International Journal of Environmental Engineering Science and Technology Research
Vol. 2, No. 3, March 2014, PP: 1 - 8, ISSN: 2326 - 3113 (Online)
Available online a t http://ijestr.org/

Research article

ENVIRONMENTAL IMPACTS AND MANAGEMENT STRATEGIES OF SOLID WASTE DISPOSAL IN JIMETA-YOLA, NIGERIA

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Abstract

One of the major problems that have besieged almost all communities in the less and developing economies is the improper waste disposal and management strategies. Considering the severity of the problem, this study was undertaken to examine some impacts of solid wastes disposal in Jimeta-Yola metropolis and to strategize for proper wastes disposal management. Both empirical and analytical data were collected from Abattoir, Wuro Kuturu, Jambutu, Shinko, Yelwa, Yolde Pate, Specialist Hospital, and Adama Beverages. The sampling locations were selected to reflect different influences of waste generation and disposal in highly populated parts of the metropolis. Results obtained indicated that 0.5–1.0 kg of solid wastes was generated by an individual in the city born out of ignorance and socio-economic related problems. It was gathered that the impact of solid wastes was on the increase as a result of inadequate environmental and health education in the metropolis. This is buttressed by the high concentrations of physicochemical parameters of dumpsites leachate collected at different locations in the city which exceeded the threshold limit values and as a result, the city is considered polluted. Therefore, proper disposal methods from the generating sources to the collection points, design of large modern compacted impermeable liner landfills to be used for not less than 80 years, and other alternative technologies like recycling, pyrolysis, gasification, composting, anaerobic digestion, have been suggested at designated disposal sites provided by government. Efficient and effective waste management is not cheap; it is best achieved at household levels. Government should take proper steps to control solid waste pollution in the city.

Keywords: disposal, solid wastes, environmental impact, management, landfills

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Introduction

Solid waste has been a major environmental issue everywhere since the industrial revolution. Besides the waste we generate at home, school, market and other public places, there are also those from hospitals, pharmaceuticals, industries, farms and other sources (Fantola and Oluwade, 1996). Humans rely so much on material things and they all (almost) end up as waste; this is why Matejicek and Benesova (2002a) considered solid waste as something, which the holder discards or intends to discard because they have become useless and unwanted such as: papers, plastic containers, bottles, cans, food and even junked cars, tires, refrigerators, stoves and scraps of broken electronic goods, broken furniture, hospitals waste, and other packaging materials are all examples. Some of these garbage, trash, refuse, and rubbish are biodegradable e.g., food droppings, paper products as well as vegetation like grass and twigs. Others are not biodegradable, and they include plastics, metals, and aluminum cans, broken computers and car parts. Since they do not easily decay, they pile up in refuse dumps and landfills; a place where the city's rubbish are sent and remain for a number of years. These bring great harm to the land, water and people around it. Sangodoyin (1991) notes that except from these wastes, there is second group of hazardous or harmful solid waste which can potentially threaten public health or environment. Such waste could be inflammable (can easily catch fire) or difficult to treat, keep, dispose of. They may contain substances which are reactive (can easily explode), corrosive (can easily eat through metals) or toxic, infectious, carcinogenic (poisonous to human and animals).

Ever since humans twigged that their health and well being is tight down to the quality of their environment, sanitation which ought to be one of the determinants of the quality of life is often neglected. The term environment refers to the air, water and the land around us. These elements provide a variety of important services such as habitats in which to live and resources to produce goods and services (Sharp et al, 2002). This implies that one cannot do away with the environment and therefore, there is the need to protect the environment. The environment, which enables us to live by interacting with other things within it, is gradually deteriorating and this is as a result of human and animals activities, thereby contributing to environmental problems such as pollution. These primarily arise from the use of the environment by producers and consumers as a place to dispose of waste. Shubler, et al. (1996) attested that the amount of waste and problems involved in disposing of waste as many countries of the world have grown wealthier, it shows that the problem of disposing of waste is becoming complex; as population and industrial production increase, waste generation has also increased. The management of solid waste in our urban communities has become a significant policy issue in the world over. Today, solid waste management has become particularly difficult basically due to rapid growth of the population. This has made it very difficult for sanitation to keep pace with population and increasing levels of wealth. For example, Smith and Enger (2000) observed that the solid waste problem facing the world today is the result of the economic boom that followed World War II. Countries such as the United Kingdom, France and the United States of America generate a lot of waste in the form of pollution. However, some of the greatest challenges to its management are felt most keenly in the developing countries. This irony is based on the gap between the pattern of growth and modernization in the developing world on one hand, and the capacity to pay for effective management of solid waste as part of the integrated national system on the other hand (Thomas-Hope, 1998).

