
ENVIRONMENTAL IMPACTS OF ROADSIDE DISPOSAL OF MUNICIPAL SOLID WASTES IN KARU, NASARAWA STATE, NIGERIA

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ABSTRACT: *The paper looked at municipal solid waste generation, disposal and the consequent environmental impacts. Primary data was generated by carrying out oral interviews and field observations for holistic and in-depth assessment of the environment and the secondary data was obtained from desk review method, information on effects of municipal solid wastes on environment were obtained from relevant literatures. The interviews were semi-structured and a purposive sampling method was adopted and analyzed descriptively. The results of the findings showed that population growth and unplanned urban expansion has exceeded the expected limit in recent time with resultant ugly system of solid wastes disposal. Municipal solid wastes which contain both biodegradable and non-biodegradable wastes are disposed at the shoulders of major highways in temporary dumpsites and are later evacuated by a waste management agency on a weekly basis. There is no organized house to house or street to street collection of the solid wastes. The study revealed that roadside disposal of municipal solid wastes has serious impacts on the environment. Some of these impacts include physical nuisance of the solid wastes to the environment, the solid waste dumps also serve as hideouts for rodents and snakes which are dangerous. The solid wastes are blown around by wind making the environment filthy, most of the wastes are also been washed by overland flow during heavy downpour to block drainage channels and subsequently lead to flooding of the environment. Most of the non- biodegradable solid wastes contain toxic chemicals which have serious implications on the environmental sustainability and human health. The paper therefore recommends that Government should come up with proper orientation and environmental laws should be put in place for the general public and also to provide necessary facilities and arrange for better methods of collection of solid wastes.*

Keywords: Biodegradable, Non-Biodegradable, Chemicals Elements, Disposal, Environment, Impacts, Toxic, Waste.

INTRODUCTION

In the current world economic paradigms, sustainable socio-economic development of every community depends much on the sustainability of the environment. The contamination of the environment by anthropogenic practices is globally known to impacts negatively on the environment. The disposal and management of municipal solid waste is a globally challenging issue especially in developing countries due to its adverse environmental effects. Ayuba *et al* (2013) observed that mankind depends on the environment to sustain their lives and that solid

waste is one of the three major environmental problems, other major environmental issues include flooding and desertification in Nigeria and many other developing and even developed countries are threatened by this. Municipal solid wastes consist of day-to-day consumed and discarded items such as food wastes, containers, product packaging and other miscellaneous like residential, commercial, electronic wastes, institutional and industries sources (Babu *et al.*, 2013).

The Federal Government of Nigeria establishments were relocated to Abuja, the Federal Capital Territory (F.C.T) in the 1990s and today rapid expansion has exceeded the anticipated master plan (Iman *et al.*, 2008), with resultant evolution of suburbs which are characterized by unplanned growth in property resulting from absence of development control. Karu in the western zone of Nasarawa state began to swell with uncontrolled influx of people as early as in the mid 90s barely five years after the seat of government officially moved from Lagos to Abuja. Construction activities which broke ground in Abuja with the expansion of government and private businesses heighten demand for affordable accommodation by construction workers and other low income working class people. Karu with proximity to Abuja became the destination (Hir, 2012). This suburb continued to experience a growth at geometric rate, but the then old Plateau state and the current Nasarawa State government failed to come up with an immediate project to effectively address what soon became, but dirty environment to Abuja.

Oyeniyin (2011) opined that environmental hazards of varying magnitude dangerously threatened human and animal lives in most urban centres in Nigeria. He further states that rapid urbanization, rural-urban migration, little or no town planning efforts coupled with attitudinal irresponsibility, lack of political will, ineptitude and graft have independently and collectively created environmental challenge in Nigeria resulting to human or solid waste decorating streets and public space everywhere in Nigeria.

