

Comparative Analysis of Municipal Solid Waste Generation Rates and Composition in Jimeta -Yola Adamawa State of Nigeria

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Abstract

This paper attempt to investigate rates of generation, and composition of municipal solid waste (MSW) in different constituencies of Jimeta-Yola, and examine the strategies use for solid waste management in the metropolis. Jimeta-Yola, over the recent times has witness an influx of population in the metropolis due to the increased in urbanisation and this has led to increase in consumption of goods and services with consequence increased in rate of generation (MSW) of municipal solid waste .The research used both qualitative and quantitative research techniques to evaluate data on solid waste in Jimeta. The findings revealed that the waste generation rates varies according to the constituencies. These generation rates were 0.78, 0.75 and 0.58 kg/capital/day for Gwadabawa, Karewa, and Nassarawo wards respectively. Other were 0.43, and

0.42kg/capita/day for Limawa and Runde wards. The result of composition analysis shows, organic waste as the largest category with 54-68%. While paper and nylon were between 5.0-15% and 10-13.5% respectively. There was inadequate management of municipal solid waste. This paper implies evaluation of the characteristics 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 sustaining environmental hygienic, composting and recycling the solid waste.

Key words: Waste Management, Environment, Household, Municipal

1.0 INTRODUCTION:

Human activities produces waste, and it is the way these wastes are handle stored, composed and dispose which can posture hazard to the environment and public health. In urban areas especially in developing countries problem of municipal solid waste management (MSWM) are of serious tasks facing urban development. Oluranti and Omosalewa (2014) reviewed that urban areas in developing countries are growing at the very speedy rate compared to the cities in developed countries and such rapid increase of population growth has implication on provision of urban infrastructures and municipal waste management is among the basic social services required in municipal communities. This over the years has drawn the attention of the governments at all level as well as the private sector (NGO's) non-governmental organisations and urban development managers. Zurbrugg and Eawang, (2003) Identified the rapid population increase in the third world countries as a predicament to urban sustainability. It has renders some increase in

generation rates and volume of solid waste in urban areas above the capacity of municipal waste management authorities. Mostly only one to two third of the solid waste generated in urban areas of developing countries are being collected., while the remaining garbage would be abandoned for so many weeks polluting the environs before being disposed. Abila and Kantola, (2013) argued that: the most common technique for municipal waste management in Nigeria is land fill disposal techniques. He further observed that, it is considered as the cheapest and most readily existing means of waste disposal in developing countries. However he reviewed, the disadvantage of this technique is the resulting environmental consequences of the landfills waste disposal to the people residing around the waste dump environs. This is because about 25% of methane gasses is being emitted from landfills procedure, which also pollute the ground water and it is a potential source of water use for domestic services.

1.1: Concepts of municipal Solid Waste Management in Developing Countries

Housley (2014): Describe Solid waste as refuse or garbage consisting of product packaging, grass clippings, furniture, textiles, plastics, bottles, food scraps, newspapers, others are some used batteries, and paints, medical and industrial waste. He studied that the best way of achieving solid waste management is to have an existing environmental sustainability plan dealing with solid waste administration policy, for each community, while obtaining a reviewed data of waste generation rates is considered as the backbone of the strategy plan. In developing countries the use of open dump sites are common phenomenon in generating solid waste in urban areas. Naveen et al (2012) Observed that Open waste dumping is the common method of waste disposal in developing countries. It is sometimes common to see the refuse dump sites indiscriminately covering a soulder of a high way and obstructing traffics, besides causing pollution to the environs. Bernardes, et al (2014) on his own study has reviewed that for the effective implementation of solid waste management system, some municipal authorities establish a metropolitan solid waste management board as an organisation, to deal with operation of solid waste management. The board objectives is to reduce the rate of environmental degradation caused by municipal waste matter, through innovation of process of, reuse, recovery, recycling and be able to plan accomplishment for an appropriate final disposal of solid waste mechanism under its own regional boundary. In order to regulate the socio economic feasibility of waste management plan of particular metropolis. Studies concerning the analysis of quantity and composition of solid waste of urban areas, are significant particularly, due to solid waste composition and characteristics are varying for both in time and space and therefore these data could be essential in order to design appropriate solid waste management resolutions in the particular urban area. Babatunde et al (2013) reviewed that the unsystematic and in proper dumping of municipal solid waste in developing countries is compounded due to speedy increase in population, poverty level and the decrease in standard of living of urban dwellers due to poor governance, and low level of environmental awareness. Therefore refuse

