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MUNICIPAL SOLID WASTE DISPOSAL AND ENVIRONMENTAL ISSUES IN KANO METROPOLIS, NIGERIA

A. W. Butu and S.S. Mshelia
Department of Geography, Nigerian Defence Academy Kaduna, Nigeria

ABSTRACT: *The paper examined the municipal solid waste disposal methods and the environmental issues associated with the management of solid waste in Kano Metropolis, Nigeria. Primary data were obtained through administration of structured questionnaires to a random size of population in the areas that have the highest heaps of solid waste on the major streets and open spaces. Oral interviews and field observations were also carried out for holistic and detail assessment of the environment. Secondary data were obtained from desk review method; information on environmental issues resulting from poor management of municipal solid waste were obtained from relevant literatures. The results of the findings clearly show that major streets, several open spaces and even water ways are been used as refuse dump sites. The composition of the municipal solid waste in the city is heterogeneous; it contained both biodegradable and non-biodegradable materials which are mostly e-wastes, plastic and polythene materials. The study also reveals that most of the refuse dumps are left unattended to for a long period. The study further shows that population growth and uncontrolled urban expansion are responsible for the continuous growth of these refuse heaps at the shoulders of the major streets, open spaces and water bodies. There is no organized house to house or street to street collection of the solid waste in some parts of the metropolis. In few areas where large waste bins are provided, they are hardly used by the community. The major environmental issues resulting from improper disposal and poor management of solid waste in Kano metropolis are physical nuisance of the waste to the environment, the solid waste are blown around by winds or rainstorm making the environment dirty, the waste sometimes block drainage channels during rainstorm causing flooding in the metropolis. The heaps of the solid waste serve as good hideouts for reptiles, rodents, and other dangerous insects. The solid waste may decompose to emit methane gas which contributes to climate change. Most of the non-decomposable solid wastes contain harmful chemical elements which have severe health implications. Generally, the study shows that soil, air and water pollution in the study area are caused by both pathogenic and chemical elements from these heaps of solid waste that dot some of the major streets and open spaces. Therefore, the paper recommends that a strong legislation with severe sanction be put in place and they should be a continuous public enlightenment on the danger of municipal waste to the general public. It is also recommended that available market be created for these waste that can be recycled*.

KEYWORDS: Biodegradable, Non-Biodegradable, Chemical Elements, Electronic Wastes, Environment, Harmful, Management, Metropolis, Refuse Dumps, Solid Wastes

INTRODUCTION

The problem of municipal solid waste (MSW) in developing countries is a major concern to government; this problem becomes much worrisome in Nigeria where the production is always on increase because of increase population pressure and some socio-economic factors. Omole and

Alakinde (2013) observe that Nigeria among other third world countries is witnessing an unprecedented growth of cities in recent time. They observe that the country's high population figure has series of implications for every aspect of people socio-economic and cultural life style. They further state that with the pressure in urban population, existing facilities such as water, electricity, road, educational institutions and housing become inadequate and solid waste generation and disposal take unprecedented precarious dimension.

Rapid industrialization and population explosion in Nigeria has led to the migration of people from the rural areas to the cities, which generates a lot of MSW on daily basis and indeed the amount of MSW is expected to increase significantly in the near future. Presently, the rapid population increase due to urbanization in Kano metropolis has caused difficulties for the Environmental Protection Agency in providing an efficient and effective management system. Urbanization affects land use and when not properly controlled causes emergence of illegal structures and neigbourhoods which is the characteristics of some quarters within Kano metropolis. This has affected the city master plan, thereby affecting social services such as waste collection, and eventually leading to indiscriminate dumping of waste in illegal areas.

Municipal solid waste are regarded as discarded materials arising from operational activities taken place in different land use such as residential, commercial and industrial. Domestic or residential wastes are those that are collected from dwelling places on a regular basis, such waste include organic matter resulting from preparation and consummation of food, rags, nylon and ashes are the remains after various cooking and heating processes. The commercial wastes are those that arise from shops, supermarkets, market and others; they include paper carton, polythene bags and nylons. The industrial wastes are those waste materials that arise from industries; these could be solid, liquid, sludge or emotive title attached to them like toxic, hazardous and special waste. The industrial waste include metals, scraps, chips and grits from machine, shops, sawdust, paper pieces and glass (Omole and Alakinde 2013). Kenneth and Huie (1983) also classified solid waste into three categories, namely; garbage, ashes and rubbish. The garbage includes organic matter resulting from preparation and consumption of food. Ashes include remains from cooking and heating process and the rubbish may either take the form of combustible such as paper, rags, wood, leaves and weeds or non-combustible such as glass, plastic, polythene and metal materials.

