Adding Value to Municipal Solid Waste in Nigeria through Mapping

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Key words: Municipal solid waste, waste management hierarchy, waste information mapping, waste-to-energy.

SUMMARY

Background and objectives.
The concept of municipal solid waste (MSW) is changing as new technologies emerge to solve the problems of waste management. This resulted to the recent change of waste management hierarchy from 3R (re-use, reduction and recycling) to include recovery (including recovery for energy) as preferred waste management process, than landfilling. Hence recognizing waste-to-energy (WtE) as a recovery process and changing the general perception of waste from being useless to recognizing waste as a resource. This has increased the percentage of resource recovery from waste. But for a country like Nigeria to tap into this opportunity, country-wide municipality waste information mapping (WIM) to provide data/information on the generated waste and its general characteristics, is necessary. The sustainability of any waste management process derives its strength from reliable data/information. Nigeria being a highly diverse country culturally, geographically and economically requires that waste generation, composition and related data/information should be available to guide decision makers and other stake holders appropriately.

Result.
The paper is a logical and systematic presentation of municipal WIM of Nigeria using Solid waste analysis protocol incorporated into GPS mapping and GIS database to reflect the MSW characterization in Nigeria. It is a call to Nigerian Surveyors to contribute to solving the MSW problem in Nigeria by providing some of this needed data/information through mapping. The paper also provides the necessary guide towards providing accurate and reliable WIM. The envisaged problems that may be encountered are highlighted and solutions suggested.
Conclusion It is believed that an accurate WIM of Nigeria will not only provide information for decision makers in government but also investors in relevant sectors of the country's waste stream and encourage further research in the waste sector.

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1. INTRODUCTION

Traditionally, rubbish is forgotten after leaving them out for collection, or after visiting 'the dump'. In recent years, however, growing awareness of the environmental effects of simply throwing waste has increased the community's expectations for enhanced environmental standard. These resulted to increased pressure to act in response to waste problems. In EU countries, The US and few other countries, legislations have been put in place to enhance effective waste management. In response to these legislative pressures, visionaries, through research and development, have developed various initiatives and technologies that is changing our perception of waste. Today, waste is no longer useless as in the last decades, but resources that are contributing positively to national economies.

The value of recycling to major economies and the resources saved by energy from waste are enormous. Waste-to-Energy (WtE) plants in Europe can supply 13 million inhabitants with electricity and 13 million inhabitants with heat. This is based on 73 million tonnes of remaining household and similar waste that was treated in 2010 in Europe , saving 7 - 40 million tonnes of fossil fuel (gas, oil, hard coal, or lignite), which should have emitted 20 - 40 million tonnes of CO2 if conventional power plants are used to produce this amount of energy (Cewep, n.d.).

In the United States, in year 2000, recycling produce annual payroll of approximately US$37 billion and annual sales of US$236 billion (Beck, 2001).

In countries like Nigeria, lack of reliable data on waste generation, collection, transportation and treatment, is affecting the effective utilization of these initiatives and technologies, which can change a good percentage of the country's generated waste to resources through re-use, recycling and energy recovery.

This paper is therefore giving a run-down of how Surveyors can contribute in the drive to change our waste to resource through data collection and dissemination. This is in the form of Waste Information Mapping. Database built on waste will help in planning ways of managing municipal solid waste (MSW) to reduce its negative impact on the environment and health of citizens.

2. THE CHANGING CONCEPT OF WASTE

Historically, the amount of waste generated by humans was insignificant due to low population density, coupled with insignificant exploitation of natural resources. Common waste produced during early human history was mainly ashes and human biodegradable waste, and these were released back into the ground locally, with minimum environmental impact. With the advent of industrial revolution, waste management became a critical issue. This was due to the increase in population and the massive migration of people to industrial

towns and cities from rural areas during the 18th century. There was a consequent increase in industrial and domestic wastes posing threat to human health and the environment. During this period, waste management was a problem as waste was looked at as useless.

