A Review and Discussion of Solid Waste Management in Nigeria: Its Challenges and Prospect

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Abstract

Solid waste management is one of the growing environmental concerns in developing countries such as Nigeria. The indiscriminate disposal and dumping of refuse in unauthorized places as resulted to rapid environmental degradation that leads to adverse effect on the general sustainability of the ecosystem, widespread of germs and diseases, extinction of aquatic bodies due to water pollution causing toxicity and acidification, and poor agricultural yield. This paper reviews and discusses the solid waste management's challenges, prospects and way forward. The study objectives were achieved through literature analysis, site sighting and as well as interaction with stakeholders in waste management sector. The paper concludes by discussing effective ways of waste management and also, recommends possible ways of handling waste during pandemic.

Keywords: *solid waste, waste management, environment, Nigeria*

JEL classification: H12; F22; J61; J68; O15
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1. Introduction

Nigeria a developing country whose climate is equatorial in the south, arid in the northern part of the nation and tropical in Centre is located in the western part of Africa with land area of 923,768 km^2 and a population size (according to the report of world bank, 2011) of 162, 470, 737 with a GDP of $235.9billion (Ogwueleka, 2009 and Iriruaga 2012). The growth in the nation industrialization and globalization has resulted into increase in population and generation of solid waste. Nigeria been the most populous in the continent of Africa and ninth in the world makes her one of the largest waste producing country generating more than 32 million tons of waste per annual in which only 20-30% is collected and the rest are dumped in unsafe places (Bakare, 2016). Solid waste management in Nigeria is characterized by insufficient coverage of the disposal in most cities coupled with inefficient method of collection of waste in which co-disposal of both municipal and hazardous waste takes place in unlined dump sites, open space, drainages and other unauthorized places that promotes indiscriminate disposal. This act put humanity at risk by aiding the spread of infectious diseases such as covid-19 that have shock the entire world since its discovery in late December 2019 killing thousands of thousands of people.

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1.1 Definition of Waste

In general terms, any materials unused and rejected as worthless or unwanted are referred to as waste hence, is known as an unavoidable by-product of most human daily activity (ESCAP, 2000). Nhlanhla (2014) reported that Government Gazette (1990) defined waste as an unwanted / superfluous by-product of everyday human activities that could be inform of gas, liquid, solid or combination of all or any of the three forms that are accumulated and stored with the purpose of In agreement with the above definitions, Leton and Omotosho (2004) defined solid wastes also called Municipal solid waste as non-liquid and nongaseous products of human activities that are unwanted.

1.2 Waste classes

Wastes are classified into two, namely, general or municipal waste and hazardous waste. The waste classification system is founded on the risk any waste posed to humanity and its environment. Waste classification system comprises of waste regulations and laws, waste classification and its management regulation and disposal (Nhlanhla, 2014). Thus, the classification system helps distinguishes between extreme hazardous waste and waste of limited risk that requires utmost precaution during disposal and less attention during disposal respectively. The categories of the classified waste include organic waste (agricultural and animal refuse), industrial residues, mining/extraction waste, construction and demolition debris and sewage sludge etc. (Ndubuisi-Okolo et al., 2016).

1.2.1 General Waste

Of a truth, no waste is in its entirety safe, hence, general waste if properly manage pose no significant threat to humanity and its environment (Department of Water Affairs and Forestry, 1998). Domestic, commercial, Institution and certain industrial wastes are classified as general waste. They are so, because the quantities and qualities of hazardous substances present in them are sufficiently minor to pose potential threat to the environment.

Table 1. Types of general waste and their source

Types of general wastes	Waste generator	Source
Food wastes, paper, plastics, textiles, leather, curtilage wastes, wood, glass, metals, ashes etc.	Household	Residential
Paper, cardboard, plastics, wood, food, special waste etc.	Stores, hotels, restaurants, markets etc.	Commercial
Housekeeping wastes, packaging, food waste, construction and demolition waste, special and hazardous waste.	Construction sites, industries and manufacturing companies.	Industrial
Same as commercial	Schools, hospitals, prisons, government centers	Institutional

Source: Nhlanhla (2014)

1.2.2 Hazardous Waste

According Nhlanhla (2014), hazardous waste no matter how minute it is has adverse effect on environment and its occupant because of its physical and chemical composition. Hence, requires high level of control measures and management. They are sub-divided into different classes according to the level of risk they pose, these includes:

