Chapter 13
Innovative Sustainable Solid Waste Management in Nigeria

Abdullahi Nafiu Zadawa, Abdelnaser Omran, and Guy Martin Robinson

Abstract Problems associated with solid waste management (SWM) have proved to be complex in origin and in solution. In Nigeria SWM is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal of solid waste. This chapter reviews the current status of SWM in Nigeria. For SWM to be sustainable in Nigeria a greater financial investment needs to be made, possibly including provision through local rates and taxes. In addition, appropriate technologies in line with the nature of garbage generated need to be explored. Finally the effort and role played by the informal sector in SWM in Nigeria needs to be recognised, but there is urgent need for this sector to be formalized so that its role can be geared towards achieving sustainability.

Keywords Innovation • Sustainable • Solid Waste Management (SWM) • Nigeria • Federal Environmental Protection Agency (FEPA) • Cart pushers • Scavengers • Resource Merchants • Recyclers

13.1 Introduction

The Nigerian population is growing at an alarming rate Statistics show that the population growth rate of Nigeria as at 1991 was 3.0 % per annum with an urban growth rate of about 5.5 % per annum. The average waste generation rate is put at 0.49 kg per day (Adewole 2009). The volume and rate of waste generated is always

A.N. Zadawa (✉)
School of Environmental Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria
e-mail: elnamz@yahoo.com

A. Omran
School of Economics, Finance and Banking, College of Business, Universiti Utara Malaysia, Sintok, Kedah 06010, Malaysia

G.M. Robinson
Centre for Rural Health and Community Development, University of South Australia, Whyalla, Australia

O. Schwarz-Herion, A. Omran (eds.), *Strategies Towards the New Sustainability Paradigm*, DOI 10.1007/978-3-319-14699-7_13

increasing. However, the lack of an efficient waste management system has led to the indiscriminate dumping of waste in the cities. According to Nabegu (2010), the speedy growth of urban population with unplanned urbanization, increasing economic activities and lack of innovation in solid waste management practices in Nigeria complicates efforts to improve solid waste services. Moreover changes in consumption patterns with alterations in the characteristics of waste have also resulted in a quantum jump in solid waste generation (Ludwig et al. 2003). The natural environment has a limited capacity to assimilate these wastes, resulting in environmental pollution, erosion or degradation of natural ecosystems (Ezeronye 2000). Solid waste management (SWM) has emerged as one of the greatest challenges facing state and local government environmental protection agencies in the country. The volume of solid waste being generated continues to increase at a faster rate than the ability of the agencies to improve the financial and technical resources needed to parallel this growth. SWM in Nigeria is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal of solid waste (Ogwueleka 2009). In their research Izugbara and Umoh (2004) posited that SWM practices in Nigeria, such as the use of incinerators, waste diversion into the sea and streams, and open dumping, cause further harm to the environment. Despite this worsening situation for SWM in Nigeria there is evidence of innovative improvements in most of the cities, including involvement of the informal private sector, emergency clean-up campaigns, privatization, monthly environmental sanitation exercises, community involvement, improved management of disposal sites and waste recycling, mostly involving the activities of scavengers. Achi et al. (2012) define SWM practices as the collection of generated wastes, waste separation or segregation, storage, transfer and transport, transformation, treatment and disposal. The task force approach in which households are merely forced to observe SWM policies attempting to overcome the problem of SWM in Nigeria was not successful (Izugbara and Umoh 2004). Subsequently the Federal Government produced a partially successful innovative initiative in the form of an environmental sanitation campaign which required all residents in Nigeria to carry out a mandatory clean-up exercise every last Saturday each month. This was enforced through a campaign, and public awareness through mass media. This initiative is still effective in some state capitals, having been supported by some trade unions. For almost two decades now sustainable SWM services in Nigeria have been enhanced by institutional arrangements mainly focusing on privatization (Cointreau-Levine 1994), with further trials currently in progress in this sector. In an attempt to strengthen privatisation the Federal Government has established the National Integrated Municipal Solid Waste Management Intervention Programme in seven cities of Nigeria: Maiduguri, Kano, Kaduna, Onitsha, Uyo, Ota, and Lagos (Ogwueleka 2009). State and local government environmental protection agencies are responsible for SWM in Nigeria. They are charged with the responsibility of handling, employing and disposing of solid waste generated. The state agencies generate funds from subventions from state governments and internally generated revenue through a sanitary levy and stringent regulations with heavy penalties for offenders if they illegally dump and litter refuse along streets.