But with the emergence of the environmental movement of the 1960s, governments went from thinking of waste as useless and of no value, to thinking of waste as pollutants and of negative value because it was difficult to manage. With the environmental revival of the 1990s, the thinking of waste changed to something that potentially has positive value, if we can find ways to reuse or recycle it rather than throw it away. With the technological evolution of our time, waste is changing from rubbish to resources, pushing the waste management hierarchy from 3R (reduction, reuse and recycling) as the accepted norm in waste management, to a higher level where energy recovery is included before disposal to landfill.

The emergence of the various technologies for energy recovery, generally referred to as Waste-to-Energy (WtE), is having a great impact in the management of MSW. WtE technology accepts a broad mix of waste, hence tremendously reducing the volume of waste that is disposed to landfill. Due its environmental friendliness, WtE systems are being termed ”green technologies” and accepted as hazard free waste management methods.
Thersfore, Michael-Agwuoke (2012) defined waste as:
Residual materials which are as a result of humanactivities which cannot be reused or recovered as a resource,recycled into material production processes orthermally/biologically utilized for energy production.

Other definitions of waste demonstrating the changing concept of waste inlude that by the Organisation of Economic Cooperation and Development (OECD) who define waste as:
“materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose”. (OECD, 2003).

The Basel convention defined waste as: (UNEP, 2004)
“Substances or objects which are disposed or are intended to be disposed or are required to be disposed of by the provisions of national laws”

The United Nations Statistics Division (UNSD)*:(UN Statistics Division, 2011)*
“Wastes are materials that are not prime products (that is products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose”.

Zero Waste America defines waste as: (Zero Waste America, n.d.)
"A resource that is not safely recycled back into the environment or the marketplace."

This definition takes into account the value of waste as a resource, as well as the threat unsafe recycling can present to the environment and public health.

The Waste Framework Directive (Directive 2006/12/EC) (European Union, 2006), as

amended by the new WFD (Directive 2008/2008/98/EC) (European Union, 2008), define waste as:

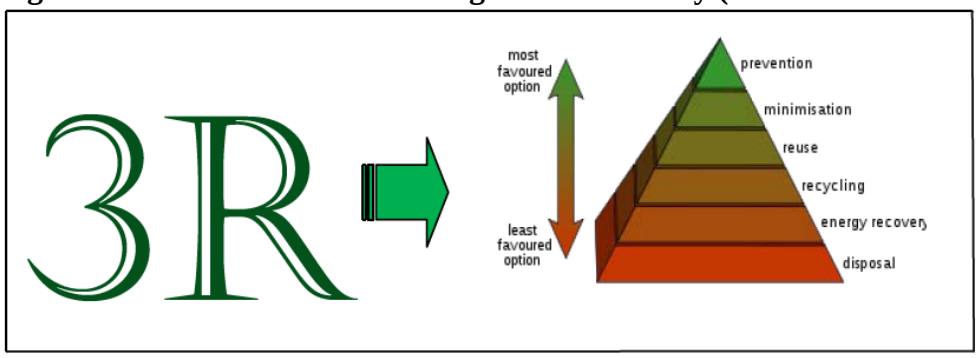
"Any substance or object which the holder discards or intends or is required to discard".

Recognising the level of technological inovations that are changing our perceptions of waste, Directive 2008/98/EC which recognised recovery as a better waste management than landfilling, defined recovery as "....any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy....".

Therefore, under the present circumstances, waste is now a resource, hence for effective utilization, knowing there location, composition, quantity and quality is very vital important. This can be achieved through Waste Information Mapping.

Waste has played a tremendous role in history. The bubonic plague, cholera and typhoid fever, to mention a few, were diseases that altered the populations of Europe and influenced monarchies. They were perpetuated by filth that harbored rats, and contaminated water supply. It was not uncommon for Europeans to throw their waste and human wastes out of the window which would decompose in the street.

Figure 1: Evolution of waste management hierarchy (Source: Michael-Agwuoke, 2012)



3. WHAT IS WASTE INFORMATION MAPPING (WIM)?

This is the process of classification and characterization of waste including the geocoding of the waste location. In this way, the location and composition of the wastes including generation data are properly documented and can be referred to by stakeholders. The accuracy of the WIM is determined by the size of the geographic locations on which the waste information are tied and the number of classification/characterization showing the waste composition.