matter is dumped illegally at any available open space, including open drainages, streets and public places. The poor state of waste management in urban areas of developing countries is nowadays not only an environmental problem but also a social handicap and a cause of transmission of ailments among low income earners in the urban areas. Previous studies revealed that, quantity and generation rates of municipal solid waste has increase over the years across urban centres, without corresponding adaptation of modern technology for managing these waste. This is due to poor funding of the institutions dealing with the waste managements, low technology know how of the personnel steering the institutions concern with the waste management in those countries. Babayemi and Dauda (2009). Argued that the urban stake holders in developing nations are giving less consideration to the proper practise of ethics required for waste collection and disposal in urban areas. Similarly the institutions in-charge of solid waste management are characterised by poor equipment's, low funding's and most alarming, these establishments are being cope by un-trained manpower. The composition of these, un-collected solid waste are occasionally mixed with human and animals excreta and is dumped indiscriminately on the streets and sometimes is wash-down into drainage by rain water. This problem has consequently causes blockage of drainages and breeding of vectors such as flies, mosquitoes which are spreading diseases in to publics. Other effects of the indiscriminate dumping of solid waste to drainages are the cause of flooding in the urban areas. The rate of waste generation is on the increase in third world nations as a result of transformation in urbanisation, industrialisation and improved in income of urban dwellers. Which influence their own purchasing power of commodities and this generate rise in waste stream of urban centres. (Samsudin and Mat Don., 2013). Abila and Kantola (2013): reviewed that: In Nigeria, there are about 25 million tonnes of municipal solid waste been generated annually in urban areas, and the rate of waste generation is ranged from 0.66kg/cap/day in urban areas compared to 0.44kg/cap/day in rural areas. Contrasting with the rate of waste generation per capita in developed nations. Which is ranging from, 0.7- 1.8 kg/cap/day.

1.2: Challenges of solid waste management schemes in developing countries

The quantity of municipal solid waste (MSW) generated from various land uses are including, residential commercial, educational, industrial agricultural land uses, and institutional areas, remain mostly un-disposed in urban areas of developing countries, The quantum and the rate of waste generation vary from towns to cities and as well as from urban to rural areas, and likewise also there is difference in waste generation rates from one neighbourhood to another, depending on the population and income distribution, as well urbanisation, and industrialisation of these zones. The rates of solid waste generation is directly proportional to rate of change of these variable from time to season. The factors responsible for the solid waste generation has also fluctuated in these areas. On his own part, Ali e'atal (2014) reviewed that: In developing countries, variables such as population, urbanisation and industrialisation increase, in higher rates and they are responsible to the rise in volume and generation rates of municipal solid waste with consequences of environmental deterioration in the urban centres. Butu and Mshelia (2014) noted the pollution is been cause by: poor management of industrial waste in urban areas, they release contaminations from industrial layout to residential communities, and these affluences were being release in all form such as solid, liquid, muck or poignant gas .The companies during the manufacturing process frequently releases toxic, hazardous, and special waste matter, that can be dangerous to people health .The industrial waste consist of the following substances, which include metals, scraps, chips and grits from engine, while paper pieces and glass may be the products of chemicals that are hazardous to health, especially when been deposited indiscriminately at refused dump. This study has been conducted in order to review and analyse the composite and rate for solid waste generation in Jimeta- Yola of Adamawa State: Nigeria. The study has identified four major challenges facing the municipal solid waste management authorities (MSWMA) in developing countries. They include the following:(a) inadequate service coverage, and operational in- efficiencies of this service, (b) Limited utilization of recycling activities, (c) insufficient landfill disposal end ,(d) poor management of hazardous and health care waste