13.2 Government Initiatives and Milestones

SWM in Nigerian cities was originally part of the urban management system and it is still directly attached to local government authorities, which have had different evolutionary phases: e.g. pre-colonial, colonial, and post-independence (Onibokun and Kumuyi 1999). The Public Act 1909 by the then British colonial administration set a foundation to regulate the indigenous peoples' relations with the environment. The colonial masters placed much emphasis on environmental sanitation, introducing sanitary inspectors, who went from house to house to ensure those houses and their surroundings were clean and they applied appropriate sanctions for recalcitrant residents (Ukoje 2011). Considering the subsequent level of deterioration of the environment relating to urbanisation and public health, the Federal Government of Nigeria pursued its mandate to set-up the Federal Environmental Protection Agency (FEPA) in 1988. Also, the National Policy on Environment was launched in 1989 in recognition of the linkage between the environment and national development. The environmental policy which subsequently emerged has been analysed extensively (Ajayi and Ikporukpo 2005). FEPA's mandate is to promote cooperation between federal and state ministries, local government councils, statutory bodies or research agencies on matters and facilities relating to environmental protection and to encourage states and local government councils to create their own state Environmental Protection Agency (EPA), for the purpose of maintaining good environmental quality (FEPA Decree 1989). FEPA documents emphasised sanitation and waste management as part of an integrated, holistic, and systematic view of environmental issues (FEPA 1999). Under the FEPA Act SWM is a major responsibility of state and local government environmental agencies. The agencies are charged with the responsibility of handling, employing and disposing of solid waste generated. The state agencies generate funds from subventions from state governments and internally generated revenue through sanitary levies and stringent regulations, with heavy penalties for offenders of illegal dumping and littering of refuse along streets (Ogwueleka 2003). To harmonize the efforts of FEPA, a State Environmental Protection Commission (EPC) was established for each state in 1989. Edict No. 18 explains the undertakings and responsibilities of the EPC concerning SWM, which include (i) advising the state government on environmental policies and priorities; (ii) formulating and enforcing policies, (iii) formulating statutory rules and regulations on waste collection and disposal; (iv) rendering advisory services and supporting all local governments; (v) preparing master plans on solid-waste collection and disposal; (vi) Monitoring discharges and the environmental impact of these discharges; (vii) Enforcing applicable laws on activities related to the environment and (viii) Establishing environmental criteria, guidelines, specifications or standards for environmental protection. In 1997, a new environmental policy emerged. This was purposely enacted in line with Vision 2010. Vision 2010 committees were instated in 1996 as part of a government development program with the aim of making Nigeria one of the 20 largest economies in the world, able to consolidate its leadership role in Africa and establish itself as a significant

player in the global economic and political arena (Ajayi and Ikporukpo 2005). In 1999, the Federal Ministry of Environment took the responsibility for administering and enforcing environmental laws from the Federal Environmental Protection Agency (FEPA). The Federal Ministry of Environment serves as the overall body charged with the management of environmental issues. The Ministry is empowered to issue guidelines and prescribe measures and standards for the management and conservation of natural resources and the environment. The guidelines on SWM recommended effective, efficient and sustainable waste management strategies requiring that stakeholders be involved in SWM and it spelt out the roles expected of all stakeholders. In 2005 the Federal Ministry of Environmental set out Federal Policy Guidelines on SWM in Nigeria. These detailed the objectives of the National Environmental Sanitation (NES) policy (Ukoje 2011). The Federal Government has also taken other positive measures to improve environmental management through the following (Ukoje 2011):

1. The National Urban Development Policy of 1989;
2. The Urban and Regional Planning Decree No. 88 of 1992; and
3. The Environmental Impact Assessment Decree No. 96 of 1992.

FEPA has instigated the enactment of the following important laws on environmental management:

- The Hazardous Wastes Criminal Provision Decree 42 of 1988;
- The Pollution Abatement in Industries and Facilities Generating Waste Regulation S.1.9 of 1991;
- The Management of Solid and Hazardous Wastes Regulation S.l.15 of 1991;
- The National Effluents Limitation Regulation S.1.8 of 1999.

