Survey of municipal solid waste in Jimeta-Yola, Northeastern Nigeria

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Abstract - This paper examined municipal solid waste from the perspective of household waste management system. Questionnaires were randomly distributed to households in eight wards in Jimeta-yola (Yola north local government area). The quantity and composition of waste generated was determined. The average waste generation per household was found to be 0.65kg/capita/day. The composition shows that 67.6% was made up of biodegradable material while 32.4% were recyclable materials. Lack of adequate waste collection system and proximity to dumpsites was attributed to causing dumping by residents in drains/gutters. Open burning is the major method of treatment. Finally the paper suggested sustainable environmental education program by the government to the populace and also the private sector. All should be encouraged to participate fully in the waste management system.

Keywords: solid waste, waste disposal, household waste, waste management, jimeta-yola.

1 INTRODUCTION

Waste is regarded as any environmental pollutant that is caused by human induced activities or through natural phenomena. This condition often upset the natural balance of the ecosystem. Waste irrespective of its source may be categorized as either organic or inorganic out-valued material to the generator, which is commonly disposed of. The generation of waste material is known as the waste stream. This includes the entire variety of refuse generated during domestic, industrial, construction and commercial processes. Our trash, or municipal solid waste (MSW), is made up of the things we commonly use and then throw away. These materials include items such as packaging, food scraps, grass clippings, sofas, computers, tires, and refrigerators. MSW does not include industrial, hazardous, or construction waste. (1).

Waste management plays an integral role in human activity and societal development. Waste management does not only involve rational decision making about whether to bury, burn, recycle or produce less waste, it must bring to bear the impacts to health, safety and environment. Assessing the costs-benefits implications of various waste management policies and project is equally a complex business involving numerous, interconnected economic, social and biological components. The challenges to effective municipal waste are not simply lack of policy, but lack of infrastructure, education, social awareness of problems and solutions, and lack of committed institutions promoting sustainable actions (2).

Municipal solid waste disposal is an enormous concern in developing countries across the world, as poverty, population growth, and high urbanization rates combine with ineffectual and under-funded governments to prevent efficient management of wastes (3., 4., 5). There are several factors that set MSW management in developing countries apart from management in industrialized countries. First, the types of materials that compose the majority of the waste are different. In developing countries, there is a much higher proportion of organics, and considerably less of plastics (5). The large amount of organic material makes the waste denser, with greater moisture and smaller particle size (5). A second difference is that technologies used in industrialized countries are often inappropriate for developing countries. Even garbage trucks are less effective because of the much heavier, wetter, and more corrosive quality of their burden (5). Other technologies, such as incinerators, are often far too expensive to be applied in poor nations. Third, developing countries' cities are characterized by unplanned, haphazardly constructed, sprawling slums with narrow roads that are inaccessible to collection vehicles (6.,7).

Solid waste management systems are an essential component of the environmental infrastructure in human settlements. These systems encompass all the activities undertaken from the point of waste generation up to the final disposal. In most of Africa's urban areas, solid waste management is ultimately the responsibility of Municipal Councils, while among most of the rural populations the wastes are handled at the household level. Thousands of tons of solid wastes are generated daily in Africa. Most of it ends up in open dumps and wetlands, contaminating surface and ground water and posing majorhealth hazards (8).

Generation rates, available for selected cities and regions are approximately 0.5 kg per person per day. While this seems modest compared to the 1-2 kg per person per day generated in developed countries, most waste in Africa is not collected by Municipal Collection Systems, because of poor management, fiscal irresponsibility, equipment failure and/or inadequate waste management budgets. Though, high and low-value recyclables are typically recovered and reused, these make up only a small proportion of the total waste stream. The majority of the waste (approximately 70%) is organic. In theory, this could be converted to compost or used to generate biogas, but in situations where rudimentary solid waste management systems barely function, it is difficult to promote innovation, even when it is potentially cost- effective to do so. In addition, hazardous and infectious materials are discarded along with general waste throughout the continent. This is especially a dangerous condition that complicates the waste management problem in Africa. Throughout most of Sub Saharan Africa, solid waste generation exceeds collection capacity. This is in part due to rapid urban population growth: while only 35 percent of the sub Saharan population lives in urban areas, the urban population grew by 150 percent between 1970 and 1990. But the problem of growing demand is compounded by broken down collection trucks, program management and design. In west African cities, as many as 70 percent of trucks are always out of service at any one time. In Ibadan, Nigeria, waste collection and disposal is frequently inadequate, with a preponderant proportion of the refuse generated remaining uncollected and with large parts of the city particularly the low income areas, receiving little or no attention. The onus is often on the local government to provide a service for solid waste management. However, the fundamental deficiency of this system is the government's failure to assume basic responsibility in raising sufficient funds to provide acceptable levels of service (9).