2.0: STUDY AREA

The study area covers Jimeta metropolis the headquarters of Yola-north local government area of Adamawa state: Nigeria, Jimeta was founded in 1912, by colonial masters as a model town of greater Yola .The commercial centre, port town and an administrative centre of Yola. It is the twin city forming the State capital of Adamawa State. Her twin sister is Yola town the traditional seat of Adamawa emirate council. (Mohammed, 1999). It 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 government area. Namely: Ajiya, Alkalawa, Doubeli Gwadabawa, Jambutu, Karewa, Limawa, Luggere, Nassarawo, Runde and Yelwa ward. It is characterized by high population progression of 3.6% and rapid urbanization of about 7%. (Census, 2006). Based on the 2006 population records, and the projected population of the metropolis is 247,892 people (population, estimates, 2014). Incidentally the zones with of low dense population are those with abundant solid waste generation rates, couple with the high income earning of the residents of these zones. While organic solid waste generations' rates increases across the high densities areas. Considering the favourite consumption of un-processed food among the low income earners, Residential structures deteriorated in some high densities subdivisions, connect with stumpy distribution of drainages system and irregular sanitary conditions of these environments. There is a visible mixed residential densities in most parts of the metropolis. Dougirei neighbourhood. Old GRA, and 80- unit residential areas are low densities residential areas. .The medium densities include, Bekaji, Demsawo and Malamre. While the entire Limawa, Luggere, Jambutu and Nasarawo, Runde, and Yelwa wards are of high densities residential areas. There is a visible mixed socio-economic status, among inhabitants of the metropolis, although the diverse category of income earners dwells in separate wards others with diverse levels of income could be found in most parts of the high densities wards. .The mean annual rainfall of the study area is about 910.8 mm at present, while the mean annual temperatures is 26 c° and relatively humidity is below 70%, and the vegetation cover is savannah, as well as the topography is on the low lands of the Benue valley. The human activities include trading. Manufacturing, attesting and fishing.

