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Efficacious waste organisation in urban areas: a case study of Bauchi city

Michael C. O. Ajufoh, Murtala A. Babaji

Department of Architecture, Federal Polytechnic, Bauchi, Nigeria

ABSTRACT

Waste management is the collection, transportation, processing, recycling or disposal of waste materials. The term usually relates to materials produced by human activity and is generally undertaken to reduce their effect on health, aesthetics, amenity and the environment and also to recover resources. Waste management can involve solid liquid or gaseous substances with different methods and fields of emphasis for each. Waste management practices differ for developed, developing nations, for urban and rural areas, and for residential and industrial production. This paper tries to deal with illegal and unplanned solid waste disposal; it also attempts to proffer solutions to the problem of improper waste disposal through incineration and recycling of metals, cellophane and Teflon and how Bauchi state can generate some revenue through the recycling of these waste materials. The paper also tries to educate on the problems associated with landfills while dealing briefly, on the advantages of biological processing and also how waste can be avoided and reduced. The paper also tries to present waste management concepts in relation to Bauchi city.

***Keywords*:** waste; pollution; disposal; recycling; concepts

1. INTRODUCTION

The oxford advanced learners dictionary defines wastes as "materials that are no longer needed and are thrown away. They could be household or industrial, toxic or radioactive. These waste materials can either be gasses, liquids or solids. Waste material not properly handled or disposed of results in to environmental pollution. And we could have air, water, and even soil pollution resulting from the inappropriate disposal of any type of these waste materials. L. F Diaz (2007) states that although the dissemination and application of innovative technical information is extremely important, the implementation of sustainable waste management practices also requires a thorough understanding of the pertinent legal, social, economic, and regulatory issues involved.

Pollution of the environment has since been made a global issue, this is due to the fact that it's contaminating nature affects the quality of life, or the natural functioning of the Ecosystems (living organisms and their physical surroundings), effects of pollutants, (materials) themselves interfere with human health. Mostly these pollutants are manmade, that is through human activities.

There are two main categories of polluting materials or pollutants. Biodegradable pollutants are materials, such as sewage, that rapidly decompose by natural processes. These pollutants become a problem when added to the environment faster than they can decompose. Nondegradable pollutants are materials that either do not decompose or decompose slowly in

the natural environment. Once contamination occurs, it is difficult or impossible to remove these pollutants from the environment.

Because humans are at the top of the food chain, they are particularly vulnerable to the effect of Nondegradable pollutants. We can see in the spread of bird flu, or other disease transmitted by animals exposed to toxic materials and subsequently eaten by humans.

Pollution also has a dramatic effect on natural resources. Ecosystems such as forests, wetlands, coral reefs, and rivers perform many important services for earth's environment. They enhance water and air quality, provide habitat for plants and animals, and provide food and medicines. Any or all of these ecosystem functions may be impaired or destroyed by pollution. Global warming, due largely to the depletion of the ozone layer, has become the topic of numerous world summits and great debates in recent times. Pollution cleanup and prevention has always been a very expensive exercise to carry out.

In addition to its effect on the economy, health, and natural resources, pollution has social implications. Research has shown that low income populations and minorities do not receive the same protection from environmental contamination as do higher income communities. Toxic waste incinerators, chemical plants, and solid waste dumps are often located in low income communities because of lack of organized, informed community involvement in municipal decision making processes.

Pollution exists in many forms and affects many different aspects of earth's environment. *Point source* pollution comes from specific, localized, and identifiable sources, such as sewage pipelines or industrial smokestacks, *non point source* pollution comes from dispersed or uncontained sources, such as contaminated water runoff from urban areas or automobile emissions. Recently top ranking athletes including Gabriel salasie of Ethiopia are threatening to back out of the Beijing Olympics due to the poor visibility in the area, which is caused mainly by automobile emissions. The effect of these pollutants may be immediate or delayed.