Solid waste management is a global issue that is a growing source of concern in developed and developing countries due to increase urbanization; changes in consumer pattern and industrialization, which all directly influence solid waste generation (Kadafa *et al.,* 2013). Adedibu (1993) is of the view that the nature and composition of solid waste is a product of climatic and business activities in urban centres. He argues further that most of the agricultural produce such as maize, cassava, vegetables, millet are brought unprocessed during the rainy and harvesting seasons from the nearby farms. The composition of refuse generated in an area determines the type of disposal method suitable for a particular form of waste and the effectiveness of a collection system depends on the cooperation of households and individuals in various sectors of the city in providing containers for storing refuse in accordance with the regulation and regularly placing the materials for collection (Afon, 2003). Abumere (1983) links socio-cultural factors to land use pattern such as housing density and eating habits. He further states that solid waste accumulation is a product of chaotic land use pattern, the number of household living and that the eating habit in a house

greatly determines the composition of refuse generated. Abila and Kantola (2013) are of the view that municipal waste management problems in Nigeria cut across concern for human health, air and water and land pollution among others. Adewole (2009) argues that continuous indiscriminate disposal of municipal solid waste is accelerating and is linked to poverty, poor governance, urbanization, population growth, poor standards of living and low level of environmental awareness.

One notable environmental problem that has bedeviled the nation since the 1970s is municipal solid waste. MSW affects the environment in different parts of the globe. In Nigeria the oil boom of the 1970s had resulted into increase in the volume of individual, commercial and industrial activities in towns and cities of the country. These gave birth to many environmental problems such as flood, erosion, solid waste materials, global warming, desertification/drought and pollutions.

Miller (1994) defines waste as man's unwanted materials that need to be discarded. Adegoke (1990) defines waste as substances and materials which are disposed of or are required to be disposed of according to the provision of the national law. Miller (1993; 1994) defines solid waste as any unwanted or discarded material that is not liquid or a gas. It may not generally be accepted that solids and indeed wastes are "useless, unwanted or discarded (undesirable) materials" given the degree of scavenging on waste heaps in less developed countries like Nigeria by both humans and animals. Urban wastes are those materials that are generated, used and have no further value and are thrown away in the environment, these materials can be valuable raw materials located at a wrong place (Sharma, 2010).

Gordon (2005) is of the view that municipal solid wastes are commonly known as trash or garbage, it is a combination of the entire city's solid and sometimes semi-solid waste. It includes mainly households or domestic waste, but it can also contain commercial and industrial waste with the exception of industrial hazardous waste (waste from industrial practices that causes a threat to human or environmental health). He categorized municipal waste into five:

i. The biodegradable which includes things like food, and kitchen waste such as meat trimmings or vegetable peelings, yard or green waste and paper.
ii. Recyclable materials: This includes non-biodegradable items like glass, plastic bottles, other plastics, metals and aluminum cans.
iii. Inert waste: Inert materials which include construction and demolition waste are not necessarily toxic to all species but can be harmful to humans.
iv. Composite waste: Items composed of more than one material such as clothing, plastics as well as children toys.
v. Households hazardous: This includes medicines, paints, batteries, light bulbs, fertilizers and pesticides containers and electronic waste (e-waste) like computers, printers and cellular phones.

Municipal solid waste are usually made up of complex biodegradable and non biodegradable substances, the composition, volume, and weight varying from place to place depending on the culture and ways of life of the people and the population size of the urban centre. Municipal solid waste contains not only "valuable" and often reusable materials such as metals, glass, paper, plastics and food remains, but also an ever- increasing amount of hazardous waste. Typical of the hazardous waste are chemical elements such as lead, manganese from batteries, cadmium and other

heavy metals like antimony, arsenic from florescent tubes, pesticides, bleaches, discarded electronic sets such as computers, toys, handsets and television and a waste of range of toxic chemicals which occur in solvents, paints, disinfectants and wood preservatives (Sharma, 2010).

The increased population growth in Kano metropolis has resulted into generation of high heaps of municipal solid waste which are discriminately dumped at the shoulders of major streets, available open spaces and even in open water bodies. It is very common to find the drainage lines and even streams within Kano metropolis being filled up with refuse after rainfall. These refuse are good contaminants of streams, ground water especially shallow wells and the entire environment. Therefore, it is necessary to assess the municipal solid waste disposal and the environmental issues in Kano metropolis. This paper is therefore aimed at looking at the various municipal solid waste disposal systems in some parts of Kano metropolis and also to examine the environmental issues associated with these waste and make necessary recommendations on waste disposal and management practices to prevent further deterioration of the environment and the negative effects on the human population in Kano metropolis.