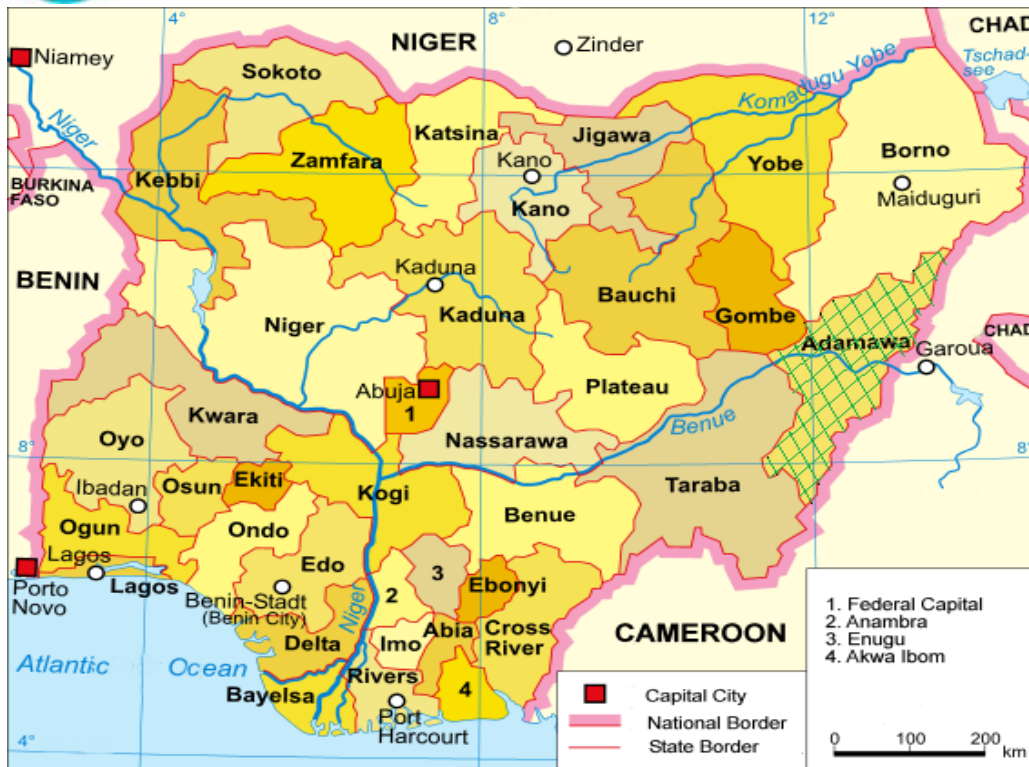


Figure 1: Map of Nigeria showing Adamawa state

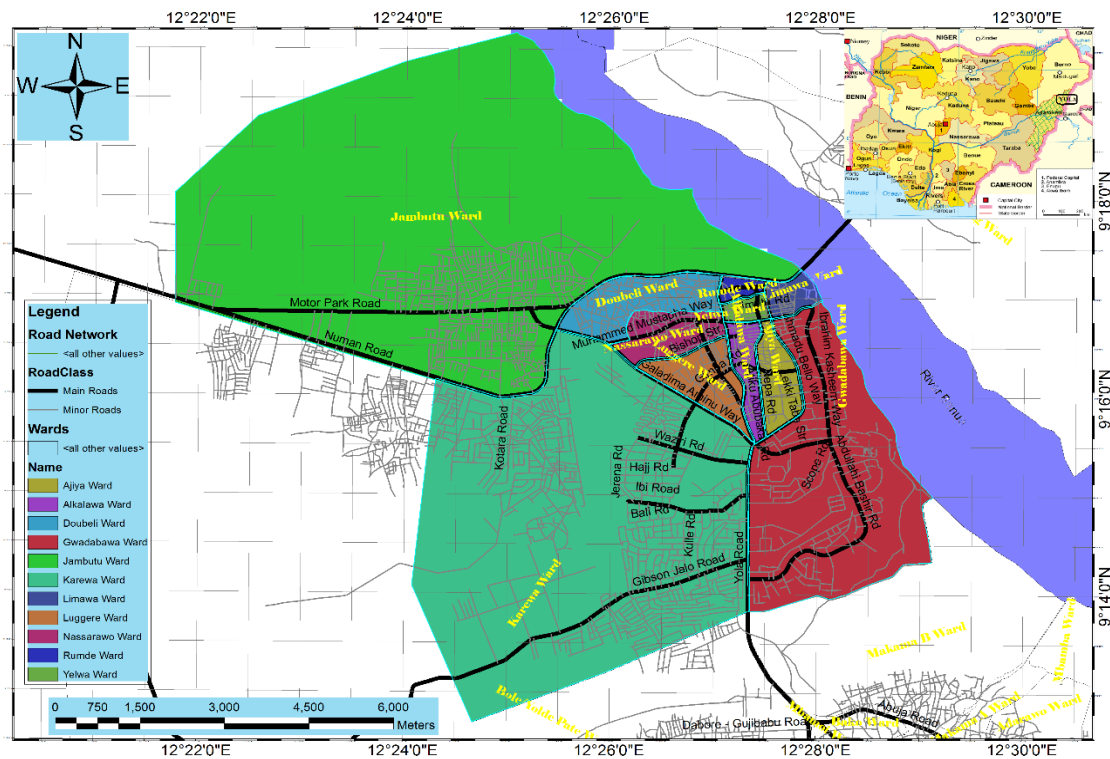


Figure 2: Map of Jimeta-Yola Showing Eleven Administrative Wards

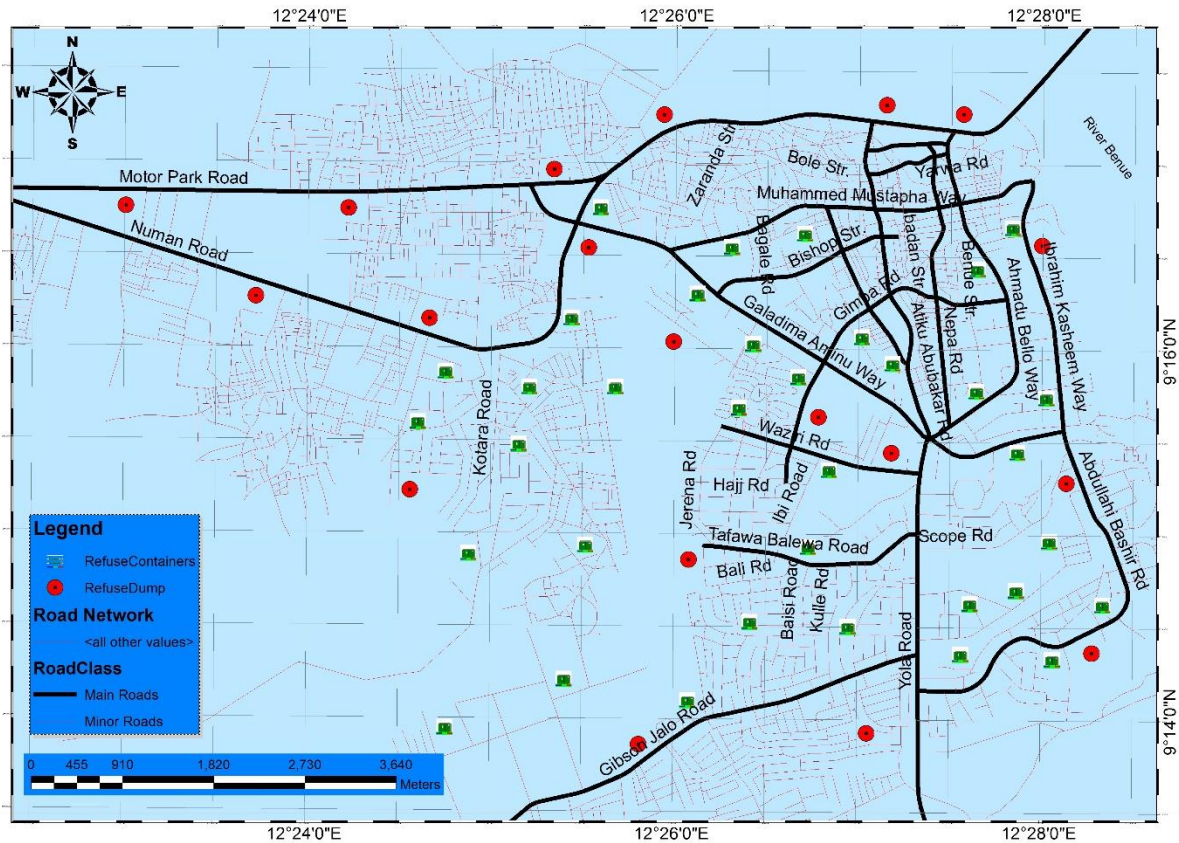


Figure 3: Map of Jimeta-Yola Showing Refuse Dump Sites

3.0 MATERIALS AND METHODOLOGY

Materials used for measurement of the solid waste in order to find the generation rates and the weight of the solid waste composites were as follows: the moveable weighing balance of capacity of 129 kg, an aluminium container with empty weight of 2.5kg, and volume of 50 l for collecting and weighing the solid waste. Other tools were, one square meter polythene material, a shovel, a fork, hand gloves, and gumboots. By using the weight balance, the mass of a composite solid waste sample was recorded for each waste dumpsite and its percentages were also determined at different categories of waste, also determined was amount of waste produced by different households in several constituencies and residential areas. This experiments were also conducted smoultaneously at all the 25 sampled dumped sites and 200 households in the experimented wards. The norms that were considered for selecting the sampling areas were, income levels location, residential densities, constituencies and land uses. In order to find a realistic estimate of the waste produced by the households and assessments, of the composite of solid waste produced by a particular constituency,

this experiment was analysed smoultaneously, for 5 different wards. These were, Gwadabawa, Karewa, Nassarawo, Limawa and Runde constituencies. The composites of municipal solid waste generated is being weighted at each selected waste dumps of these wards in the study area.

3.2 Primary Data

The primary data was acquired through refuse dump and household study. Total of (25) refused dumps and (200) households were designed for this study. A direct random sampling was used where refused dumps and households survey were investigated proportionately in the (5) out of (11) administrative wards in Yola-north local government area of Adamawa State Nigeria, being the study area. Interviews were held with Staff of Ministry of Environment of Adamawa State in Yola. A