Table 2. Hazardous waste sub classes

Class Number	Class type
Class 1	Explosives
Class 2	Gases
Class 3	Flammable liquids
Class 4	Flammable solids
Class 5	Oxidising substances and organic peroxides
Class 6	Toxic and infectious substances
Class 7	Radioactive substances
Class 8	Corrosives
Class 9	Other miscellaneous substances

Source: Nhlanhla (2014)

2. Waste Generation

According to Yusuf et al. (2019) report, one of the major environmental threats in developing countries is solid waste. In which the rate of waste generation is greatly influenced by the population and their respective income, the high earners generates more waste than the low income earners. As a result of increase in national development there are various data on waste generation and its composition from different literatures in which the most recent shows that the rate of waste generation in the country varies from 0.4 – 0.79kg/capital/day (Abur, Oguche, and Duvuna, 2014; Nnabugwu, 2014). Which is quite low compare to that of developed countries that ranges from 2.75 – 4kg/capital/day hence, on a average developing countries such as Nigeria waste generation is 0.595kg/capital/day (Thitame, Pondhe and Meshram, 2010). As shown in Table 3 there is an upward trend in waste generation as population of the nation increases with a forecast specifying that by 2030 waste generated will be estimated to be 36,250 Gg (Yusuf et al., 2019).

Table 3. Annual waste generation in Nigeria

Year	Waste generation (Gg)	Year	Waste generation (Gg)
1959	6,471	2000	17,940
1960	6,601	2005	20,383
1965	7,335	2010	23,243
1970	8,195	2015	26,601
1975	9,281	2020	29,849
1980	10,760	2025	33,050
1985	12,249	2029	35,611
1990	13,961	2030	36,251
1995	15,829		

Source: (Yusuf et al., 2019).

3. Waste characteristics of major cities in Nigeria

According to Johari et al., (2012) with the aid of waste characterization the optimal waste management can be determined and adopted. Table 4 shows the typical waste characteristic of Nigeria solid waste of some state whose waste data were captured. It was observed that there is an increase in the generation of waste as the year progresses as seen in the case of Lagos and Kano State respectively except for paper, textile, metal and glass.

Table 4. Characterization of Typical Solid Waste in Nigeria

Materials	Lagos		Kano		Ilorin	Abuja	Nsukka	Onitsha	Ibadan	Makurdi	Maiduguri
	x	*y*	*x*	*y*	*y*	*y*	*x*	*x*	*x*	*x*	*x*
Food/ Organic/ Putrescible	56	68.16	43	57.5	70.18	54.1	56	30.7	76	52.2	25.8
Plastic	4	11.33	4.0	17.6	7.99	5.13	8.4	9.2	4.0	8.2	18.1
Paper	14	12.46	17.0	6.7	5.89	11.23	13.8	23.1	6.6	12.3	7.5
Textile	-	-	7.0	4.5	1.3	1.01	3.1	6.2	1.4	2.5	3.9
Metal	4.0	2.08	5.0	3.9	2.43	1.65	6.8	6.2	2.5	7.1	9.1
Glass	3.0	1.78	2.0	2.5	2.21	4.51	2.5	9.2	0.6	3.6	4.3
Wood	-	-	-	1.8	0.08	-	-	-	-	-	-
Leather	-	-	-	-	0.78	-	-	-	-	-	-
e-waste	-	-	-	-	-	-	-	-	-	-	-
Rubber	-	-	-	-	0.29	6.88	-	-	-	-	-
Others	19.0	4.2	22	4.2	8.85	16.09	9.4	15.4	8.9	14	31.3

Source: x = Ogwueleka (2009) and y = Yusuf et al., (2019)

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Table 5. Characteristic of waste in some cities in Nigeria

City	Population	Gg/month	Density (kg/m^3)	kg/capita/day
Lagos	8,029,200	255.56	294	0.63
Kano	3,248,700	156.68	290	0.54
Kaduna	1,458,900	114.43	320	0.58
Port Harcourt	1,053,900	11783	300	0.60
Maiduguri	971,700	850,000	-	-
Aba	784,500	236,703	-	0.46
Ilorin	756,400	-	-	0.43
Abeokuta	529,700	-	-	0.66
Onitsha	509,500	84.14	310	0.53
Warri	500,900	66,721	-	-
Akure	369,700	-	-	0.54
Ibadan	307,840	135.39	330	0.51
Makurdi	249,000	24.24	340	0.48
Ado-Ekiti	241,200	9,518	-	0.71
Abuja	159,900	1479	280	0.66
Uyo	102,400	20,923	-	-
Nsukka	100,700	12.00	370	0.44

Source: Ogwueleka (2009), Beatrice and Jussi (2013)

Table 5 shows the waste characteristic of the cities in five different Geopolitical Zones captured and arranged in descending order of their respective population in which Lagos is the highest waste generator of all the cities with the highest density also. The quantity and composition of wastes generated varies from city to city and are directly proportional to population, socio-economic status and level of urbanization of each cities (Ogwueleka, 2009, Beatrice and Jussi 2013).

