

## **A Study on the Modes of Disposal of Household Plastic Waste in Kaduna Metropolis, Kaduna, Nigeria**

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### **Abstract**

Information on practices used by households in disposing waste is crucial for an effective management of household plastics wastes. The research was aimed to study the Mode of disposal of household plastic wastes and awareness on waste management in Kaduna Metropolis, Kaduna State, Nigeria. Exactly 200-households from 10 localities were investigated using a stratified random sampling (SRS) techniques. Structured close-ended questionnaire and interviews were used to collect data from 200 households and analyzed using XRealStats Package for Excel version 7.8 and Microsoft Excel. The result of the study showed that the residents of Kaduna Metropolis usually adopt an informal mode of disposing their waste. About 33% of waste is disposed by wheel-barrow boys, other methods include open-dumping (26%), collection by Government agencies (16%), Private agencies (12%), Burning (6%), Open-drain (5%) and by Burying (2%). The most educated members of the study group practice a proper method of waste disposal (Chi-square test of independence reveals;  $X^2(30, N = 42) = 138.27, p < .001$ ). The causes of indiscriminate waste disposal according to the residents are high cost of waste collection services (32%), distance to dumping site (26.5%), absence of dumping site (13%), irregular waste collection (12.5%), lack of waste management services (8.5%), lack of waste bin (4%) and 3.5% encounter no challenge. There was a high level of awareness (77%) among the residents. Improper household plastic waste disposal contributes to disease occurrence. The outcome of this research will inform policymaker on the state of the communities' mode of plastic waste disposal; helps in designing an effective management strategy and guide educational campaigns and behavioral interventions to promote responsible waste management practices among the public.

**Keywords:** Disposal of plastic waste; Health impact of plastic waste; Household; Plastic waste.

## 1. Introduction

Plastics are a blessing and the curse of our time. More than 300million metric tonnes of virgin plastics are manufactured in a year globally and almost half of this bulk are disposed within a year of their sale. This make a good method and management of Plastic waste a thoughtful matter of importance (Singh and Sharma, 2015).

As the usage of plastics heightened in our societies today, so did the hazardous effects of the plastics to the environment due to its manufacturing and disposal heightened. United Nation Environment Programme (2018) draw attention of the world to the environmental costs of plastic application, which have exceeded 7billion in 2011 and is predicted to go beyond 9billion by 2050. The future is scary due to the increasing need for resources which is intensifying the hike in resource utilization and waste accumulation, resulting to degradation of the ecosystem and the cause for climatic changes (Ogwo *et al.*, 2013).

A heap of plastic waste continues to emerge in cities on a daily basis due to a poor disposal practices, obstructing drainages/gutters and traffic flow, environmental degradations, general unsightliness, littering and creating a fertile site for breeding flies and other disease-causing vectors which have in effect cause serious health hazards.

Health hazards caused by plastics arise from their monomer's structural components (e.g., Bisphenol-A), their additives (example, plasticizers) or from a mixture of both (example, antimicrobial-polycarbonate). More than a few lethal substances are discharged by plastic items. Constituents and additives of major worries are Bisphenol-A and phthalates (Proshad *et.al.*, 2018), others are the heavy-metals, flame retardants and so on.

Demerits of this plastic materials to the human habitation is harmful effect of its constituents such as; the numerous forms of toxic it contains as additives, for example di-(2-ethylhexyl) phthalate (DEHP), biphenol A (BPA), poly halogenated compounds and heavy metals that pose a greater health risks to biotic components of the environment). The secondary components present in plastic have been revealed to have the ability of being discharged easily into the environment and this creates a detrimental effect on human and animal health. Researches on animals revealed that Bisphenol-A instigates several effects on the organism reproductive system and also an upsurge in body mass and insulin-resistance (Ben-Jonathan *et al.*, 2009). The foremost cause of alarm with the adverse effect of this compound is its connection to the present-day disease trend, which are the rise in prostate-cancer, breast-cancer, sperm-count decrease, abortion, overweight and type-2-diabetes (Oehlmann *et al.*, 2009). Because of the slow or non-degradability and stability of plastic waste in the ambient environment, the disposal of waste into the environment has presently generated an enormous pollution problem (Ilyas *et al.*, 2018).

