



Sustainable Solid Waste Management Through Resource Recovery and Recycling

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Sustainable solid waste management through resource recovery and recycling

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Abstract

In this study, analysis of solid waste management through resource recovery and recycling was conducted. Investigation into waste resources recovery were carried out using two methods; visitation to streets in Awka to collect data on different method of waste recovery and waste auditing in Nnamdi Azikiwe University hostels. Result from street visitation revealed four different waste recovery methods which include waste recovery from dump site, waste recovery by itinerant waste buyers and scavengers, waste recovery by event waste pickers and source-separation. Waste audit showed weight of recyclable, reuse, organic and single use to be 26%, 47%, 21% and 6% respectively. The audits indicated that a reasonable amount of 64% of the waste should be diverted to recycling industries while only 38% will be disposed to landfill and incinerators. In conclusion, it is clear that more than half of the received waste at the landfill originates from recyclable and reuse discarded materials. It is therefore recommended that public awareness on recovery of waste through source separation be implemented and government should establish recycling plant within the cities to help obtain hundred percent (100%) recycling of waste in order to decrease its negative impact in our environment..

Keywords: *solid waste management, waste recovery, recycling, waste pickers*

INTRODUCTION:

Sustainable solid waste management is an essential component for a healthy life and pollution free environment. Naturally, all forms of human activities generate different types of wastes that must be properly disposed and effectively managed. (Cointreau, 1982). Implementation of effective waste management practices has been identified as essential for economic development in low income countries in particular (Zerbock, 2003). In Nigeria, it is a common place to see open spaces used as a collection centre of either plastic or scraps metals, aluminum such as old iron spring bed, can drinks, tins of sea and liquid food,

beverage cans, etc. These scrap metals are picked by waste pickers and scavengers who trade on them as a means of livelihood.

Recycling in Nigeria is gradually gaining ground, making a notable contribution to waste reduction, poverty alleviation and job creation (Nzeadibe and Iwuoha, 2008). Some recycling companies are Chanja Datti Co. Ltd, Verde Impacto, Takman Recycling services, Julius Recycling Company, Recycle Point, and so many others. Materials like paper, plastic, metals and nylon are some of the materials recovered from mixed waste and are recycled to manufacture new products (Korner, 2006). Recycling of plastic is a more efficient method for material and energy recovery than incinerating and land filling. When plastic is incinerated, it emits greenhouse gases which is detrimental to environment and consume more energy than when it is being recycled (Recycling Revolution, 2011). Nearly 10% of energy will be consumed to produce new plastic products from recycled plastic when compared to virgin materials (Bloch, 2010). Moreover, when 1000kgs of plastic is recycled, it saves up to 7.4 cubic yards of landfill space (Benefits of Recycling, 2011). When 1kg of aluminum is recycled, it saves 6kg of bauxite, 4kg of chemical products and 14KWh of electricity (Benefits of Recycling, 2010). In Nigeria, a good number of home-made drinks are being sold in plastic bottle recovered from used table water bottle. This locally-produced drink includes soya milk, tiger nut, drink, kunu, zobo. Most retailers use it for bottling red palm oil, palm wine, burukutu etc. Hausa hawkers use them in packaging their traditional herbs. Empty sachet bags are not left out, as they could be reused or recycled as seen in Togo, where they are crafted to handbags and umbrellas (Oladimeji, 20019). Hence, recycling and reuse are considered as effective solution to greenhouse effect.

Recovery of these waste are done through dumpsite collection, Itinerant waste buyers and scavengers, event waste pickers and finally source separation at the household or places where waste

material is being generated. Materials from municipal waste can be retrieved and served in the manufacturing process for producing new products and material recovery.

This study reveals ways waste are being recovered and also evaluate the amount of recycled material that could be recovered through source separation in order to recover valuable metals, reduces indiscriminate dumping and develop sustainability in human settlement and cities.

METHODS:

Investigation into waste resources recovery was carried out using two methods; visitation to streets in Awka to collect data on different methods of waste recovery and waste auditing from Nnamdi Azikiwe University hostels .

