

APPRAISAL OF MUNICIPAL SOLID WASTE MANAGEMENT (MSWM) IN JIMETA-YOLA ADAMAWA STATE OF NIGERIA: THE NEED FOR INNOVATIVE, PPP STRATEGIES

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Graphical abstract



Abstract

This study try to investigate rates of generation, of municipal solid waste (MSW) in different constituencies of Jimeta-Yola, and examine the strategies use for solid waste management in the metropolis., Over the recent times Jimeta-Yola has witness an influx of population due to the increased in urbanisation and this had led to increase in consumption of goods and services with consequence increased in rate of generation (MSW) of municipal solid waste .The research used quantitative research techniques to evaluate data on solid waste generation rates in Jimeta. The findings revealed that the waste generation rate varies according to the constituencies ranging. Between, 0.42- 0.78/capita/days cutting across low, medium and high density wards. The analysis of waste management profile in the study area shows, there is inadequate management of municipal solid waste in the metropolis. This paper implies evaluation of the generation rates of municipal solid wastes (MSW) as the basic tool in planning for improve management of solid waste in the Metropolis, with balancing the aim of privatizing of solid waste management, sustainability in service coverage and recycling the solid waste into energy generation.

Keywords: Solid waste management, environmental management, privatization, landfills.

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1.0 INTRODUCTION

Urbanization has increased in speed and scale in recent times, with more than half of the world population are living in urban areas and 64% of them are in developing countries [1]. Rapid urbanization evolution has resulted in a number of land uses and infrastructural challenges including municipal solid waste management (MSWM) National and municipal governments are often having insufficient capacity of capital to meet the growing demand of solid waste management. The solid waste

management is the single largest budget item for many cities [2].

In most of the developing nations the explanations for lack of capacity of governments to mediate the effect of population increases with economic growth and reduction of poverty incidence remain the major challenges of the urbanization in those countries. This study aimed at evaluating the municipal solid waste generation in Jimeta-Yola, with the view of planning for the sustainable municipal solid waste management in the metropolis. The rapid urban growth of the

metropolis goes with speedy socio-spatial change of the township, stretches high prevalence of slums among the high density areas, besides less attention is given to the municipal solid waste management (MSWM) and the maintenance of urban infrastructures. The transition in population growth and urbanization in developing nations is given urban managers and developers with issues that required urgent attention [3].

The objectives of this study are to provide sustainable service coverage of municipal waste management in Jimeta-Yola, through private-public participation and recycling of municipal solid waste. The failure of successive generations of imported western development strategies to deliver municipal solid waste management (MSWM) in cities of developing countries has motivated a deep questioning of performance of western concepts and Methodologies of the municipal solid waste management (MSWM) in the developing nations. (4) reviewed that most of the local authorities and States in developing countries spend 30% of their funds on refuse collection and disposal, however most of these establishments can only cover between 50-70 % of the municipal solid waste collection which do not even meet the environmental safe disposal approaches, because of lack of hygienic landfills in their areas. There is no single urban management theory which can openly offer wide ranging management concepts than the top-down management strategies did in urban management. Nevertheless, the private-public participation theory has provided prospect for more relevance and Private-public cantered urban management strategies, which seems to be more appropriate to municipal solid waste management (MSWM), Perspective for developing countries. The recycling of the municipal solid waste (MSW) in Jimeta-Yola provides raw materials for biogas energy generation in the area through incineration techniques.

1.1 Concept of Municipal Solid Waste Management Scheme in Developing Countries

Municipal solid waste management covers the functions of collection, transfer, resource recovery, recycling, and treatment of solid waste. "The most important target of recycling technique is to protect the health of the populace, promote environmental quality, develop sustainability and provide support to economic efficiency, Zurbrugg (5)". "Recycling also reduced the cost of waste disposal and save natural environment from degradation. For instance recycling of paper saves green trees and water, recycling also prevents the emission of greenhouse gasses and water pollution to the physical environment. (6) Observed that open waste dumping is the common method of waste disposal in developing countries. This has led to location of many dump sites arbitrarily even on the high way and they are causing pollution to the environment.

