metropolis is sub-divided by the Anambra State Environmental Protection Agency (ANSEPA), into six zones: Okpoko, Fegge, Housing Estate, Upper Iweka, Inland Town and Government Reservation Area (GRA). [4] The urban slum, Okpoko is characterised by low cost buildings, poor road network with high population density and the residents are mostly of low socio- economic class. Fegge zone is an urban settlement in Onitsha inhabited by middle income earners. It has good road network and the accommodation is predominantly the apartment type with 4-8 households living in the same compound. The GRA is a low population density zone where usually one or two households live in a compound. The road network is good, while residents are mostly of high socio-economic class including civil servants. The drainage system is well organised in Fegge and GRA but poor in Okpoko. The inhabitants of Onitsha metropolis are predominantly traders but there is a strong presence of employees of private liability companies as well as Federal and State civil servants.

Included in this study are all the residents who were up to ten years of age, have lived in Onitsha metropolis for at least two consecutive years and are willing to participate in the study. Staff of LAGA International limited (the private firm contracted by the State government as partners in waste management) who had worked for at least two consecutive years and who gave consent, were enrolled for the Key Informant Interviews (KII). The first two participants to indicate their willingness to participate from each of the staff categories were recruited. They comprised two participants from the management staff, two truck drivers, two cleaners, two dump site managers.

Using the Cochran formula for sample size determination for descriptive studies in population greater than 10,000, $n = \dfrac{z^2 pq}{d^2}$ [11] where

n= the desired sample size (when population is >10000)
z = Standard normal deviate at 95 percent confidence interval which is set at 1.96.
p= Nkwocha*et al.,* on evaluating the efficiency of solid waste collection services in Owerri Municipality Nigeria reported about 61% efficiency in waste collection in the Municipality. [8] So p= 0.61, while q = 1 − p = 0.39
d = Degree of accuracy desired = 0.05

$$n = \frac{(1.96)^2 (0.61)(0.39)}{(0.05)^2} = 366$$

This study anticipated 80 % response rate and to make up for this, the calculated sample size n, was divided by a factor f= 80/100
i.e. nf= n/f [11] = 366/0.8= 458
Four hundred and fifty- eight questionnaires were distributed but 425 were valid on return and were thus analysed.

A multistage sampling technique was used.

Firstly, stratified sampling technique was done, grouping Onitsha into six zones, using the classification of Onitsha by ANSEPA. [4]

Secondly, stratified sampling technique was done, classifying the zones into three using social classification by occupation. [12,13]

A. Urban Slum- e.g. Upper Iweka and Okpoko typified by semi-skilled workers like truck drivers, machine operators, vendors, construction labourers, security agents.

B. High density residential and commercial area e.g. Fegge and Inland Town typified by white collar and semi-professional workers, nurses, sales man, traders with shops, fashion designers and caterers.

C. Low density residential area- e.g. GRA and Housing Estate typified by professionals in high business concern, bankers, doctors, dentists, professors, engineers and lawyers.

Thirdly, simple random sampling by balloting was done and three zones were selected, one from each area thus: Okpoko from the Urban slum, Fegge from High density residential and commercial area and the GRA from low density residential and commercial area.

Fourthly, each select area was considered a cluster. A central place in each area was located e.g. market or hall and an empty bottle was spun on the ground (the bottle made a minimum of three complete turns before stopping). When it ceased to move, the direction of the neck of the bottle was taken as the starting point for the inclusive streets.

Then systematic sampling technique was used through longitudinal recruitment of households to select eligible and consenting mothers at the household level. This enrolment exercise was continued in a clockwise direction until the required number allotted to each cluster has been obtained. Where there are more than one household within

the compound, a simple random sampling method by balloting was used to select one household.

This study used a mix of quantitative (questionnaire) and qualitative (KII) data collection methods. A semi-structured interviewer administered questionnaire which was designed based on the research topic and objectives: Section A consisted of bio-data of the respondents while section B consisted of questions to assess respondents' practice and pattern of waste management. The questionnaire was designed in English, translated into Igbo language and then back-translated into English but was administered in Igbo language by three assistants (LAGA staff) trained in interview technique. The questionnaire was pre-tested on some residents of Nnewi, an urban area in Anambra state to determine suitability/appropriateness of the questions. Key Informant Interview (KII) was conducted on Staff of Waste Management Agencies using a KII guide.