Kaduna metropolis is not left out in the menace of indiscriminate solid waste disposal. The rapidly developing urban city is experiencing incidences of urban floods and loss of sustenance and livelihood yearly due to blockage of drainages caused majorly by these plastics (Ijigah and Akinyemi, 2015; Rigasa *et al.*, 2016). This supports the assertions made by Ajibuah and Fansen (2013) that improper dumping of wastes along Kaduna Metropolis is the chief factor influencing proneness of inhabitants along Kaduna River to floods annually. Although Kaduna State Government instituted various agencies for city planning and developmental control such institutions include; Kaduna Environmental Protection Agency (KEPA) and Kaduna State Urban Development Authority (KASUDA) but they are bedeviled by sharp practices, professional inadequacy and technical inefficiency by all standards. Information on methods household use

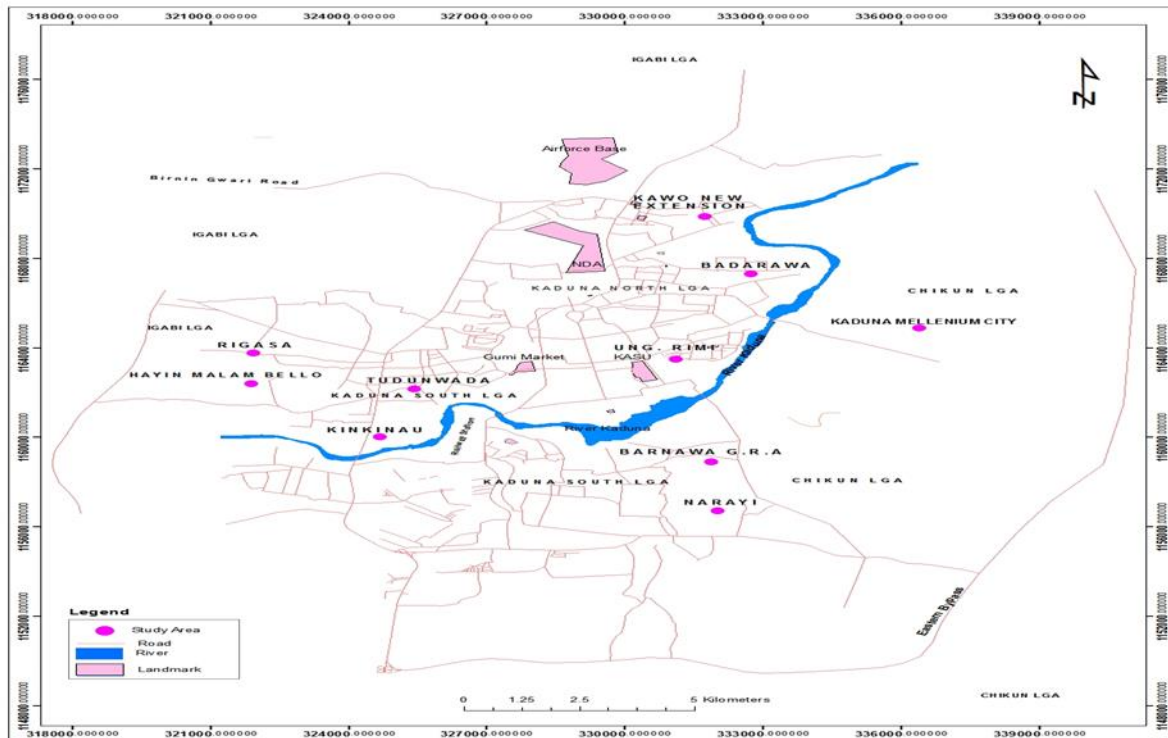
in disposing of their plastics wastes is a very vital function in the effective management of household plastics waste. The state and site wherein the household plastic waste is to be collected in the environment by the waste management may ease or make it difficult for the staff of the waste management firm. It is very important to know how households dispose their plastics wastes (Yintii *et al.*, 2014).

The study therefore, is aimed at identifying types, pattern and disposal techniques of household plastic wastes within the Metropolis and also assesses the level of awareness of the studied communities on poor waste disposal practices.