One of the encounters of establishments of waste management in developing countries is the insufficient

recycling of the solid waste matter in to valuable products. Recycling technique is been adopted in urban management as response to the municipal solid waste management. This is been implemented within the sphere of available technology. That is why recycling technique of solid waste management is more corporate in industrialized countries than in the developing countries. [7] suggested: a way to regulates household waste by enforcing regulation , over manufacturing industries to produce bio -gradable utensils for daily household's needs which can be recovered for other uses.

while [4], argued that "Some solid waste are considered recyclable and those category may stay a number of years at refused dump without decomposing, and these include , plastics, metals, aluminum, cans, broken computers, and car parts, these group of solid waste are potential causes of public ailments and they are nuisance to the environment. They often formed the highest composition of municipal solid waste (MSW) in developing countries. (8) observed that: recycling of solid waste matter, required routine sorting of the solid waste into common composition to separate the waste into different categories: such as aluminum, metals or cans, from the level of domestic households or offices of an institutions. These can be recycled with the waste recovery industry in order to catch up with high demand of those objects in the society.

1.2 Service and Coverage for Waste Collection

Housley [9] argue that: Solid waste are refuse or garbage consist of product packaging, grass clippings, furniture, textiles, plastics, bottles, food scraps, newspapers, others are waste like batteries, and paints , medical and industrial waste. A study by (10) reviewed that, a metropolitan solid waste management board minimizes, the municipal waste accumulation through introduction of reused, recovery, recycling techniques, and plans accomplishment for appropriate final disposal of solid waste management under its own regional boundary.

(11) Observed that: analysis of municipal solid waste generation rates and composition are veritable tools required in order to design appropriate solid waste management resolutions for the metropolitan waste management board. (12) Reviewed that: the waste management boards needs to be financially sustainable in order to maintain the regular management of solid waste disposal within its own territory.(13)reviewed :that low communities' participation in the delivery of urban municipal waste management in developing countries, which is contributing to the low culture of urban environmental management in those countries.

(14) Argued that: The new approach of solid waste management is by contracting out waste collection and disposal services to private companies, this method has been established more reliable because of higher operating efficiency, it is free from administrative huddle, and good conditions of vehicles and

equipment's, were used and thus result in to higher efficiency and profitability of services. On his own part, (15) suggested that: the private sector participation in solid waste management is to enhance efficiency and lower the service cost by extending maximum coverage of waste management and rallying the private investment in to the urban management. The investment can cover collaborations with fertilizer blending factories to deliver raw materials used in the productions of fertilizers. On his own view, (16) articulated that privatization of solid waste management in urban areas provide employment opportunities for the un- employed youth, and creation of income generation, through waste collection, disposal, and recycling of solid waste , this is a means of backing to poverty reduction and provide strategies of urban waste management.

On the other hand (17), reviewed that. composting technique involve the process of decomposition of solid waste in the log pile of waste on the ground This involve a mechanical system which is converted biologically to humus to produce chemical substances of nitrogen, potassium and phosphorus content of one to three percent curative blending with bagging and marketing.(18) explain that Composting technique, could be used for soil conditioning and compost production ,it also help to return nutrients to the soil and thus letting the reduction of high demand of artificial fertilizers by the teaming rural farmers in developing nations and (19) argue that, organic waste substances are been decomposed to manufacture fertilizers .These chemical components support nutrients to arable crops and provide livelihood of rural dwellers besides it's enhance the local economy of the society On his own contribution (20) Analysis the service cost for municipal solid waste management (MSWM) in different categories of cities across the world.

As categorized from table 1, below, (19), analyzed that: the high income countries like U.S.A are generating an average of 0.17 per capita and spend USD75 per head in a day for the cost of services of solid waste management across their own cities. While, the upper-middle category such as Brazil, are generating an average of 0.59 per capita and they spend USD 33 per head for cost of the service .Countries in the lower middle category which are including India is generating an average of 0.69 per capita and they spend USD10 per head for the labor cost. Lastly the low income Countries such as Bangladesh, Egypt and Nigeria generate an average of 0.32 per capita while they spend USD1.4 only for the cost of solid waste management.