total of (25) refused dumps and 200 households were sampled, and analysed, this is supplemented by focus group discussion, and stakeholder analysis. All the respondents appreciated with the rapid urbanisation of Jimeta and were grieved with low culture of environmental hygiene especially in the high density areas of the metropolis .which; they

attributed as existence main causes of flooding being experience in the metropolis, during the rainy season. .

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, and National Population Commission. The data includes population and household distribution in Jimeta, Solid Waste management profile of Adamawa State Ministry of Environment and the street guide map of Jimeta- Yola, showing refuse dump distribution sites.

3.4 Discussion of Findings

The data and findings of this study are presented using descriptive and spatial analysis. The study findings show that there is higher generation rates of solid waste in the low and medium density wards of Gwadabawa (0.78kg/day) and Karewa (0.75kg/day) constituencies respectively. This is due higher income level of the occupants of these residence

which determine their high level of consumption rate of goods and services than those living in the high densities constituencies. The characteristics of solid waste in Jimeta, varied from one constituency to another, with organic waste as most prominent category ranging between 54- 68% of the total quantity of waste generation in Jimeta-Yola. The data indicated that Runde ward (a high density) generates the highest category of the compostable organic municipal solid waste of 68%, While Gwadabawa ward (a low density) produces the least category of the organic waste with 54% of the total production of the municipal solid waste. This goes together with preference eating habits of low income earners for un- processed food substances, while the high income inhabitants mostly consumed the modern conserved food as their own daily meals and nylon is second largest category, with range between 10-13.5 % of the municipal solid waste production. This could be explain due to all goods and services purchase in the markets are being package with polythene bags which were often dispose after single usage.

