AN APPRAISAL OF SOLID WASTE MANAGEMENT IN MINNA, NIGER STATE: POLICY AND PLANNING IMPLICATION TO NIGERIAN CITIES

[1]Adamu Abubakar, [2]Muh'd Nasir Ibrahim [3]Kuso umaru [4]Adamu Bala, [5]Shidali Samuel David

[1,2,3] Department of Urban and Regional Planning, School of Environmental Studies, Niger State Polytechnic, Zungeru- Nigeria
[4] Department of Building Technology, School of Environmental Studies, Niger State Polytechnic, Zungeru- Nigeria
[5] Department of Urban and Regional Planning, School of Environmental Technology, Federal University of Technology, Minna-Nigeria

Email: samshidali@gmail.com

Abstract: *Man's environment is of immense importance and the management of the living environment has great health implications. The activities of man and his interaction with his environment results in the generation of different kinds of wastes. The most obvious are the Solid Wastes. A lot of areas in our cities have become eyesore due to indiscriminate dumping and poor management of solid wastes. This has led to environmental degradation and pollution. The management of solid wastes presents particular challenges to city authorities in Nigeria, because the volume of wastes generated in different cities has been increasing over the years. This paper therefore, examines the magnitude of solid waste problems in Nigeria and the challenges of managing these wastes, with a view of assessing the policy and Planning Implication to Nigeria cities.*

Keywords: *Solid waste, Generation, Dumping, Pollution, Management, Planning implication*

1.0 INTRODUCTION

The environment in which man lives can be described as the totality of his surroundings that exert direct and indirect influence upon his life. The environment and natural resources have played a defining role in social, political and economic transformations. They have also being a major contention in characterizing Africa as a continent in crisis (Opara and Gerhard, 2008). The environment has been at the receiving end and over-burdened with the aftermath of the excesses of humans in their struggle for survival. The activities of man and his interactions with his environment results in the generation of different kinds of waste (Aluko, 2001, UNDP, 2001). These wastes may be in the form of solids, liquids or gases. The most worrisome are *solid waste,* because they are the most visible of all kinds of waste and cause the most irritation to urban dwellers. The Oxford Advanced Learner's Dictionary defines waste as something that is no longer useful and so to be thrown away. Ranjith (2012) defined waste as a substance which is not valuable and signify no economic worth to a person possessing it. Solid waste can therefore be referred to as substances not in the liquid or gaseous form that are no longer useful and need to be thrown away or discarded.

According to World Bank (2012), as the universe plunges into an urbanized future, the rate of growth of urban solid waste; a major important effect of urbanized way of life, exceeds urbanization growth. About 2.9 billion municipal residents generated about 0.64 kg of urban solid waste in 2005 at the rate of one individual in a day, thus amounting to 0.68 billion tons per year. However, estimates today show a gross increase to about 3 billion urban residents generating 1.2 kg per person per day; amounting 1.3 billion tons per year. Subsequently, an

increase to 4.3 billion urban residents generating about 1.42 kg of urban solid waste per person per day is inevitable in the year 2025 (World Bank, 2012).

In most Nigerian cities like Minna, tons of solid wastes generated daily find their final destination in hazardous places such as canals, streams and open spaces (Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA, 2009). Solid waste management (SWM) is the process which involves the collection, storage, transfer and disposal of solid wastes in a harmless manner to humans, animals, plants and the overall environment (Agwu, 2012). Solid waste management has always been a problem in human settlement that must be adequately and efficiently managed.

Efficient management of waste would safeguard human health, protect the environment and preserve natural resources (Environmental Protection Agency [USEPA], 2009).

With the increase in population of Minna, the concentration of human activities also increases which translates to a proportionate increase in waste generation. Wastes are disposed in an unsustainable manner in Minna, usually in open spaces, gullies, roads, and in drains which subsequently runs into fresh water body, a water source for people within such area. The uncontrolled nature of solid waste disposal coupled with increasing population has made solid waste management a challenge in urban areas and regarded as a major barrier in the path towards sustainability and a sign of urban deterioration (Agwu 2012; Udoakah and Akpan, 2013). Several studies such as Adeoye *et al.* (2011); Ayanshola *et al.* (2015); Okwesili *et al.* (2016) revealed that poor and unhealthy environment particularly poor waste management has adverse effect on the health of the population. Though, there is a dearth of studies on the policy and planning implications of waste management in the study area.