Each completed questionnaire was reviewed for completeness prior to analysis. The data collected was sorted and analyzed in respect to the demographic characteristics of the respondents. Area of residence was also used in the categorisation of respondents so as to see the effect of residence on the practice, pattern and challenges of solid waste management among residents in the Metropolis.

Descriptive and analytical statistics of the data were carried out using computer Graph Pad Prism version 5.3. Summary indices were generated and descriptive data were presented as simple frequencies and percentages. Tests of statistical significance were carried out using ANalysis Of Variance (ANOVA). Multiple comparison was done using post hoc Tukey's HSD (honestly significant difference) test, after ANOVA has shown that a statistically significant difference exists among area of residence and personnel designated for waste disposal in the household, household solid waste disposal pattern and waste separation respectively. A p value of < 0.05 was considered significant. The KII findings were analysed thematically and quotes made.

Ethical clearance was sought and obtained from Nnamdi Azikiwe University Teaching Hospital Ethical Committee (NAUTHEC) before the work was carried out. Written permission to carry out this study was sought and obtained from the appropriate authorities in the Ministry of Environment. Consent and co-operation of the respondents was solicited and obtained for the conduct and publication of this research study. All authors hereby declare that the study has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

3. Results

3.1. Summary of Quantitative Data from Questionnaire

Table 1 shows respondents' Socio-demographic characteristics. Four hundred and fifty- eight questionnaires were distributed but 425 were valid on return and were thus analysed giving a response rate of 92.8%. The mean age of the respondents is 36.84±12.21 years. Majority of the respondents 258 (60.7%) were

males and 209 (49.2%) were married. About 260 (61.2%) attained at least the secondary level of education, while more than 50% were traders.

Table 1. Respondents' Socio-demographic characteristics

Characteristics	Frequency, N=425	%
Age (years)		
10-19	21	4.9
20-29	115	27.1
30-39	125	29.4
40-49	94	22.1
50-59	47	11.1
60-69	19	4.5
70-79	4	0.9
Mean age in yrs = 36.84 $\pm$12.21 years		
Sex		
Male	258	60.7
Female	167	39.3
Male: Female = 1.5: 1		
Marital status		
Single	189	43.4
Married	209	49.2
Divorced/Separated	13	3.0
Widowed	9	3.1
Non- response	5	1.2
Educational status		
No formal education	27	6.4
Primary	128	30.1
Secondary	171	40.2
Tertiary	89	20.9
Non-response	10	2.0
Occupation		
Civil servants	115	27.1
Traders	224	52.7
Farmers	21	4.9
Artisans	33	7.8
Students	30	7.1
Non-response	2	0.4

Table 2 shows the patterns of solid waste disposal by the respondents. Two hundred and forty four (57.4%) use government facilities / services, 115 (27.1 %) use private contractors and 47 (11.1%) dump refuse on streets and drainages. Two hundred and ninety five (60.90%) practice waste segregation and in 211(49.6%) of the households, children were the persons that dispose wastes.

Table 2. Patterns of solid waste disposal

Patterns of solid waste disposal	Frequency	Percent
Persons that dispose household waste		
House helps	94	22.1
Children	211	49.6
Wife	13	3.1
Husband	21	4.9
Not specific	80	18.8
Non response	6	1.4
Total	**425**	**100.0**
Prior segregation of solid waste for disposal		
Yes	295	60.9
No	166	39.1
Total	**425**	**100.0**
Disposal facility used		
Govt facilities / services	244	57.4
Private contractors	115	27.1
Street and drainages	47	11.1
Others **	17	4.0
Non-response	2	0.5
Total	**425**	**100.0**

** Burning, burying,

Table 3 shows respondent's residence and solid waste disposal personnel. There is a statistically significant difference between area of residence and solid waste disposal personnel (F=31.529, p<0.05). A multiple comparison test (post hoc test) carried out after ANOVA showed statistically significant difference between area of residence and waste disposal personnel between Okpoko and Fegge (p=0.000, CI= 0.74-1.42), Okpoko and GRA (p=0.000, CI=0.46-1.26), while there was no statistically significant difference between GRA and Fegge (p=0.428, CI= 0.28-0.65).