Many people feel that solid waste management is a simple affair – simply putting waste into a vehicle and unloading it at a dump. If this were true, then why do so many towns suffer from uncollected refuse blocking streets and drains, harbouring flies and rats, and degrading urban environment? Successful solid waste management is rarely achieved without thought, effort, and much learning from mistakes. According to a United Nations Development Programme survey of 151 mayors of cities from around the world, the second most serious problem that city dwellers face after unemployment is unsatisfactory solid waste disposal (UNDP, 1997). Solid waste management could not be limited to dealing only with refuse material that has been produced. The approach must incorporate a proactive dimension in order to reduce not only the amount of waste generated or discarded, but also to redirect the

minds and behaviours of populations towards a new level of positive participation in maintaining the environment in a healthy condition. Dhamuja (2006) notes that the final disposal of waste is the most neglected aspect of municipal solid waste. He observed that the most common method of disposal in developing countries is open dumping which contravenes all accepted landfill principles. Solid waste management includes all activities that seek to minimize the health, environment and aesthetic impacts of solid waste. The current problems associated with solid waste management lie not only in the increased quantities and greater urban concentrations of the waste generated, but also in the varieties of the waste which have to be managed, and in transitional potential for contamination.

To Zhu et al. (2008), a typical waste management system in a low or middle – income country includes the following elements:

• Waste generation and storage;

• Separation, re-use and recycling at the household level;

• Primary waste collection and transport to a transfer station or community bin;

• Street sweeping and cleaning of public places;

• Management of the transfer station of public places;

• Management of transfer station or public bin;

• Secondary collection and transfer to the waste disposal site;

• Waste disposal in landfills; and

• Collection, transfer, and treatment of recyclables at all points on the solid waste pathway (collection, storage, transport and disposal).

For Schubler et al. (1996), the scope of solid waste management system encompasses the following functions and concerns:

i). Planning and management (strategic planning, legal and regulatory framework, public participation, financial management: cost recovery, budgeting, accounting, etc, Institutional arrangements including private sector participation) and disposal facility sitting;

ii). Waste generation (waste characterization, source, rates, composition, etc.), waste minimization and source separation;

iii) Waste handling (waste collection, waste transfer treatment and disposal etc)

Isaac and Theophilus (2013) lamented that thirty to fifty percent of developing countries is urban and produces high volume of waste. Thousands of tons of solid waste are generated daily in Africa; most of it ends up in open dumps and wetlands, littering roadsides, floating in lakes and streams, collecting in ugly dumps contaminating surface and groundwater thereby posing major health hazards. They reported that generating rates of solid wastes in most African cities are approximately from 0.5 – 0.8kg per person per day as against the 1-2kg per person per day generated in developed countries. EPA, USA, (2010) notes that Europe generates about 1.8 billion tones of waste each year. This means each person generates about 3.5 tones on average. In 2010, Americans generated about

250million tones of trash and recycled and composted over 85 million tones of these materials, equivalent to a 34.1 percent recycling rate.

In Jimata-Yola, the situation is not different in the various components of the city such as Shinko, Wuro Kuturu, Jambutu, Yolde Pate, Yelwa, Abbatoir, etc. Disposal of waste constitute a serious problem in the city. In all these places, sorting and separating of waste is not done, and some of the waste e.g. papers, food, diapers, glass and plastics take years to decompose. The dumpsites become full, smelly and unsafe for environment. Leachate; liquid that forms as water at dumpsites trickles through contaminated areas. It forms very harmful mixture of chemicals that may result in hazardous substances entering surface water, groundwater or soil. Wastes that end up in water bodies negatively change the chemical composition of water. Technically, this is called water pollution and this will affect all ecosystems existing in water. It can also cause harm to animals that drink from such polluted water. When solid waste are stored in dumps, one major impact is, it provides food and shelter for disease carrying animals, such as cockroaches, rats, reptiles, and other vector insects. When solid wastes are destroyed by incineration, the smoke causes air pollution. As a result, production of solid waste is on the increase; materials that decay and burn are replaced by plastics that will not decay and will give off harmful gases when burnt.

However, it is important to study the solid waste generated and disposed off in a particular locality so as to design an appropriate intervention package for that community or city. The following objectives apply to this current study: (1) to assess the various methods of collection, sorting and dumping of solid wastes presently in use, (2) strategize for solid waste disposal management techniques in Jimete-Yola, (3) correlate the relationship between physico-chemical parameters of leachate samples collected from open dumpsites and the sampling areas graphically.