Despite the fact that several measures in combating the problem have been tried, the problem still persists. In fact, the deposit of refuse in different parts of the city has become readily cited means of assessing the performance of city administrations in Nigeria. It is the intent of the paper to examine the existing management strategies of waste and suggest ways that will enhance improvement in policy and planning initiatives to combat the menace.

1.1 Study Area

The name Minna is derived from a Gbagyi word "mina" meaning "gushing fire". Minna one of the major towns in Nigeria, became the Capital of Niger State after its creation in 1976. Minna is located on latitude 9° 33' N and longitude 6° 33'E. According to Max Lock Group (1980), the railway line construction from Baro to Minna in 1911 was a major factor that led to the development of Minna, in addition to its role as the administrative headquarter of old Niger Province, it later created an avenue for non-indigenes and merchants to stay in the town. Minna as a town is growing fast by virtue of its nearness to Abuja; thus, the town is experiencing considerable expansion.

2.0 REVIEW OF RELATED LITERATURE
2.1 Generations and Magnitude of Solid Waste in Nigeria Cities

Waste materials in the contemporary world are generated from different sources either with the same or different compositions and types. However, on general terms, irrespective of compositions, five main sources have being identified based on land-use and practices. These are; *Domestic* or *Residential, Commercial. Agriculture, Industrial* and *Educational* and *Administrative centres,* (Rouf *et al.,* 2018). Among these five sources, industrial and residential areas are the leading ones in terms of the volume of waste generated annually. They are also the most troublesome in terms of hazards and management. The remaining three sources, (Agricultural, commercial and educational administrative) on the other hand are relatively easy to handle and pose fewer hazards compared with the former. The rate of which waste is

generated has spontaneously exceeded the rate of its proper management all over the world (World Bank, 2012). Thus, the magnitude of waste generated and the associated problems are quite enormous, although with some variation between the industrialized and the non-industrialized, based on compositions and volume. Toxic wastes, for example are generated more in the industrialized countries than in the non-industrialized countries. Out of the total of 338 million tons of hazardous waste produced in the world annually, 81.4% comes from North America, 7.4% from Western Europe, while the balance of 11.2% from South America, Asia and Africa (World Bank, 2012). Several numbers of factors are responsible for such great variations. However, the most important of these factors are the standard of living, local customs, food habits, geographical location, climate, occupations and type of business as well as daily and weekly variation. In the developing countries, these variations are more dramatic than those of the developed countries. In a city, because of the wide gaps between the rich and the poor, the compositions of refuse from one area may be completely different from those of another area. Another important aspect of the special factors of refuse from developing countries, especially the relatively, "Rich" ones, is the proportion of carcasses of imported consumer and luxury items, like cookers, refrigerators and automobiles. In Nigeria the policy of many "Rich" people is "Buy', use and discard 'and not Buy, use and maintain". Therefore abandoned automobiles are causing serious problems to solid waste management authorities.

Statistically, it is observed that the quantity of refuse generated in Nigeria cities has been increasing each year. The volume of wastes generated in each city usually increases with increased household property and hence rising consumption, increased levels of urbanization and industrialization, as well as with increased population (World Bank, 2012). In retrospect, Table 1 shows the estimated and projected volumes of solid wastes for selected Nigeria cities (Maton *et al.,* 2016).

Table 1: Estimated and projected volumes of solid waste generation in some Nigeria cities intones/Year

Urban Area	1982	1985	1990	2000
Lagos	625,399	681,394	786,079	998,081
Ibadan	350,823	382,224	440,956	559.882
Kano	319,935	348,580	402,133	535,186
Kaduna	257,837	280,925	324,084	431,314
Onitsha	242,240	263,929	304,084	386.593
Port Harcourt	210,934	229,821	265,129	352,853
Oshogbo	131,903	143,712	173,720	253,841
Aba	131,903	143,712	169,719	236,703
Jos	99,871	111,905	135,272	197,660
Warri	67,477	75,607	91,396	133,531
Gusau	44,488	48,471	57,243	79,835
Potiskum	15,434	16,816	19,399	28,347
Uyo	12,508	13,628	15,721	20,923
Suleja	9,383	10,514	13,311	21,336
New Bussa	5,690	6,200	7,152	9578

Source: Maton *et al.* (2016)

From the table above, Lagos State generated the highest volume of waste with 625,399 metric tons in 1982 to 998,081 metric tons in 2000. New Bussa generated the list with 5,690 metric tons in 1982 to the projected volume of 9, 578 metric tons in 2000.