The solid waste composition in developing countries like Nigeria is heterogeneous and mixed, the harmful components are made up of electronic waste (e-waste) and other hazardous left over. Electronic waste refers to end of-life electronic products including computers, printers, photocopy machines, television sets, mobile phones and toys which are made of sophisticated blend of plastics, metals, among other materials (Atiemo *et al.*, 2012). Hilty *et al* (2004, 2008) and UNEP (2005) observed that the number of electronic devices used per capita at the global scale is growing at a rate of about 4% and will continue to increase as it is becoming the fastest waste stream worldwide. Most developing nations are fast becoming an e-waste destination because most second handed electronics, substandard and recycled electronics from China, India and other Asian countries find fertile grounds in these countries and are patronized mostly by the low income population. As a result of these ugly practices most municipal solid wastes contain high quantities of these e-wastes. There is therefore need for urgent and strict control measures by Nigeria government to regulate the importations of substandard electronics which have short life span.

The rapid population growth as a result of urbanization in suburbs of Abuja City area has resulted to difficulties for environmental management agency in providing an effective and efficient solid waste management. Olanrewaju and Ilemobade (2009) are of the view that urbanization affects land-use, when not controlled causes the emergence of illegal structures and

filthy neighborhoods which is characteristic feature of most areas in Karu, therefore services such as waste collection becomes difficult and eventually leads to illegal dumping. The illegal dumps mostly along the roadside grow into mountain like open dumps in the middle of residential quarters and along the major roadsides. These open dumps cause a lot of health hazards and reduce the beauty value of the surrounding environment and also contaminate the natural resources.

Atiemo *et al* (2012) observed that 20 to 50 million tonnes of waste electronic equipments are generated worldwide, which pose potential threat to human and the environment. They are of the view that electronic waste and electronic equipments can contain many different substances, some of which are toxic whereas others have a relatively high market value when extracted. They also stated that inadequate disposal and poor recycling practices in the recovery of precious metals such as gold, copper and silver contribute to the release of toxic metals into the environment which can pose health risk to exposed individual. The generation and disposal of solid wastes in the world is a problem that continues to grow with urbanization, development of industrialization and growing population (Butu and Bichi, 2013). Longe and Balogun (2010) observed that groundwater pollution in Nigeria is mainly due to the process of industrialized urbanization that has progressively developed over time without regard for environmental consequences. They are of the opinion that increased in population, industrialization and technological revolution have resulted in the increase in waste generation with resultant production of wastes which have become too complex to manage and control. Thus, Uzoigwe *et al* (2013) pointed out that the impact of solid wastes in recent times on groundwater and other water sources has attracted a lot of attention because of its overwhelming environmental significance.

The problem of solid waste disposal in urban centres in developing countries is a major concern to government and this problem becomes worrisome in Nigeria where municipal waste generation is always on the increase because of increase in population pressure and socio-economic factors (Omole and Alakinde, 2013). Kenneth and Huie (1983) classified solid waste principally as garbage, ashes and rubbish. The garbage includes organic matter resulting from preparation and consumption of food. Ashes include remains of cooking and heating process and rubbish may be papers, rags, wood, leaves and other non biodegradable materials such as glass, metal and polythene materials. Sharma P.D. (2009) classified solid waste as garbage which include man made waste from food, rubbish comprised of non biodegradable or non decomposable waste either combustible (such as papers, wood and cloths) or non combustible (such as metals, glass, ceramics and polythene). Ashes comprised of residues of combustible solid fuels, large wastes are made up of demolition and construction debris and trees, dead animals and finally sewage- treatment comprised of materials retained on sewage treatment screen, settled solid and biomass. The current state of plastic bag waste pollution in Nigeria is alarming. Several environmental impacts including blockage of waterways and choking of animals, soils and mosaic litters of pure water sachet in the landscape requires urgent attention (Ogwo *et al.*, 2013).