In Nigeria, because of the complexities across the various aspects of the national characteristics, these determinant factors will vary across the nation. These complexities are represented in the population densities (Figure 3), culture, weather, settlement patterns, etc.

Therefore, the geographic size of the waste classification areas will vary from point to point, depending on the expected accuracy, which will highly be dependent on funding. Depending on the waste collection and transportation system (where they already exist), the classification area can be based on the collection zones or regions.

Figure 2: Possible waste classification

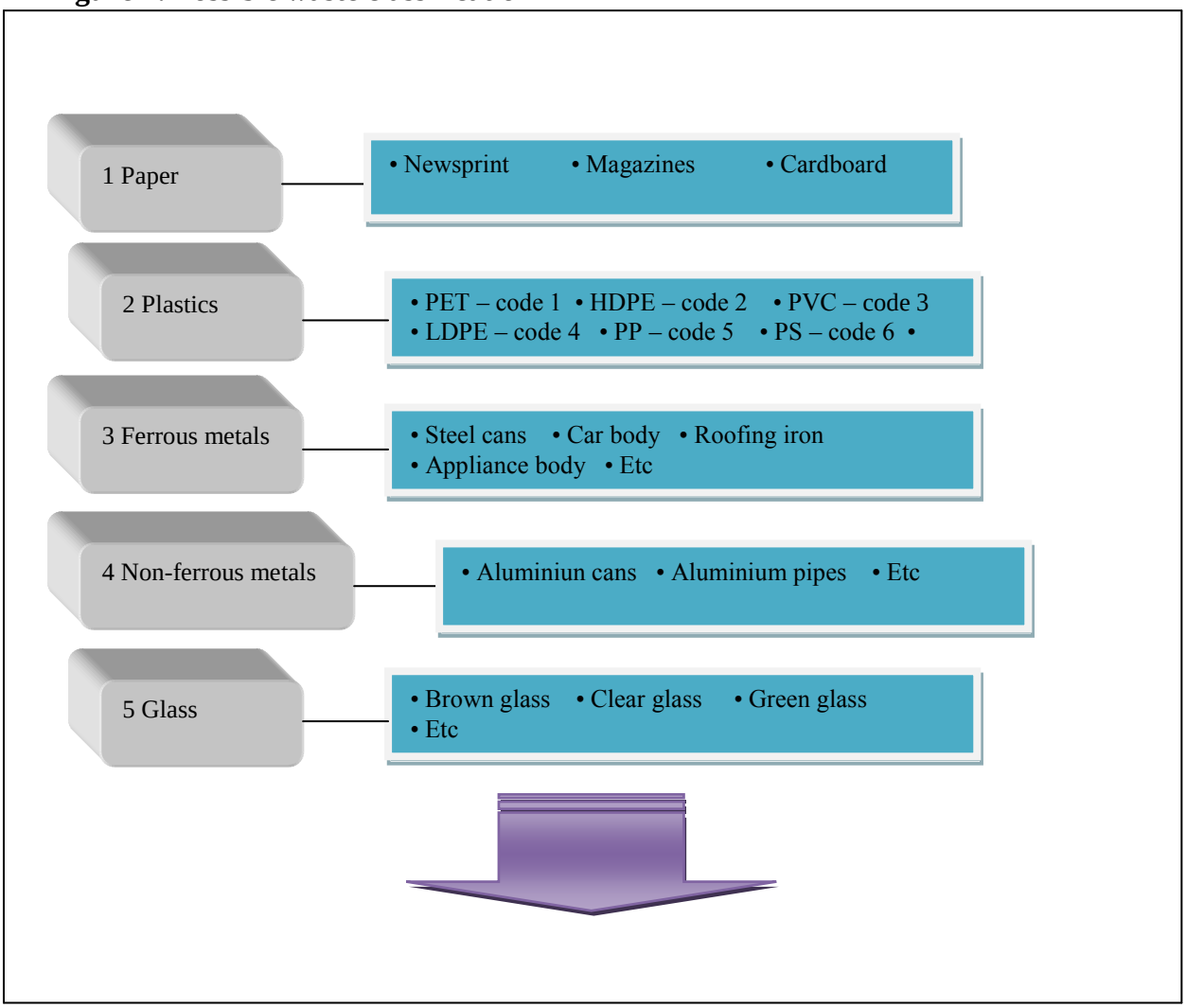
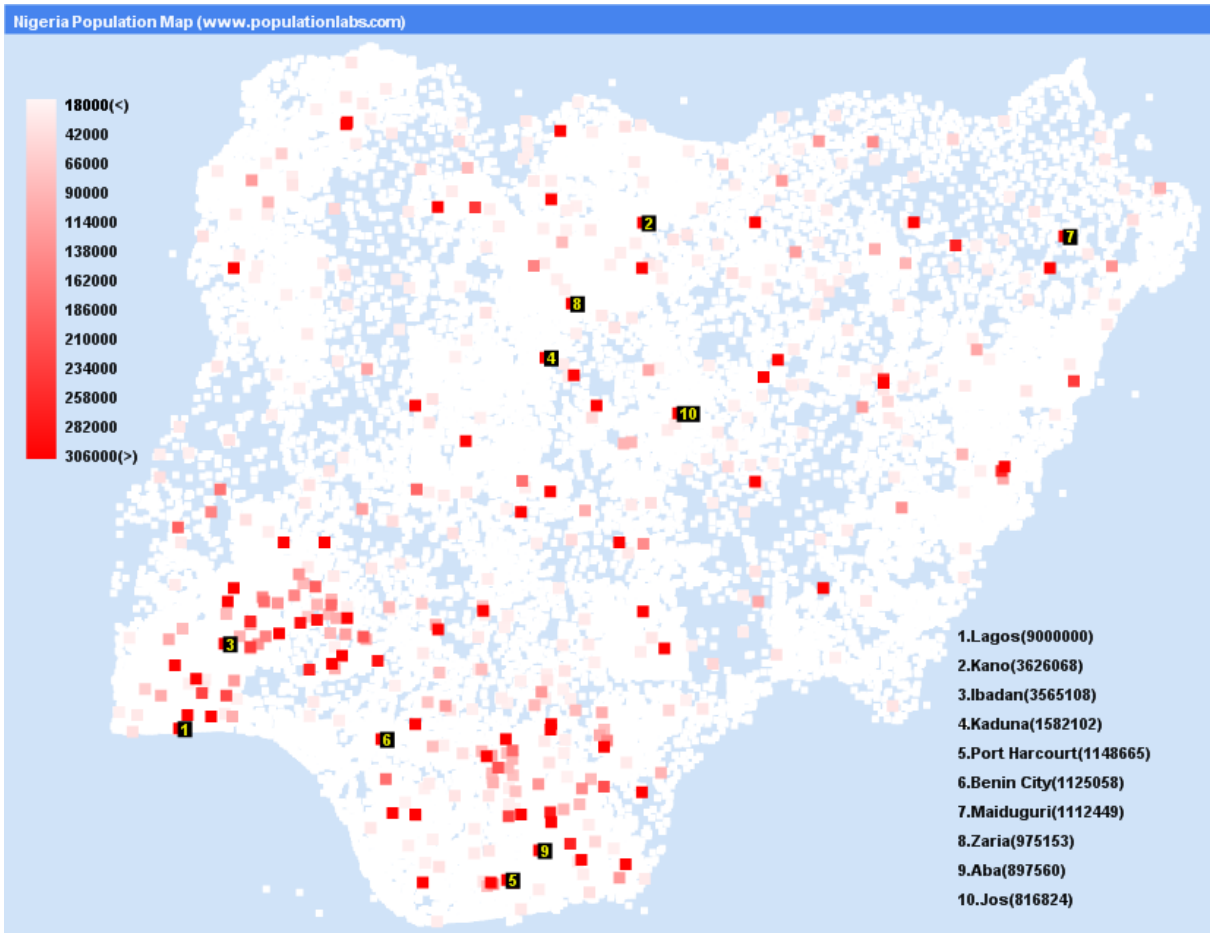


Figure 3: Nigeria Population map (Populationlabs.com, 2011)