Table 1: Administrative Wards of Yola-North and the Characteristics of Neighbourhoods

S/No	Name of Ward	Area(sq.km)	Base Population NPC (2006)	Projected Population (2014)	Neighborhood type
1	Ajiya Ward	1.1783	14,359	17,949	Planned
2	Alkalawa Ward	0.8886	23,043	28,804	Planned
3	Doubeli Ward	1.9224	31,077	38,846	Semi planned
4	Gwadabawa Ward	11.8160	21,209	26,511	Planned
5	Jambutu Ward	41.4737	17,981	22,476	Semi planned
6	Karewa Ward	31.0710	22,227	27,784	Planned
7	Limawa Ward	0.5941	14,426	18,116	Semi planned
8	Luggere Ward	1.6621	15,854	19,817	Semi planned
9	Nasarawo Ward	1.7281	15,891	19,864	Semi planned
10	Rumde Ward	0.3147	11,493	14,366	Un planned residential
11	Yelwa Ward	0.3686	10,687	13,359	Semi planned
	Total	93.0176	198,314	247,892	

Source: National Population Commission (NPC), Nigeria and Field work, in 2014

Table 2: Population and Household Waste Generation Rate Data for Jimeta-Yola

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	Gwadabawa Ward	21,209	26,511	5,302	0.78	20678.58
2	Karewa Ward	22,227	27,784	5,557	0.75	20838
3	Limawa Ward	14,426	18,116	3,623	0.43	7789.88
4	Nassarawo Ward	15,891	19,864	3,973	0.58	11521.12
5	Rumde Ward	11,493	14,366	2,873	0.42	6033.72

Source: National Population Commission (NPC), Nigeria and Field work, in 2014

Table 3: Percentage Composition of Waste Categories from Different Locations in Jimeta-Yola

Category	Percentage in Low and Medium Density		Percentage in High Density		
	Gwadabawa	Karewa	Nassarawo	Limawa	Rumde
Organic	54.0	58.0	61.0	64.0	68.0
Paper	15.0	14.0	12.0	8.0	5.0
Plastics	5.8	5.5	5.0	6.0	5.0
Metals	4.0	4.0	2.0	3.0	2.0
Glass	3.0	2.5	1.5	1.0	1.5
Nylon	12.0	10.0	12.5	12.6	13.5
Others	6.2	6.0	6.0	5.4	5.0
Total	100	100	100	100	100

Source: field work in 2014

As shown in Table 1 below, Ajiya ward is covering the land mass area of 1.1783 km². It is a planned medium density neighborhood with the total population of 17 949. The area comprise of some few institutional land uses such as schools and primary health care, facilities while the residential Structures are mostly bungalows type. Alkalawa ward cover the space area of 0.8886 km² only, it is occupied with population of 38 846, it is a medium density area inhabited by mostly civil servants, and business men the neighborhood is situated around the central business District. Gwadabawa ward

covers the land area of 118160 km². It is a low density planned residential zone, dominated by mainly elites of Adamawa state, it is also comprises of the Government house Yola, some of the boards of ministries and the Ribadu square, which is the main civic center of the State capital. Karewa constituency, with a total land area of 310710, km² comprising of Malamre, Karewa and Bekaji neighborhoods. These zone is make up of medium residential density area and some educational institutions, the police and military barracks. Some high density wards includes, Doubeli ward a high