13.3 Solid Waste Generation

According to Ogwueleka (2009) the estimated solid waste generated yearly in Nigeria amounts to 25 million tonnes. This ranges from 0.66 kg/cap/d in urban areas to 0.44 kg/cap/d in rural areas. The constituents of waste generated vary from urban areas to rural areas and likewise from state to state. Waste generated is directly proportional to population, socio-economic status and level of urbanization (Abila and Kantola 2013). The constituents of waste produced per state are a function of socio-economic status, industrialization and commercialization. In their research Achi et al. (2012) posited that the key factors influencing solid waste generation in Nigeria include inadequate technology, lack of facilities for separation at source, strength of SWM policy and enforcement, environmental education and awareness and income status of individuals. Table 13.1 below shows the waste tonnage for some selected urban cities in Nigeria.

Table 13.1 Waste generation in selected cities in Nigeria

City	Population	Tonnage/month	Density (kg/m^3)	kg/capita/day
Lagos	8,029,200	255,556	294	0.63
Kano	3,348,700	156,676	290	0.56
Ibadan	307,840	135,391	330	0.51
Kaduna	1,458,900	114,443	320	0.58
Port Harcourt	1,053,900	117,825	300	0.60
Makurdi	249,00	24,242	340	0.48
Onitsha	509,500	84,137	310	0.53
Nsuka	100,700	12,000	370	0.44
Abuja	159,900	14,785	280	0.66

Source: Ogwueleka (2009), Tobore (2012)

Table 13.2 Composition of waste stream characteristics for selected cities

	Nsuka	Lagos	Makurdi	Kano	Onitsha	Ibadan	Maiduguri	Zaria	Average
Putrescrible	59.8	63	59.3	58	56.9	58.5	60.8	58.8	59.38
Paper/ Polythene	25.72	45	23.22	38.42	39.11	37.6	35.6	39.07	35.46
Textile	1.57	3.1	2.5	7	6.2	1.4	3.9	2.13	3.47
Glass and metal	2.5	3	3.6	2	9.2	0.6	4.3	5.15	3.79
Others	9.4	19	14	22	15.4	8.9	31.3	4.33	15.54
Moisture Cont	20.79	28.36	20.27	18.88	21.17	23.52	17.95	18.33	21.15

Source: Amberis et al. (2012)

13.4 The Composition of Solid Waste

There is no doubt that the greatest segment of the total solid waste generated in Nigeria is organic; higher than glass, textiles, metals, paper, plastics ceramics and bones (Dauda and Osita 2003; Ogwueleka 2003). Nabegu (2010) argued that there is a striking difference in the organic composition of solid waste, which is much higher in the low income areas than the high income, while the paper and plastic content is much higher in high income areas than low income areas. This is as a result of variation in consumption patterns, and cultural and educational diversity. Ogwueleka (2009) noted that packaged products are mostly consumed by high income earners, thereby generating inorganic materials such as metals, plastics, glass etc. Waste characteristics vary according to season, income level, population, social behaviour, climate, and industrial production, the size of markets for waste materials, the extent of urbanization, and effectiveness of recycling. Table 13.2

shows a comparative analysis of solid waste composition in some major cities in Nigeria. It can be seen that the constituents of the solid waste are quite similar except that the amount and proportion present in waste dump sites varied is greatly influenced by the type of activity dominant in the environment where the waste is generated and deposited. This further shows that the great majority of the total solid waste generated in Nigeria is organic. The high level of reuse of recyclable waste reflects the extent of poverty, typical in the developing countries, where over half of the waste stream comprises organic materials (Ogwueleka 2009).

13.5 Solid Waste Collection and Transportation

In Nigeria the responsibility of solid waste collection rests solely with the state and local government environmental protection agencies. Waste collection is an imperative aspect of waste management, hence over the years, diverse waste collection techniques have been in use worldwide (Achi et al. 2012). These methods as stated by Lasisi (2007) include: house-to-house, communal depots, curbsides, block systems, commercial and industrial collection, and bulk loading. Where the waste collection is undertaken by the private sector it is a function of income of the owner of the waste to be able to pay the amount charged. Informal solid waste collection plays a vital role towards achieving innovative sustainable SWM. Informal solid waste collection processes operate in parallel with official agencies in some major cities of the country. Informal collectors provide the service for a fee. According to Ogwueleka (2009), the most widely adopted waste collection system in Nigerian urban areas is the stationary container system; the residents deliver their waste to the storage containers, which are located at 500–800 m intervals in open spaces at the end of streets or at road junctions. Because of the high level of efficiencies of SWM services rendered by the private sector the collection of refuse in most urban areas is sublet to private companies. The current interest involving private companies in solid waste is driven by failures of government agencies to provide adequate services, so as to achieve more innovative sustainable SWM. A wide range of vehicles is used for solid waste collection. Compactor trucks, side loaders, rear loaders, mini trucks, tippers, skip trucks and open back trucks are the most commonly used collection vehicles. Yet 60 % of waste collection vehicles are mostly out of service at any one time (Ogwueleka 2009). And even the usable trucks are characterized by frequent breakdowns resulting from overuse (Agunwamba et al. 2003).