MATERIALS AND METHOD

The primary sources of data for this study are from oral interviews from selected residents in major parts of Kano where these solid wastes are commonly seen. One hundred people were randomly selected and interviewed on the vital aspects of municipal waste such as composition, disposal methods, environmental impacts and management of the municipal solid waste in Kano metropolis. The departmental heads in Sanitation Board in Kano metropolis were also interviewed on the vital aspects of municipal solid waste such as composition, disposal and management system. Another important primary source of data was the field observations of the municipal solid waste composition and dump sites and the environmental issues in Kano metropolis where photographs of the various municipal solid wastes were taken at different locations. The secondary sources of data were obtained from desk review method. Documented information on municipal solid waste in the city was obtained from the relevant literatures and records from Refusal Management and Sanitation Board (REMASAB).

RESULT AND FINDINGS

The prominent visible features that welcome guests along the some major streets of Kano are the municipal solid waste. These heaps of waste which in some areas have formed mountains can be seen at places like Gyadi-gyadi Court road, Naibawa, Mosque Road, Unguwa Uku behind Police Station, Gandun Albasa by Zoo Road, Jayin Filling Jirgi, Kofar Ruwa Katsina Road, Gadon Kaya near Yayan Awaki, Sabowar Gandu. Other areas are Rijiyan Zaki near Azman Filling station, BUK Road old side, Kabuga opposite Taxi Motor Park, Tal'udu by Police Station, at the front of Federal College of Education, Kofar Fumfo, Dakata near Custom office, Sabon Gari along Benin and Enugu Roads as well as Ibadan, Onitsha and Port Harcourt Roads. Other notorious waste dominating areas are Hotoro Road by Mopol Barracks, Kawu opposite Total Filling Station. The one around Sabon Gari market, Kasuwan Kwari, Singer, Bata and Bompai are more pronounced. These municipal solid waste dump sites are sited on the major streets at various locations as shown on Figures 1 to 11.

Figure 1. Municipal solid waste along Court Road Gyadi-gyadi

Figure 2. Municipal solid waste along Zoo Road

Figure 3. Municipal solid waste at Naibawa

Figure 4. Municipal solid waste at Dakata showing children selling sugar cane around the waste.

Figure 5. People and animal scavenging MSW at Yan Kara Sabon Gari

Municipal solid waste management is an important part of the urban infrastructure that ensures the protection of environment and human health (World Bank 2002; 2003). The accelerated growth of urban population with unplanned urbanization, increasing economic activities and lack of training in modern solid waste management practices in developing countries complicate the efforts to improve solid waste management services. The changes in consumption patterns with alterations of the waste characteristics have also resulted in a quantum jump in solid waste generation (Ludwig *et al.*, 2003). Proper management of solid waste is critical to the health and well-being of urban residents (World Bank, 2003).

In Kano metropolis, like most cities in the developing world, several tones of municipal solid waste is left uncollected on the streets each day, clogging drains, creating breeding ground for vectors and spreading diseases and creating a myriad of related health and infrastructural problems. A substantial part of the urban residents in the old Kano city and suburban informal settlements of Kano metropolis have little or no access to solid waste collection services. This is due to lack of proper land use planning which resulted into the creation of informal settlements with narrow streets making it difficult for collection trucks to reach many areas. The result is that a large portion of the population is left without access to solid waste management making them particularly vulnerable Nabegu (2008).

Sources and Causes of Municipal Solid Waste in Kano Metropolis

Nabegu (2013) identifies the following sources and volume of municipal solid waste generated in Kano metropolis as shown on Table 1.