2.2 Classification of Waste
Environment Protection Authority (EPA, 2014) classified waste into the following categories:

2.2.1   Hazardous and Non-hazardous Waste
Hazardous wastes are wastes that are potential to cause harm and are characterized by the following properties; ignitable, toxic, corrosive, infectious and reactive. Non-hazardous wastes include all other types of waste that are less harmful.

2.2.2   Liquid waste
Liquid waste also known as waste water and includes runoff (flood water or storm water), silage, industrial waste water, human waste and other forms of waste water from different sources. Human waste is generally composed of urine and feces known as excreta. Human body waste is categorized as liquid waste and mixture of human waste with waste water is known as sewage also called black water. Runoff is basically rainwater that falls on the ground surface and runs off into ditches, rivers and channels. Sullage is also known as grey water, it does not include human waste but water that has been used for washing in kitchens and bathrooms.

2.2.3   Solid waste
Solid waste is defined as an unwanted waste discarded by people in dry form. It can be solid waste inform of residential waste i.e. from general housekeeping such as refuse, household waste or domestic waste. It can also be waste produced in other areas and defined as commercial, institutional, agricultural waste, industrial or waste from street sweeping depending on its sources. In urban sceneries, municipal waste refers to solid waste that is collected by the municipality (local government) and include commercial, industrial, household and street sweepings. Garbage is a solid waste that is produced in kitchen as a result of food preparation or foodstuff leftover after eating. Solid waste is classified as a function of land use and is shown by Table 2.

Table 2: Classification of solid waste as a function of land use

Category/Source	Description	Type of garbage
Institution, restaurant and household	Cloth, leaves, grasses, plastic, paper, wood, bedding, combustible materials, cartons.	Rubbish
Institutional, commercial and residential solid waste	Residues from fire used for cooking, minerals or non-combustible inorganic refuse; metals, cans, tins, ceramics, stones, bricks.	Rubbish
Sidewalks and streets	Poultry dung, cow, goats, donkey.	Paupers, dead animals and animals dung
Municipal transportation	Vehicle parts, tyres, appliances, abandon vehicles.	Junks

Farm and animal rearing, households	Fertilizer, crop residue and manure	Animal and agricultural waste.
Construction and demolition sites, factories and plants	Solid waste resulting from manufacturing operations and industrial processes.	Industrial and construction waste.

Source: Uchegbu (2002).

2.2.4 Biodegradable Waste

Biodegradable wastes are waste that decomposed into their constituent elements by reaction of microorganisms or bacteria i.e. waste that can be broken down. It can be applied to both liquid and solid waste and includes animal wastes, human, paper agricultural wastes, and food waste.

2.2.5 Non-biodegradable Waste

Biodegradable wastes are those that cannot be broken down or decomposed into their constituent elements by microorganisms and bacteria. Most plastics are non- biodegradable in nature and create environmental problems because they remain unchanged over a long period of time. Examples of non-biodegradable materials are: glass**,** metals, plastics, batteries and tyres.

2.3 Waste Characterization and Quantification

In order to design waste management systems and their various components, accurate data on quantity and composition as well as the chemical and physical properties of waste materials are required. Bilitewski *et al*. (2014) reported waste generation units and its management in some selected countries and emphasized the use of data on yearly averages, specific waste per capita quantities (kg/p/y), and waste composition estimates can only be used during the first steps of planning a refuse management.
Bilitewski *et al*. (2014) attributes difference of generation units to the effect of technological advances. Cities like New York have generation units of 18 liter/capita/day while most cities in developing countries have units less than 1 liter/capita/day.

2.4 Waste Disposal

The final Functional element in the solid waste management system is disposal. Disposal is the ultimate fate of all solid wastes, whether they are residential, commercial wastes collected and transported to landfill site, incinerator, compost, or other substances from the various solid waste processing plants that are of no further use to society (Joseph *et al.,* 2000).

