Research Paper

Municipal Solid Waste and Pollution Management in Jalingo Metropolis: Problems, Challenges and Strategies

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Abstract

This research present finding of a study carried out in Jalingo Metropolis of Taraba State, Nigeria, with the current solid wastes management practices, problems, challenges and strategies. Prior to the assessment, field work studies indicated that current solid wastes generation rate in the metropolis is 0.34 kg/ca/day and total wastes generation is within the range of 54 tons/day. A detail investigation was made regarding the method of practices associated with source, quantity generated, collection, transportation, storage, treatment and disposal of Municipal Solid Waste (MSW). The data concerning Solid Waste Management (SWM) in the metropolis was obtained through questionnaire, individual field visit and interviewing responsible persons/municipality. Photographic evidences were also made about generation, storage, collection, transportation, treatment and disposal of MSW. As a result of this study, sanitary landfills were suggested to replace the practice of open dumping and to reduce the reliance on wastes incineration, but yet have some obvious problems and challenges. The paper recommends that, the current method of wastes collection and disposal by the government should be immediately reversed to the new option been campaigned for in the recent time. This is wastes-to-wealth or trash-to-treasure through recycling and community participation to be the right measure in attaining sustainability and effective solid wastes management in study area.

Keywords: Wastes management, Jalingo, Sustainability, Landfill, Disposal, Recycling, Solid Waste

1. Introduction

Municipal Solid Waste Management (MSWM) constitutes one of the most crucial health and environmental problems facing governments of Nigerian cities. This is because despite the fact that these cities are using 20-55% of their budget in solid wastes management, only 40-80% of the waste is collected. The uncollected or illegally dumped wastes constitute a disaster to human and environmental degradation. The federal government of Nigeria has promulgated various laws and regulations to safeguard the environment. These include Federal Environmental Protection Agency Act of 1988. The Federal Ministry of Environment administers and enforces environmental laws in Nigeria. It took over this function from the Federal Environmental Protection Agency (FEPA) in 1991, which was created under the FEPA act. According to the act, each state and local Government in the country has to set up its own environmental protection body for the protection and improvement of the environment within its borders. Municipal Solid Wastes and Pollution Management is a major responsibility of State and Local Government Environmental Agencies. The agencies are charged with the responsibility of handling, employing, disposing of solid wastes generated and finally abating pollution (Ogwueleka et al, 2009).

The term municipal solid wastes, refers to solid wastes from houses, streets and public places, shops, hospitals and offices, which are very often the responsibility of municipal and other government authorities. Solid waste from industrial processes is generally not regarded as “municipal” but, however, it needs to be taken into consideration when
dealing with it because of often end up in the municipal solid wastes stream (Zurbrugg, 2003).

Inappropriate wastes handling, storage, collection and disposal practices poses environmental and public health risks. In densely populated urban centres, for example, appropriate and safe municipal solid wastes and pollution management is of paramount importance to create a healthy environment for the citizens (Mosler et al, 2006). Typically, one to two thirds of the solid wastes generated is not collected. As a result, the uncollected wastes, which is often also mixed with human and animal excreta, is dumped indiscriminately on land, so contributing to flooding, breeding of insect and rodent vectors and the spread of diseases. Also, even collected waste is often disposal off in uncontrolled manner/dumpsites and/or burnt, polluting water resources and air (Zurbrugg, 2009).

The volume of solid waste being generated is seen continually to increase at a rapid rate than the efforts and ability of the responsible agencies to improve on the technical and financial resources needed to curtail this growth. Therefore, solid wastes management and pollution control in Taraba State is characterized by insufficient methods of collection, transfer and storage, insufficient coverage of the collection system and uncontrolled disposal of the waste. In developing cities, local authorities on environmental protection spend 20-55% of their revenue on collection and disposal, but can only collect almost 40-80% of municipal solid wastes (Ogwueleka et al, 2009).

Recently some developing countries have realized that the solid wastes and pollution management policies they follow do not serve the objectives of sustainable development and there is a need for a paradigm shift in dealing with municipal solid wastes and pollution management problems (Agamuthu, 2003), with a focus on the technical aspects of different means of collection and disposals (WB, 1992).

Adequate municipal solid waste and pollution management is much more than a technological issue - it also involves institutional, social, legal, and financial aspects and involves coordinating and managing a large workforce and collaborating with many involved stake-holders as well as the general public. It also needs inputs from a range of disciplines, and careful consideration of local conditions (Zurbrugg, 2009).