Study Area

Nnamdi Azikiwe University is located in Awka Anambra State. It lies within the geographic boundary limit of Latitude 6.24288°N and Longitude 7.11828°E. It shares boundary with Amansea at North East and Ifite at North West directions respectively. In the school premises, there are only three hostels for both male and female. They are Elmada Hostel (private hostel) which has blocks A(girls) and B(boys) Each block has four floors and a total of one hundred and forty four (144) rooms. Dora Akunyili Girls and Basil Oli Boys hostels have the same features: forty rooms per floor for third and second floors and eighteen rooms for ground floor.

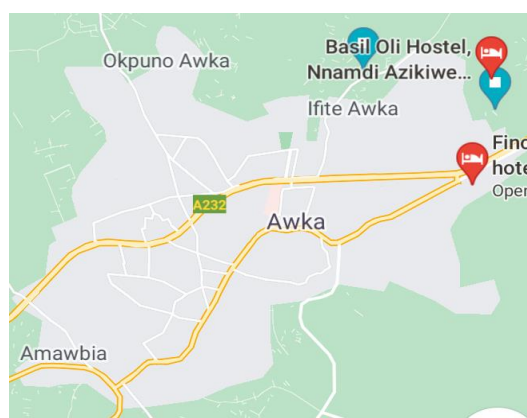


Fig 1:Map of Awka showing Nnamdi Azikiwe University hostel

Application of waste auditing in source separation method

In this study, waste auditing was carried out to determine waste diversion rate in three school hostels, situated inside the school premises. The hostels are Basil Oli hostel, Girl's hostel Block A (Dora Akunyili) and Elmada hostel, Unizik. The waste was collected with separate bags from all the three hostels for a period of thirty days. Picking of this waste were done from student's room, along the corridors of each floor and waste bin placed along the corridors. None were picked from their dumpsite situated close to their hostels. Then, waste audit was carried out on five different component of the solid waste. These components are metals, paper, nylons, plastic cans and kitchen wastes. Each day, five different waste bags for the different components were loaded, weighed and the value recorded using a spring balance. The solid waste collected includes metals, nylon, plastic cans, papers and kitchen waste. After collection, the wastes were sorted into five categories as stated above, in separate bags and weighed using spring balance. The wastes were then sorted into four sub-categories: recyclables (metals cans), reuse (plastics bottles), organic (paper and kitchen waste), Paper in this case includes cartoon used for packaging of soap, toothpaste, indomie, cabin biscuits etc. and single use (nylon sachet water and black nylon bags).

Waste Diversion Rate calculation

Waste diversion rate represents the amount of waste that is diverted for recycling either from the point source or refuse dumps. The total weight of recycling, compost and reusable wastes collected were recorded and waste diversion rate calculated using the formula.

$$\text{Diversion Rate} = \frac{\text{Weight of diverted waste only}}{\text{Weight of all waste}} \times 100 \quad (1)$$

In this study, the diversion rate equation is

$$\text{Waste Diversion Rate} = \frac{\text{Recycle+Reuse}}{\text{Weight of all waste}} \times 100 \quad (2)$$

RESULTS:

Result from street visitation:

Waste Recovery from dump site :

Waste is being sorted by waste collection team. These teams are employers working under Anambra State Waste Management Authority (ASWAMA). At every dumpsite as waste are being collected, these workers sort out recyclables and packed them for sale to waste dealers who in turn sells to industry. In this way, they are able to reduce the waste and divert it to where they will be made useful again. The waste normally collected includes plastic bottles (PET - polyethylene terephthalate) utilized for water and soft drinks packaging including malt drink cans. With this, they are able to make some money. This act prevents blockage of drainage paths and trenches by PET bottles during precipitation. Aside from this, there is drastic reduction in roads littering which consistently look so filthy due to poor waste management. This method produces the highest amount of recoverable waste materials at a shortest time compared to other methods as seen in Figure 2.