density area of Jimeta. The ward is occupied with the total population of 38, 846 people, inhabiting the land area of 199224 km², visibly planned across the major streets. Although the interior clusters are semi-planned environs. Others zones which are in similar category to Doubeli include Luggere, Jambutu, Limawa Nassarawo and Yelwa ward. Runde ward is the smallest ward in terms of land mass occupying the land area of only 0.3686 km² with the populations of 14366 persons, who are mainly low income earners. It is characterized by squatter settlement with dilapidated buildings. Occupied by major dump sites situated along the high way of these areas, which is aggravating the environmental problems of this neighborhoods'. As indicated in Table 2, there exist a strong relationship between socio economic level of a households, of specified wards and per capita solid waste generation rates of these zones in Jimeta, the data revealed that Gwadabawa ward being the administrative and corporate residential areas, recorded the highest per Capita solid waste generation rate of 0.78kg/cap/head, this ward is trailed by Karewa ward a medium density constituency which is occupied by elites, with data of waste generation rates of 0.75kg /cap./head. Nassarawo wards a high density constituency with capital waste generation rates of 0.58kg/cap/head. Others are also Limawa and Runde wards representing residents' of neighborhoods with common socio economic background. They share the capital rates of waste production ratios of 0.43kg and 0.42kg/capita/head in a day. These constituencies are representing some spatial homes of mostly low income earners. Table 3, shows that, organic waste generations 'rates increases with rise of residential density of a neighborhood. Dougirei, the low density households with high income earners has recorded 54% of the organic waste production in the constituency, whereas paper constitute the second major composition of solid waste in the area with 15%. While nylon constitute the third major category of municipal solid waste in the zone with 12%. Plastics and metal categories recorded 5.8 and 4.0% of waste compositions respectively. Glass recorded only 3.0% of the total waste. And finally un-identified waste category generation rate was 6.2% in the area. At Karewa the

medium density wards and the residential areas produce the organic waste generation rates of 58%, followed by paper with 14%. The high volume of paper category in the ward is attributed to the locations of educational institutions in the constituency. The afterward is nylon which has recorded 10% of the solid waste composition of the ward. Others are plastics and metals with record of trashes generation rates of 5.5% and 4.0% respectively. Glass and un-identified category of solid waste formed 2.5% and 6.0% respectively. The outcomes from analysis of solid waste composition in the high density areas of the metropolis such as, Nasarawo, Limawa, and Runde wards, revealed, that organic waste category recorded the highest composite of waste generation, at Nasarawo and Limawa wards, with a shared rates of 61 and 64 % of the composition of municipal solid waste respectively. While Runde ward the most densely populated area, and most affected prevalence of slum rate recorded the highest percentage of organic waste of 68% .While Nylon category recorded second composite of municipal solid waste in these areas, somewhere as Nasarawo and Limawa recorded 12.5% and 12.6 % respectively and. Runde ward with 13.5% of the of nylon category. While Paper category documented 12% in Nasarawo ward, due to location of educational institutions and some printing press in these areas. While the data indicated lower record of paper waste in Limawa and Runde with the rates of 8.0 and 5.0 respectively. Plastics category recorded 5.0%, 6.0% and 5.0% of waste composition in the three wards respectively .Moreover the records of metals was 2.0%,3.0% and 2.0% of waste composition in Nasarawo Limawa and, Runde wards respectively. While glass category was the least in the composition of the municipal solid waste was recorded, 1.5%, 1.0% and 1.5%, separately in these wards. Un-identified solid waste category recorded 6.0 %, 5.4 % and 5.0 % respectively in the composition of municipal solid waste of the high density neighborhoods. Finally the percentage distribution of combustible organic solid waste stream, are ranging from 54-68% in Jimeta and can be able to manufacture compost fertilizers in the State capital. Figure 4, presents the mean percentage municipal waste composition in Jimeta-Yola.