In most cities of Nigeria refuse disposal and storm water drainage are inefficient, refuse are disposed indiscriminately and there are inadequate defined channels for storm water drainage. It is very common to find the drainage lines being filled up with refuse after rainfall. The refuse

from these roadside dumps are very good pollutants of the stream, groundwater and entire the environment. The ugly scene that welcomes guests as one approach Karu is becoming worrisome. The entire Abuja- Keffi Expressway, especially at Mararaba and other major routes in the study area are often blocked by flood whenever there is heavy downpour. Therefore there is need to assess the effects of municipal solid waste generation and management in Karu. This study is therefore aimed at looking at the environmental impacts of roadside disposal of solid wastes that characterized the main expressway that dissects Karu spanning from Mararaba, One-Man Village, Ado, New Nyanya, Masaka, Kuchikau, Auta Balefi as well as cluster of other shanties at the Nasarawa state border with Federal Capital Territory (F.C.T) Abuja and make suggestions on waste disposal and management to avert further deterioration of the environment.

MATERIALS AND METHOD

The study area is Karu, the Headquarters of Karu Local Government Area, located in the western zone of Nasarawa state and suburb of the Federal Capital Territory (FCT) Abuja, the Nigeria Capital. The sample area spans from Mararaba, One-Man Village, Ado, New Nyanya, Masaka, Kuchikau, Auta Balefi as well as a cluster of other shanties at the Nasarawa state bordering FCT. In this study the major Abuja – Keffi Expressway which dissects Karu Local Government area stretching from Mararaba to Auta Balefi and other major streets in Mararaba, One-Man Village, Ado, New Nyanya, Masaka, Kuchikau are selected as the main focus of the study. Qualitative data which was mainly primary data was generated by carrying out oral interviews and field observations towards getting an in-depth and holistic assessment of the environment and the secondary data was obtained from desk review method where information were obtained from relevant literatures on the subject matter. The interviews were semi-structured and a purposive sampling method was adopted, there after the qualitative data was analysed descriptively.

RESULTS AND DISCUSSION

The study focused on seven settlements along the Abuja – Keffi Expressway ranging from Mararaba, One-man Village, Ado, New Nyanya, Masaka, Kuchikau and Auta Belafi. Each of these settlements is responsible for solid waste generation within their individual jurisdiction. A World Bank Assisted Project called Supreme with Karu Local Government Area Council undertakes the cleansing and waste management exercise of the study area.

Mararaba

Mararaba is the closest settlement to F.C.T. Abuja, the largest settlement and the commercial nerve centre of Karu Area Council. The area is highly unplanned, there are no defined streets and house numbers, the major and only accessible roads are the Abuja – Keffi Expressway and the Abacha road. As shown on Figures 1-3, the main Expressway is characterized by heaps of municipal solid waste dump. The composition of this waste is very complex, they comprised of synthetic materials, electronic wastes and biodegradable materials. The synthetic wastes are made up of plastic materials, bottles, empty metal containers and remains of polythene bags of sachet water, the so called “pure water”. High quantities of plastic waste are generated from food containers and beverages, empty containers of bottle water and other polythene materials. The electronic wastes commonly found in Mararaba roadside waste dumps include discarded pieces

of television sets, computer parts, and electrical bulbs and discarded electrical fitting. Other synthetic materials such as used tyres and all sorts of plastics and polythene materials are also seen in the complex composition of the solid wastes in Mararaba.

Figure 1: A heap of complex municipal solid waste on the roadside of Abuja-Keffi Express way at Mararaba.



Source: Field work, 2013

Figure 2: A heap of Complex municipal solid waste on the roadside of the popular Abacha road at Mararaba.



Source: Field work, 2013

Figure 3: Another heap of complex municipal solid waste on the roadside of Abuja-Keffi Express way around Sharp Corner at Mararaba.



Source: Field work, 2013

The biodegradable solid waste sighted on the roadside dumps at Mararaba are mostly household consumable materials such as kitchen remains, discarded food items, yard wastes, pieces of clothes and discarded cartons that were used for packaging. These solid waste materials are dumped on the roadsides at Mararaba in several heaps at designated temporary dumpsites and are evacuated weekly by Supreme, a World Bank Assisted Project that undertakes the packing of the refuse. There is no special organized system of solid waste collection by the Waste Management Agency. The only alternative for the residents is to dump the solid wastes on open designated points along the major Expressway and other internal inlets, where they remain for days or weeks before evacuation to the permanent dumpsites.