4. Waste management

If wastes are left unchecked and uncontrolled it will lead to unaesthetic to the environment and pose health risks that can be aggravated by hazardous material in the waste stream. As such waste must be efficiently collected from source of generation and disposed in controlled disposal facilities (CSIR, 2000).

According to Ndubuisi-Okolo et al., (2016) waste management consist of waste collection, transport, storage, treatment, recovery and disposal. Furthermore waste management was viewed as the body looks into waste characterization and classification, waste selection and treatment, storage, transportation and disposal.

In addition to the definition above, Adewole (2009) defined waste management as the process of collecting, accumulating, treating and disposal in ways that are harmless to humanity and her ecological system. Unfortunately, in Nigeria, wastes are usually dumped along roadsides, nearby bush, available pit and drainage channels in most cities. While in rural areas waste are managed by burning, composting, occasional dumping in open field as well as feeding animals

with it to (Ndubuisi-Okolo et al., 2016). Management of waste in general is to prevent possible harm waste can cause on human health, its environment and utilization of the most optimal method of waste management of all the methods available. According to Hart (1997) sustainability of a city though actualized through blending of product stewardship, green technology and prevention of pollution, is merely impossible if the waste generated is more than what can be imbibe through waste reduction compare to its disposal. Ndubuisi-Okolo et al., (2016) further emphases that effective and timely waste management is critical to sustainable development of cities that meet the needs of the present generation without compromising that of the future generation. On contrary waste management in Nigeria has not yet key into sustainable ways of managing wastes as the process still involves accumulation / storage, collection, transportation and disposal at dumpsites. Indiscriminating dumping of this refuse as resulted to clogging of drainage channels and rivers, resulting in floods, and breeding ground for disease carrying animals as in the case of stagnant water there by increasing the spread of Malaria, lassa fever, Zika virus and other contagious bacterial and virus such as Covid 19.

5. Challenges of Effective Waste Management in Nigeria

There are several techniques for waste management and they varies considerably from country to country in terms of choice and other significant indices that are to be put into consideration such as the economic, type of waste generated, availability of land for disposal, availability of suitable technology, psychological and political aspects etc.(Ezechi et al., 2017, Beatrice and Jussi 2013). The challenges of appropriate waste management in Nigeria are synonyms to other developing nations, which comprises of poor legislation and implementation of policy, poor sensitization programs on environmental sanitation, Limited infrastructures and professionals, poor funding of environmental agencies, lack of incentive to recycling initiatives and disposal technique.

5.1 Poor Legislation and Implementation of Policy

Though, The Federal Government of Nigeria enacted Decree number 58 that established Federal Environmental Protection Agency (FEPA) on 30th December 1988 to guide and mitigate indiscriminate disposal and dumping of refuse, the goal behind this degree has not yet been achieved due to weak, ineffective constitutional strength of municipal waste management policy in the country and poor implementation of this policy. The policy are not well structured and are lagging in keying into the sustainable development goal of actualization of reduction in waste generation by encouraging 3R's of waste management (reduce, reuse and recycle) (Beatrice and Jussi 2013). Likewise, the policy is not comprehensive enough to back up the public cooperation and no adequate plan for waste disposal making the nationwide monthly environmental cleanup exercise not to significant effect on waste management in most cities.

5.2 Poor Sensitization Programs on Environmental Sanitation

Level of awareness on sustainable waste management in the nation is still poor as there is little or no effort by waste agencies on sensitization of municipals on the adverse effects of indiscriminate disposal of waste and benefits of desisting from such act. Also, there is no rise in public sensitivity towards relationship between products and the environment there by encouraging customer choice of product to solemnly basis on products economic price rather than its environmental friendliness and shifting manufacturing firm's attention away from ecofriendly rendering of services/production of goods to focus more on profitability (Agunwamba, 1998). The level of growth as soon as awareness program mention above are initialed will also help curtain the cultural believes of some people who sees waste as invaluable and useless materials rather than wealth (Zender).