4. STEPS IN UNDERTAKING WIM

Stages in executing a WIM cover the following:

- Decide on the geographic size of the classification area
- Decide on the pattern of definition which may be as points or as polygons
- Carryout the mapping using suitable mapping method(s), which will achieve the required accuracy level.
- Collect appropriate waste samples for classification, making sure that the samples are tied to their geographic locations.
- The samples are sorted accordingly into the possible classes as shown in Figure 2. The higher the number of classes, the better the purpose it can serve.
- The sorted samples are weighed. The simplest check on data entry are the totals before and after sorting.
- Produce the Waste Information Map of the area.
- Items containing hazardous waste (materials) will always be classified as hazardous waste (e.g. tins with paint residues or a medicine bottle with a few pills left in it, etc)

4.1 Waste sampling regime

The procedures consider how accurate the completed survey is in representing the waste stream for the period of the survey. However, we also need to consider the accuracy of survey data in representing the waste stream over the longer term – such as a complete year.
It cannot be over emphasized that time is one of the dimensions being mapped. A survey will not be of, say, households in Enugu, but of households in Enugu in the year 2012, or even of a given week in 2012. A sample cannot be considered to represent a population unless it has been selected from that population

The difficulty of obtaining an adequate sample size for the time period, or even knowing what constitutes "adequate" in this context, is one of the factors strongly favouring continuous sampling where this is possible. However, the option of continuous monitoring is unlikely to be financially feasible in most cases.
Weather is another important variable. A survey covering a single week may overestimate or underestimate quantities of rubbish depending on the attitude of residence as impacted by the weather situation. This may be due to consumption pattern over this period. The composition of the rubbish may also be expected to vary with the weather.

To take account of longer-term variability of waste data, two main approaches are possible:

- Repetition of the survey at different times to account for the longer-term variation or to monitor for change.
- Spreading the survey period over a longer time, with small individual samples totaling to the full sample size. Many monitoring systems rely on collecting small samples frequently. For solid waste, this could mean sampling one load of refuse each day. This approach may give more realistic yearly estimate than a survey over a single week, as well as make seasonal comparisons possible. The number of times a year sampling should be carried out to give adequate precision depends on the amount of variations that may be expected over the year.

4.2 Moisture content

For simplicity, determination of moisture content may not be needed. Wet weighs are used for both analysis and presentation of result.
Determination of moisture content is however recommended since it will be required for the following activities;

- Considering WtE as a disposal option
- Quantifying seasonal effects
- Determining accurate refuse quantity.

The moisture content is the difference in weight of the wet waste and the dried waste. Gartner Lee (1991), in a report, *Procedural Manual for Municipal Solid Waste Composition Analysis*, prepared for British Columbia Ministry of Environment, recommended a drying temperature of about 77ºC for 24 hours to assure complete dehydration and yet avoid undue vaporization of volatile materials.

The presentation of the results should be in the format that meets the objective of the mapping exercise. Items of data should be accurately described, and the survey method well

documented.

5. PROBLEMS AND SOLUTIONS

The major problem that will be faced in realizing the objective of this exercise is funding. This is as a result of lack of political will from the politicians who are the decision makers. This is very visible in the management of waste in Nigeria. MSW management has not been given its pride of place in the governance process. But this clarion call can be the impetus to push the private sector into waste management. Private survey firms can go into public/private partnership with government to develop this database which will create the awareness on the volume and type of waste being generated in Nigeria.

Secondly, expert ideas to execute the mapping may be lacking in the country presently. This is because we have not seen reasons to carry out serious studies on waste. Recognizing that waste industry is worth billions of dollars if well managed, will create the interests in research and development from which the required expertise will emerge.

Thrower pay policy should be implemented to help in providing some of the required funding for waste management projects.

Covering the entire country is a big task. But having the courage to start the mapping is the first step towards the success.

6. CONCLUSION

Providing complete database of waste generation and composition trends in Nigeria, will open the waste sector for investments, creating jobs, preserve existing raw material, save foreign reserve in importation of raw materials and keep our environment clean. Therefore, we should consider it as a necessity and give it the urgent attention it deserves.

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