2. AN OVERVIEW OF SOLID WASTE MANAGEMENT METHODS

Solid wastes are unwanted solid materials such as paper, plastics, cellophane and other synthetic materials, metals, and wood. According to the Microsoft Corporation (2002), during research made on the compilation of the Microsoft Encarta 2003, the United States alone produces about 200million metric tons of municipal solid waste each year which is among the billions of tons thrown out annually worldwide. A typical American generates an average of 2kg of solid waste each day. Cities in economically developed countries produce far more solid waste per capita than those in developing countries. Moreover, waste from developed countries typically contains a high percentage of synthetic materials that take longer to decompose than the primarily biodegradable waste materials of developing countries.

2. 1. Landfills

Oprah Winfrey, in one of her television talk shows on the theme "GOING GREEN", says when you throw waste away its not actually away but A PLACE. She was actually talking on how most wastes end up in landfills.

Landfills are areas where wastes are buried. They are the cheapest and most common disposal method for solid wastes worldwide. Disposing of waste in a landfill involves burying waste to dispose of it, and this remains a common practice in most countries. Historically, landfills were often established in disused quarries, mining voids or borrow pits. A properly-designed

and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly-designed or poorly-managed landfills can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate.

Another common byproduct of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobic ally. This gas can create odor problems, kill surface vegetation, and is a greenhouse gas. Design characteristics of a modern landfill include methods to contain leachate such as clay or plastic lining material. Deposited waste is normally compacted to increase its density and stability, and covered to prevent attracting vermin (such as mice or rats). Many landfills also have landfill gas extraction systems installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity. Many local authorities, especially in rural areas, have found it difficult to establish new landfills due to opposition from owners of adjacent land. As a result, solid waste disposal in these areas must be transported further for disposal or managed by other methods. This fact, as well as growing concern about the environmental impacts of excessive materials consumption, has given rise to efforts to minimize the amount of waste sent to landfill in many areas. These efforts include taxing or levying waste sent to landfill, recycling waste products, converting waste to energy, and designing products that use less material. Up to just a few years ago, one of the waste disposal sites in Lagos state, the landfill at Ojota was considered as an environmental problem due to the odors and smoke resulting from untimely burning, and was a serious eyesore until the state government decided to cleanup the area by compacting the wastes and subsequently covering them up properly.

2. 2. Incineration

Incineration is a disposal method that involves combustion of waste material. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam, and ash. Incineration is carried out both on a small scale by individuals and on a large scale by industries. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal due to issues such as emission of gaseous pollutants. Incineration is common in places like Japan and Lagos where land is scarce, as these facilities generally do not require as much area as landfills. Waste-to-energy (WtE) or energy-from-waste (EfW) are broad terms for facilities that burn waste in a furnace or boiler to generate heat, steam and/or electricity. Modern combustion technologies maintain the advantages of incineration without its numerous disadvantages, while providing a clean energy source. Installation of a "boiler" such as the RCBC (rotary cascading bed combustor) allows the consumption of problem waste as fuels for the generation of electricity. Municipal solid waste, sewage, sludge, "dirty coals", and coal by products, are cleanly and efficiently consumed for energy production with emissions well within strict regulatory standards. The fly ash by product is inert, and can be mixed with compost. Tridel SA, a public corporation, is a modern waste-to-energy plant in Lausanne, Switzerland. It provides both electrical and thermal energy, totalling about 60 MW. It uses an oscillating firebed. The emitted gases are treated to reach as low as about 10 % of the permitted values of pollutants as regulated by the severe Swiss legislation, except for NO_x, which is held at 50 %. The water used is collected mostly from roofs and paved areas and all waste water conforms to strict standards. Solid waste is mostly treated clinker plus washed fly ash and is

almost inert, occupying about 10 % of the volume of the original compacted municipal waste and other sources. Heavy metals, including mercury, are extracted and sent by rail for recycling. A unique feature is that much of the waste arrives by rail, through a purpose-built 4 km tunnel; as the plant is built about 250 m higher than the lake, this avoids the pollution from numerous trucks per day climbing the steep hill. Environmentally, Tridel SA supplies almost 10 % of the electricity consumed in its catchment area at full output, from a renewable fuel. Economically, it is viable.