**Material and Method**

**Study Area**

The research was carried out in Kaduna metropolis; the capital of Kaduna State (Fig.1) located between latitudes 10° 22'00''-10° 40'00'' N and longitudes 7° 20'00''-7° 028'00'' E. Kaduna North, Kaduna South, and a part of Igabi and Chikun Local Government areas made up the metropolis covering an area of about 260 km<sup>2</sup> with a population of about 2,389,984 persons as of 2020 projection by Kaduna State University, GIS unit (KASU-GIS Lab, 2020). The population of the study area spread over high, medium and low-density residential areas of the city.



**Figure 1. A Map Showing the Study Area.**

### Sampling and Data Collection

For the study, 10 localities were selected within the metropolis using a Stratified Random Sampling (SRS) technique adopted from Abdulkadir *et. al.* (2023); Badarawa, Tudun-wada, Rigasa and Narayi (From a High-density area), Kawo New Extension, Kinkinawu, Hayin Malam-Bello and Kaduna Millennium City (Medium-density) and U/rimi GRA, Barnawa GRA (Low-density Area). Two hundred (200) households, 20 households each from the stratified randomly selected localities were randomly chosen. Head of every household or member responsible for the deposition of household waste is presented with a questionnaire and interviewed. The study used both structured close-ended questionnaire and interviews, in order to explore the in-depth perception of the inhabitants on waste disposal and the confronting challenges. The parameters for the design of the questionnaire are the demographic information of the residents (gender, age, level of education and occupation), knowledge and awareness, current waste disposal practices, challenges and health concern.

### Data analysis

Data collected were analyzed using a Descriptive and inferential statistics. All the data analysis was generated using the Real Statistic Resource Pack Software version 7.6, Copyright 2013.

### Results and Discussion

The residents of Kaduna metropolis didn't separate their plastic wastes. The household plastic wastes in the metropolis are usually being disposed along with other wastes. This lack of source-separation by residents diminishes the proficiency of recycling and waste-to energy potentials because of adulteration of the plastic waste with other wastes (Gwada *et.al.*, 2019).

Table 1 shows the demographic and socio-economic characteristics of the head of the households. Gender ratio of responders in the study shows a higher percentage for male 63% than female 37%. The outcome of this study on the gender responds correlate with the report of Kaoje *et al.* (2017), Yusuf (2017) and Bello and Manasseh (2019) but differs with the findings of Yoada *et al.* (2014) and Keita (2016) where females are having the highest participation. Yusuf (2017) attribute the higher participation of the male gender to the less key societal roles performed by the womenfolk due to social and religious factors in the Northern parts of the country, Nigeria.

With regards to the age group of the responders, the highest respondents were from age group above 35years (35%), followed by age group 26-35year (33%), age group 18-25years (28%) and those below 18years of age were the least respondents (4%). About 96% of the total respondents were above 18years old which is the suitable age capable of giving the needed data for the study. This is supported by the work of Olorunfemi (2009) where he inferred that since practically all the respondents were adults they could talk on behalf of their relatives. This validated the data received from the respondents.

With respect to the educational level of the respondents, 4% had no formal education, 6% had a primary education, 19% underwent secondary school, 36% obtained an NCE/OND certificate, 26% of the respondent were B.sc/HND holders while the remaining 9% underwent one or more postgraduate studies. On the educational level of the communities, there was fairly high level of literacy among the respondents since more than three quarter of respondents went beyond secondary education (Secondary 19%, NCE/OND 36%, BSC/HND 26% and Postgraduates 9%).