One – Man Village

One-man village is a new suburb that came into existence as a result of spillover population and settlement growth from Mararaba. This area is also not well planned; there are no defined streets with house numbers. As shown on Figures 4 and 5, solid waste materials are dumped along the major routes especially the Abuja – Keffi Expressway on open ground. Because of the economic status of the residents of One-man village who are mostly low income earners and petty businessmen/women, the composition of the solid waste as showed on Figures 4 and 5 is mostly biodegradable materials which are mainly household remains and discarded remains of food, polythene bags from sachet water, discarded plastics and other discarded containers that were used for packaging as well as remains from construction sites. The residents here did confirm that solid wastes are been evacuated on weekly basis by Supreme, a World Bank Assisted

Project. There is no house to house or organized system of refuse collection apart from the open roadside dumps.

Figure 4: A mountain of mixed organic and in-organic solid waste on the roadside of Abuja-Keffi Express way at One-man Village.



Source: Field work, 2013

Figure 5: Another mountain of complex municipal solid waste on the roadside of Abuja-Keffi Express way at One-man Village.



Source: Field work , 2013

Ado/New Nyanya

Ado is the Headquarters of Karu Local Government Area Council and the seat of the traditional ruler of Gbaggi in Nasarawa State. It is an ancient settlement that recently experienced a fast growth rate with mostly low income earners and petty businessmen/women from the neighbouring F.C.T. The area is not well planned with defined road networks system and

therefore house numbering is completely absent. Solid waste dumps are commonly sighted along the main road that goes into Ado and the Abuja – Keffi Expressway stretching up to New Nyanya which has the same morphology and structure with Ado.

Figure 6: A mountain of complex municipal solid wastes on the roadside of Abuja-Keffi Express way at Ado, Karu (the waste is mostly discarded polythene materials).



Source: Field work, 2013

Figure 7: Scattered complex municipal solid waste on the roadside of Abuja-Keffi Express way at New Nyanya, Karu.



Source: Field work, 2013.

Roadside refuse disposal is the only means of solid waste management by the residents in these areas. Because of the low income status of the inhabitants of these areas the solid waste composition here is dominated by biodegradable materials mainly kitchen remains and yard wastes, discarded plastic and polythene materials from sachet water (pure water). Garbage heaps emitting foul stench are what assail ones two senses when approaching some of these open roadside solid waste dumps as shown on Figures 6 and 7.

Masaka/Kuchikau

Masaka and Kuchikau are both ancient villages that gained prominent attention in terms of population growth and urban expansion without commensurate urban planning and infrastructural development. These two settlements unplanned urban growth especially Masaka has exceeded all other settlements in Karu in the last five years, but there are no planned road networks and proper house numbering for easier identification. The only method of municipal solid waste management in Masaka and Kuchikau is by open dumping of the solid wastes at designated points along the major Abuja-Keffi Expressway that dissects the two settlements. These refuse materials as shown on Figures 8 and 9 consist mainly of biodegradable materials from household and yard wastes, discarded polythene materials of all sorts and discarded plastic as well as remains of chemicals from construction and renovation works. The field work revealed that the open solid waste dumps which ooze out offensive odour are evacuated on weekly basis by the World Bank Assisted waste management agent, Supreme. However it's unfortunate to note that these municipal solid wastes are dumped on bare open ground and most of the wastes are dispersed by wind or runoff during torrential downpour littering the neighbouring landscape before evacuation date.

Figure 8: A heap of mixed biodegradable and non biodegradable municipal solid waste on the roadside of Abuja-Keffi Express way at Masaka, Karu (the waste is dominantly empty sachet water bags).



Source: Field work, 2013

Figure 9. Scattered municipal solid waste on the roadside of Abuja-Keffi Express way at



Kuchikau, Karu.