Joseph *et al.* (2000) stated that landfill has a capacity of absorbing at least 10 years if all conditions are assumed to be not changing. Bloemhof-Ruwaard & Salomon, (2012) described landfills as advantageous as the sole waste disposal method because the technology is rather simple. Furthermore, short-term operational considerations and the low associated cost, depending on the landfills location size and age, are also important. Land filling of solid wastes is a method of waste disposal, which has been, practiced since very early times. Landfill was discovered as the most economical waste disposal techniques in current uses. It is often referred to as the only final solid waste disposal method since, unlike incineration or composting, it is not a processing operation, which yields a residue or end product, which requires disposal.
The wastes deposited in a sanitary landfill are considered to be ultimately 'eliminated'. Because of this, land filling of solid waste material is in some ways a very undesirable procedure; many potential useful materials, which could be recycled, are buried in the earth and lost (Chang and Chang, 2008).

In early fills (developed countries) and still in many developing countries, refuse is deposited in an open dump on a selected piece of land and allowed to decompose in the open air. The nuisances associated with such open dumping odors, airborne litter and waste paper, the preference of disease vectors such as rats and mice's, and other problems caused in alternation in land filing operations (Oztirk, 2015; Chang and Chen, 2010).

2.5 Solid Waste Management in Nigeria

Over 50% of waste generated in different state in Nigeria are biodegradable waste. Tobore (2012) explained that services of waste collection is mainly offered by the public sector although some States engages in public-private participation. Informal waste collector using push carts are also common rendering door to door waste collection services in some parts of Nigerian cities.

The informal sector has been the major participant in recycling services in Nigeria. However, the formal sector is also getting interested in waste recycling practices in some States putting projects in place. Some recycling activities in Lagos State include; Waste to Energy plant in Ikosi Market generating biogas using market waste and used in operating the markets 2KVA generator, Compost plant at Ikorodu for the treatment of market waste and Plastic recycling plant at Olushosun were water sachets are converted into bags.

In Nigeria, Wastes are usually dumped at open dumpsites and in burrow pits illegally. Some dumpsites are designated by either public sector or private owners in rare cases. Olusohun dump-site in Lagos is the largest dump-site in Nigeria. The several dump-sites and dumps-heaps all over in Nigeria brings health and environmental challenges requiring a need for proper management.

2.6 Solid Waste Management (SWM) Challenges in Nigeria

Contributory factors to SWM challenges in Nigeria according to Tobore (2012) include:
Unplanned and uncoordinated development: most of the city layouts and estates are not often planned prior to development. This lead to haphazard creation of structures, which does not take into cognizance the distribution of urban infrastructure, provision of basic amenities e.g. functional drainage channels, toilet facilities, refuse receptors, etc.

Urbanization and uncontrolled population increase: the explosion of urban Population following the end of the Nigeria civil war in 1970 and the oil boom of the same period contributed in no small measure to the aggravation of the poor state of sanitation in the cities. As a result of the uncontrolled population increase, the available facilities in the cities became overstretched leading to environmental degradation.

Inadequate technical managerial skills: Most times, career civil servants with poor managerial or technical expertise or inexperience in waste management are appointed to lead the various states waste management authorities. Lacking in managerial capacity and competence, they are unable to come with the arduous task of managing men and materials towards the goal attainment of adequate waste management. Technical defences and lack of technical capability in Nigeria, often contribute immensely to the problems of poor management in our cities.

Poor funding of waste management operations: The equipment of most state waste management authorities were imported from the industrialized countries, but they often grind

to a halt soon after delivery and installations. The lacks of technological know-how in Nigeria leads to improper maintenance of this equipment, while the lack of ready spare parts often compounds this situation.

Indebtedness to waste Management Agencies: More often than not, subscribers to the services of waste management agencies hardly ever meet up with their financial obligation to the agencies. This often cripples the operations of the agencies concerned.

Socio-cultural habit: The behavioral tendencies of city dwellers to dump solid wastes into the nearby drains, gutters or surrounding neighborhood, certainly help to worsen the ugly look of our neighborhoods. A situation such as this appears to be a function of ignorance, low literacy level and a carry–over from unwholesome practices of village life.