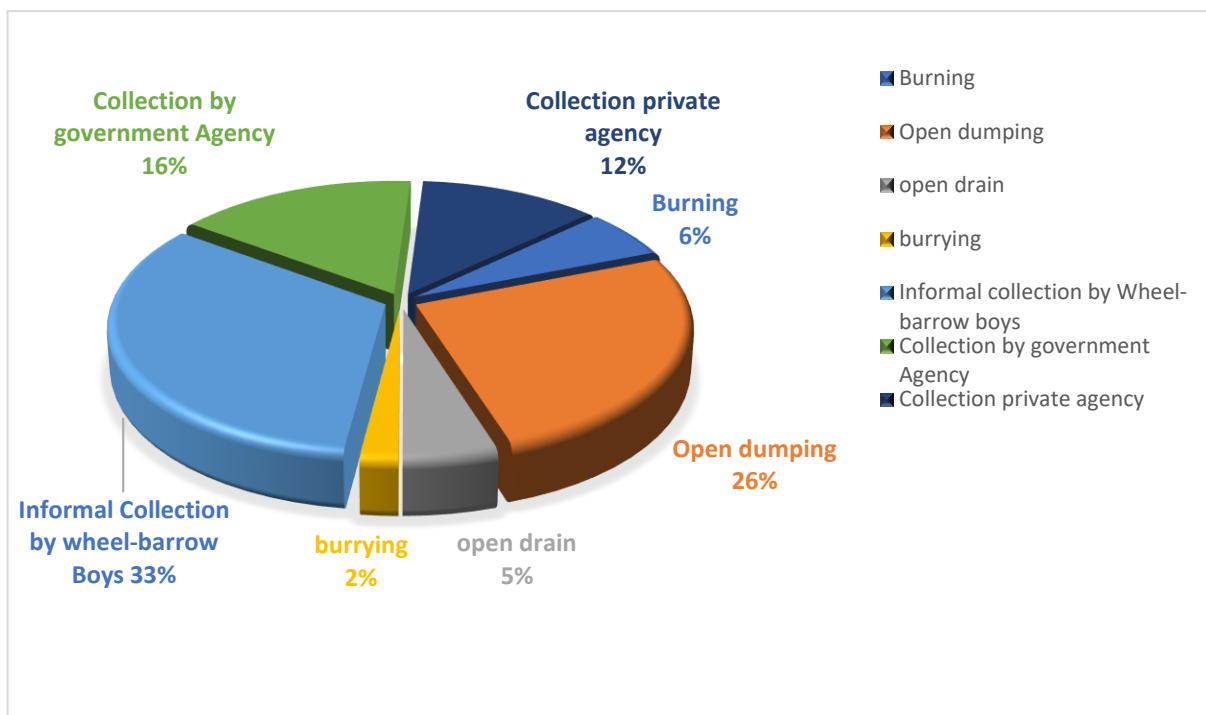
Looking at the occupation of the respondents. Thirty nine percent (39%) of the respondents were Civil servants, 35% engaged in trading followed by farmers (12%), student (4%) and others (10%) respectively.

**Table 1. Demographic and Socio-economic Characteristics of Respondents from the Selected Households in Kaduna Metropolis.**

VARIABLES	FREQUENCY	PERCENTAGE
<b>Genders of Responders</b>		
Male	126	63
Females	74	37
<b>Age Group of Responders</b>		
Below-18years	8	4
18-25year	56	28
26-35years	66	33
36years -Above	70	35
<b>Level of Education</b>		
Non-formal	8	4
Primary	12	6
Secondary	38	19
NCE/OND	72	36
BSC/HND	52	26
Postgraduate	18	9
<b>Occupation</b>		
Civil servants	78	39
Trading	70	35
Farmers	24	12
s	8	4
Others	20	10
Total	200	

Figure 2. how the mode of waste disposal in Kaduna metropolis. Thirty three Percent (33%) of the wastes in the metropolis were disposed via Informal collection by wheel-barrow boys. Followed by Open-dumping (26%), Collection by government agencies (16%), Collection by private agencies (12%), Burning (6%), Open-drain (5%) and Burying (2%).

Regarding the method of waste collection used by residents in the metropolis, thirty nine Percent (39%) of waste in the metropolis were disposed by the respondents indiscriminately (Open-dumping 26%, Burning 6%, Open-drain 5% and Burying 2%). Informal collection of waste by wheel-barrow boys (33%) appears to be the most common waste disposal practice in the metropolis according to this study. Whereas, Ogwueleka (2009) and Olukanni and Mnenga (2015) reported that open dumping of waste is the most widespread practice in their study areas.