Table 3. Relationship between residence and solid waste disposal personnel

Residence	Disposal personnel					Total
	Servant	Children	Wife	Husband	Others	
Okpoko	23	95	7	6	68	199
Fegge	46	77	4	4	12	141
GRA	25	39	2	13	6	85
Total	**94**	**211**	**13**	**21**	**86**	**425**
		F= 31.529, p < 0.05*				
		Post Hoc Test				
Turkey HSD Multiple comparison		**p value**		**95% Confidence Interval**		
				Lower boundary	Upper boundary	
Okpoko and Fegge		0.000*		0.74	1.42	
Okpoko and GRA		0.000*		0.46	1.26	
GRA and Fegge		0.428**		0.20	0.65	

* p<0.05= statistically significant
** p>0.05= not statistically significant

Table 4 shows the relationship between residence and household pattern of solid waste disposal. There is a statistically significant difference between area of residence and household pattern of solid waste disposal (F=6.717, p<0.05). A multiple comparison test (post hoc test) carried out after ANOVA showed statistically significant difference between area of residence and household pattern of solid waste disposal between Okpoko and Fegge (p=0.011, CI= 0.05-0.48), Okpoko and GRA (p=0.006, CI=0.08-0.59), while there was no statistically significant difference between GRA and Fegge (p=0.820, CI= 0.34-0.20).

Table 4. Relationship between residence and pattern of solid waste disposal

Residence	Household solid waste disposal pattern				Total
	Govt facilities	Private contractors	Street dumping	Others	
Okpoko	91	74	23	11	199
Fegge	96	19	21	4	140
GRA	57	22	3	4	86
Total	**244**	**115**	**47**	**19**	**425**
		F= 6.717, p< 0.05*			
		Post Hoc Test			
Turkey HSD Multiple comparison		**p value**	**95% Confidence Interval**		
			Lower boundary	Upper boundary	
Okpoko and Fegge		0.011*	0.05	0.48	
Okpoko and GRA		0.006*	0.08	0.59	
GRA and Fegge		0.820**	0.34	0.20	

* p<0.05= statistically significant
** p>0.05= not statistically significant

Table 5 shows relationship between residence and solid waste separation. There is a statistically significant difference between area of residence and solid waste separation (F=6.637, p<0.05). A multiple comparison test (post hoc test) carried out after ANOVA showed statistically significant difference between area of residence and practice of solid waste segregation between Okpoko and Fegge (p=0.022, CI= 0.27-0.20), GRA and Fegge (p=0.002, CI= 0.38-0.07), but there was no statistically significant difference between Okpoko and GRA (p=0.002, CI=0.38-0.07).

Table 5. Relationship between Residence and Solid Waste Separation

Residence	Solid waste separation		Total
	Yes	No	
Okpoko	127	72	199
Fegge	69	70	139
GRA	63	24	87
Total	**259**	**166**	**425**
	F = 6.637, p< 0.05*		
	Post Hoc Test		
Turkey HSD Multiple comparison	**p value**	**95% Confidence Interval**	
		Lower boundary	Upper boundary
Okpoko and Fegge	0.022*	0.27	0.20
Okpoko and GRA	0.349**	0.06	0.23
GRA and Fegge	0.002*	0.38	0.07

* p<0.05= statistically significant
** p>0.05= not statistically significant

Table 6 shows respondents' major waste management challenges. Irregular solid waste collection by waste management trucks, ranked topmost with 237 (55.8%), while non availability of collection center was next with 141 (33.2%).

Table 6. Respondents' major waste management challenges

Challenges	Frequency	Percent
Irregular waste collection	237	55.8
Non availability of collection center	141	33.2
Improper disposal of waste collected	34	8.0
Poor attitude	10	2.4
No response	3	0.7
Total	**425**	**100.0**

3.2. KII Report Summary of LAGA Waste Management Agency's Staff in Onitsha

The key findings include: On the description of environment, an environment is considered as being neat, *if refuse is not seen littered along the roads.* Onitsha was not considered a neat environment, and suggestions made for improvement include *employing more waste management staff and buying more equipment for them.* Also households can help maintain the neatness of Onitsha *by ensuring they throw refuse inside the provided bins instead of dropping it around the waste bin.*

On disciplinary measures that will serve as a deterrent for those that make Onitsha dirty, suggestions were made for *a task force (a team that will enforce conformance to standard waste management practices) to be set up which will seize the wheelbarrows of those who throw their waste on the floor, till they put the wastes in the bins provided for this purpose-"The only language that Onitsha residents understand is task force."* Also relevant laws should be implemented so that defaulters will be made to pay a fine or go to jail.