Table 1 Service Costs for Municipal Solid Waste Management (MSWM) in different Categories of Cities in the World (David eta l, 2014)

Income Level (Kg/Year)	City SW Budget Per Capita	Maximum City SW As Per GNI/Capita	
		Range	Average
High	USD75	0.03-0.40	0.17
Upper –Middle	USD33	0.14-1.19	0.59
Lower-Middle	USD10	0.40-1.22	0.69
Low	USD1.4	0.14-0.52	0.32

1.3 Limited Utilization of Recycled Activities

(7) reflected that: the problem of urban waste management is becoming a global matter, as urban population is increasing, affluence and consumption rates is also increasing, while the health and environmental challenges related to refuse disposal are escalating in developing nations., (15) suggested that: private sector participation in municipal solid waste management (MSWM will improve service delivery of municipal solid waste management through the options of privatization, contracting, and public - private participation of the metropolitan solid waste management, and Johari et al.

(21) Suggested that: the municipal solid waste (MSW) can be used to create a drive, for generating and distribution of electricity, in the developing countries'. The combination of physical and chemical components of the solid waste substances offers the fuel produced from the composition of municipal solid waste (MSW) and would be used to generate energy for electrification in the metropolis.

The combine aggregate of chemical components of solid waste required for energy generation are: carbon, hydrogen and oxygen. The category of the municipal solid waste required for energy generation would be analyze, in order to determine the oily value of the solid waste composition been used. (22) Reviewed that: The combination of the demand in municipal solid waste market, resources inadequacy and the availability of modern technology are opening opportunities for turning municipal waste in to new products.

1.4 Poor Controlling of Landfills Disposal End

A study by, (23) argued that: the most common technique for municipal waste management in Nigeria is landfill disposal techniques it is considered the cheapest and most readily available means of waste disposal in developing countries. However the consequences of landfills waste disposal is enormous to the people and the environs. This is due to 25% of methane gasses is being emitted from landfills areas and they cause pollution to the ground water which is a potential source of water for domestic services in communities. Most of the metropolitan solid waste

(MSW) in developing nations is discarded on landfills in uncontrolled manner. The management makes very un- efficient use of the obtainable space at dumps sites.

They allow free access to waste pickers, animal and flies and these often result to unpleasant odor, while harmful smoke from slow burning waste dump site is aggravating the air pollution. The increase of population growth in metropolis of developing countries has resulted in to generation of high heaps of municipal solid waste which are sometimes indiscriminately dumped at a solder of Major streets . (24) On his own contribution reviewed that: most accidents cases recorded in cities of the developing countries arise from traffic logjam caused by stray animals and irregular location of waste dump sites by

the high way and these has often caused loss of lives and properties on the high ways. (21) explained that: Municipal solid waste management in Malaysia, are mainly through land filling disposal method which accounted about 80-90% of the total waste generations in the country, but alternatives techniques such as combustion and gasification methods is necessary due to the steady increase in volume of waste generation in the country.

(25) reviewed that: the urban poor in developing countries is the one mostly suffering from pollution of uncontrolled refused dumps as dumping sites are often located in high densities residential areas. The municipal authorities are poorly funded and as such they are concentrating of waste disposal in low density residential areas occupied by the elites. Although the environmental problems is minimized at the medium and low density residential areas, however the city wide environmental problems remain a general problem to all class of citizens as the refuse dumps are also occupying major high ways connecting in to the metropolis.

(26) Reviewed that haphazard dumping and illegal landfills caused negative impact to the public health and the environment. He further argued that: the dry cells are made up of chemicals such as cadmium, lead, and mercury as electrodes and were been disposed after single used at an open field rubbish dump site, which increased the heavy metal concentration of the soil and sometime contaminating the ground and surface water, often been the source of public drinking water, and this has caused dangerous illness to those drinking from the contaminated water sources.

1.5 Inadequate Management of Health Care Waste from Hospital and Hazardous Waste

Health care waste is generated as a result of activities applicable to medical care and sales of pharmaceuticals packages, and industrial waste.(27) noted that; waste generated from industries including solid, liquid, muck or poignant gas produced some toxic, hazardous, and special elements .The industrial waste consist of the following matter, metals, scraps, chips and grits from engine, paper pieces and glass which are made up of chemicals that are dangerous to health if deposited in to the indiscriminate refused dump site.