Source: Field work, 2013

Auta Balefi

Auta Balefi a settlement located almost 30km away from FCT that used to be a small village but has grown into a large settlement of low income earners. The settlement is also characterized by lack of proper urban planning; there are no proper road networks and no numbering of houses. The only method of solid waste management is by open disposal at the shoulder of the main Expressway as shown on Figure 10. The municipal solid waste composition here is dominated by biodegradable materials mainly food remains, yards and some synthetic materials such as plastic, polythene and chemical remains from building.

Figure 10: A heap of mixed solid waste on the roadside at Auta-Balefi, Karu.



Source: Field work, 2013

ENVIRONMENT IMPACTS

The disposal of municipal solid waste by the roadside in Karu has negative impacts on the general environment. The heaps of garbage emitting offensive stench welcoming guests as one enters Karu, spanning from Mararaba, One-man village, Ado, New Nyanaya, Masaka, Kuchikau, Auta Balefi as well as cluster of other shanties at the Nasarawa State border with Abuja the FCT made Karu a twin, but dirty environment to Abuja. The mountains of refuse dumps which decorate the major roadsides in Karu serve as good hideouts for rodents and snakes. These rodents are known to be vectors of the deadly *Lassa fever* and the snakes are also known to be poisonous reptiles. Also the biodegradable wastes serve as good breeding grounds for cockroaches, houseflies and also create stagnant water which serves as breeding ground for mosquitoes. These spread various diseases like cholera, typhoid fever, malaria and yellow fever. It therefore impacts negatively on the health of the residents.

The garbage are been washed from the heaps of solid waste at the shoulder of the roads by rainstorm scattering all over the environment. Some of these solid wastes are been washed by rainstorm into the drainages/gutters that were made for free flow of water and end up blocking them preventing easy flow of water and subsequently lead to flooding of the highway and even people's homes. The blockage of the drainages by solid waste especially non biodegradable materials such as plastics and polythene materials lead to a situation where stagnant water bodies and un-cleared drainage/gutters run right in front of living quarters and major highways as shown on Figures 11 and 12. These blocked gutters contain a lot of debris including decomposable ones with offensive stench which attracts flies and also contain harmful bacteria which are pathogenic to humans.

Figure 11: A heap of mixed solid wastes removed from a blocked drainage channel on the popular Abacha Road, Mararaba.



Source: Field work, 2013

Figure 12: A Heap of mixed garbage removed from a blocked drainage channel along Abuja-Keffi Expressway, near Sharp Corner – Mararaba.



Source: Field work, 2013

The blockage of drainages by debris moved from refuse dumps by runoff during storm is the major cause of flood in most cities. Toyobo *et al* (2013) observed that empty sachet water disposed in gutters caused blockage of drainages which constitute to the level of flood during heavy downpour, and this is the characteristics feature of Abuja-Keffi Expressway especially around the Mararaba area and before the Bridge at One-man village as shown on Figures 13 - 15.

Apart from the physical damage caused by roadside disposal of municipal solid wastes to the environment, studies have shown that most of the synthetic or non biodegradable materials which are disposed in these open roadside dumps contained some harmful chemical elements which have their origin in the decomposing high refuse dumps that dot the entire landscape of Karu area. Yusuf (1983) is of the opinion that chemical elements released from refuse dumps into soil profile in Kano metropolis contribute to the pollution of soil and this is also expected in the study area (Karu). The major sources of pollution in urban areas are from urban wastes of all categories. Farouk (1987) and Olofin (1991) traced the pollution of ground and stream water in Kano to refuse dumpsites. Igusi *et al* (2001) also observed that several chemical elements have their origin from the decomposing high refuse dumps that dot the landscape of the built up section of the catchment area of Kubanni dam, Zaria.

Butu and Ati (2013) traced the sources of some chemical elements such as europium, manganese, arsenic, zinc and copper into Kubanni dam that is used for domestic purposes to loading of debris that contain these metals from the refuse dumps that dot the entire landscape. Some of these metals could be toxic to human health. Butu and Bichi (2013) also linked the presence of chromium, cadmium, cobalt, zinc and copper in Galma dam, Zaria to the washing of these metals from refuse dumps in Galma catchment area.