Table 1: Sources of Municipal Solid Waste in Kano Metropolis

Sources	Percentages
Residential	62.5
Commercial	26.9
Industrial	2.9
Institutional	5.9
Others	1.9

Source: Nabegu (2013)

Nabegu (2012) identified two types of waste in Kano metropolis; the first group is the light and predominantly non-biodegradable waste, which comprises mainly tins, plastic materials and bottles while the second, is the heavier predominantly biodegradable wastes which contain high proportion of food scrap, ash, dirt and vegetables. The non-biodegradable wastes are commonly found in commercial areas while the biodegradable wastes are mostly linked to residential quarters. The causes of municipal solid waste in Kano metropolis are enumerated as follows:

i. **Population growth**: Kano metropolis is among the fastest growing cities in Nigeria, with a population presently estimated at 3.5 million and a population density of about 1000 inhabitants per Km. It is one of the most crowded cities, hence generation of municipal wastes in heaps on daily basis are enormous. (Nabegu, 2012).

ii. **Poor town planning**: Generally, with the exception of Government Reservation Areas (GRAs), almost all parts of the Kano city are poorly planned. There are no access roads, some residential areas are not accessible to cars or trucks, example some areas in the ancient part of Kano called city. This has made it difficult to evacuate or dispose solid waste deposited in such areas. (Nabegu, 2008).

iii. **Urbanization**: Nabegu (2008) is of the view that urbanization process in Kano has gone wrong. According to him the heaps of waste pilling up with each passing day is due to the massive indifference on the part of the people and their loss of affective and responsible relation to the environment as a result of colonialism.

a. **Government failure to evacuate municipal solid waste**: Muktar (2008) attributed the cause of persistent problem of solid waste to the fact that the Kano state government has problem with solid waste management because this function traditionally is a local government obligation. This resulted to lack of coordinated jurisdiction and there has been no standards or specifications established.

iv. Insufficient or inadequate knowledge of some of the residents in Kano metropolis of the ways in which the environment functions (environmental science) has contributed to the heaps of municipal solid waste in the state capital.

v. **High rate of illiteracy/cultural/religious inclinations**: A good percentage of the female populations of Kano are not widely educated on environmental impacts of dumping solid waste indiscriminately. Even if they are cautioned on the dangers of municipal solid waste such as diseases they will say *"Allah ne mai kiyaye wa"* that is "God is the one that protects." Their socio-cultural and religious belief is that everything (good or bad) comes from Allah (God) and it's only Allah that protects.

vi. **Commercial activities**: Kano is the commercial nerve of the northern Nigeria, characterized with large and many markets which resulted in the production of large quantity of solid waste seen around the markets.

vii. The notion of common ownership of resources, for example, opens spaces and playgrounds; that is the notion of "no man's land". Make people to pile heaps of municipal solid waste in such areas.

Municipal Solid Waste Management Systems

Generally municipal solid waste are dumped along some major streets at close proximity to the houses and public places and some close to river, despite the fact that trash bins are provided by the state government in few areas and along the main roads. More than two-third of the residents do not use authorized dumpsites for their waste (Nabegu, 2013). The Kano state government is doing the best in ensuring that the municipal solid waste are properly managed, but the social-cultural characteristics of the residents are counterproductive, in addition some areas are totally inaccessible for collection of these waste because of poor urban planning.

The practice of disposing solid waste indiscriminately has a price to pay in terms of collection, transport and disposal costs and loss of valuable raw materials (recyclables, reusable and repairable) and the impact on the environment due to air, water and soil pollutions, and associated health risks that ultimately impact the economic sustainability. This economic impact creates lack of resources for municipal solid waste management and hence a vicious cycle is generated unless remedial measures are taken to break the circuit, the cycle continues and expands leading to further environmental degradation. It is also observed that the low income residential quarters are worst affected with this numerous heaps of refuse. This could possibly be as a result of their socio-economic status.

It was also observed that, even the residents that collect and transport the wastes to the collection/transport point from where the waste should be collected immediately, collection is not immediate and this creates not only unhygienic dumpsites but resistance from residents close to the collection points. Furthermore, the attitudes some residents of Kano metropolis in management of municipal solid waste is poor; little or no individuals effort is accorded to the immediate dangers on humans and the environmental impacts it has on the environment. Programmes to disseminate knowledge and to improve behaviour patterns and attitudes regarding waste management are therefore critical. However for such programmes to yield positive results it must be based on sound understanding of the social and cultural characteristics of the communities.

Environmental Issues

The environmental consequences of municipal solid waste in Kano are enormous. If the solid wastes are not managed properly, decomposition and putrefaction may take place, causing land and water pollution when the waste products percolate down into the underground water resources. The organic solid waste during decomposition may generate obnoxious odours. Stray dogs and birds may sometimes invade garbage heaps and may spread it over the neighbourhood causing unhygienic and unhealthy surroundings. Some of the most prominent environmental issues resulting from municipal solid waste disposal are as follows:

Climate Change: It is observed that municipal solid waste in Kano that are put into enormous piles often decompose to emit methane a "greenhouse gas" that is more potent than carbon dioxide. This methane contributes to global warming which could result into climate change as a result of destruction of ozone layer (Sharma, 2010). The continuous increase of methane gas in Kano metropolis will surely contribute to climate change.