**Figure 2. Mode of Waste Disposal by the Residents of Kaduna Metropolis.**

Table 2. Shows the relationship between level of education and mode of waste disposal in the municipality. A chi-square test of independence ( $X^2(30, N = 36) = 138.27, p < .001$ ) compared the relationship between the level of education of the respondents with their method of waste disposal. The result indicated a significant relationship ( $p < .001$ ) between the level of education with the method adopted. Suggesting that, there is a relationship between method of waste disposal and level of education among residents of Kaduna metropolis.

From the table of the education versus mode of waste disposal it was observed that most of the indiscriminate disposal (Open-dumping, Burning, Open-drain and Burying) which is about 39% were made by the low-educated class (non-educated, primary and secondary school leavers). The higher educated members of the society (NCE/ND, BSC/HND and Postgraduate Certificate holders) shows a lower

participation in the use of the unsafe methods. Therefore, this highlights more on the relationship of the education of resident of Kaduna metropolis and their mode of waste disposal.

**Table 2. Mode of Waste Disposal in Relation to Level of Education.**

Education	Mode of Waste Disposal							Total	Percentage (%)
	Burning	Open-dumping	Open-drain	Burying	Informal Collection by Wheel-barrow	Collection by Gov't Agency	Collection by Private Agency		
Non-formal	2	6	-	-	-	-	-	8	4
Primary	-	6	2	2	2	-	-	12	6
Secondary	2	18	8	-	6	2	2	38	19
NCE/ OND	4	14	-	2	32	12	8	72	36
BSC/HND	-	8	-	-	26	12	6	52	26
Postgraduate	4	-	-	-	-	6	8	18	9
Total	12	52	10	4	66	32	24	200	100

$X^2(30, N = 42) = 138.27, p < .001$

Table 3. Shows the Responses from 200 households of selected communities of Kaduna Metropolis on the Associated Problems faced while disposing their Household Plastic Wastes. The major causes of the indiscriminate waste disposal according to the residents is the high cost of waste collection services (32%), followed by the distance to Dumping Site (26.5%). Other problems are the absence of dumping sites (13%), irregular waste collection (12.5%), lack of waste management services (8.5%) and lack of a waste bins (4%). While 3.5% of the respondents reported no problem faced during the disposition of their household plastic wastes.

Similar challenges were reported by Yintii *et al.* (2014) where the members of the community reported irregular collection and lack of dumping site as the key challenges. Mwanthi *et. al.* (1997) reported long distance to dumping ground and insufficient waste bins. The high cost of waste collection services was also reported by Adelaide (1995) as serious challenge for effective waste disposal.

**Table 3 Responses from Residents in Relation to Challenges Associated with Waste Disposal within the Metropolis (n = 200).**

Challenges	Responses	Percentage (%)
Distance to Dumping Site	53	26.5
Absence of Dumping Site	26	13
Lack of Waste Bin	8	4
Irregular Waste Collection	25	12.5
Lack of Waste Management Services	17	8.5
Cost of Waste Collection Services	64	32
None	7	3.5
Total	200	100

Table 4 shows the Residents level of awareness on Poor Household Plastic Waste Management Practices. Seventy eight percent (78%) of the inhabitants interviewed were aware of appropriate waste disposal methods. This can be attributed to the level of literacy of the metropolitans.

Only 47% of the inhabitant were satisfied with the available waste management services. Which can be attributed to the challenges listed in (Table 3), more especially the high cost of waste disposal services and irregular waste collection.

With regard to the community's awareness on the impact of poor household waste management to the community health. Majority of respondents (77%) believed that improper waste disposal practices contribute to diseases occurrences, 18% disagreed while 5% were not sure. The level of awareness observed in Kaduna metropolis was lower than what was reported by Fadhullah *et al.* (2022) in the East Coast of Malaysia.

In respect to the perceptions of the respondents on diseases that may be related to improper household plastic waste disposal, 36% said malaria was related. While 24% mentioned typhoid fever, followed by other diseases (21.5%), Diarrhoea (17%) and Cancer (1.5%) respectively.

The study is limited to only Kaduna Metropolis (comprising of four Local Government areas of the state), studying more Local Government areas is needed to generalize the findings of the study. Also, some areas not fully explored by the study is the relationship of the community's method of household plastic wastes disposal and the income and occupation of the residents.