(28) Observed that organic waste matter when not properly managed can be vulnerable to pre-school children; waste workers and residence living close to the waste dump site. This may expose them to illness such as chronic heart infections and contagions relating to growth of microbial pathogens. A study by, (29) observed that the open dump of medical solid waste are associated with breeding of microorganism, which is responsible for thriving of vectors in the communities and could Transmit Communicable diseases to occupants of the immediate environment.

A study by (14) observed that: the indiscriminate dump of medical waste is responsible for the

environmental and health problems caused by land pollution which is being transmitted through air, water and soil medium in to the human beings. (26) ,argued :That burning of trash and health care solid waste, in urban environment caused serious environmental pollution as result of emission of gaseous wastes and the pollutants were often been released including carbon dioxide , nitrogen oxide , methane and smoke which could trigger hazard to public's health.

The release of toxic gasses is responsible for spread of health problems such as pulmonary and, nervous illness, such as asthma, allergic and carcinogenic disease (30) observed that: electronic waste continues to be a major source of new and composite harmful garbage to the environment and human health in urban areas across the globe. The potential infection from electronic waste, are including cancer, birth defect, low birth weight, and consequent increase in mortality rates among children living around the landfills sites in urban areas.

2.0 STUDY AREA

This study area covers Jimeta the headquarters of Yola-north local government area of Adamawa state: Nigeria, Adamawa State. Jimeta was founded in 1912, by colonial masters as a model town of greater Yola .The commercial center, port town and an administrative center of Yola and the twin city forming the State capital of Adamawa State. It twin sister is Yola town the traditional seat of Adamawa emirate council (31). Jimeta, lies on latitude 9N° of the equator and on longitude 12 28° E of the Greenwich meridian consisting of 11 administrative wards in the Yola -north local governments' area. Namely: Ajiya, Alkalawa, Doubeli Gwadabawa, Jambutu, Karewa, Limawa, Luggere, Nassarawo, Rumde and Yelwa ward.

It is characterized by high population growth of 3.6% and rapid sprawl of about 7% Based on 2006 the] population census, [32], the projected population of the metropolis is 247,892 people [33]. Incidentally the zones with of low dense population are abundant solid waste generated areas considering the high earnings status of the residents of these zones. While organic solid waste generations' rises across the high densities zones, in the metropolis, considering the favorite consumption of un-processed food among low income earners, Residential structures deteriorated in some high densities sectors couple with stocky distribution of drainages system and irregular hygienic conditions.

There is a visible mixed residential density in the metropolis in most of the wards. Dougirei, Old GRA and 80- unit residential areas are of low densities, while the medium density areas include, Bekaji, Demsawo and old GRA quarters. The entire Luggere, Jambutu, Nassarawo, Rumde, and Limawa wards are high density residential areas. There is a visible mixed socio-economic position among populaces of the residential areas, although the high, medium and low income

earners dwells in separate wards others with mixed levels of earnings, could be found in most wards.

The mean annual rainfall of the study area is between 700- 900 mm at present, while the mean annual temperatures is 26 c° and relatively humidity is below 70%, and the vegetation cover is grassland, while the topography is on the low lands of the Benue valley. The human activities include trading, manufacturing, attesting and fishing and these reflected on the categories of waste produced in the municipality.

3.0 MATERIALS AND METHODOLOGY

Materials used for measurement of waste in order to determine the quantity of waste being generated are the weighing balance of capacity of 129 kg and an aluminum container with empty weight of 2.5kg, and volume of 50 l for collecting and weighing the solid waste. Other tools were a shovel, a fork, hand gloves, and gumboots.

By using the weight balance the amount of waste generated per household per day were determine at different sources from different residential densities, and other land uses this experiments were also conducted simultaneously at the designated sampled of commercial, and institutional establishments, others are markets, recreational and industrial areas, across the (11) wards in Jimeta-Yola. Where questionnaires were also been administered to the respondents in the households and all the other land uses.