Pollution: Many areas have heaps of municipal solid waste unattended to; and many of the objects that are thrown away contain toxic substances which leach into soil and water as well affecting the health of plants, animal and humans. Electronic waste contains mercury, lead, arsenic cadmium, chromium and other metals that have environmental health implications. Construction waste may contain asbestos, fossil fuel derivatives, and other toxic substances. Measures to control these substances are hampered by the fact that they are dispersed within millions of tons less toxic trash, making their removal very problematic. Thus, Yusuf (1983) observes that soils under refuse dumps sampled in Kano city contained high levels of metals greater than acceptable limits.

The high rate of municipal solid waste in Kano has tremendously contributed to land, water and air pollutions in the city. For example, very large areas of land at Gyadi-gyadi, Zoo Road, Gwale, Kofar Ruwa, Sabon Gari, Dakata, Mallam Kato, Kawo Hotoro Road, Yan Kaba, Sabuwar Gandu and Gandun Albasa have become waste disposal areas amounting to heaps as shown on Figures 6 to 11. The heaps of garbages that decorate major open spaces and shoulders of the major roads in Kano metropolis emit offensive stench that welcomes guests as one moves around Gyadi-gyadi, Zoo Road, Gwale, Kofor-Ruwa, Sabon Gari, Dakata, Mallam Kato, Kawo Hotoro Road, Yan Kaba, Sabuwa Gandu Gandun Albasa and other areas in Kano metropolis.

The huge heaps of refuse dumps that are commonly seen on open spaces and shoulders of the major streets in Kano metropolis are also been washed by rainstorm scattering all over most of the environment. Most of these solid waste are been moved by rainstorm into drainage channels that were made for excess runoff thereby preventing easy flow of water and finally lead to flooding of the highways and sometimes people homes. The blockage of most of these gutters or drainage channels by non biodegradable materials such as plastics, tyres and other polythene substances often result into a situation whereby dirty stagnant water runs in front of living quarters and major roads in the metropolis. These blocked drainage channels often contain a lot of materials including decomposable substances with offensive odour which welcomes different types of flies and other harmful bacteria carrying insects which are harmful to humans. The blockage of drainage channels by solid waste is a major cause of flooding in urban cities (Butu *et al.,* 2013).

The numerous heaps of refuse that are seen commonly in Kano metropolis have a negative impact on the beauty of the city. In addition to the physical damage on the city look, most of the non biodegradable materials which are mostly synthetic in nature contained some toxic elements which have their origin from the decomposing waste that decorate most of the landscape in Kano metropolis. Yusuf (1983), Farouk (1987) and Olofin (1991) traced the pollution of the soil, surface and groundwater to chemical elements originating from refuse dump sites. Iguisi *et al* (2001); Butu and Ati (2013) also traced the sources of some chemical elements such as europium, manganese, arsenic, zinc and copper into Kubanni dam Zaria that is used for domestic purposes to washing of debris that contained these metals from refuse dump sites that surround the landscape. Butu (2013) observes that debris transported by runoff into Kubanni stream contained high levels of metal pollutants. He is of the view that most of these elements are leached into soil from the refuse dump sites and drained into the Kubanni stream through subsurface and base flow during rainstorm. It is therefore not over assumption to observe that water sources for human consumption in Kano metropolis are exposed to this similar threats.

Several studies have shown that most of the synthetic and electronic waste (e-waste) that are found in these open dump sites in our cities contain toxic elements that are harmful to humans, plants and animals. Obirri *et al* (2010), Akrong *et al* (2012) and Shagal *et al* (2012) emphasized on the effects of toxic metals which originate from these synthetic and e-waste that are commonly and carelessly dumped in our cities. Kano metropolis, been a highly populated city in Nigeria with very high use of electronic materials is similarly exposed to this type of chemical pollution.

Human faecal matter presence in all the solid waste dump sites in Kano metropolis presents a faecal health problem not only to the waste workers, residents, but also to scavengers, other users of the same municipal drop-off points and even small children who like to play in or around waste containers as shown on Figures 4 and 6. The usual disease pathways include placing contaminated hands in the mouth or eating food, through vector insects such as cockroaches or mosquitoes, or by directly inhaling air borne particles contaminated with pollutants.