On the role of the organised private sector in solid waste management in Onitsha, it was reported that *they are quite helpful as the organised task force of landlord association is yielding positive results in areas with*

difficult terrains like in Okpoko. Landlord association is in partnership here and sometimes trucks and tippers carte away refuse with each street serviced on special days.

To awaken people's interest towards proper waste disposal in Onitsha, *sensitization using the electronic, print and other information disseminating media was proffered.*

On the proper way of disposing waste collected in Onitsha, they proposed *sanitary landfill as a means of eradicating the open dump sites that exists presently.*

The challenges encountered in the course of carrying out your duties as a waste management staff are lack of access to *some neighborhoods due to poor road network, poor maintenance of equipment, poor/delayed staff welfare packages and disrespectful attitude of residents to waste management staff." In Germany waste management staff work with self-esteem". Also mentioned, was that there was no arrangement to collect solid waste from residents in a segregated form because only one receptacle is used. In the same vein, the street sweepers could not work at night, therefore the collection work hour could not match waste generation.*

4. Discussion

The response rate of 92.8% achieved in our study corresponds with the response rate in the study by Adogu and colleagues in the assessment of waste management practices among residents of Owerri Municipal Nigeria. [14] Majority of the respondents (56.5%) were aged between 20-39 years. This alsoagrees with the finding of the Owerri study. [14]

The findings of our study revealed that majority of the residents (68.5%) dispose of the waste generated via government agencies or private contractors, whilemore than one tenth of the generated waste is not accounted for. This finding is consistent with findings in Owerri Nigeria and Accra Ghana. [8,15] The reason for this could be non-availability of dump sites in the area as wasobserved by Nkwocha and Okeomain the study on street littering in Nigeria towns. Difficulty in accessibility due to challenging terrain has also been reportedly attributed. [16]

The study result showed that residents of Onitsha still practice open dumping. This agrees with the findings of other studies. [17,18,19] This practice raises some public health concern as it encourages proliferation of houseflies, mosquitoes, rats and other vermin and aid in the spread of infectious diseases amongst other hazards that present threats to human health and the environment. [19] This implies that instead ofusing ideal sanitary landfill (equipped with features such as weighbridge, internal access, treatment plant, leachate collection system, gas recovery system and being sited far from human settlements and existing water bodies to help avert public health nuisance), [20] most of the waste generated in the study area is deposited in environmentally unsafe sites.

This study also showed that about six out of every ten households practice at least a form of solid waste separation. This effort is however defeated since the results of the KII revealed that the waste management agency has no arrangement for the collection of solid waste from residents in a segregated form since only one receptacle is used. Findings in Awka Nigeria, showed that most of the households did not recycle their solid waste, [19] while a study in Limpopo South Africa recorded that waste collected is not sorted into recyclables or non-recyclables and is all disposed of at the final dumpsite unsorted. [21] This is at variance with the practice in Curitiba Brazil where the City council educated and sensitized residents on how to sort their waste. [22] Source separation collection, as a waste reduction method, has been successfully carried out in demonstration residential and commercial areas in Beijing China such that Demonstration districts have been advocated.[23]This further elucidates the case for the introduction of recycling programme 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. [14,16]

Our findings showed some relationship between area of residence and waste disposal personnel between Okpoko and Feggeas well as Okpoko and GRA. This is in tandem with the finding of the study on Residents' knowledge, behavior and practices of municipal solid waste management in Chandigarh and Hyderabad India. [9] However, between GRA and Fegge there was no relationship in waste disposal personnel. This may be due to the time for waste disposal as they receive similar services, allowing people to dispose at will sometimes in the collation bins.

There was a relationship between area of residence and pattern of waste disposal. But the significant relationship in waste separation between Okpoko and GRA, may be because people in the lower social class residing in the earlier are usually employed to take care of some domestic functions by those in the high income areas (GRA), hence the similarity. Thus the heads of the households and their children may not know much about how their servants and maids handle solid waste.

There was no significant difference in waste disposal pattern between Fegge and GRA. This may be because the same method is used by LAGA for both areas. They have their vehicles moving round the area, picking the waste from households and to remove the collection bins. This is in contrast with the operation in Okpoko where the KII findings revealed that a different arrangement exists (the Landlord association is in partnership here and sometimes trucks and tippers carte away refuse with each street serviced on special days).