5.3 Limited Infrastructures and Professionals

In Nigeria lack of suitable technology is one of the greatest constraints to effective waste management. Insufficient waste collection equipment's and their poor maintenance lead to refuse accumulation at illegal sites likewise is the insufficient experts to man these machineries (Ezerie et al., 2017). Most of the environmental protection agencies and waste management personals are not adequately trained to meet international standards on waste management. This can be attributed to the fact that only few institutions in Nigeria offer specialized courses and training on waste management also lack of collaboration with International Solid Waste Management Organization or Agencies by the local waste agencies further contributes to shortage of skilled labor and impedes rapid sustainable development in the waste management sector (Beatrice and Jussi 2013 and Agunwamba1998).

5.4 Poor Funding Of Environmental Agencies

Poor funding is another major constraint hampering solid waste management in Nigeria, as actualizing sustainable waste management requires consistent funding to achieve the targeted goal of sustainable environment as in developed countries (Agunwamba 1998, Beatrice and Jussi2013, Ezerie et al., 2017). Limited and poor maintenance of machineries and limited staffs are evidence of shortage of funding in the sector.

5.5 Recovering, Recycling, Reuse and Disposal Technique

There are no formal recycling program/initiatives or policy by the government to encourage the 3R's of waste management and composting as found in the developed countries. Except for the informal recycling activities of scavengers who search and pay for recyclable waste items within the neighborhood, legal and illegal dumpsites (Oguntoyinbo, 2012). This act is expected to serve as an eye opener to the government who has not yet/fully adopted issuing of incentives for recyclable waste to motivate residents to practice the 3R's of waste management (Ezerie et al., 2017). According to Agunwamba (1998) the

country can posed of only two sanitary landfills without suitable technology to manage it. Due to insufficient sanitary landfills solid waste is often disposed of on controlled landfills, open dumps, drainage channels and uncontrollable burning of waste by residents as become abnormal normalcy in the society thereby contributing to greenhouse effects continuous outspread of infection in the society through carrier animals and scavengers that visits dumpsite to harvest reusable items.

6. The Way Forward

Waste management and disposal in Nigeria must be a joint effort of households, institutions, manufacturing companies and government. There is a desperate need for government at state levels to intensify awareness programs on importance of desisting from indiscriminate disposal of refuses and encourages sustainable waste management through initiation of incentive programs that encourages the 3R's (reduce, reuse and recycle) of waste in each state. Likewise, government should integrate sustainable technologies for resources recovery through bio-gasification that can serve as a boost to the national energy status and composite organic waste to produce manures and fertilizers for farming thereby creating additional source of revenue to the government (Ezerie et al., 2017). More sanitary landfill and incineration centers should be made available and well equipped. In line with the above, waste management policies are to be reviewed, restructured, upgraded, reaffirmed, implemented and monitored. Government of each state should strive to equip their respective waste management agencies with expertise that have the technical know-how of waste management. Trainings, workshops in collaboration with international solid waste management should be organized often for all stakeholders in keeping them updated. Above all, federal government should financially support and monitor each state on the road to achieving sustainable waste management. Likewise, Private partnership should be encouraged in management of waste. In Nigeria, the current processes of waste management include storage, collection, transportation and disposal at dumpsites. In bridging the gap such method pose a proposed waste management flow chat is as shown in figure 1. It gives a detailed summary of how waste can be manage from point of generation to collection of wastes. It further shows the importance of identifying and sorting of various wastes into different categories at the point of generation which helps in implementation of the 3 R's of waste collection and management with significant impact on national economy and health/safety of the citizens.