The objectives of this research study is to present an overview on problems and challenges facing the wastes sector on the simple wastes disposal and pollution control techniques and to formulate strategies that could be efficiently utilized in Jalingo Metropolis of Taraba State. Recommendations of the study were provided about institutional, political, social, financial, economic and technical aspects of municipal solid wastes and pollution management as well as flow of information and training of all on the use of new techniques wastes-to-wealth or trash-to-treasure and methods (recycling) to be the right measure in attaining sustainability and effective solid waste management in Jalingo Metropolis of Taraba State.

2. Materials and Methods

2.1. Study Area-Jalingo Metropolis

The city of Jalingo (centre of Muri Emirate) is roughly located between latitude 8°47’ to 9°01’N and longitude 11°09’ to 11°30’E. It is bounded to the north by Lau Local Government Area (L.G.A), to the East by Yorro L.G.A, to the south and west by Ardo-Kola L.G.A. (Figure 1). It has a total land area of about 195,071 km². Its altitude from free seas is 351 meters. Jalingo L.G.A has a population of 139,845 people according to the 2006 population census, with a projected growth rate of 3% (Oruonye and Abbas, 2010). Presently, it has a projected population (2013) of 167,548 based on the 2006 population census figure of 139,845 at 2.83% annual growth rate. Politically and administratively, the city is divided into 10 wards (Turaki A, Turaki B, Sintali A, Sintali B, Majidadi, Sarkin Dawaki, Kachalla Sembe, Barde, Kona and Yelwa). It is estimated that about 72% of the population in the metropolis live in informal or unplanned settlements. Solid waste management is administered through city cleansing section department of Environmental Health Service, which is a subsection of the Taraba State Ministry of Environmental and Urban Development (ME & UD).

2.2. Data Collection

This research was compiled based on both theoretical and empirical research with in depth insights on problems and challenges facing municipal solid waste and pollution management. The solid waste from the different segment of society was collected, mixed and one kilogram (1 kg)
sample was prepared by using quartering method. The waste was then characterized and the percentage of each component was calculated. Secondary source of data include municipality information, direct observation, photography of selected sites and personal interview were embarked upon. Questionnaire was administered to determine how each of the ministries and agencies in Solid Waste and Pollution Management (SWPM) participate or cooperate in solid waste collection services, disposal methods and how their waste was generated?

3. Results and Discussion

3.1. Solid Waste Generation Rates

The amounts of solid waste generated per capita per day in Jalingo Metropolis was determined so as to estimate the total amounts of domestic solid waste generated per day. Measurement of waste generation in the metropolis was carried out every week on Friday for a period of ten months and mean value determined. The result suggests that, the waste generation rate in Jalingo Metropolis was about 0.34 kg/ca/day. Result obtained in this studies are present in Table 1 (a and b) and are comparable to those presented in Table 2 as reported by Smith (1997), which suggests that income level is a determining factor for domestic solid waste generation rates as ascertained by the fact that Jalingo Metropolis indicated high waste generate-on rates.

<table>
<thead>
<tr>
<th>Waste Source</th>
<th>Total Waste Generated (tons/day)</th>
<th>% age of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>18.72</td>
<td>34.70</td>
</tr>
<tr>
<td>Commercial Setup</td>
<td>12.00</td>
<td>22.22</td>
</tr>
<tr>
<td>Markets</td>
<td>10.08</td>
<td>18.67</td>
</tr>
<tr>
<td>Institutions</td>
<td>6.00</td>
<td>11.11</td>
</tr>
<tr>
<td>Others including Industries</td>
<td>2.88</td>
<td>5.33</td>
</tr>
<tr>
<td>Hospitals and Clinics</td>
<td>4.32</td>
<td>8.00</td>
</tr>
<tr>
<td>Total</td>
<td>54.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Field Experiment by Author, June 2011

Table 1b. Waste Generation and Collection in Jalingo Metropolis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Tons/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Generated (Total)</td>
<td>54.00*</td>
</tr>
<tr>
<td>Waste Collected (Total)</td>
<td>37.80</td>
</tr>
<tr>
<td>Waste Uncollected in the Metropolis</td>
<td>16.20</td>
</tr>
</tbody>
</table>

*Estimated Value, ME & UD, Jalingo
Source: Field Experiment by Author, June 2011

3.2. Factors Influencing Solid Waste Management in Jalingo Metropolis

In solid waste management and development, many factors influencing the process vary from place to place and that must be considered in the design amongst others include:

3.2.1. Waste Amount and Composition

Domestic waste from industrialized countries has a high content of packaging made from paper, plastics, glass and metals, and so the waste has a low density. In many developing countries such as Nigeria, with Jalingo city inclusive; waste contain large amounts of inserts such as sand, ash, dust and stones and high moisture levels because of the high usage of fresh fruit and vegetables. These factors make the waste very dense. The consequences of this high density are that vehicles and systems that operate well with low-density wastes in industrialized countries are not suitable or reliable when the wastes are heavy. Hence, due to the heaviness, abrasiveness of the sand and the corrosiveness caused by the water content can cause rapid deterioration of equipment. In this situation, incineration is not suitable rather recycling or salvage operations should be employed to reduce the proportion of combustible paper and plastic in waste before it reaches the treatment stage.

3.2.2. Awareness and Attitudes

Public awareness and attitude to waste can affect the whole solid waste management system. All steps in solid waste management starting from household waste storage to waste segregation, recycling, collection frequency, the amount of littering, the willingness to pay for waste management services, the opposition to the siting of waste treatment and disposal facilities, all depend on public awareness and participation. Thus, this is also a crucial issue which determines the success or failure of a solid waste management system in Jalingo Metropolis (Zurbrugg, 2009).

3.2.3. Access to Waste for Collection

Many source of waste might only be reached by roads or alleys which may be inaccessible to certain methods of transportation due to their width, slope, congestion or surface. This is especially critical in unplanned settlements such as slums or low-income areas in Jalingo and thus largely affects the selection of equipment.

3.2.4. Institutions and Legislation

Institutional issues include the current and intended legislation and the extent to which it is enforced. Standard and restriction may limit the technology options that can be considered. The governmental policy regarding the role of the private sector (formal and informal) should also be taken into consideration. The strength and concerns of...
trade unions can also have an important influence on waste management.

Table 2. Comparison of Solid Waste Generation Rates Among Various Countries

<table>
<thead>
<tr>
<th>Description</th>
<th>Low Income Countries</th>
<th>Middle Income Countries</th>
<th>Industrialized Countries</th>
<th>RSA High Income Area</th>
<th>RSA-Low Income Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Generation Rate (kg/cap/day)</td>
<td>0.4-0.6</td>
<td>0.5-0.9</td>
<td>0.7-1.8</td>
<td>1.24</td>
<td>0.33-0.87</td>
</tr>
<tr>
<td>Waste Density (kg.m(^{-3}))</td>
<td>250-500</td>
<td>170-330</td>
<td>100-170</td>
<td>DNA</td>
<td>DNA</td>
</tr>
</tbody>
</table>

DNA= Data not available, RSA= Republic of South Africa
(Source: Smith, 1997)

3.3. Solid Waste Collection, Storage and Disposal Method

3.3.1. Collection and Storage

The solid waste is collected from different sources/establishment by various methods in Jalingo Metropolis. This includes primary collection (from household to collection points) or secondary collection (collection from the household level, collection centres and open spaces and roadside i.e. illegal mini dumps) and is to its final disposal. ME & UD is solely responsible for secondary solid waste collection. There are approximately 2,653 dust bins placed in Jalingo Metropolis as source of primary collection, these are cylindrical, semi-cylindrical and rectangular bins with 2-10 m\(^3\) capacity placed in Ministries, Agencies, Hospitals, Schools, Parastatals etc. The collection of waste from the dust bins is planned in accordance with the frequency of container becoming full as of the time of this study. The present location of the dust bins and the waste collection point have been classified into daily collection, weekly once collection, weekly twice collection as designed by ME & UD.

In addition, there are 23 dumper placer containers (Roll-on, Roll-off) used as primary collection containers in commercial areas and bulk generator. All the dust bins (metal bin, plastic bin, plastic bags, oil drum etc.) are frequently used as individual containers for storage while Roll-on, Roll-off are frequently used as communal containers for storage with the collection frequency to be thrice weekly corresponding to 35.1% of total waste generated (Table 3).

In Jalingo Metropolis, door-to-door waste collection as in high-income areas is partially practiced, communal collection is also partly practiced and in this regard, households dispose waste in enclosures located along roadsides. At these points, considerable time is spent for waste collection since waste has to be raked and shovelled in to the truck. In low-income areas, where most settlements are not planned, the main collection system used is communal collection. Here handcarts (wheel barrows) are used to dispose the waste either at the primary collection points or at the municipal collection points. From these points the waste is finally hauled to the two dumpsites.