Figure 13: Another heap of mixed garbage removed from a blocked drainage channel along Abuja-Keffi Expressway at another location at Mararaba.



Source: Field work, 2013

Figure 14. Another heap of solid waste covering gutter along Abuja-Keffi Expressway at One-man Village, Karu.



Source: Field work, 2013

Figure 15: A blocked drainage with mostly Synthetic municipal solid wastes at Abuja-Keffi Expressway Mararaba (the gutter is covered with used tyres and other synthetic wastes).



Source: Field work, 2013.

Butu and Iguisi (2013) observed that heavy metals such as chromium, antimony which exist in most household materials have been washed into the soil along Kubanni River in a high level of concentration. Butu (2013a) observed that debris transported by runoff into Kubanni stream which is used for domestic purposes contained high levels of metal contaminants. He also observed that some metals that are leached into the soil from refuse dumps and transported into the Kubanni waterway through subsurface flow during rainy period contributed to pollution of the water system.

Addo *et al* (2012) studied the physico-chemical characteristics of water samples from Mokwe Lagoon Ghana and observed that there was high enrichment of metals which reflected anthropogenic effects of contamination and attributed it to refuse or solid wastes as one of the major sources. Barakat *et al* (2012) also linked metal pollution in Day River to the urban solid wastes from Beni-Mellal city, Morocco. Butu (2013b) looked at the seasonal variation in concentration of some heavy elements in surface water at the lower region of Galma dam, Zaria and discovered that the level of concentration of chromium was high in the dam in the rainy season and concluded that the metal was washed into the dam from debris that dotted the entire dam area because chromium is a household related metal

Gamboa -Rodriguez *et al* (2012) traced the presence of zinc and lead in Tabasco Lagoon, Mexico to pluvial discharges from city around the lagoon that washed roasted irons and carry domestic discharges, paints and roof of insulation debris of building as well as oil and combustion particles from automobile combustion. The proliferation of urban settlements and slums with heaps of refuse dump around the Ebute Meta creek has resulted in deterioration of the water quality of the creek, some of the effects of the pollution include aesthetic nuisance of sludge, accumulation, offensive odour, microbial contamination, increasing organic load, increased turbidity, reduced dissolved oxygen and loss of biodiversity due to decimation of biota (Etim, 2012). The negative impact of solid wastes on the environment in recent time is becoming an issue of concern especially on groundwater and other water sources. These wastes

migrate from dumpsites or landfill and release pollutants that pose a high risk to groundwater resources if not adequately managed (Ikem *et al.*, 2002).

Rajkumar *et al* (2010) also observed that the environmental problems existing in the areas of developing countries, municipal solid waste management and its impact on the groundwater quality have been the most prominent in the recent years and the case in Karu cannot be an exception. Solid waste generation in Karu is very high as observed from the field and shown on Figures 1 to 10 due to the economic status and population density. The highest quantities of the waste are organic materials from food and yard wastes. A large quantity of plastic and polythene wastes are also generated from food containers, beverages and packaging materials. There is a high correlation between waste generation quantity, quality and income level. This therefore explained the high volume of solid waste in Karu. Population, income, economic growth, season, climate change and social status are the major determinants of waste generation and composition (Ayuba *et al.*, 2013). This is clearly exhibited in the structure of the waste generation and management system in Karu. It is a common site to find heaps of open solid waste at the shoulders of major streets in the so called designated waste collection points in Karu for days or weeks with no apparent attempt at getting rid of them with all the attendant risk of air pollution, ground-water pollution, flood risk and other environmental nuisances. Although it is confirmed that these roadside solid wastes are been evacuated by the appropriate authority, the method of collection is out dated and prone to environmental contamination physically and chemically.