3.0 METHODOLOGY

Data for the study were collected through field survey, questionnaire administration and interview with staff of NISEPA (Niger State Environmental Protection Agency). The sample frame include households in the 11 wards in the study area which are: Minna Central, Makera, Tundun Wada South, Tundun Wada North, Nasarawa A, Nasarawa B, Nasarawa C, Limawa A, Limawa B, Sabon Gari, and Minna South. The sample size for the study was 372 which determined the number of questionnaire administered. 321 questionnaire were returned which was used for analysis. Simple random sampling was used for the administration of questionnaire. Data were analyzed using descriptive statistical method.

4.0 RESULTS

4.1 Sources of Solid Waste Generation in Minna

The sources of solid waste generation in Minna are categorized into Households, Offices, commercial centres and industrial. Table 3 indicates the various categories of Solid waste generated in the study area, including their composition and sources.

Table 3: Sources of Waste Generation in Minna

S/N	Types of solid waste	Waste Composition	Sources
1	Garbage	Waste from preparation of cooking, left over, markets, etc.	Household kitchen, restaurants, stores and markets
2	Rubbish	Combustible paper, carbon, rags, etc.	Offices, households and market
3	Ashes and dust	Residues from fire used in cooking, carpentry, etc	Restaurant, stores
4	Street trash and sweepings	Leaf, liters, can, cobs and fruit peels	Restaurant, stores, Households
5	Abandoned vehicles	Unwanted cars, motorcycles, bicycle parts and other metals	Roadside mechanics

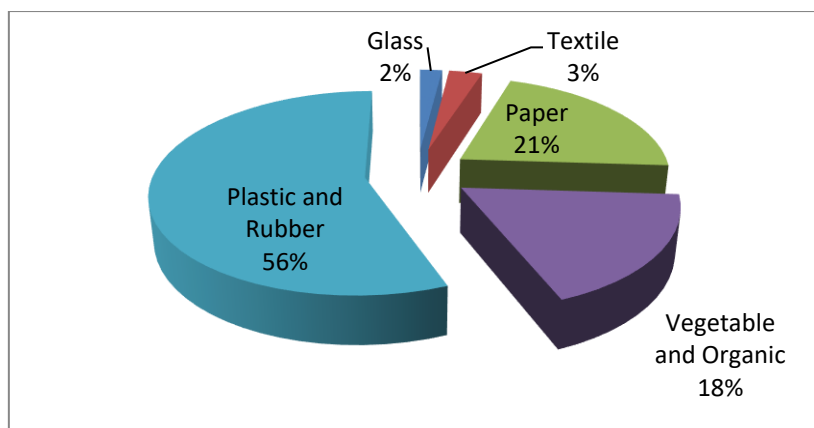### 4.2 Composition of Solid Waste Generated in Minna

Figure 1: Composition of solid waste generated in Minna.

From the analysis on Figure 1, plastic and rubber materials are the most generated solid waste representing 56%. This is due to the large quantity of packaging materials made of plastics and nylon bags such as sachet water. 21% of waste are generated from paper, this is due to the broad application of paper as printing and writing materials such as newspapers. 18% generated from vegetables and organic wastes which are biodegradable in nature and generated mostly by households due to consumption of farm products, unpackaged and dry foods. 3% generated from textile used for clothes and 2% generated from glass usually from glass wares used at home and packaging of beverages and drinks. Examples are cups, jugs, plates, and broken windows or car screen.
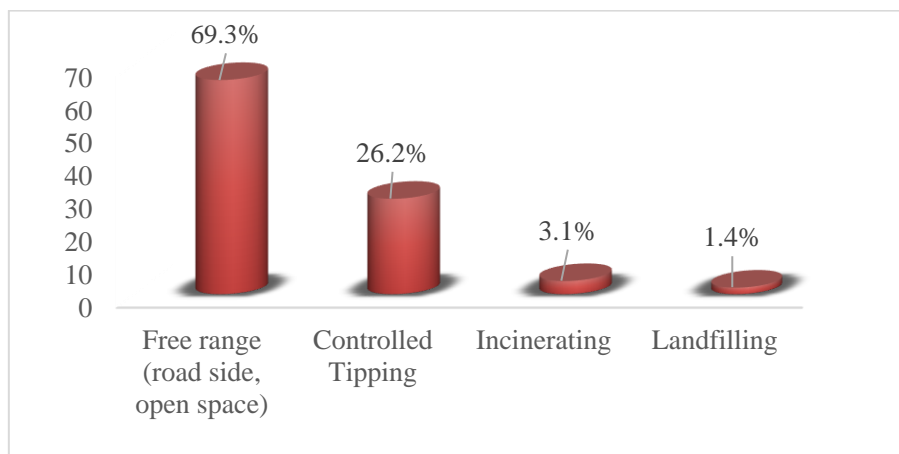
4.3 Method of Solid Waste Disposal