Table 3. Waste Collection and Disposal by Ministry of Environment and Urban Development

<table>
<thead>
<tr>
<th>Waste Collection Agent</th>
<th>Waste Collected (tons/day)</th>
<th>Percent of Total Waste Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agencies Involved: Ministry of Environment and Urban Development</td>
<td>35.10</td>
<td>65.00</td>
</tr>
<tr>
<td>Private Contractors</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Collection through Recycling (Scavengers)</td>
<td>2.70</td>
<td>5.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.80</td>
<td>70.00</td>
</tr>
</tbody>
</table>

Source: Field Experiment by Author, June 2011

3.3.2. Disposal System

In Nigeria, like most developing countries, wastes are commonly dumped in open dumps, uncontrolled landfills where a waste collection service is organized. Dumps are located along or beside major roads (Ogwueleka et al., 2009). In Jalingo, Taraba State, there are two (2) dumpsites which are 3 km away from the city along Wukari/Jalingo road (WK/JLB/pit) and Jalingo/Yola Road (YLAB/pit) with disposal starting in 1991 and at present, they are used up or filled.

Open dumping of waste cannot be considered as a long-term environmental method of disposal. The dangers of open dumping are many health hazards to scavengers at the dump sites, pollution of ground water, spread of infectious diseases, highly toxic smoke from continuously smouldering fires and foul odours from decomposing refuse. In addition, refuse spreads into the road, blocking traffic, culvert within the metropolis and the wastes are burnt open on the side of the road.

Waste can be disposed in several ways but sanitary landfill is the only land disposal option that enables control and effective mitigation of extreme emission and of surface
and groundwater contamination. Sanitary landfills require much greater initial investment and hence higher operating costs than controlled dumps.

Sanitary landfill is not practiced in Taraba State but open dumping is the most commonly practiced. There is no landfill regulation or standard that provides a basis for compliance and monitoring. Wastes in open dumps are set on fires in order to reduce the volume of the wastes.

The activities associated with the management of solid wastes from the points of generation to final disposal have been grouped into the functional elements as waste reduction, waste generation, re-use, storage, collection, transfer/transport, processing/recovering, recycling and disposal. By considering each fundamental element separately, it is possible to:

- Identify the fundamental elements and
- Develop, when possible, quantifiable relationships for the purpose of making engineering comparisons, analysis and evaluations.

### 3.4. Characteristic of Solid Waste

The quantity and characteristics of solid waste vary from place to place. Factors that influence the quantity and composition are the average income level, the sources, the population, social behaviours, climate, industrial production and the market for waste materials. Waste generation and economics level of the society have been related by studying the quantity of domestic solid waste generated from these three socio-economic strata; Low Income Strata (LIS), Middle Income Strata (MIS) and High Income Strata (HIS) and a positive correlation between the high income and waste generation was observed. The HIS people tend to through away more plastic, metallic and glass waste and also hazardous waste which accounts for 25.3% in Jalingo Metropolis Solid waste.

During the studies it was observed that, the composition of solid waste in Jalingo Metropolis has 30% organic component followed by 35% Rubber and leather materials and 2.8% clothes and rags. This reveals that municipal solid waste of Jalingo Metropolis has an appreciable amount of biodegradable materials. The percentage of non-biodegradable waste like metals and plastic is appreciably high, which is an indication of large consumption of packaged plastic leather/Rubber products. The typical composition of municipal solid waste of Jalingo Metropolis is given in Table 4.

### 3.5. Transport and Transfer

In recent years, the use of small transfer stations in different cities of developing countries in the world has become popular (Moghadam et al, 2008). At present, due to technological advancement, there are few transfer stations in Jalingo Metropolis. The main reason of using a transfer station is to reduce the rate of open dumping near households and commercial centres which are special structure of streets and old alleys. The type of the transfer station in Jalingo Metropolis is direct load. The waste that is collected by small vehicles (e.g. vans) is discharged into various categories of collection dumper trucks fitted with corresponding specialized devices for removing and dumping waste at the disposal sites.