**Table 4 Residents Level of Awareness in Relation to Poor Household Plastic Waste Management Practices (n = 200).**

<b>Plastic Waste Management Practices</b>	<b>Responses</b>	<b>Frequency</b>	<b>Percentages (%)</b>
Awareness of Poor Method Knowledge/Awareness on an Appropriate Waste Disposal?	Yes	156	78
	No	44	22
Satisfied with Available Methods	Yes	94	47
	No	106	53
Perceptions on Improper Practices	Yes	154	77
	No	36	18
	Not Sure	10	5
Perceptions on Disease Occurrence	Malaria	72	36
	Typhoid	48	24
	Diarrhea	34	17
	Others	43	21.5
	Cancer	3	1.5

## 2. Conclusion

The residents of Kaduna metropolis do not separate their plastic wastes before disposal. Informal collection of waste by wheel-barrow boys (33%) is the most common waste disposal practice in the metropolis. The educational background of the residents has an impact on the method of waste disposal adopted. The educated members of the society adopted proper and safer methods of waste disposal.

Some of the challenges faced by the residents while disposing their household wastes range from high cost of waste collection services (32%), followed by the distance to dumping site (26.5%), absence of dumping site, irregular waste collection, and lack of waste bins.

There was a high level of awareness (77%) among the residents in the study area on improper methods of household plastic waste disposal and the possible disease that may occur.

### 3. References

- [1] Abdulkadir, S., Ishaq, S., Auta, K. I., Ibrahim, B. and Aliyu, K. I. Household Plastic Waste Generation and Composition in Selected Locations Within Kaduna Metropolis. *International Journal of Emerging Multidisciplinaries: Biomedical and Clinical Research*, **1**(1), 1-13. <https://doi.org/10.54938/ijemdbmcr.2023.01.1.161> (2023).
- [2] Ajibuah, B. J. and Fansen, T. Pattern and Disposal Methods of Municipal Waste Generation in Kaduna Metropolis of Kaduna State, Nigeria. *International Journal of Education and Research*, **1**(12), 1-14 (2013).
- [3] Bello A. O. and Manasseh S. L. An Assessment of the Methods of Collecting and Disposing of Household Wastes in Zaria, Kaduna State. *International Journal of Social Sciences and Humanities Reviews*, **9** (2), 119-130 (2019).
- [4] Ben-Jonathan, N., Hugo, E. R. and Brandebourg, T. D. Effects of bisphenol A on adipokine release from human adipose tissue: Implications for the metabolic syndrome. *Molecular and Cellular Endocrinology*, **304**(1-2), 49-54. <https://doi.org/10.1016/j.mce.2009.02.022> (2009).
- [5] Fadhullah, W., Imran, N. I. N., Ismail, S. N. S., Jaafar, M. H. and Abdullah, H. Household solid waste management practices and perceptions among residents in the East Coast of Malaysia. *BMC Public Health*, **22**,1. <https://doi.org/10.1186/s12889-021-12274-7> (2022).
- [6] Gwada, B., Ogendi1, G., Makindi, S.M. and Trott, S. Composition of Plastic Waste Discarded by Households and its Management Approaches. *Global Journal of Environmental Science and Management*, **5**(1), 83-94. <https://doi.org/10.22034/gjesm.2019.01.07> (2019).
- [7] Ijigah, E. A and Akinyemi, T. A. Flood Disaster: An Empirical Survey of Causative Factors and Preventive Measures in Kaduna, Nigeria. *International Journal of Environment and Pollution Research*, **3**(3), 53-66 (2015).
- [8] Ilyas, M. et al. Plastic waste as a significant threat to environment – a systematic literature review. *Review for Environmental Health*; **33**(4), 383–406. <https://doi.org/10.1515/reveh-2017-0035> (2018).
- [9] Kaoje, A. U., Sabir, A. A., Yusuf S., Jimoh, A. O. and Raji, M. O. Residents' Perception of Solid Waste Disposal Practices in Sokoto, Northwest Nigeria. *African Journal of Environmental Science and Technology*, **11**(2), 94-102. <https://doi.org/10.5897/AJEST2014.1791> (2017).
- [10] Keita, M. Factors Influencing Attitude, Safety Behavior, and Knowledge regarding Household Waste Management in Guinea: A Cross-Sectional Study. *Journal of Environmental and Public Health*, 2016, 1-9. <http://dx.doi.org/10.1155/2016/9305768> (2016).