The norms that were considered for selecting the sampling areas were income levels location, residential densities and other several land uses. In order to find a realistic estimate, the quantity of solid waste produced by a particular household or land use, this experiment was repeated simultaneously, for 3 different days. That was, Sundays, Wednesdays and Fridays. The quantum of solid waste generated is being weighted at each day per the selected households and other land uses and the means of waste generation rates was also determined. The questionnaires were administered to sample household head of the study area.

3.1 Sampling and Data Collection

The study also used the questionnaires to obtain data from both primary and secondary sources. This is to study the back ground of the households, community participation, account of manpower and equipment used for managing domestic solid waste, composition and the concepts of the households and other land uses used in solid waste management in the metropolis, the state of solid waste at dumping sites, in Jimeta metropolis. Data on population distribution, number of households, composition of solid waste, profile of

personnel and equipment for solid waste management, and distribution of designated solid waste dumping sites in Jimeta were obtained from secondary sources such as Adamawa State Ministry of environment, Yola-north local government council, and National population commission. The data on generation rates and quantity of domestic solid waste, as well as public participation on municipal waste management were obtained from primary sources.

3.2 Primary Data

The primary data was acquired through land uses and household study. Total of (500) households and (200) other land uses were designed for this study. A direct random sampling was used where solid waste generation rates were investigated in land use categories such as residential, institutional, commercial markets, industrials, and recreational. Aggregates of 45 houses and 40 each of the other land uses were experimented proportionately in the (11) administrative wards in Yola-north local government area of Adamawa State Nigeria, being the study area.

Interviews were held with head of households and Staff of Ministry of Environment of Adamawa State in Yola. A total of 500 households (200) of the other land uses were sampled and analyzed, this is supplemented by questionnaire administrations, and stakeholder analysis. All the respondents appreciated with the rapid sprawl of Jimeta and were grieved with low culture of municipal solid waste management in the metropolis.

3.3 Secondary Data

The secondary data has been sourced: from Adamawa State Ministry of Environment, Adamawa State Urban and Regional Planning and Development Authority, National Population Commission, Yola-north Local government and existing literatures. The data includes population and household distribution in Jimeta, Solid Waste management profile of Adamawa State Ministry of Environment, and Yola-north Local Government, and the street guide map of Jimeta- Yola, showing refuse dump distribution sites.as well as the service cost of municipal solid wastes managements (MSWM) of various cities across the world.

As shown in Table 2, only 24% of the respondents attended primary school education, while 30% had secondary school certificate, and 26% attended tertiary institution. However, only 20% of the respondent attended adult education.

Table 2 Educational background (field work in 2014)

Status	No. of Respondents	Percentage of Respondents (%)
Adult education	100	20
Primary education	120	24
Secondary education	150	30
Tertiary education	130	26

representing 60% have not participated in the environmental sanitation in Jimeta-Yola.

Table 3 Participation in Environmental Sanitation (Field work in 2014)

Participation in Solid Waste management	Frequency of Respondents	Percentage (%)
Yes	200	40
No	300	60
Total	500	100

As shown in Table 4, 52 respondents representing 17.3% did not participate because of their engagement at the essential public services such as nursing and midwifery, medical Doctors, and security services, Whereas 138 respondents representing 46%, did not participate in the monthly environmental sanitation because of their personal reasons and they remained indoors until the sanitation was over representing 37% of the survey. While 110 respondents representing 36.3% indicated that they have not participated in the monthly environmental sanitation in Jimeta-Yola because they travelled in sanitation days.

Table 4 Reasons for not participating in monthly sanitation (Field work in 2014)

Reasons for not participating	Frequency of Respondents	Percentage (%)
Busy at my duty post providing very essential Public services.	52	17.3
Hiding inside home until when sanitation exercise is over.	138	46
Travel in sanitation days	110	36.7
Total	300	100