<table>
<thead>
<tr>
<th>Components</th>
<th>Fraction in 1 kg</th>
<th>Approx. Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Components (Leaves, Crop Straws Vegetable waste etc.)</td>
<td>0.30</td>
<td>30</td>
</tr>
<tr>
<td>Metals (Cans, Scraps, Zinc etc.)</td>
<td>0.10</td>
<td>10</td>
</tr>
<tr>
<td>Rubber/Leather</td>
<td>0.35</td>
<td>35</td>
</tr>
<tr>
<td>Plastics</td>
<td>0.15</td>
<td>15</td>
</tr>
<tr>
<td>Clothes/Rags</td>
<td>0.028</td>
<td>2.8</td>
</tr>
<tr>
<td>Glass</td>
<td>0.003</td>
<td>0.3</td>
</tr>
<tr>
<td>Stones/Sands/Silts/Pebbles</td>
<td>0.019</td>
<td>1.9</td>
</tr>
<tr>
<td>Wooden Materials</td>
<td>0.05</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Source: Field Experiment by Author, June 2011

### 3.6. Environment Problems Resulting from Solid Wastes

Traditionally, the government was the sole provider of almost all basic services such as water supply, electricity, roads, and health’s services with solid waste management inclusive etc. The adoption of such a conventional approach led to inadequate infrastructure services delivery (Kyessi, 2009).

Despite several intervention measures put in place since the early 2000(s), such as partnership with private contractors, and civil societies organizations, yet several problems are experienced in solid waste management in Jalingo Metropolis that include:

- Inadequate service coverage (some people not given service)
- Lack of authority to make financial and administrative decision
- Lack of financial resources
- Lack of trained personnel

Available online at www.scientific-journals.co.uk
• Lack of vehicles and equipments/existing once frequently breaks down

• Lack of capability to maintain/repair vehicles/equipments

• Lack of legislation, to enforce measures and capability.

• Rapid urbanization outstripping service capacity

• Uncontrolled proliferation of squatter settlements

• Difficulty to locate and acquire landfill site

• Poor public cooperation

• Lack of qualified private contractors

• Control of contractual service being difficult

Unfortunately, at the site, scavengers collect valuable components of MSW informally. In addition, various animals such as dogs, goats, sheep and cows consume organic components of the waste. Such inadequate disposal methods and practices lead to problems that impair human and animals’ health (Figure 2 and 3). Environmental problems resulting from MSW include: No action to control inserts, rodents and other vectors, No consideration for leachate control, unfavourable odour at sites, air pollution due to burning of waste etc.

Finally accumulation of garbage on streets, on open spaces and on compounds forms another problem associated with MSWM. Despite of some interventions that were intended to improve solid waste management in many areas of the metropolis, there are still high rates of uncollected solid waste.

It is a common sight in Taraba today to see heaps/accumulation of festering waste dumps in our communities. All sides of residential apartments, the drains, the highways, corners of major or and minor streets, underdeveloped plots of land have all become waste dumps for many households. This makes waste to increase in a geometrical progression and collection and disposal at an arithmetical progression (Akinwale, 2005).

Figure 2. Picture of a Dumpsite at Nyamusalla within the Metropolis

Figure 3. Picture of a Dumpsite along Jalingo-Wukari Main Road

3.7. Solid Waste Reduction and Recovery

There are a few formal systems of material recovering in Taraba. However, there is a wide reuse of plastics, bottles, papers, cardboard, cans for domestic purposes. This practice is highly common among the poor in the city. The greatest problem is the lack of local or national markets for the recyclables (Yhdego, 1995).

The waste in developing countries contains so much moisture that combustion can only be enacted and maintained on the addition of fuel. This leads to a low calorific value and combustible components of solid waste in Nigeria, thereby making incineration uneconomical in conjunction with high cost of construction and maintenance (Ogwueleka et al, 2009). Hence, suggests that composting could be a very viable recovery alternative which is practically applicable in Jalingo Metropolis.

Most of the rural areas in Taraba State use food from households to feed animals where the waste are home composted and used to condition the soil. Composted material could be used as fertilizer. As it was recorded, composting programme is not well practice in Nigeria with Jalingo inclusive, but rather back yard composting was practiced. Composting is the decomposition of organic materials under controlled condition of temperature, humidity and pH under aerobic biological process. To encourage its practice, Non-Governmental Organization (NGOs) internationally based tried to sponsor small scale composting in Nigeria but the practice has not or less significant impact in Nigeria. Hence, windrow composting been least expensive and most appropriate for the socio-economic and clim-
atic conditions of developing countries with Jalingo inclusive is recommended for waste reduction and recovery (UNEP-IETC, 1996).