The four most common methods of municipal solid waste management are landfilling, incineration, composting and anaerobic digestion. Incineration, composting and anaerobic digestion are volume reducing technologies; ultimately, residues from these methods must be landfilled (10).

Landfilling is the only true "disposal" method of managing MSW. It is also the most economical, especially in developing countries where it typically involves pitching refuse into a depression or closed mining site (7). Landfills produce landfill gases and leachate which can harm human and natural systems. Landfill gases (LFGs), produced when methanogens decompose complex molecules, are primarily methane and carbon dioxide (up to 90%), but also include CO, N2, alcohols, hydrocarbons, organosulfur compounds, and heavy metals (11). Leachate forms as water percolates intermittently through the refuse pile, and can contain high levels of nutrients (nitrogen, phosphorous, potassium), heavy metals, toxins such as cyanide, and dissolved organics (11).

Incineration is the high-temperature combustion of wastes (12). Non-combustibles must be sorted out before incineration. Benefits of incineration include reduction of volume of waste and production of energy in the form of electricity and heat (10). However, construction and start-up costs of incineration facilities can be prohibitively expensive for developing nations.

Composting and anaerobic digestion use natural microbial organisms to decompose the organic fraction of MSW (10). The non-organic fraction must be landfilled or incinerated. These methods reduce the volume of waste that must be landfilled, and end products can potentially be used as agricultural fertilizers, or processed into fuels for motor vehicles (13). However, like incineration, project implementation can be too expensive for poor communities.

Assessing the impacts of municipal solid waste management involves consideration of a large number of components. Health impacts include exposure to toxic chemicals through air, water and soil media; exposure to infection and biological contaminants; stress related to odor, noise, vermin and visual amenity; risk of fires, explosions, and subsidence; spills, accidents and transport emissions (14). Environmental impacts can be clustered into six categories: global warming, photochemical oxidant creation, abiotic resource depletion, acidification, eutrophication, and ecotoxicity to water (10).

1.1 MSW COLLECTION AND DISPOSAL IN NIGERIA.

The sheer magnitude of the solid waste problem in Nigeria is hard to comprehend. There are no public waste bins, as the amount of trash that accumulates in a matter of hours would be more than waste collectors could haul in a day. Nigerian garbage "dumps" are located on the side of the highway at the fringe of cities and slums. Since there are no means for containment, trash often spreads into the road, blocking traffic. A fair percentage of the trash never makes it as far as the informal dumps; when refuse accumulates, households and businesses pile it in the median of major roads and burn it.The collection of solid waste is the most difficult and expensive aspect of solid waste management in developing countries. As a result of the unplanned nature of most cities in Nigeria, this task can sometimes be daunting. Ineffective collection systems often leads to waste accumulation, creating nuisance and odour problems, environmental pollution, fire hazards and generally threatening the physical well-being of the populace. (15)

Standard waste collection receptacles are rarely available at household level in most parts of sub-Saharan Africa (16). In Nigeria particularly, many low and middle income households use whatever container that is readily available, such as baskets, cans, buckets, open drums and sometimes black bin bags for waste collection. As a result of the high organic and moisture contents and high prevailing temperature, waste collected in such sub-standard receptacles decay rather rapidly giving rise to undesirable environmental consequences. In contrast however, most upper income households and government offices use standard receptacles, with covers, for collection of their waste. Door to door waste collection requires good planning and management. Collection crews come on specified days to empty the bins for transfer to dumpsites. This system demands a minimum outlay of manpower and equipment as well as accessibility. Where these are not readily available the system readily collapses.

In most parts of the country, waste conveyance is still carried out haphazardly with wheel barrows, carts, open trucks, lorries, tippers and more recently by compactor trucks (16; 17; 18). As the most common means of transporting waste are open trucks and lorries, it is not uncommon to see street littered with waste dropping from vehicles in transit. There is need to properly dispose of all collected waste in a safe and sustainable manner so as to avoid any negative environmental and health impacts. Various methods of waste management have evolved over the years such as burning, open dumping, landfilling, composting, incineration, disposal into the sea, pyrolysis, recycling etc (19). In the study "Recovery and recycling practises in municipal solid waste management in Lagos, Nigeria", Kofoworola (20), noted that "the inhabitants of Lagos dump their waste at any location that suits them because there are no defined waste disposal points in the City". This situation best mirrors the state of waste disposal in Nigeria. Open dumping and burning are still the most prevalent waste disposal methods in the country (21). The very few landfills that exist in the country are neither engineered nor secured; as a result waste dumped at such dump sites eventually find their way back to block access ways, drainages, farmlands and water bodies (15; 22; 23).