13.6 Solid Waste Recycling

Recycling is the removal of materials from a solid waste stream and the use of those materials in other innovative ways. Recycling is a more environmentally desirable method of SWM than incineration (Ruzi 2001), and it has ample economic, social

and environmental benefits. According to Medina (1993) waste recycling can help generate income; save water and energy; cause less pollution among others, and these will in turn reduce operating costs, lessen the amount of waste to be generated, collected, and subsequently disposal, and it extends the life of disposal facilities. Solid waste recycling is considered as a source of direct employment through both public and private waste recycling facilities, indirect jobs through businesses that purchase recyclable commodities, and a source of induced direct jobs by means of manufactures or re-users of recyclable materials and shops selling recycled merchandise. Also in his study Agunwamba et al. (1998) argued that efficient recycling and composting could save 18.6 % in waste management costs and 57.7 % in landfill costs. About 60 % of wastes collected in Nigeria are organic waste, but only 8 % are recovered for reuse (Ogwueleka 2009). At the moment recycling or recovering activities of solid waste are mostly practiced by the informal sector in Nigeria, owing to the absence of formal resource recovery programmes in the country (Ogwueleka 2003). Recycling and /recovery are undertaken by scavengers who pack refuse for a fee and salvage any recyclables prior to the disposal of the waste. In Onitsha, a city in eastern Nigeria, 48 % of the raw materials used by 40 % of indigenous artisans and small-scale industries are obtained from scavengers (Ogwueleka 2009). This illustrates the innovative role played by the informal sector towards achieving sustainable SWM. Details of this are discussed below.

13.7 Solid Waste Disposal

Disposal of solid waste generated in a community is a vital step in a SWM. In Nigeria most of the refuse collected is disposed of in two main ways: open dumping and burning. In most urban areas a designated collection point is provided by the state or a local environmental protection board so that the public can dump refuses. A metal box container is provided that can be mechanically loaded onto trucks (Nabegu 2010). Solid waste is generally dumped openly on available space, buried or burnt at the side of the road, in every available open space (Achi et al. 2012). In Lagos state there are landfills, while in Abuja, the federal capital, a controlled dumpsite is located along the outer northern expressway (ONEX). Open dumping is damaging to the environment and is a health hazard to scavengers at the dump site. It pollutes groundwater, spreads infectious diseases and highly toxic smoke from continuously smouldering fires and gives off foul odours from decaying refuse (Ogwueleka 2009). However, the significant participation of the informal sector as well as the private sector in SWM is associated with innovative approaches and may yield positive results.

13.8 Community Participation in Solid Waste Management

The community and its representatives have direct concerns in SWM, as residents, service users and taxpayers. Communities in low-income areas generally receive marginal or no services in terms of infrastructural service provision such as electricity, drinking water, sanitation, drainage and also waste management among others. However, they sometimes take the initiative to organise community-based organisations with the sole aim of self-help and improving their living conditions (Ukoje 2011). In some instances the community-based organisations (CBOs) may obtain financial and technical support from various agencies. Their activities can involve direct participation in SWM. Community members, local rulers and leaders in urban communities play different roles in SWM. Local leaders play the role of intermediaries between communities and municipalities. Local leaders can be divided into traditional, formal and informal leaders. These roles correspond to different levels of community participation in SWM. Community members can participate in SWM by depicting proper sanitation methods, by contributions in cash, kind or labour, by participation in consultation and by participation in administration and management of solid waste services (Bello 2011). Proper sanitation etiquette is considered as the most vital role expected of a community to facilitate sustainable SWM. Bello (2011) identified such behaviour to include:

1. Adapting daily habits to an agreed solid waste system (rules, schedules, e.g. to offer these at the right time and place to a collection team);
2. Bringing garbage in a plastic bag, a special bin etc.;
3. Cooperating in clean-up campaigns;
4. Keeping houses and the immediate environment clean (drains, streets in front of the house);
5. Separating waste into organic and non-organic, wet and dry, keeping plastics, paper and other recyclable materials apart;
6. Contributing in cash, kind or labour, which represents more direct contributions to the operation of SWM.