Several scholars have proved that most of the synthetic materials and the e-wastes that are contained in the open roadside disposed municipal solid wastes contain toxic metals that are lethal to humans, plants and other living organisms. Akrong *et al* (2002) observed that heavy metals concentration in soils as a result of irrigation with contaminated water has serious health implications on human health. Some of these heavy metals are neurotoxin and carcinogenic and continuous intake as a result of consumption of contaminated vegetables will affect the central nervous system, the endocrine system and kidneys of people exposed to these toxicants (Obirri *et al.*, 2010; Amonoo – Neizer and Amekor, 1994). Several studies linked the presence of heavy metals such as lead and cadmium to cases of cognitive disorders especially in kids (Kogers *et al.*, 2005; Myers and Davidson, 2000; Weiss, 2000).

Shagal *et al* (2012) observed that vegetables tend to absorb and accumulate cadmium and lead and suggested that vegetables for human consumption should not be cultivated in areas where refuse dumps are close to, because municipal solid wastes are the major sources of these metals in our environment. Most of the synthetic materials disposed in these municipal solid wastes collection centres by the roadside are suspected to contain toxic metals such as lead and cadmium. The result of the study showed that runoff transports a lot of this solid debris that are disposed by roadside in Karu area, thereby contributing to environmental deterioration. Banadda (2011) observed that runoff during rainy season increases the concentration of nutrients (elements) and in turn affect the environmental quality especially the water quality. Water movement is a complex system with so many factors determining the transportation and dispersion of pollutants in a given environment.

Heavy metals are common chemical pollutants that are easily transported and dispersed in our environment and Karu especially Mararaba cannot be an exception for presence of these lethal elements. Most of the electronic and electrical fittings that are commonly seen in most of the refuse dumps in Karu contain a lot of heavy metals that are carcinogenic to humans. Heavy metals are non-biodegradable and persistent environmental contaminants which may be deposited on the surface and then absorbed into the tissues of vegetables and might be accumulated in the food chain with risks to health of animals and humans which are sensitive to metal toxicity (Doberty *et al.*, 2012).

The results of the study revealed that there is no organized municipal solid waste collection system in Karu and that solid waste is indiscriminately disposed by the roadside in the entire study area, the study also observed that most built up areas of Karu are not well planned for easy identification and collection of refuse. It is also noted from the research that no form of segregation or recycling is practiced in Karu except by local scavengers. It was also observed that the solid waste collection from these roadside dumpsites is on weekly basis and this amount to growing heaps of refuse which are easily scattered and dispersed during rainstorm. Most of these dispersed solid wastes constitute great nuisance with negative impacts on the environment and the human health because most toxic chemical elements have been proven to originate from the non biodegradable and e-waste from the refuse dumps.

CONCLUSION

Municipal solid waste generation and management is a serious issue in Karu; due to its environmental and human health implications. The study showed that population growth with uncontrolled and unplanned urban expansion of the study area compounded the problems of waste management. The solid waste generation and roadside disposal system in the study area fall below acceptable standard. Non biodegradable fractions of the municipal solid wastes are the major problems in solid waste management, because plastic, polythene and e-waste materials constitute physical nuisance to the environment. In addition most of these non biodegradable materials contain high levels of chemical elements which some have been implicated in the etiology of many ailments peculiar to humans.

The biodegradable content of the solid waste disposed at the major highways in Karu are mostly food remains, yard wastes, kitchen consumables and discarded papers/cartons for packaging. These materials have no direct chemical implications, but constitute physical environmental nuisance and also harbour bacteria and other dangerous insects, rodents and reptiles. It is necessary to observe that not only Karu that is being polluted by the indiscriminate dumping of solid wastes, most growing cities of developing countries suffer these impacts of environmental pollution. To avert this ugly menace, the following recommendations are considered;

1. Proper orientation and environmental laws should be put in place for the general public.
2. Government should make quick efforts to improve the present waste disposal and management system of the study area by providing necessary facilities for house to house and street to street waste collections.

3. Residents should be made to pay for the collection of the solid waste they generate.
4. Government to train more sanitary staff that will educate the residents and also enforce the sanitary laws.
5. Efforts should be made at recycling waste since this is even economically very beneficial.
6. Government should set-up private partnership in waste collection, sorting and disposal. This would help in cleaning up Karu and it would also help in creating employment most especially in the area of waste recycling.

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