Figure 6. Air and land pollution for MSW at Dakata

Municipal solid waste in Kano are being dumped on the open streets at close proximity to the houses and public places and some very close to rivers, while some are being dumped right into the river especially in the city and the suburban areas this may be detrimental to the aquatic organisms. For examples, waste disposed at Yan Awaki and inside the Jakara Rivers as shown on Figures 7 to 9, could be washed down by rain and flood into larger water bodies which are used for irrigation and water supply to many communities from the Wasai dam where the Jakara River is impounded posing serious health hazards.

Figure 7. MSW at Yan Awaki

Figure 8. MSW into channel of River Jankara

Figure 9. Bank of Jakara River

Habitat distribution and creation of habitat for vectors

It was observed that one house was almost covered with municipal solid waste in Sabon Gari area of Kano as shown on Figure 10 and it was confirmed that as a result the owner had relocated to No man's land, another part of Kano. Here the man's habitat has been destroyed. More still, disposal locations may encroach upon existing habitat for native flora and fauna as in the case of Gwammaja and Gandun Albasa areas of Kano. The huge and numerous heaps of solid waste or refuse dumpsites in the environment on the other hand serve as a breeding heaven for diseases carrying vectors. Reptiles such as snakes and lizards live comfortably in these wastes. Other dangerous rodents such as rats which transmit *lassa fever* are also found in these refuse dumps. Insects such as houseflies, cockroaches and mosquitoes also find these refuse dump sites as the best hideouts. These insects spread various diseases such as malaria, cholera, typhoid fever and yellow fever.

Figure 10. MSW at Sabon Gari Kano

Land Degradation: Many plots of land in Kano are being claimed for landfills, which have made them no longer hospitable for plants, wildlife and humans. Often the fertility cannot be completely reclaimed, even after the landfill is capped. In the case of Kano, there is little or no effort to reclaim or put to use in the near future, the piece of land in use presently for waste collections or dump sites as shown on Figure 11, this also has a potential danger on the available land for the fast growing population in the near future.

Figure 11. Vast land rendered useless for agricultural, commercial and residential use at Rijiyan Zaki

CONCLUSION AND RECOMMENDATIONS

Municipal solid waste generation, disposal and management in most parts of Kano metropolis is a serious issue because of the environmental issues these waste present. The study has shown that increase in population, uncontrolled and unplanned nature of most parts of Kano especially the old Kano city, Kano municipal council, Gwale, Daurayi and other areas compounded the problems of waste management. The municipal solid waste generation in Kano metropolis is very high, non biodegradable waste such as polythene bags, the so-called "pure water sachet" and e-waste are scattered all over indiscriminately. These materials are known to contain high level of metals which are toxic when exposed to above certain limits. The biodegradable fractions of municipal solid waste disposed at major open spaces and highways in Kano are mostly food remnants, yard wastes, kitchen consumables and discarded papers for packaging. These biodegradable wastes have no direct chemical implication, but constitute environmental nuisance and good hideouts for diseases carrying vectors such as rodents, reptiles and insects.

To prevent this ancient city and the commercial nerve centre of Northern Nigeria from environmental deterioration the following recommendations are considered necessary:

i. There is the need to reassess all legislations regarding waste management with a view to stream lining them so that there is a comprehensive and clear role for all the agencies, various tiers of government, as well as the public including Non-Governmental Organizations (NGOs) and community associations.
ii. Continuous public enlightenment on the dangers of municipal solid waste to the general public especially the female population.
iii. Landfills: Standard landfills (not the ordinary dug earth) should be constructed at specific locations to minimize the impacts of municipal solid waste. Landfills are engineered to protect the environment and prevent pollutants from entering the soil and possibly polluting ground water in one ways. The municipal solid wastes are synthetic liners like plastic to separate the landfill's trash from the land below it.
iv. Combustor: This involves the burning of municipal solid waste at extremely high temperatures to reduce waste volume, control bacteria, and sometimes generate electricity.
v. Regardless of the type of waste management strategies will translate into reality unless the government takes the required initiatives and makes the necessary inputs available. These inputs do not necessarily have to be financial. For example, waste recycling can be promoted through consumer campaigns encouraging citizens to cooperate in waste separation and promoting to them the purchase of recycled products.
vi. Citizens should be made to pay a realistic fee for waste services in return for the guarantee that indeed these services will be provided.
vii. There should be effective and proper monitoring of solid waste disposal activities.
viii. Severe Sanction: Re-introduction and enforcement of monthly sanitation. This will assist in cleaning up the city.

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