13.9 Solid Waste Recycling Activities by the Informal Sector

The role of the informal sector in waste collection in Nigeria is vital. Ogwueleka (2009) argued that the informal sector is responsible for removing 30 % of total generated waste in the urban areas of the country. This sector is a body of its own with little acquaintance with integrated waste management techniques of collection, transportation, recovery, recycling and merchandise recovered and recycled material to industries within and outside the country. Evidence of positive results yielded by the SWM activities of the informal sector to the environment is obvious in Lagos state (Opeyemi 2012). The informal private sector is labour intensive and serves as

a source of income by providing ample job opportunities to many people. It involves unregistered, unregulated activities carried out by individuals, families, groups or small enterprises involving low technology manufacturing or provision of services. The stakeholders are consumers/scavengers, middlemen, and manufacturers. Though there is no information regarding the official population of scavengers in the country. Informal sector solid waste collection and recycling is carried out by the less privileged and marginalized social groups who resort to waste collection and picking, scavenging, and recycling for income generation and for everyday survival (Ukoje 2012). According to Ogwueleka (2009) informal waste collectors mostly use pushcarts, wheelbarrows and sacks to collect waste. They provide service coverage in areas where agencies cannot, some of them concentrating in public places like markets. Another valuable contribution of the informal waste management sector is in recycling, in the form of either itinerant waste buyers or scavengers interested in buying used materials such as plastics, paper, used electronic electrical equipment, glass and metal. Such activities have a great impact on innovative sustainable SWM. Even though the informal sector has not been officially integrated into the SWM system in most parts of the country, in her study Tobore (2012) stated that the Lagos state waste management authority had recently introduced recycling banks in some parts of the state, where some scavengers were employed to be the resource managers. Under this arrangement households are encouraged to deposit their recyclables like plastics, cans and bottles while the organic components are collected from door-to-door. The activity of informal waste collectors varies depending on how and at which stage or where the recovery takes place. Ukoje (2012) identified five main categories of informal waste activities:

(i) Itinerant waste buyers: Waste collectors who go from door to door collecting sorted dry recyclable materials like newspapers, glass, metals, tin cans and plastics from households or domestic servants and shopkeepers, which they buy or barter and resell to dealers;
(ii) Street waste pickers: Collectors who recover raw materials from mixed wastes discarded on the streets and communal dumps within neighbourhoods of households, commercial establishments and industries before collection;
(iii) Municipal waste collection: Secondary raw materials are recovered from vehicles transporting municipal solid waste to disposal sites;
(iv) Waste pickers from dumps: Waste pickers and scavengers who sort through wastes that are dumped at major dumpsites in a neighbourhood and on the urban periphery. These wastes can originate from institutions, commercial areas or households.
(v) Direct waste collectors: These provide waste collection services in several areas especially in commercial areas and residences where there is no normal municipal system in place. The motivations for this activity include a fee that is charged and the income that can be made from sorting and recycling of the waste collected. The following are identified as informal SWM solid waste management stakeholders in Nigeria:

13.9.1 Cart Pushers

Cart pushers constitute a group using purpose-built carts for house-to-house waste collection in most cities (Fig. 13.1). Cart pushers are believed to be brought into the industry by the ineffectiveness of the relevant authorities responsible for SWM. In Lagos state alone there are approximately over 5,000 cart pushers operating within the industry and about 70 % of waste generated is collected by cart pushers (Olugbenga 2006). They normally embark on house-to-house collection and subsequently transfer the waste into waste collection containers. Cart pushers are also involved in waste recovery, by means of sorting and recovering reusable and recyclable materials from waste collected before final disposal of the remains. They collect refuse from house-to-house at an agreed cost.