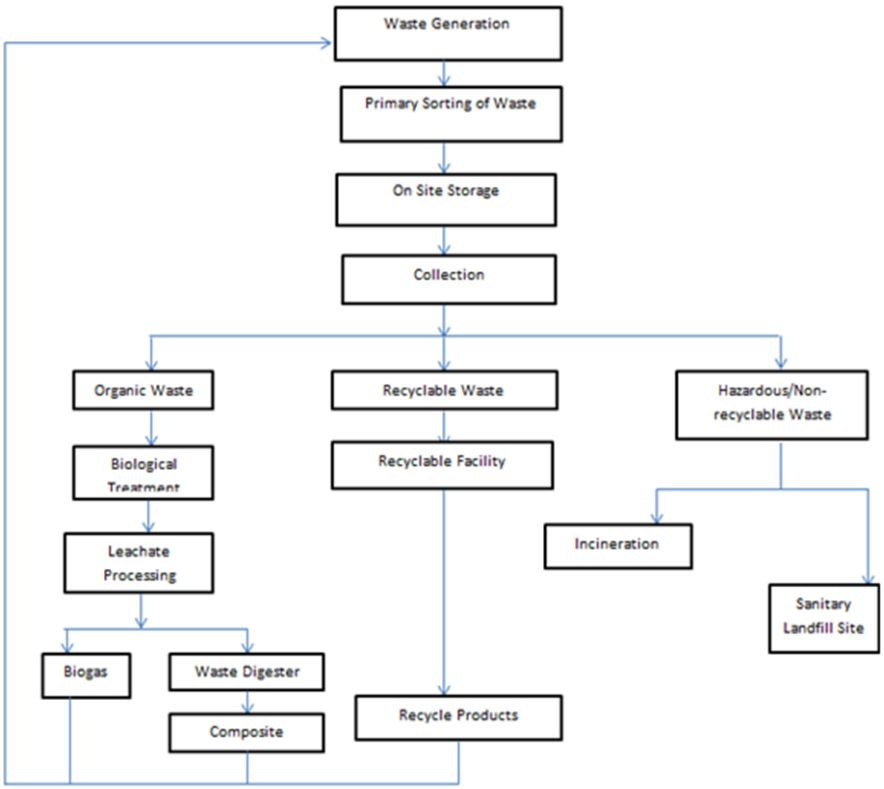

Figure 1. A Proposed Waste management flow chart

6.1 Possible Waste Management Technics in Pandemic Period

Pandemic as defined by wordweb is an epidemic that is geographically widespread; occurring throughout a region or even throughout the world. A pandemic could therefore be referred to as global disease outbreak. When an influenza pandemic such as covid 19 occurs there is little or no immunity in the human population causing exponential spread from person to person, leading to illness that mostly result in death (Nigeria National Pandemic Influenza Preparedness and Response Plan,2013). Waste management if not cautiously managed during period as such it will contribute to the outspread of this virus through the waste generated in household, isolation centers, testing centers, laboratories and hospitals.

6.2 Waste Management Recommendations during Pandemic

i. **Training, Collaboration and Monitoring**: Waste agencies can organize trainings on precaution/preventive steps for their staffs on how to go about rendering of their services during pandemic periods. Emphases should be made on

importance of wearing of protective gears and how to disposed them, practicing of social distance while on duties with the collection drivers staying always in the collection vehicle with the window rolled up. The agency should work with NCDC (National Center for Disease and Control) to identify units that have reported members with covid 19 symptoms and support such homes with supplies and information on how to use them such as double bagging of waste before storing for pick up. Likewise routine environmental cleansing of work place and disinfection of working equipment should be encouraged and in cases where an employees feel sick such individual should stay at home and reach out to NCDC for guidance on what to do while being monitored (Managing Infectious Medical Waste during Covid 19 pandemic, 2020 and Solid Waste Management during the COVID-19 Outbreak, 2020).

ii. Disposal of Waste: In time as this, Reschedule of frequency on solid waste collection to suite present situation should be encouraged and Recycling of waste should be discourage to prevent human contact with any potentially infectious domestic and medical waste, all solid waste should be treated as non-recyclable waste and be dumped in sanitary landfill, medical incineration and autoclaves can also be utilized. In cases where by the afore mention capacities are overloaded integration of other waste management techniques such as mobile incineration, industrial furnace and cement kilns could be utilized with all precaution necessary taken. Increase management and security of places such as sanitary landfill should be considered to prevent scavengers from visiting such site.

All health care waste produced during pandemics should be collected safely in designated containers/bags which are to be disinfected, and then safely disposed of or incinated, preferably onsite. Pedal-operated waste collection bins with liners, Color-coded waste segregation bins i.e. 3-bin system designated for infectious waste, sharps and general waste should be encouraged and in the absence of pedal-operated waste bins, bins with swinging lids and open waste containers can be opted as the alternative to prevent direct contacts. In developing countries where access to sanitary landfill, medical incineration and autoclaves are limited or not available Pit burning with the aid of fuel drops such as kerosene can be opted for.

7. Conclusions

A sustainable environment is not actualize-able in countries with faulty waste management system. Successful waste management in any country depends majorly on funding, suitable technical support, adequate human resources, knowledge management and enabling legislations/policies.