From our findings one major challenge in proper waste disposal in Onitsha is irregularity in collection pattern by the waste management authorities. This finding agrees with the observation in Mutare Zimbabwe. [24] The irregularity in solid waste collection in Onitsha may be due to poor funding of the solid waste management contractors and agencies. This finding is consistent with the findings by other authors. [17,25] Non-availability of waste collection center was also reported andcould explain the unhealthy habit of disposal shown by this study. This agrees with the finding by Nkwocha and Okeoma who observed that 87.9% of their respondents in 120 streets selected from 20 urban centers in the six geopolitical zones of Nigeria stated that absence of waste bins is the reason for littering the streets with solid waste. [26]

Apparent absence of policies and laws to prosecute offenders on improper waste disposal was also revealed by a participant in the KII who noted "the only language that Onitsha residents understand is task force". Another

challenge observed in our study was low self-esteem among some waste management staff. One of the KII participants observed that Onitsha residents look down on their staff and noted that "in Germany waste management staff work with self-esteem". This agrees with Cointreau-Levine who observed that in developing countries of the world, young people do not take up waste management job hoping to keep it till their retirement as they do not want to be associated with solid waste and its low societal perception. [26]

Limitation of study: Some residents refused to open their gates or attend to the interviewers perhaps because of the precarious security situation in the state at that time. This setback was however largely circumvented by selection of well-known residents as guides for the interviewers.

5. Conclusions

The study results has created a general picture of poor waste management practices in Onitsha metropolis as evidenced by open dumping and burning of wastes, non-availability of ideal sanitary landfill or dump sites and lack of arrangement to collect solid waste from residents in a segregated form. There was some relationship between area of residence and waste disposal personnel, pattern of waste disposal and waste separation respectively. This study showed observable private sectorparticipation as well as challenges in waste management.

Based on these, strategies for improving the MSWM in Onitsha Nigeria are suggested.

1. Government through federal and state ministries of Health and Environment should provide mediums for mass environmentaland health education campaigns on the need for waste segregation and harmful effects of improper disposal of waste through seminars, radio, televisions etc.
2. Proper waste management policy should be formulated and implemented. This policy should promote new healthy treatment technologies like reduction in the quantity of recoverable materials in residential and commercial waste streams to minimize wastes, recycling and incineration while phasing out the old and unsanitary methods like open dumping and burning.
3. Government and private partners should direct adequate efforts towards the provision of adequate home collection services such as provision of means of ferrying collected waste from the point of collection to the final dump site; this will help in reducing the common practices of open dumping by individuals and households.
4. There is need for community participation and enforcement of relevant laws through neighborhood check to prevent dumping of solid waste at non designated points.
5. There should be more private sector participation to enhance coverage to the unattended areas on Onitsha metropolis.
6. The State Government, its agencies and private partners should improve the welfare of solid waste management staff to make the job more lucrative and attractive.
7. The above recommendations cannot be put in place without political will to ensure improved budgetary allocation and appropriate legislation.

Acknowledgments

Source of Support or Funding

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

Author **OFE** and **OCA**were involved in the design and implementation, **CCN** was involved in analysis of data, interpretation of results and write up of this study, while **NFA** and **QNS** were involved in the design and editing of the main paper. All authors read and approved the final manuscript.

References

[1] Bilitewski B, Haratle G, Marek K, Weissbach A. Boeddicker H. Waste management. Springer-verag Berlin Heidelberg Germany. 1996 p564=571. Accessedonline@ htpp:// Bookgoogle.com/book?id on 14/5/2012.

[2] Okalebo SE, Opata GP, Mwasi BN. An analysis of the household solid waste generation patterns and prevailing management practices in Eldoret town, Kenya International Journal of Agricultural Policy and Research.2014; 2 (2):76.

[3] Zhang DQ, Tan SK, Gersberg RM. Municipal solid waste management in China: status, problems and challenges. J Environ Manage. 2010; 91(8):1623-1633.

[4] Ogwueleka T. Route optimization for solid waste collection: Onitsha (Nigeria) case study. Journal of applied science environment management. 2009; (13)2:37-40.

[5] Lawal, ASD. Composition and special distribution, solid waste collection points in urban Katsina, northern Nigeria. The Environmentalist. 2004; 24, 62-64.