13.9.2 Scavengers

Scavengers recover recyclables and re-usable materials either off-site or on-site, such as aluminium, glass, paper, metals etc. (See Fig. 13.2). The majority are aged between 17 and 30 years old and are driven into this activity by poverty (Ogwueleka

Fig. 13.1 Typical cart pushers (Source: Olugbenga 2006; Opeyemi 2012)

Fig. 13.2 Typical scavengers on disposal sites (Source: Opeyemi 2012)

2009). Most operate with no appropriate protective clothing. Like cart pushers some scavengers walk from house to house, and street to street to retrieve recyclable and re-usable materials, although most of them limit their activities to waste disposal sites (Olugbenga 2006). Many households now store waste paper, cans, glass, and plastic separately and sell to scavengers when they visit (Agunwamba 2003). A study conducted by Saleh (2008) in Kano, a city in north-western Nigeria, by Saleh (2008) showed that no fewer than 25,000 people were engaged in scavenging, recovering about 15 % of the solid waste generated in the city. Apart from income generation to teeming unemployed youth, scavengers that are involved in an informal recovery of plastics can provide cheap raw materials for plastics manufacturing industries (Mukhtar 2008). Once resource materials are recovered from waste, scavengers store them by building waste heaps prior to selling or transporting to the recycling industries. According to Olugbenga (2006) in Lagos only about 50 % of the recovered items are utilized by the local recycling industry, the remaining 50 % being exported to neighbouring countries such as Ghana, Togo, Cameron, Mali, Republic of Niger, and Sudan for both industrial and personal use. Activities of scavengers in some instances involve processing the recovered waste materials, which may include washing or burning depending on the material type before selling to either recycling industries or resource merchants.

13.9.3 Resource Merchants

Resource merchants are traders engaged in the purchase of all recovered recyclable and re-usable materials from the scavengers. Some members of this group are retired scavengers who cannot scout for materials on the site again due to either old age or improved financial capability. Some wealthy resource merchants extend their trading to neighbouring countries by exporting recovered resources thereby earning foreign exchange. Resource merchants are also very influential and obtain local purchasing orders (LPOs) from companies to supply recovered materials.

13.9.4 Recyclers

Recyclers are also an integral part of informal waste management. They include micro- and small scale recycling companies, who transform recovered waste materials like paper, aluminium, animal by-products, plastics and scrap metals etc., to valuable materials and raw materials for the consumption of the industrial sector (Olugbenga 2006). The recycling sector involves huge investment of money, where some specialized equipment and machines are used for the transformation of the retrieved items to finished products or raw materials that are also used in many other ways. Some of these recycled products and raw materials are exportable products through which foreign exchange is obtained.

13.10 Conclusion

Based on the above account, it can be said that the current practice of SWM in Nigeria is unsustainable. For SWM to be sustainable in Nigeria a greater financial investment needs to be made, possibly including provision through local rates and taxes. This could possibly be realised with strong support from political and traditional rulers. An enlightenment campaign is another means of motivating households towards achieving sustainability, particularly in the aspects of waste disposal of which many are ignorant regarding the inherent dangers associated with improper waste disposal such as pollution and diseases. Developed countries treat sustainable development as an environmental concept placing the emphasis on intergenerational equity focusing on future needs (Carter 2001). The developed economies of Japan, South Korea, Taiwan, and Singapore ultimately aim for the elimination of landfills from their systems. In these countries, SWM systems have stabilized through a variety of legal measures supported by national funding (Shekdar 2009). Likewise, in these high-income Asian countries, their citizens are highly aware of their responsibilities making SWM a common practice. Public awareness through improved education has an important role to play. This is the key to the success of any SWM policy. Environmental education for the communities should be a priority. This will help communities appreciate sound practices such as sorting and recycling. This will also help encourage communities to abandon illegal practices such as burning, and open space dumping. In order to encourage public support an effective environmental policy targeted at the poor needs to have elements of economic incentives. There is need to develop a policy that promotes community involvement in waste management. Finally there is urgent need for the informal sector to be formalised so that its role can be geared towards achieving sustainability.