Materials and Methods

Materials: polythene bags, hand trowel, camera, hand gloves. The camera was used to sample photos from selected open dumpsites while the polythene bags, hand trowel and gloves were used to handle solid waste samples and leachate at dumpsites and during laboratory analysis. Personal observations at collection and dumpsites were applied in data collection. Laboratory equipment and instruments such as atomic absorption spectrophotometer (AAS), BOD testing kits, pH meter, thermometer, reagents and other conventional contaminants testing equipment were used.

Methods: Leachate, the liquid formed from water that trickled through the solid waste dumpsites was collected in clean washed BOD and plastic bottles for laboratory analyses of pH, total hardness, calcium, magnesium, sodium concentration, total dissolved solid, nitrate and total alkalinity. On the site interviews with residents of sampled areas and some government officials about solid waste generation, collection and disposal was employed in this study

Figure 1: Solid waste dumpsite at Shinko near River Benue

Figure 2: Samples of other solid waste dumpsites at Abattoir, Yolde Pate, Jambutu and Adama Beverages.

Results and Discussion

Impacts Assessment of Solid Waste Disposal:

From the data collected, the solid waste generated consisted of maize cobs, leaves, charcoal, ashes, papers, vegetables and fruits leftover, polythene bags, metals, bottles and electronic parts. It was observed that the problem of polythene bags is that they are not biodegradable and can remain in soils for many years without been decomposed which creates eye sore in the environment. They fly, litter and make the environment dirty as wind blows across the dumpsites; they are transported to other places by dry deposition. Small containers and barrels were the only collection, storage and dumping materials available. Surprisingly, people don't even use them but prefer the use of open dumps. The largest capacity of the containers was $12m^3$ and the volume of the dumpsite mass depends on the population density of the areas. Seventy two (72) were visited out of about a hundred (100) dumpsites in Jimeta-Yola metropolitan city among which only eight (8) were selected due to their high wastes generation and being central to the residents in those areas.

The transport facilities were inadequate for both private and public sanitation agencies and the usual method of the overall central waste disposal was a small landfill area adopted behind the Federal Radio Corporation (FM) radio along University-Sangere Road. Until recently, some peasant farmers who could not afford inorganic fertilizer picked interest on solid waste (manure) as a substitute for inorganic fertilizer and requested or paid for waste to be dumped on their farmlands without minding its health hazards or not regarding where these wastes came from. The use of this refuse/waste by farmers is dangerous to health and environment because these wastes contain dissolved toxic chemicals, metals, etc which can be infectious when matched on or even when inhaled. The large quantity of plastic bags used without recycling reduces soil aeration and infiltration of storm water into the soil. All the dumpsites are sources of epidemics as they also bring about bad odour and eye sore. Leachate from these dumps migrate as non point source (NPS) of contaminants to pollute soils, rivers or groundwater while emissions released from decaying open dumps pollute the atmospheric air. It was gathered that solid waste stored in containers overflow and those in the open dumps keep on increasing daily due to lack of evacuating trucks which constitutes environmental nuisance.

Analysis of Liquid Waste Samples from Solid Waste Dumpsites:

Laboratory analysis was carried out on leachate samples collected from the eight (8) selected solid waste open dumps within Jimeta-Yola metropolitan city: Jambutu, Shinko, Wuro Kuturu, Specialist Hospital, Adama Beverages, Abattoir, Yelwa and Yolde Pate in order to determine the concentrations of physicochemical parameters of contaminants contained in the solid waste liquid and compare them with the threshold limit values of World Health Organization (WHO, 2007) Standard. The parameters analyzed were: pH, total hardness, calcium, magnesium and sodium concentrations, total dissolved solid, nitrate and total alkalinity as contained in Table 1 below.

Table 1: Characteristics of liquid waste samples in solid waste compared with WHO'07 Standard

Parameters	Jambutu	Wuro Kuturu	Shinko	Specialist Hosp.	Adama Beve.	Abattoir	Yelwa	Yolde Pate	WHO 2007
PH	8.40	8.30	7.60	7.70	7.80	10.00	8.50	8.50	6.50-8.50
Total hardness	140.00	120.00	130.00	105.00	110.00	180.00	122.00	128.0	100.0
Calcium	18.20	18.30	35.50	40.00	38.20	60.00	52.30	52.40	20.00
Magnesium	30.00	28.00	25.00	20.00	22.00	31.00	21.00	23.00	40.00
Sodium	5.80	5.70	4.90	6.10	6.05	9.10	5.10	5.80	20.00
Total dissolved solid	0.06	0.06	0.05	0.03	0.03	0.12	0.05	0.05	500.0
Nitrate	25.83	28.12	47.10	22.32	24.50	59.10	40.50	44.78	50.00
Total alkalinity	48.00	46.00	41.00	36.00	38.00	58.00	41.00	42.00	30-40