References

1. Abur, B. T., Oguche, E. E., & Duvuna, B. G. A. (2014). Characterization of municipal solid waste in the Federal Capital, Abuja, Nigeria. *Global Journal of Science Frontier Research: H Environment & Earth Science, 14(2), 1–6*
2. Adewole A.T. (2009). Waste management towards sustainable development in Nigeria: A case study of Lagos state. *International NGO Journal, vol. 4, no.40, pp. 173-179*
3. Bakare W (2016) Solid Waste Management in Nigeria. Bio-Energy Newsletter 5: 68-72.
4. Beatrice A. and Jussi K. (2013). Municipal Solid Waste Management Problems in Nigeria: Evolving Knowledge Management Solution. *International Journal of Environmental and Ecological Engineering Vol:7, No:6*
5. Council of Scientific and Industrial Research Building and Construction Technology, Solid waste management, guidelines for human settlement planning and design, 2000, CSIR
6. Department of Water Affairs and Forestry, *Minimum requirements for the handling, classification and disposal of hazardous waste*, 1998.
7. Ezerie H. E., Chima G., N., Ogbonna C., E., & Chibunna J., B. (2017). Municipal solid waste management in Aba, Nigeria: Challenges and prospects. *Environmental Engineering Research; 22(3): 231-236.*
8. Hart, S. L. {1997}. Beyond Greening: Strategies for a Sustainable World. Harvard Business Review/ 75(1), 66-76.
9. Iriruaga, E. T. (2012). Solid waste management in Nigeria. Retrieved from https://www.d-waste.com/new.../13_2eb98714b1d4af8a8c8c0d5e0ba7b5ed.html [Accessed 10 June 2020].
10. Johari, A., Ahmed, S. I., Hashim, H., Alkali, H., & Ramli, M. (2012). Economic and environmental benefits of landfill gas from municipal solid waste in Malaysia. *Renewable and Sustainable Energy Reviews*, *16*(5), 2907–2912
11. Leton, T. G. and Omotosho, O. (2004). Landfill Operations in the Niger Delta Region of Nigeria. *Engineering Geology 73(1-2): 171-177.*
12. Managing Infectious Medical Waste during Covid 19 pandemic (2020). Retrieved from: https://webcache.googleusercontent.com/search?q=cache:8hLy9jybMwJ:https://www.adb.org/publications/managing-medical-waste-covid19+&cd=1&hl=en&ct=clnk&gl=ng&client=firefox-b-d [Accessed 10 June 2020].
13. Nigeria National Pandemic Influenza Preparedness and Response Plan (2013).Retrieved from: http://ncdc.gov.ng [Accessed 10 June 2020].
14. Ndubuisi-Okolo P. U., Anekwe R., I., & Attah E., Y. (2016). Waste Management and Sustainable Development in Nigeria: A Study of Anambra State Waste Management Agency. *European Journal of Business and ManagementVol.8, No.17*
15. Nhlanhla P Nkosi (20114). Waste Tyre Management Trends and Batch Pyrolysis Feasibility Studies in Gauteng, South Africa. Published Master of Technology Thesis.
16. Oguntoyinbo O.O. (2012) Informal waste management system in Nigeria and barriers to an inclusive modern waste management system: A review. *Public Health, vol. 126, pp. 441-447.*
17. Ogwueleka, T. (2009). Municipal solid waste characteriztics and management in Nigeria. *Journal of Environmental Health Science & Engineering*, *6*(3), 173–180
18. Solid Waste Management during the COVID-19 Outbreak, (2020). Retrieved from https://www.iswa.org/iswa/covid-19/[Accessed 10 June 2020].
19. United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). 2000; Retrieved from: http://www.unescap.org/.[Accessed 10 June 2020].

20. Thitame, S. N., Pondhe, G. M., & Meshram, D. C. (2010). Characterization and composition of municipal solid waste (MSW) generated in Sangamner City, District Ahmednagar, Maharashtra, India. *Environmental Monitoring and Assessment, 170*(1-4), 1–5
21. Yusuf R. O., Adeniran J. A., Mustapha S. I. & Sonibare J. A. (2019). Energy recovery from municipal s olid waste i n Nigeria and its economic and environmental implications. *Environ Qual Manage.* 2019; 28:33–43. https://doi.org/10
22. Zender L.E., "Culture, society and solid waste management. Retrieved from: www.zendergroup.org. [Accessed 10 June 2020].