References

Abila B, Kantola J (2013) Municipal solid waste management problems in Nigeria: evolving knowledge management solution. World Acad Sci Eng Technol 78:313–318

Achi HA, Adeofun CO, Gbadebo AM, Ufoegbune GC, Oyedepo JA (2012) An assessment of solid waste management practices in Abeokuta, southwest. Nigeria. J Biol Chem Res 29(2):177–188

Adewole TA (2009) Waste Management towards sustainable development in Nigeria: a case study of Lagos State. Int Non-Governmental Organ J 4(4):173–179

Agunwamba JC (2003) Analysis of scavengers' activities and recycling in some cities of Nigeria. Environ Manage 32(1):116–127

Agunwamba JC, Ukpai OK, Onyebuenyi IC (1998) Solid waste management in Onitsha, Nigeria. Waste Manag Res 16(1):23–31

Agunwamba JC, Egbuniwe N, Ogwueleka TC (2003) Least cost management of solid waste collection. J Solid Waste Techn Manag 29(3):154–167

Ajayi DD, Ikporukpo CO (2005) An analysis of Nigeria's environmental vision 2010. J Environ Policy Plan 7(4):341–365

Amberis I, Gukop N, Kullais MD (2012) Municipal waste in Nigeria generation, characteristics and energy potential of solid. Asian J Eng Sci Tech 2(2):84–88
Bello AH (2011). Evaluation of constraints affecting solid waste management among health workers and heads of house hold in Nigeria. PhD dissertation, Ahmadu Bello University
Carter N (2001) The politics of the environment. Cambridge University Press, Cambridge, UK
Cointreau-Levine S (1994) Private sector participation in municipal solid waste services in developing countries. Volume 1: The formal sector. UNDP/UNCHS/World Bank, The world bank, Washington, DC
Dauda M, Osita OO (2003) Solid waste management and reuse in Maiduguri, Nigeria: towards the millennium development goals. Paper presented at the 29th WEDC international conference, Abuja
Ezeronye OU (2000) Solid waste management in the tropics: a case study of the Nigerian urban environment. Int J Environ Stud 57(4):437–442
Federal Environmental Protection Agency (1989) National policy on the environment. Federal Republic of Nigeria. Abuja, Nigeria
Federal Environmental Protection Agency (1999) National policy on the environment. Revised Edition, 1999. Federal Republic of Nigeria. Abuja, Nigeria
Izugbara CO, Umoh JO (2004) Indigenous waste management practices among the Ngwa of Southeastern Nigeria: some lessons and policy implications. The Environmentalist 24:87–92
Lasisi KS (2007) An appraisal of municipal solid waste management in Lagos State. Longman Press, Ibadan
Ludwig C, Hellweg S, Stucki S (2003) Municipal solid waste management: strategies and technologies for sustainable solutions. Springer, Berlin/Heidelberg
Medina M (1993) Recovery of recyclables in Mexico City. Urban issues. Urban Resources Institute, New Haven
Mukhtar M (2008) Analysis of plastic waste recycling in Kano Nigeria. PhD thesis, Bayero University
Nabegu AB (2010) An Analysis of municipal solid waste in Kano Metropolis, Nigeria. J Hum Ecol 31(2):111–119
Ogwueleka TC (2003) Analysis of urban solid waste in Nsukka, Nigeria. J Solid Waste Tech Manag 29(4):239–246
Ogwueleka TC (2009) Municipal solid waste characterization and management in Nigeria. Iran J Environ Health Sci Eng 6(3):173–180
Olugbenga AO (2006) The role of informal private sector in integrated solid waste management (ISWM) in Lagos, Nigeria – a developing country. Paper presented at the 21st international conference on Solid Waste Technology & Management, Philadelphia
Onibokun AG, Kumuyi AJ (1999) Governance and waste management in Ibadan, Nigeria. In: Onibokun AG (ed) Managing the monster urban waste and governance in Africa. IDRC, Ottawa
Opeyemi OM (2012) Proposal for new waste management system in Nigeria. Master's thesis, Seinäjoki University of Applied Sciences
Ruzi JA (2001) Recycling overview and growth. In: Lund HF (ed) Recycling handbook, chapter 1. McGraw Hill Inc., New York
Saleh GA (2008) Analysis of scavenging activities and reuse of solid wastes in Kano Metropolis, Nigeria. PhD thesis, Bayero University
Shekdar A (2009) Sustainable solid waste management: an integrated approach for Asian countries. Waste Manag 29:1438–1448
Tobore IE (2012) Solid waste management in Nigeria. Retrieved January 23, 2014, from: http://www.d-waste.com/new-infographics/item/124-solid-waste-management-in-nigeria.html
Ukoje JE (2011) Analysis of the determinants of participation of stakeholders in solid waste management in Zaria, Nigeria. Unpublished PhD thesis, Ahmadu Bello University
Ukoje EJ (2012) Informal sector solid waste collection and recycling in Zaria, Nigeria. J Environ Sci Eng 1:649–655