All units of concentrations in mg/L except pH

From the table above, the pH values range from 7.6 – 10.0 being slightly alkaline with the least and highest values at Shinko and Abattoir respectively. This makes soils around the dumpsites contain excessive soluble salts and harmful absorbed sodium. Total hardness ranges from 105.0 – 180.0 mg/l with consequences of having hard water around the solid waste disposal sites. Calcium and magnesium contents of these solid waste range from 18.2 – 60.0 and 20.0 – 31.0 mg/l; while sodium concentrations range from 4.9 – 9.1 mg/l. Excessive sodium can leach into soils thereby reducing plants growth in the area and increase the electrical conductivity of surface waters around. Total dissolved solid can generally clog pore spaces of soils and reduce infiltration rate of water into soils through the crops root zones. Generally, the values of contaminants from solid waste dumpsites studied were above WHO permissible limits of 2007 standards and the highest values of these contaminants were recorded at Abattoir. However, a plot of the contaminant concentrations data against the sampling areas shows Abattoir dumpsite as the most polluted area within the city as can be observed from Figure 2 below.

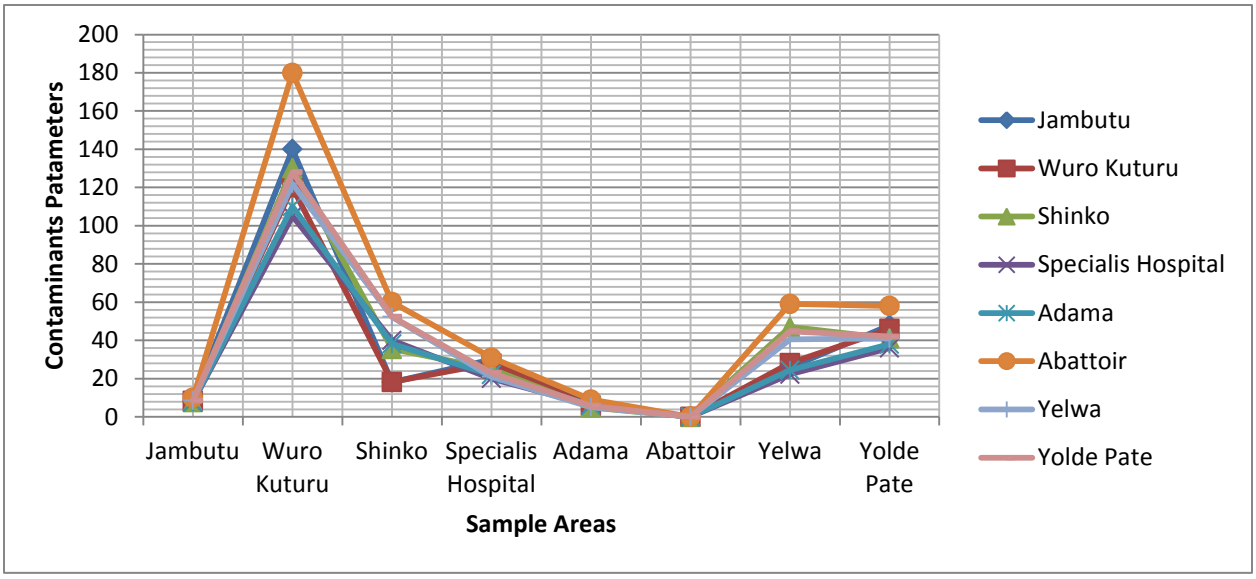

Figure 2: Graph of Contaminants Concentrations against Sample Areas

Conclusion

The level of indiscriminate dumping of solid waste is on the increase in Jimeta-Yola city as a result of rapid urban development that has occurred and is still ongoing. Solid waste dumpsites were studied in eight selected populated and high solid waste generated areas and leachate of dumped waste was collected in clean washed plastic bottles for laboratory analysis of both metals and conventional contaminants present in the leachate. Most of their concentrations were found to be on the higher side in comparison with WHO Standards of 2007. The study reveals that the status of solid waste pollution was found to be very critical especially when these dumps were burnt and increased the ground level ozone pollution. This has taken the problem to a threatening dimension. In general, there is only a limited understanding of environmental pollution due to ignorance and the absolute lack of basic sanitation education in the city whose rate of growth of urban population is very high. As a State Administration Headquarters and commercial capital city, the rate of urbanization is also high. The impact of solid waste as a result of large influx of population in the city has been quite strong on the overall environmental situation in the city. The municipal authority should take a lead in organizing a concerted and coordinated effort with other governmental and non-governmental agencies in solving the problem as soon as possible. The community people should also be mobilized in such efforts, because people's participation can be very much fruitful in improving the environmental situation.

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