1.2 LOCAL ENTERPRENEURS IN MSW RECYCLING IN NIGERIA

Despite government's apathy towards resource recovery, economic pressures often force many amongst the urban poor to scavenge waste dumps in Nigerian cities to earn a living (24). In a study on recovery and recycling practises in Lagos, Kofoworola (20), found out that only materials with high market value such as paper, plastics, glass and metals

were scavenged. In a similar study in three cities in the South Eastern parts of the country (Nsukka, Onitsha and Port Harcourt), Agunwamba (24), discovered that between 70%-83% of scavengers were unemployed or underemployed urban youths (mostly males). While most scavengers restrict their activities to open waste dumps and landfills, some prefer to go from house to house and from bin to bin, looking for discarded but useable materials (24). They are known by different names in different parts of the country: "Baban bola" or "Mai bottle" in the northern parts and "Baro boys" or Ndi-ebulu" in the southern parts (17). In all cases however, materials recovered are either kept for personal use or sold to middle men who further sort them for sale to small scale industries around the City and beyond. Agunwamba's study showed that average daily earnings by the scavengers were as high as US $10 in 2003 while middlemen made even much higher profits. In a country where over 60% of the population live on less than $1 a day (25), such activity poses good prospects for environmental as well as economic sustainability and poverty reduction (26; 27). The objective of this work is to provide information on the local perception and characteristics of municipal solid waste in Jimeta-Yola in order to appreciate the impacts of indiscriminate waste disposal practices.

2.0 THE STUDY AREA.

The study area, Jimeta-Yola; is situated within latitudes 9°11'N to 9°20'N and longitudes 12°23'E to 12°33'E and at an altitude of about 185.9m. The area has a tropical climate with rainy season from April to October and dry season November to March or April. The area is characterized by broadly flat topography with gentle undulations and hill ranges. The population of the area is about 325, 925 (28). The major occupation of the people is agriculture and small-scale industries such as Bajabure Nima foam, polyplastic industry, Adama beverages and a few bakeries. Farms and furniture factories occur in the area. Small-scale metallurgical works, numerous water sachet activities and traditional textile factories occur the area (29). The waste disposal practiced in the area is through open dump for solid wastes. House hold solid wastes are largely dumped along the flood plains of the Benue River which borders the Yola-Mubi bye-pass. Other refuse dumpsites are located in the densely populated areas of the metropolis. The growth in population has affected the land use pattern, which has subsequently resulted in the area to generate more waste than is more or less manageable.

3.0 DATA PRESENTATION AND ANALYSIS

A structured household survey and waste characterization study was carried out over a period of three months. The waste characterization study was conducted to determine the daily per capita waste generation of the study area.

A total of One hundred and twenty (120) questionnaires were randomly distributed to residents of various wards in Jimeta-Yola. One hundred and fifteen (95.8%) questionnaires were retrieved fully completed. The data obtained from the questionnaires were displayed in tabular form and analysed. The data were categorized according to the objectives of the study.

3.1 WASTE GENERATED PER CAPITA PER DAY

The mean value of the per capita waste was calculated by dividing the total waste generated by the total number of people in a household. The per capita value ranged from 0.39 to 1.02 and the average value was estimated as 0.65kg/capita/day.

3.2 COMPOSITION OF WASTE

It can be seen from figure 1 that the waste consists mostly of biodegradable materials (kitchen waste, paper, textile, wood etc.) which amount to 67.6%; which if properly sorted, a good proportion of it can be composted and used as manure. Plastic, glass and metal, which constitute 18.3%, 3% and 5.8% respectfully, could

Table 1: Descriptive statistic of Waste Generation per Ward

Ward	Waste Generation (kg/capita/day)	Average number of persons in a house
Karewa	0.59	11
Alkalawa	0.53	7
Nasarawo	0.39	6
Luggere	0.54	6
Doubeli	0.66	12
Gwadabawa	0.76	10
Damilu	0.64	6
Jambutu	1.02	13