- [11] Mwanthi, M. A., Nyabola, L. O. and Tenambergen, E. D. The present and future status of municipal solid waste management in Nairobi city: knowledge and attitudes. *International Journal of Environmental Health Research*, **7**(4), 345-353. <https://doi.org/10.1080/09603129773805> (2010).
- [12] Oehlmann, J., Schulte-Oehlmann, U., Kloas, W. et al. A critical analysis of the biological impacts of plasticizers on wildlife. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, **364**(1526), 2047-2062. <https://doi.org/10.1098/rstb.2008.0242> (2009).
- [13] Ogwo, P. A., Obasi, L. O., Okoroigwe, D. S. and Dibia, N. O. From Plastic Bag Wastes to Wealth: A Case Study of Abia State University, Nigeria. *Journal of Environmental Management and Safety*, **4**(1), 35 – 39 (2013).
- [14] Ogwueleka, T. C. Municipal solid Waste Characteristics and Management in Nigeria. *Iran Journal of Environmental Health, Science and Engineering*, **6** (3), 173-180 (2009).
- [15] Olorunfemi, F. B. Willingness to Pay for Improved Environmental Quality among Residents Living in Close Proximity to Landfills in Lagos Metropolis, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, **2**, 3. <https://doi.org/10.4314/ejesm.v2i3.48263> (2009).
- [16] Olukanni, D. O. and Mnenga, M. U. Municipal Solid Waste Generation and Characterization: A Case Study of Ota, Nigeria. *International Journal of Environmental Science and Toxicology Research*, **3**(1), 1-8 (2015).
- [17] Proshad, R. et al. Toxic effects of plastic on human health and environment: A consequences of health risk assessment in Bangladesh. *International Journal of Health*, **6** (1), 1-5. <https://doi,10.14419/ijh.v6i1.8655> (2018).
- [18] Rigasa, Y. A., Badamasi, A. G., Galadimawa, N. and Abubakar, G. U. Community based solid waste management strategy: a case study of Kaduna metropolis. *WIT Transactions on Ecology and the Environment*, **210**, 761-772. <https://doi.org/10.2495/SDP160641> (2016).
- [19] Singh, P. and Sharma V. P. Integrated Plastic Waste Management: Environmental and Improved Health Approaches. *Procedia Environmental Sciences*. **35**, 692-700 (2016).
- [20] UNEP. Single-Use Plastics: A Roadmap for Sustainability. Retrieved on July 30, 2020 from <https://www.unep.org/resources/reports/single-use-plastics-roadmap-sustainability> (2018).

- [21] Yintii, B. B., Anim-Gyampo, M. And Braimah, M. M. Household Perspective of Plastic Waste Management in Urban Ghana: A Case Study of the Bolgatanga Municipality. *Global Journal of Biology, Agriculture and Health Sciences*, **3**(2), 18-26 (2014).
- [22] Yoadu, R., Chirawurah, D. and Adongo, P. B. Domestic Waste Practice and Perceptions of Private Sector Waste Management in Urban Accra. *BMC Public Health*, **14**, 697 (2014).
- [23] Yusuf, A. A. Municipal Solid Waste Management Techniques in Kaduna North Local Government Area, Kaduna State, Nigeria. Unpublished M.sc Thesis of the School of Postgraduate Studies, Ahmadu Bello University, Zaria Nigeria. Department of Geography with registration number: MSc/SCIE/02617/2009-10 P15SCGS8045. Retrieved on July 15, 2020 from <https://www.kubanni.abu.edu.ng/items/2241d29d-928b-4076-bce9-e2c574a306c8> (2017).
- [24] Zaiontz, C. Real statistics Resource Pack Software (Release 7.6) Copyright 2013 [Computer Software]. [www.real-statistics.com/](http://www.real-statistics.com/) (2013).