Figure 2: Method of solid waste disposal

Findings as shown in Figure 2 revealed that 69.3% of respondents dispose solid waste indiscriminately on road sides, open spaces, drainages, canals and uncompleted buildings. 26.2% used controlled tipping; which is the provision of designated solid waste bin. It is also noted that areas with controlled tipping also practices free range system whenever the bins are filled up and not evacuated promptly. 3.1% practice incineration of solid waste. 1.4% used Landfilling, this is where a central waste disposal point is designated.

4.4 Solid Waste Management System in Minna

Niger State Environmental Protection Agency (NISEPA) is the sole agency responsible for solid waste management in Minna. The system employed by NISEPA for collection of wastes is basically through collection points usually by drums purchased by residents or communally owned from where wastes are transfer from the collection point to a designated dumpsites for further disposal.

4.5 Method of Solid Waste Collection
Table 4: Method of Waste Collection in Minna

Composition	Frequency	Percentage (%)
Individual Containers	221	68.9
Communal Containers	100	31.1
Total	321	100

Table 4 shows that majority representing the waste collection is majorly (68.9%) by individual containers, where households collects waste and dispose individually. However, a lesser percentage (31.1%) of respondents are involved in communal collection of waste before disposal.

4.6 Sorting of Waste in Minna
Table 5: Sorting of Waste in Minna

Sorting of Waste	Frequency	Percentage (%)
Yes	53	6.7
No	299	93.3
Total	321	100

Source: Field Survey (2015)

Findings from field survey as shown Table 5 revealed that majority of the respondents representing 93.3% do not engage in any form of sorting of their waste before disposal. Sorting of waste in Minna is only carried out by scavengers and personnel of NISEPA involved in disposal of solid waste. Solid waste that are mostly picked out include metal scraps, electronics, plastics/rubber, tin, glass and paper among others. Scavengers sometimes engage in the art given materials such as brand new plastic buckets in exchange for valued solid waste mentioned above.

4.7 Frequency of Waste Evacuation per Week

Table 6: Frequency of Waste Evacuation per Week

Times	Frequency	Percent
Once in more than a week	121	37.7
Once a week	184	57.3
2 times	16	5.0
Total	321	10

The frequency at which solid waste is evacuated in Minna is shown in Table 6 with 37.7% experiencing solid waste been evacuated from the collection points once in more than a week. 57.3% said once a week. While, 5.0% said 2 times per week. This variation in the frequency

of solid waste evacuation is also according to the different wards in Minna. It was observed that areas along major streets have more frequency of solid waste evacuation and areas where wastes are indiscriminately dumped correspond with areas with less frequent evacuation like once in more than a week.

4.8 Policy and Planning Implications

The above discursions of solid waste management have enormous policy and planning implication such as:

Urban population: The greatest problem of urban waste management is the uncontrolled urban population increase. This arises from high urban birth rate and migration from rural to urban areas. An estimate by World Bank (2018) suggests that only 68% of the world's population has access to basic sanitation, and only 39% of people have access to safely managed sanitation (which includes containment, through safe collection and conveyance, to treatment and end use/disposal). Rapid and massive urbanization causes the discharge of unprocessed waste into the environment, resulting in severe health problems especially for the poor. It is the poor who generate more wastes, have no access to waste removal facilities and live in marginal and least choice urban ecosystems. The greatest assault on solid waste generation therefore, has to do with scaling down urban population through population education, taking integrated rural development much more seriously so as to keep rural population influx to urban area minimal.

Environmental Education: Policy and planning initiatives be directed to environmental education and the creation of environmental awareness. This can be achieved through formal and informal education and by institutionalizing environmental education at all levels of our educational curricular. While, environmental consciousness can be created in the general public via adult and non-formal education fora, the media, (print and electronic) and the organization of environmental awareness in communities and neighborhoods. There is preceding environmental illiteracy which militates against the creation of strong environmental base political constituency demanding better protection of the environment. This illiteracy envelops top government officials too as is evidenced by the way they handle environmental issues. The connection between the non- creation of waste dumps and indiscriminate disposal of refuse is not perceived by those in authorities and category of people.