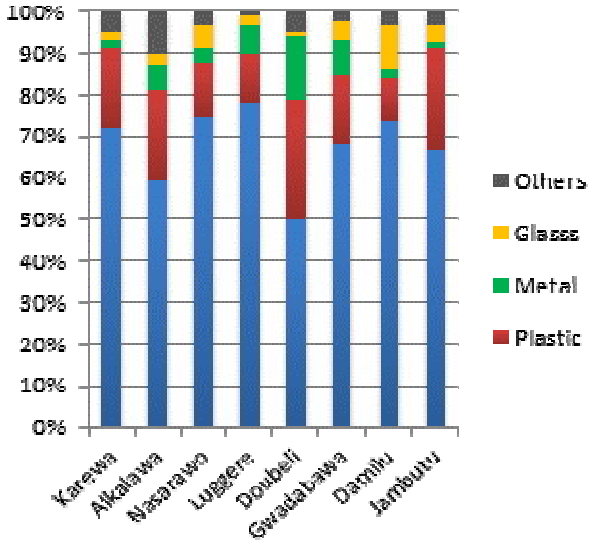

Fig. 1: Composition of Waste in each Ward

be recycled. Others (batteries, car parts, used oil, etc.) make up the remaining 5.3% of the waste stream and these can be recycled to create energy or new products.

3.3 AVAILABILITY AND PROXIMITY OF COLLECTION POINTS TO RESIDENCE

75 (65.2%) of the respondents complained of the unavailability of waste collection centers. Although 40 (34.8%) affirmed the availability of collection centers and proximity of about 500m from their residences, 15 (37.5%) of the affirmers complained of walking long distances to get to dumpsites and as such resort to dumping the wastes in drains or gutters.

3.4 FREQUENCY OF WASTE COLLECTION FROM DUMPSITES AND ROADSIDES

25 0f the respondents affirmed that waste was being collected from dumpsites and roadsides, 21 (84%) of those that affirmed the waste are collected reported the frequency of collection to be more than a week. 3 (12%) respondents stated that collection vehicles come about twice a week while only 1(4%) person claimed the refuse being collected daily.

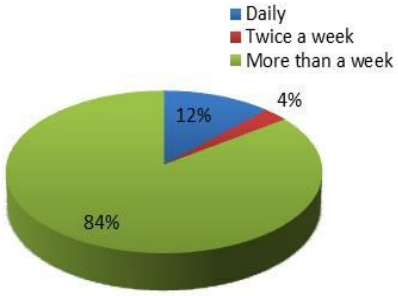

Fig. 2: Frequency of Waste Collection

3.5 METHODS OF STORING AND CONVEYING WASTE TO COLLECTION CENTERS AND DUMPSITES

48.7% of the respondents reported storing their waste in closed containers in their homes, 36.5% store theirs in open containers while 14.8% throw it on the ground, in a corner of their homes before finally burning or disposing at collection centers. Responding to how it is conveyed, 23 (20%) reported conveying waste in covered containers or plastic bags, 65(56.5%) convey theirs open to the road side/drains or empty plots while the rest take care of their solid waste in their surroundings. 6(5.2%) out of the 115 respondents stated that private refuse collectors collect solid waste at their doorsteps

3.6 TREATMENT AND DISPOSAL OF WASTE

Open burning is the major method of waste disposal by respondents. Only a few the respondents make use of garbage truck to transport to dumpsites and none of the respondents separates waste before disposal, recycles or composts waste.

3.7 OPINIONS ON RESPONSIBILITY FOR WASTE COLLECTION AND DISPOSAL

77 (67%) of the respondents think that Government is responsible for ensuring clean environments, as such, it has responsibility to provide collection points and endeavour to dispose of all waste dumped to avoid pollution. 21 (18.2%) stated that a clean and healthy environment is the responsibility of all citizens, thus, believes that waste collection and disposal should be a joint effort to achieve an effective and sustainable environment. The rest of the respondents (24.8%) stated that though they believe everyone should take care of his refuse, they couldn't afford any other suitable method of waste disposal apart from open burning.

3.8 OPINIONS ON EFFECT OF INDISCRIMINATE WASTE DISPOSAL

100% of the respondents were concerned about the problems of solid waste management. They all think indiscriminate dumping of waste is unpleasant and are concerned about the diseases related with improper waste storage and disposal.

4.0 CONCLUSION AND RECOMMENDATION

Waste Generation is a daily affair and though cannot be eliminated completely, it can be minimized by adopting the appropriate measures of using reusable items, reducing the generating of waste, sorting at household level, composting and recycling. The waste could also be used as a management strategy to produce Biogas for domestic uses. This could be achieved by the private sector using simple digesters within the communities. There is also a need for sensitization programs to inform the populace about the dangers associated with poor refuse collection and disposal on the environment and health of the public in general. They also need to be enlightened about various sustainable options available for waste management. Focus should be placed on educating the public to segregate waste by promoting waste reduction, reuse and recycling and enable the diversion of recyclables and biodegradable materials from being dumped on the roadsides, drains and on empty lands.

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