Fig. 2: Waste collection team sorting plastic can

Waste Recovery by itinerant waste buyers and scavengers:

Itinerant waste buyers roam the streets with bags, or pushcarts buying source-separated recyclables from residents. As they move, they shout out for condemned material in order to attract attention. They are also in the lookout for any material they

can pick along the road or nearby dumpsite. Their specialty is mostly materials made of both ferrous and non-ferrous metals and aluminum. These include scrap metals from vehicles, earth moving equipment, electronic waste (e-waste), spring bed, and any household utensil. When, they gather these items, they take them to waste dealers who pay them according to the weight of their waste. These have helped in contributing to the cleanliness of the environment. The problem with this recovery method is that these scavengers searching for recyclables in dumpsite normally scatter well - packaged waste, and litter dump sites making it difficult for waste collectors who spend time packing them.



Fig.3: Itinerant waste buyers

Waste Recovery by event waste pickers:

Two newly novel waste recoveries are the use of magnet by waste pickers in picking metal covers of bottle drinks and picking of sachet water bag by another group of pickers. The magnets are tied at the end of a long rod for easy handling. These set of people visits places where different ceremonial events (like burial, wedding, etc) are going on to pick up metal covers. Occasionally, they are seen along the road picking discarded waste. In this method, wastes pickers are often seen as nuisance and sometimes are forced out of the occasion. Again, indiscriminate littering of sachet water bags

is reduced as they are also resources. Neatly used ones are picked for recycling to produce new sachet bags while fairly dirty ones are used to produce black nylon bags. Nylon collection is not fast moving like other waste as much awareness has not been created and waste pickers prefer waste with heavy weight because it gives them more revenue. This may be attributed to the fact that companies that buy waste nylon and polythene material are mostly located outside Anambra State and no middleman on this nylon business has not been identified within Awka.

Source-separation:

Any activity which helps in reducing waste, toxicity, and focusing on reuse and recycling at the source is termed as source reduction. Source-separation of recyclables is better preferred to the recovery of materials from mixed wastes. Source-separation is normally done at hostel, residential home, hotel where the sorting is done instantly before it gets to the dump sites. This method is the best, but most people have no time for it, as it requires storage place before disposing it to itinerant waste buyers. Source-separation method produces cleaner, higher-quality materials, and command higher prices.

Source separation by waste auditing:

The results of waste auditing are presented in bar charts and pie charts as shown below in figures 4, 5 and 6.

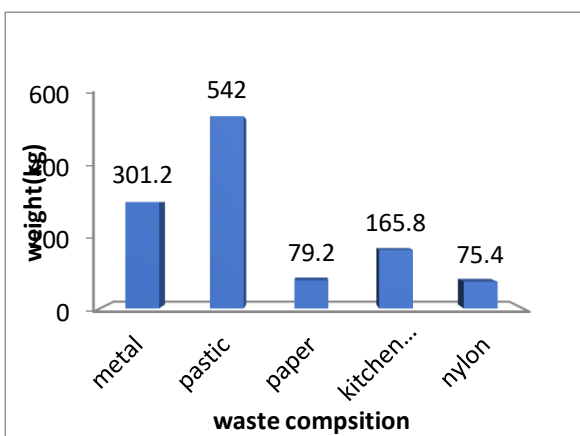


Fig 4: Monthly Weights of waste composition from the three hostels

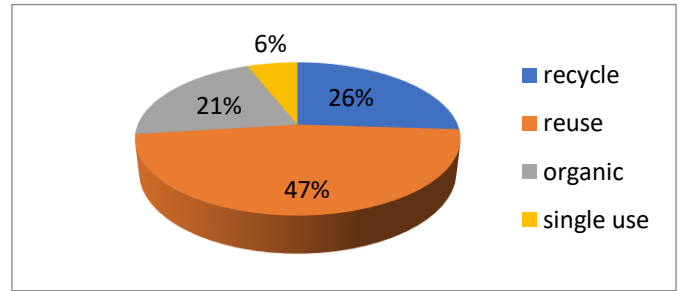


Fig 5: Percentage of weight of waste stream

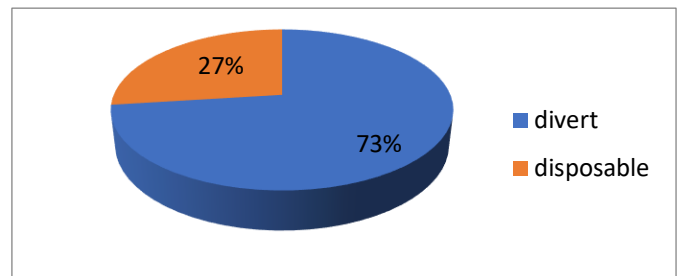


Fig 6: Diversion rate of the waste

DISCUSSION & CONCLUSIONS:

Discussion:

Result from street visitation shows that different waste recovery systems will largely minimize the quantity of waste needing transportation to the landfill and will also provide significantly more raw materials for the existing waste recycling companies in Nigeria. Each recovery system is seen to render economic and environmental benefits as seen in Figures 2 and 3. Waste auditing reveals in Figure 4, the weight of plastics to be 542.0kg which means that there is high consumption of plastic drinks in hostels. Many students rely on such drinks for lunch and sometimes at night. This is followed by 301.2kg metal, 165.8kg kitchen waste, 79.2 kg paper and nylons with least weight of 75.4kg. Figure 5, shows weights of recyclable, reuse, organic and single use to be 26%, 47%, 21% and 6% respectively. Low percentage of recycle may be attributed to students preference over beverages in sachet packages (which are in high demand now) than tin ones. Again, Iron materials with reasonable weights are not commonly seen among

students and many prefer plastic drinks to can drinks. Figure 6, indicates that a reasonable amount of 64% of the waste are to be diverted to recycling industries while only 38% will be disposed to landfill.

Conclusion:

From this analysis, it is clear that more than half of the received waste at the landfill originates from recyclable and reuse discarded materials. The percentage of disposable could further be reduced if single use is recovered for recycling. Recycling and reuse is a useful tool for both environmental and economical development. When source separation is applied in every household and institution, this will make it easy for sorted waste to retain its quality. Unlike recovery from dumpsite methods, for example, where single use (cartons and paper) mixes up with food waste and losses its quality and so cannot be used for paper recycling. With an improved waste management, these recovery resources will make great contributors to local revenue generation and job creation in our society.

Recommendation:

It is important for government to help establish recycling plant within the cities to help obtain hundred percent (100%) recycling of waste to decrease its negative impact in our environment. Public awareness on the recovery of waste through source separation should be implemented by government. Then waste pickers can be integrated into waste management to pick up those sorted waste from residents who receive a token in exchange. This will be a big encouragement for people to take time and sort the recyclable and reuse skillfully and carefully. This will be a good initiative in the right direction as compare to indiscriminate littering.

REFERENCES:

S. Cointreau (1982). *Recycling From Municipal Refuse: A State-of-the-art Review and Annotated Bibliography*. Washington, D.C.: World Bank technical paper. <https://documents.worldbank.org>

O. Zerbock (2003). *Urban Solid Waste Management: Waste Reduction in Developing Nation*. Unpublished Msc Thesis Michigan Technological University.

T.C. Nzeadibe and H.C. Iwuoha (2008). *Informal Waste Recycling in Lagos*; IWM Business Services Ltd. Nigeria, Africa, Volume 9, pp. 24–31.

K. L. Korner (2006). *Municipal solid Waste Generation in Asia* (p. 220). TUHH, Hamburg University of Technology, Germany.

Recycling Revolution. (2011). <http://www.recycling-revolution.com/recycling-facts.html> (Retrieved 10th April, 2021)

M. Bloch (2010). *Recycling Energy savings*. Green Living tips

<http://www.greenlivingtips.com/articles/182/1/Recycling-energy-savings.html>

Benefits of Recycling. (2010). <http://www.benefitsofrecycling.com/recyclingmeta> [ls](http://www.benefitsofrecycling.com/recyclingmeta). (Retrieved 14th April, 2021)

S. L. Oladimeji (2019). *Environmental Problems of Sachet Water Consumption in Saki town, Oyo State, Nigeria* Degree thesis for Bachelor of Natural Resources Degree Programme in Sustainable Coastal Management. Raseborg, University of Applied Science Novia.