Citizen participation: A major factor in the failure of environmental programmes is the non-involvement of the target population in decision-making and implementation process. Once communities are involved in a programme, they will follow it up which is the essence of Sustainable City Programme (SCP) aimed at fostering rather than restricting community and individual initiative. What Niger State government lacked is the nurturing of community development spirit in Minna for planning of environmental management programmes.

Treatment of Waste: In Minna, waste management ends with dumping waste on the outskirts of the city on vacant lands. Experience has shown that solid waste can become sources of raw materials for industries. It can also be a vibrant sector of the urban economy through recycling. At a meeting On 'Recycling Waste for Agriculture, the Rural-Urban connection organized by the World Bank, it was decided that the recycling of urban solid organic waste for agriculture would address positively the accumulating waste in cities (Zwart, 2015). In the developing countries organic matter (food waste, paper and paper products leaf and ash) accounts for a staggering 50-75%.

Urban Services: A major problem in urban service delivery is the dearth of funds. Shortage of fund was blamed for the failure of local government to shoulder their statutory functions, which include sanitation. As a result some of these functions were taken away from them and in the case of sanitation, state-wide bodies, such as Niger State Environmental Protection Agency (NISEPA) was established. This agency too suffered from shortage of funds, personnel and equipment.

Poor Infrastructure Permission and Urban Management Problem: The major issue regarding infrastructure in solid waste disposal relate to the absence or poor state of road, neighbourhood dumps and provision of cadasters. This creates problems of setting up of dump sites and makes distances to dump sites great and so encourages indiscriminate disposal of solid waste by urban dwellers.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Cities are the greatest polluters because they are energy-intensive, consume and deplete vast non-renewable resources in concentrated areas, and generate massive waste, all of which threaten human health, economic productivity, and ecosystems. This is compounded by the lack of facilities needed for adequate waste disposal. It was discovered that there is no comprehensive policy which pulls together the collection, removal, treatment and disposal of solid waste.

In Minna, the waste generated are not sorted, both toxic and non-toxic wastes are frequently dumped in the same dumpsite and the so-called sanitary landfills, which are in close proximity to communities and accessible to scavengers. This constitutes a challenge to human health. Among the constraints identified include inadequate public participation, citizen attitude characterized by a high level of environmental illiteracy, low level of service finance-generating system, and above all the geometrically rising population of Minna.

5.2 Recommendations.

To achieve proper management of solid wastes in Minna, efforts must be made to overhaul the existing management practice with a view to increasing the coverage, effectiveness and efficiency of the service offered. The following action steps are suggested:

1. **Re-orientations towards refuse disposal**: It is pertinent that residents of Minna understand the environmental health problems associated with improper waste management. Community mobilization and re-orientation for waste management is therefore necessary to ensure proper waste disposal.
2. **Environmental sanitation:** needs to be incorporated into the usual daily activities of residents. Monthly sanitation should be reintroduced and enforced adequately. It should go beyond once in a month exercise, since wastes are generated every day in the course of routine existence.
3. **Public enlightenment campaigns:** On waste reduction, management should be carried out by NGO'S in collaboration with government agencies.
4. **Waste avoidance and safety measures**. This involves appropriate procedures and measures to reduce or avoid the production of waste in order to take the pressure off the capacities of waste disposal systems and thus off the environment. For example, at the household level, waste are avoided through adoption of a waste-saving attitude such as avoidance of superfluous packing,   non-returnable containers, disposable articles

etc. while at the commercial and industrial levels, wastes are often avoided by adopting new recycling- oriented production processes.

REFERENCES

Adeoye, P. A., Sadeeq, M. A., Musa, J. J., Adebayo, S. E. (2011). Solid waste management in Minna, North Central Nigeria: present practices and future challenges. *Journal of Biodiversity and Environmental Sciences (JBES),* 1(6), 1-8.