3.8. Solid Waste and Pollution Management Challenges

The challenges facing the waste management departments that include municipal waste and pollution management are universal. This observation as supported by facts like global population growth, funding, resource and land scarcity factors that directly influence the level of and the need for waste minimization as part of waste management. Those that have to be overcome to address the waste services backlogs include issues of:

- Political commitment
- Increasing quantities of waste
- Institutional issues
- Financing and charge for waste services
- Education and awareness
- Illegal dumping and littering
- Legislation and enforcement
- Waste minimization
- The role of the private sector in providing waste management services
- Data and information
- Ineffective collection systems and fleet management
- Scavenging at landfills
- Separation at source
- Lack of land for additional landfills
- New waste streams from new products and process
- These challenges also increase the need for improved environmental management and increased resource protection, at an integrated level. Collectively, this requires constant innovation in terms of waste management technology, waste minimization approaches and resource management to keep the costs directly or indirectly to society, to service providers and the impacts on the environment in balance with the need for sustainable development (Coetzee, 2006).

The challenges faced by the waste sector/department of the state can therefore be summarized as:

- Altering consumption patterns to reduce waste generation
- Changing behaviour to encourage waste separation at sources
- Integrating waste recycling systems into the existing and future waste management systems
- Breaking the link between economic development and environmental impacts of waste
- Finding alternative waste treatment technologies to reduce the need for disposal at landfills

The solid waste quantities generated have been increasing due to a rise in the population rate, especially during the last 15 years. It has increased from 28 tons/day in 1998 to 54 tons/day in 2011.

3.8.1. Inadequate Funds, Human Resources and Equipment

While allocating resources, including financial resources, solid waste management is assigned a low priority compared to other municipal activities resulting in inadequate funds. There are inadequate human resources mainly due to the absence of trained personnel. In addition, the equipments presently in use for collection system are old and insufficient.

Household hazardous waste, including paint, used batteries, and pesticides containers, are not collected separately. Plastic waste especially thin plastics used as packaging materials and PET bottles, have become a nuisance in waste management in almost all the part of the metropolis.

In most developing counties, regulations have been enacted or are in the process of being drafted. However, there is a need for stringent control and an enforcement mechanism for successful enactment (Shekdar & Tanaka, 2004). Jalingo also faces legal provisions regarding environmental issues, especially in solid waste management (Moghadam et al, 2008).

Solid waste management operational efficiency depends upon the active participation of both the municipal agency department and the citizens. Considering the social status of solid waste management in most developing countries to be low, hence, the need for strong apathy towards it, which can be seen from uncollected waste in many areas and the deterioration of aesthetic and environmental quail-
ies at uncontrolled disposal sites (Shekdar and Tanaka, 2004). Providentially, public participation in Taraba, especially related to municipal solid wastes, has improved due to NGO and media activities during the last 10 years.

4. Conclusion

The increase in solid waste generation in the metropolis is mainly due to the increased population and other commercial/industrial activities. The generation rate of 0.34 kg/cap/day recorded is almost the same as 0.39 kg/cap/day reported by Kaseva and Gupta (1996) and it is within the range of 0.4-0.6 kg/cap/day for developing countries as reported by Smith, 1997. The waste analysis of Jalingo Metropolis showed that a solid waste collection activity in city has improved tremendously in the last decade. This is as a result of government agencies and citizens involvement in solid waste collection in the metropolis. Lack of resources, infrastructure, suitable planning, leadership, and public awareness are the main challenges in MSW management.

Based on the finding of this study, the following recommendations can efficiently improve current problems of Jalingo Metropolis MSW:

- Construction of closed community depots or secondary collection centres for inaccessible areas
- Recycling and composting activities should be encouraged
- Establishment of appropriate policies, legal frameworks and financial management for municipal waste management
- Provision of landfills liners, leachate collection systems, roll-on/roll-off control systems, final covers, ground water monitoring systems and gas collection systems
- The sites should be properly fenced
- The site should be made in such a way that insects, rodents and other vectors could be controlled
- The site should be devoid of open burning and prohibit scavenging
- Awareness campaign should be enhanced in community by govt. and NGO
- Government should adopt the new method/option for waste collection and disposal such as Waste-to-Wealth or Trash-to-Treasure known as Integrated Solid Waste Management (ISWM)

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Reference