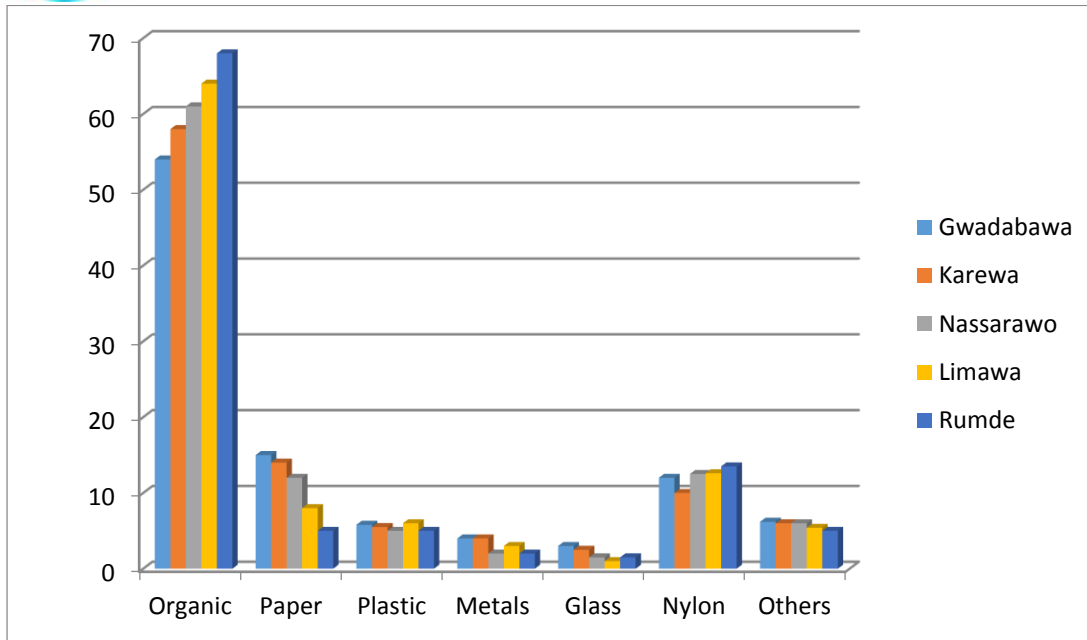


Figure 4: Mean Percentage Values of Waste Composition in Jimeta-Yola

3.5 Focus Group Discussion

At a focus group discussion, the staff of State ministry of environment informed low communities’ participation in urban waste management in the state. The participating household’s heads have the obligation of collecting and disposing their own household’s generated waste into some stand by containers around their areas. On the other hand, the Yola-north local government council received support from the ministry and they signed the memoranda of understanding with the ministry for implementation of the waste management scheme in the metropolis. The project suffered sets back in the hands of communities as well as the local government. Most of the households cannot collect and dispose their own households waste. Some households of the high densities neighborhoods resorting in to disposing their own solid waste in to drainages which are often causing flooding. However, it was reported, one time an association of tipper operators assisted the ministry with manual intensive labor and vehicles for evacuating solid waste. It was also decried, lack of enough environmental personnel to boost household sanitation in the Jimeta community .It was also noticed, that the ministry of environment is working under inadequate funding and thus has affected the performance of the department of waste management and pollution control, to deliver its own mandate in the State

(Adamawa state solid waste management report, 2015). While, some communities, members in the metropolis decried of inadequacy of waste dump sites and other problem is irregular schedule of evacuating waste dump in in their neighborhoods equally responsible to some of their own ailments, more especially at the typical high density constituencies such as Runde, Limawa Doubeli, and Jambutu wards.

4.0 Management and Policy Recommendation

For effective planning of solid waste management in Jimeta –Yola, community leaders and public servants needs to intensify their own effort in sustaining the environmental cleanness in the metropolis. The magnitude of solid waste presently generated in Jimeta- Yola is not being dispose regularly by the State ministry of environment and Yola- north local government, considering other competing services of the two institutions that are of utmost important to the populace. The study recommended for the following items. Creation of solid waste management board in the state. Since about 54-68% of the solid waste generated in Jimeta-Yola is organic matter,. Recycling and composting techniques should be implemented to derive the expected commercial values being acquired from the new uses of the solid wastes matter. They include compost fertilizers, recycled papers and artistic metal work. The study also suggested for more

funding in the, solid waste management sector because of the rising quantity of solid waste production in the metropolis, there is need to engage the private-public participation to invest in solid waste management in the state. This is to promote efficiency in the service, while attention should be given to the rehabilitating of the abandoned Adamawa state fertilizer blending factory, considering the readily available raw material required for the manufacture of the fertilizers in the state. This will help in supporting the teaming farmers and youth with employment prospects.

5.0 Conclusions

It could be concluded that the waste generation and disposal is not adequately managed in Jimeta considering the limited capacity of the establishments concerned with this mandate, as well as low community participation in the waste management programme. This study provided the

necessary data for the planning of the improvement of municipal solid waste management scheme in Jimeta- Yola. The findings of this research has implication for the improvement of the current waste management practices in Jimeta-Yola and the study proposed strategy for the take-off of the Adamawa State fertilizer blending factory in the State capital.. Lalanda e'atal (2015) argued that: organic waste and animal manure comprise of valuable chemical component and organic compound that would support the plant growth and increase of the crop yield, besides it can be useful source of raw materials for the manufacture of fertilizers. This will ensure the long-time boast of farming activity in the region. The waste streams of Jimeta has been analysed and the data revealed the diverse generation rates and composition of municipal solid waste reflecting the background of different wards in the Metropolis.

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