Agwu, M. O. (2012). Issues and Challenges of Solid Waste Management Practices in Port Harcourt City, Nigeria- a behavioural perspective, *American Journal of Social and Management Sciences, 3(2), 83-92.*

Aluko, O. (2001): Environmental Pollution and Waste Management (ed) Ola Aluko in Introductory Course in Environmental Sciences. Pg 43-59.Ibadan: Odunprints.

Ayanshola, A. M., Aremu, A.S., Jacob, S. O., Bilewu, S. O. & Salami, A. W. (2015). Evaluation of Municipal Solid Waste Management System and Willingness To-Pay for its Improvements in Ilorin, Kwara State, Nigeria. *Nigerian Journal of Technology (NIJOTECH),* 34(4), 868 – 874.

Bilitewski, B., Härdtle, G. & Marek, K. (2014). *Waste Management.* Berlin Heidelberg: Springer-Verlag.

Bloemhof-Ruwaard, J. M. & Salomon, M. (2012). The Capacitated Distribution and Waste Disposal Problem. *European Journal of Operational Research*, 88(1), 490-503.

Chang, Y. H., Chang, N. B. (2008). Optimization Analysis for the Development of Short term Solid Waste Management Strategies using Presorting Process prior to Incinerators. *Resources, Conservation and Recycling*, 24(1), 7-32.

Chang, N. B., Chen, Y. L. (2010). A Fuzzy Interval Multi objective Mixed Integer Programming Approach for the Optimal Planning of Solid Waste Management Systems. *Fuzzy Sets and Systems*, 89(1), 35-60.

Environmental Guidelines for Small-Scale Activities in Africa (2009). Solid waste: generation, handling, treatment and disposal. Retrieved from: http://www.encapafrica.org

Environment Protection Authority (2014). *Waste Classification Guidelines.* Sydney, Australia: Environment Protection Authority, State of New South Wales (NSW).

Joseph, L. P., John, E., Heer, D. & Joseph, H. (2000). *Hand Book of Solid Waste Disposal: Material & Energy Recover.*

Maton, S. M., Dabi, D. D., Dodo, J. D. & Nesla, R. A. (2016). Environmental Hazards of Continued Solid Waste Generation and Poor Disposal in Municipal Areas of Nigeria. *Journal of Geography, Environment and Earth Science International,* 6(3), 1-10.

Okwesili, J., Ndukwe, C. & Nwuzor, C. I. (2016). Urban Solid Waste Management and Environmental Sustainability in Abakaliki Urban, Nigeria. *European Scientific Journal,* 12(23), 155-183.

Opara, J. A. & Gerhard, B. (2008) Environment and Development: An Interdisciplinary Perspective.

Granada: Afro-Euro Centre for Development Studies

Oztirk A. (2015). Global warming and infectious disease. *Journal of advances in Environmental Research,* 3(1), 45 – 69.

Ranjith K. A. (2012). Sustainable Solid Waste Management in India, Waste-to-Energy Research and Technology Council, Department of Earth and Environmental Engineering Fu Foundation School of Engineering and Applied Science Columbia University, New York.

Rouf, A. B., Shabeer, A. D., Davood, A. D. & Gowhar, H. D. (2018). Municipal Solid Waste

Generation and current Scenario of its Management in India. *International Journal of Advance Research in Science and Engineering,* 7(2), 419-431.

Tobore I.E. (2012). Solid Waste Management in Nigeria, Intervention of Waste Management Society of Nigeria, Lagos.

Uchegbu, N. S. (2002). *Environmental management and protection.* Enugu, Nigeria: Spotlite Publishers.

Udoakah Y. and Akpan U. (2013). *A Sustainable Approach to Municipal Solid Waste Management in Southern Nigeria,* Department of Electrical/Electronic & Computer Engineering, University of Uyo, Uyo, Nigeria, Sustainability, Policy and Innovative Development Research (SPIDER) Solutions Nigeria, Uyo, Nigeria.

United States Environmental Protection Agency (2009). Municipal Solid Waste Generation, Recycling, and Disposal in the United States: *USA Facts and Figures for 2009.*

World Bank (2018). Sanitation. Retrieved from: https://www.worldbank.org/en/topic/sanitation

Zwart, K. (2015). Recycling urban organic waste to agriculture and horticulture Innovative strategies. Retrieved from: https://www.reusewaste.eu/fire_meeting/Kor_Zwart.pdf