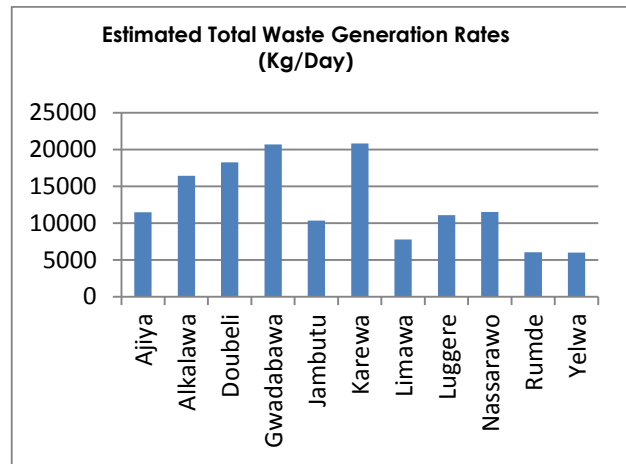


Figure 1 Estimated Municipal waste generation rates Per day in various administrative wards in jimeta

Table 5 shows, the analysis of waste generation indicated relationship between socio economic level of households in wards and per capita solid waste generation of these zones in Jimeta, the data revealed that Gwadabawa ward being the residential areas for administrative and corporate class recorded the highest waste generation rate of 0.78kg/cap/day, this was trailed by Karewa and Ajiya wards which are medium densities constituencies, with generation rates of 0.75, and 0.64 kg/cap./day respectively. The generation rates at Luggere, Nassarawo and Alkalawa wards were 0.56, 0.58 and 0.57kg/per capita respectively. Other set is the typical high density residential areas including, Doubeli, Limawa Jambutu, and Yelwa wards, and they are homes of low wages earners with waste generation rates of 0.43 and 0.47 kg/capita per head separately. The least category is Rumde ward, being occupied by commoners with the analysis rates of 0.42 kg/capita/day

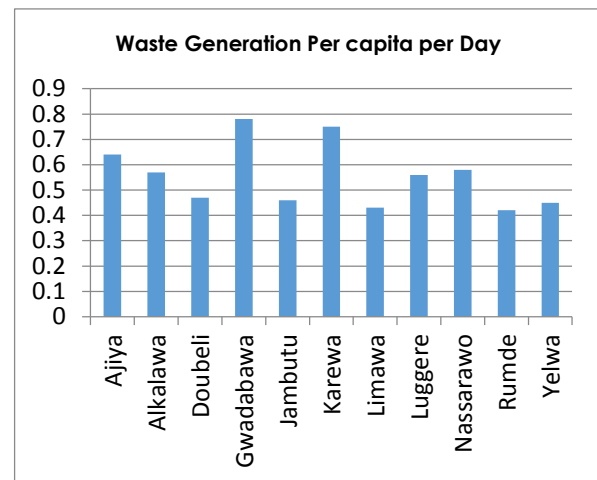


Figure 2 Waste generation per capita/day in different Administrative wards in Jimeta-Yola

Table 5 Population and household waste generation rate data for Jimeta

S/No	Name of Ward	Base Population NPC (2006)	Projected Population (2014)	Number of Household (2014)	Waste Generation per capita per head/kg/day	Estimated Total Waste Generation Rates (Kg/Day)
1	Ajiya	14,359	17,949	3,590	0.64	11487.36
2	Alkalawa	23,043	28,804	5,761	0.57	16418.28
3	Doubeli	31,077	38,846	7,769	0.47	18257.62
4	Gwadabawa	21,209	26,511	5,302	0.78	20678.58
5	Jambutu	17,981	22,476	4,495	0.46	10338.96
6	Karewa	22,227	27,784	5,557	0.75	20838
7	Limawa	14,426	18,116	3,623	0.43	7789.88
8	Luggere	15,854	19,817	3,963	0.56	11097.52
9	Nassarawo	15,891	19,864	3,973	0.58	11521.12
				2,873	0.42	6033.72
				2,672	0.45	6011.55
10	Rumde	11,493	14,366			
		10,687	13,359			
11	Yelwa					
Total		198,314	247,892	49,579		130484.59

Table 6 classified that: the house hold waste generation in Jimeta- Yola is 1301, tons/day representing 58.7% of total waste generation in the metropolis, while commercial waste originated from shops ,and streets constitute of 75 tones representing 3.4%. Others are institutional solid waste originated from educational intuitions, secretariats and offices, which are mainly papers nylons, and, packages, constituted of 160 tone representing 7.2% of the survey. Waste that are ignited from markets are made up of organic solid waste, from nylon, cellphone and provision packages, they constitute of 345 tons produced each day representing 100% of the survey, representing 15.6 % of the study. While the last category consisting of recreation and industrial waste made of cans, plastics, metals, and nylons and they constitute of 335 tons representing 15.1 % of the analysis, and in the whole 2216 tons of solid waste were produced each day representing 100% of the survey.