[6] Nabegu A. An analysis of municipal solid waste in Kano Metropolis. Kamla-Raj Journal of human ecology, 31(2): 111-119.

[7] Kofoworola OF. Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria.Waste Manag. 2007; 27(9):1139-1143.

[8] Nkwocha E, Pat-Mbano E, Dike M. Evaluating the efficiency solid waste collection services in Owerri municipality, Nigeria. International journal of science and nature. 2011; 2(1): 89-95.

[9] Godura S, Aggarwal A, Bhatia P, Kumar R. Residents knowledge, behaviour and practices of municipal solid waste management in Chandigarh and Hyderabad India. Accessed online@ htpp:www. Washinstitute.org/conference/shefali%20Godura.pdf. on 8/3/2011.

[10] Ononugbo V,Akpan A,Osho G, Kritsonis W. Housing need for low income people of Enugu metropolitan area of Nigeria: policy

issues and challenges. International journal of management, business and administration 2010; 13: 1.

[11] Araoye MO. Research methodology with statistics for health and social sciences. Nathadex Publications, saw-mill, Ilorin 2nd ed.2008: p 115- 122.

[12] Akamu A, Abudu O, Akinsete I. Influence of socio economic status on haemoglobin and haematocrit levels during pregnancy in Lagos Nigeria. Nigerian postgraduate medical journal. 1988; 5 (3): 131-135.

[13] Onwasigwe CN. Principles and methods of epidemiology. EL 'DEMAK publishers Uwani Enugu.2010:p173.

[14] Adogu POU, Uwakwe KA, Egenti NB, Okwuoha AP, Nkwocha IB. Assessment of waste management practices among residents of Owerri Municipal Imo State Nigeria. Journal of Environmental Protection, 2015: 6, 446-456.

[15] Tsiboe IA, Marbell E. A look at urban waste disposal problems in Accra, Ghana. Masters thesis. Roskilde University 2004.p1-90.

[16] Nkwocha EE. Okeoma IO. Street littering in Nigeria towns: towards a framework for sustainable urban cleanliness. African research review. 2009; 3 (5): 147-164.

[17] Etengeneng D. Municipal solid waste in Grahamstown, Republic of South Africa. Degree thesis for bachelor of Natural Sciences. 2012. p 1-34.

[18] Aderemi, AO, Falade TC. Environmental and health concerns associated with the open dumping of municipal solid waste: a Lagos, Nigeria experience. American Journal of Environmental Engineering. 2012; 2:160-165.

[19] Modebe IA, Onyeonoro UU, Ezeama NN, Ogbuagu CN, Agam NE. *Public health implication of household solid waste management In Awka South East Nigeria.*The Internet Journal of Public Health. 2009; 1(1).

[20] PuopielF, Owusu-Ansah J. Solid waste management in Ghana: the case of Tamale Metropolitan Area. Journal of Environment and Earth Science. 2014; 4(17):129-147.

[21] Ogola, J.S., Chimuka, L. and Tshivhase, S. Management of municipal solid wastes: A case study in Limpopo Province, South Africa, integrated waste management. 2011; 1. Accessed online@ http://www.intechopen.com/books/integrated-waste-management-volume-i/management-of-municipal-solid-wastes-a-case-study-in-limpopo-province-south-africa on 14/5/2012.

[22] Rohn TV . Improvements to Curitibás waste disposal system : A comparative study between Curitiba and Germany solutions. International Symposium on Sustainable Design 2007-85-60186-02-0.

[23] Li ZS, Yang L, Qu XY, Sui YM. Municipal solid waste management in Beijing City. Waste Manag. 2009; 29(9):2596-2599.

[24] Manyanhaire IO, SigaukeE, Munasirei D. Analysis of domestic solid waste management system: a case of Sakubva high density suburb in the city of MutareManicaland province, Zimbabwe. Journal of sustainable development in Africa. 2009; 11(2):126-141.

[25] Mwanthi MA, Nyabola LO, Tenambergen T. Solid waste management in Nairobi City: knowledge and attitudes. Journal of Environmental Health.1997; 60: 345-353.

[26] Cointreau-levine S. Private sector participation in municipal solid waste management in developing countries. The formal sector. The International bank for reconstruction and development / the world bank. 1994; 1: 1-47.