Table 6 Distribution of municipal solid waste generation data in Different Land uses of Jimeta-Yola (Field work in 2014)

Waste source	Total waste Generated {Ton/day}	Percentage (%)
Household	1301	58.7
Commercial	75	3.4
Institutions	160	7.2
Markets		15.6
Others including	345	
Recreational and industrial waste	335	15.1
Total	2216	100

Table 7 displays that, 2 of the staff working in Yola-north L.G., waste management unit has obtained only first school leaving certificate, While 6 of them had secondary school certificate, and 4 of the personnel obtained diploma and none of the staff had degree. However on possession of equipment, the study discovered that although the unit had 4 refuse collection vehicles only 1 one of them is functional and there was only 1 loader machine under the local government.

Table 7 An account of manpower and equipment use in solid waste management in Jimeta (Yola-North L.G.).

Characteristics	Number
Staff with first leaving school certificate	02
Staff with (SSCE) Senior school certificate	6
Staff with (HND) higher national diploma	4
Operational Vehicles (functional)	1
Operational Vehicles (non- functional)	3
Front loader machines	1
Total number of personnel	10
Waste collection schedule	No specific routine

Table 8 indicated 3 staff of Adamawa State Ministry of environment in Jimeta waste manage unit, had only first leaving school certificate. While 11, had secondary school certificate and 5 had training certificate. In addition to 23 staff had obtained diploma and 14 of the staff has ordinary national diploma or national certificate of education, While 4 staff has each of the higher national diploma and degree respectively While only 41 personnel working

in the waste management and pollution control department. The analysis of equipment revealed that although the department had 6 refuse collection vehicles only 1 is functional and there is only 1 loader machine for loading of garbage in the whole metropolis. Finally there were 100 units of waste collection containers designated in the strategic midpoints in the metropolis, but there was no specific routine for waste collection and disposal in Jimeta

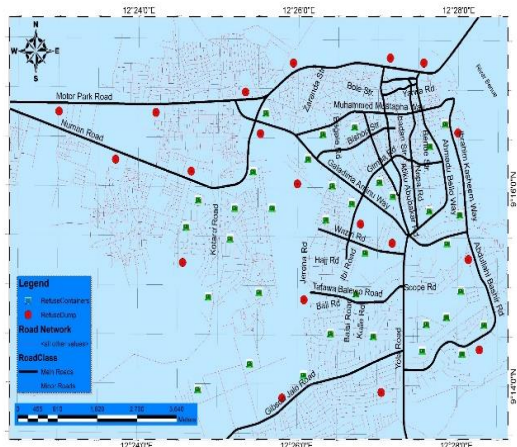


Figure 3 Map of Jimeta-Yola showing refuse dump sites

Table 8 Manpower and equipment use in SWM, Ministry of Environment, Yola (SWM and pollution control department 2015)

Characteristics In Jimeta Division	Number In Jimeta Division
Staff And Their Own Qualification	
Staff with first leaving school certificate	3
Staff with ordinary level certificate (SSCE)	11
Staff with Trainee Certificate	5
Staff with Diploma / National certificate of Education	14
Staff with (HND) higher national diploma	04
Staff with Degree	04
Total number of personnel	41
EQUIPMENT AND SCHEDULE OF ACTIVITIES	
Waste collection and disposal Vehicles (functional)	1
Waste collection and disposal Vehicles (non- functional)	5
Front loader machines	1
448m ³ Waste collection containers	100
Waste collection schedule	No specific Routine

Table 9 Distribution of municipal solid waste disposal spots in Jimeta- Yola (Field work in 2014)

Characteristics	Number	capacity
Waste collection containers	100	448m ³
Disposal at simple controlled site	20	un define
Disposal at illegal dump site/ drainages	30	un define
State of art Landfill site	00	----
Total capacity of 100 waste containers per day	448 x100	44800 tone

Table 9 shows the distribution of solid waste gathering system in Jimeta-Yola. The survey indicated that there are 100 stands by containers with capacity of 448m³ are designated at strategic points in the metropolis for collection of solid waste by residents in their neighborhoods. 20 controlled disposal sites are also spreading in the metropolis. While there are 30 illegal identified dump sites and dumping at some open drainages in the metropolitan area but there was no (0) land fill disposal system in the metropolis.

4.0 DISCUSSION OF FINDINGS

The data and findings of this study is presented using descriptive and spatial analysis. The study revealed only 40% of the sample participated in the monthly environmental sanitation exercise. The outcomes, shows, the solid waste generation rates of Gwadabawa a Low density, ward was 0.78kg/capita, while Ajiya and Karewa the medium density residential areas recorded waste generation rates of 0.64 and 0.75 kg/capita respectively. Whereas the high density constituencies such as Alkalawa, Limawa, Luggere, Nassarawo, Jambutu Rumde and Yelwa wards, fall within generation rates between 0.43- 0.58 kg/capita.

Therefore Gwadabawa a low density wards generates the highest volume of waste of 20678.58 kg and was trailed by Karewa, a medium density with daily generation rates of 2083 kg. The amount of municipal waste generation rates is inversely proportional to population density of the Neighborhoods, Yelwa and Rumde; the high densities wards recorded the least daily generation rates of 6011.55 and 6033.72 kg respectively. The result indicated relationship between socio economic level of households, and per capita solid waste generation rates of these zones in Jimeta, the data indicated that Gwadabawa ward being the residential areas for administrative and corporate class recorded the highest per capita solid waste generation rate of 0.78kg/capita, and is trailed by Karewa and Ajiya wards which are medium densities constituencies, with records of waste generation rates of 0.75 and 0.64 kg per capita respectively.

The solid waste generation at Luggere, Nassarawo and Alkalawa wards are of 0.56, 0.58 kg and 0.57kg per capita respectively. Other set is the high densities

residential areas including, Doubeli, Limawa, Jambutu, and Yelwa wards, and they are homes of low income earners recorded the solid waste generation between 0.43 to 0.47 kg per capita separately. The least category is Rumde ward a squatter settlement. It is occupied by very low income earners with the analysis of generation rates 0.42 kg per capita. The overall household waste generation of Jimeta was 1301tons representing 58.7% while a commercial waste generation rate was 75 tons accounting 3.4%.

Others were institutions which generate 160 tons daily representing 7.2% ,while markets produce 345 tons representing 15.6% .and finally industrials , recreational and other land uses generates 335 tons accounting 15.1% and the entire metropolis produces 2216 tons of municipal solid waste daily representing 100%. On account of manpower power, equipment and operation both Yola- north local government and the State ministry of environment is thriving under inadequate and low skilled manpower, inadequate Equipment and non-regular operation of waste collection and evacuation, hence the needs for privatization of municipal solid waste management (MSWM) in the metropolis for better service delivery and recycling of solid waste.

5.0 CONCLUSION

One of the causes of Wide spread of environmental problem in developing countries is the increase in generation rates of municipal solid waste, and over the years the quantity of the waste has increase to the level that it is not adequately dispose This is couple with low public-private participation in waste management schemes. Jimeta-Yola produces about 2216 tones daily which can be converted to biogas for energy generation and could improve the viability of the municipal solid waste management (MSWM) through public- private participation (34) Observed that: the incineration is the common techniques of integrated waste management which reduces the mass and volume of municipal solid waste by 70% and 90% respectively ,as well as it's provide recovery of energy from waste which would be converted to generate electricity. The most important process of the energy recovery from municipal solid waste (MSW) is reduction in the quantum of waste by 60-90% and the demand of land for waste disposal as well as cost of for transporting of the solid waste to the landfills areas. The technique has been tested of having less effect of environmental pollution.

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