Besides the construction of incinerators, especially in less developed communities, proper enlightenment should be done on the use and advantages of these incinerators. Recently, during the construction of small incinerators in some local government areas of Bauchi state, I sent some of my workers to educate the people on the advantages of the proper utilization of these incinerators so as to avoid misuse as is usually the case with most facilities provided in less developed areas.

2. 3. Recycling

Recycling is the reprocessing of materials into new products. Recycling generally prevents the waste of potentially useful materials, reduces the consumption of raw materials and reduces energy usage, and hence greenhouse gas emissions, compared to virgin production. Recycling is a key concept of modern waste management and is the third component of the waste hierarchy. Recyclable materials, also called "recyclables", may originate from a wide range of sources including the home and industry. They include glass, paper, aluminum, asphalt, iron, textiles and plastics. Biodegradable waste, such as food waste or garden waste, is also recyclable with the assistance of micro-organisms through composting or anaerobic digestion. Recyclates are sorted and separated into material types. Contamination of the recylates with other materials must be prevented to increase the recyclates' value and facilitate easier reprocessing for the ultimate recycling facility. This sorting can be performed either by the producer of the waste or within semi- or fully-automated materials recovery facilities. There are two common household methods of recycling. In curbside collection (UK: kerbside collection), consumers leave presorted recyclable materials in front of their property to be collected by a recycling vehicle. With a "bring" or carry-in system, the householder takes the materials to collection points, such as transfer stations or civic amenity sites.The term *recycling* does not generally include reuse, in which existing items are used for a new purpose. An example is the reusing of a peanut butter jar or jam jar (bottle) being used as container for sugar or salt.

2. 4. Biological processing

Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter. There are large varieties of composting and digestion methods and technologies varying in complexity from simple home compost heaps, to industrial-scale enclosed-vessel digestion of mixed domestic waste. Methods of biological decomposition are differentiated as being aerobic or anaerobic methods, though hybrids of the two methods also exist. An example of waste management through composting is the

Green Bin Program in Toronto, Canada, where household organic waste (such as kitchen scraps and plant cuttings) are collected in a dedicated container and then composted.

3. TURNING ON BAUCHI

Nigeria has experienced some growth in its economy and population since independence leading to consequent expansion in infra structural facilities and social services to sustain the population growth. This structural development has brought about an increase in the commercial and industrial activities resulting in a phenomenal increase in volume and diversity of solid bio-waste generated on daily basis throughout the country especially in the urban centers. Lewcock (1994) stated that the urban waste generated on daily basis in most urban centers poses a great threat to environment through pollution in Nigeria. I consider this very true for Bauchi state.

Bauchi local Government Area (LGA) in Bauchi state lies between latitude 10^0 17' – 10^0 20' north and longitude 9^0 49' – 10^0 05' east, with an altitude of 690.2m above sea level (Kowal and Knabe,1972).

The principal sources of street refuse in Bauchi local government area are households, markets, street sweepings and drain clearance. Refuse is found in one or two locations at the side of streets and in formal and informal land fill dumps.

The evacuation of urban refuse from the urban center is carried out by the Bauchi state Environmental protection Agency, (BASEPA). The waste generated on household basis is less than 0.4ton/household/day. The refuse is usually dumped at the outskirts of the town along major road outlets or on farmlands, if requested by commercial farmers. These wastes sometimes stay at the various collection points for several weeks or months before being transported to the designated dumping grounds in the open usually not very far from the city. A typical example is the dumping site at federal low-cost.

An almost similar situation is the handling of agro – industrial wastes like rice husk, groundnut shells, and locust bean shells. These materials are either thrown out in the open or burnt to get rid of the urban refuse. Most times the abundant quantity of these materials constitutes a nuisance to the environment and the community.

4. CONCEPTS TO ADOPT

There are several waste management concepts that can help bring sanity to the waste problems in Bauchi city and below are some of them.

- Best practicable environmental option (BPEO)
- Extended producer responsibility
- Muda (Japanese term)
- Pay as you throw
- Polluter pays principle
- Precautionary principle
- Product stewardship
- Proximity principle
- Sustainability
- Waste strategy
- Waste hierarchy

- Reduce
- Reuse
- Recycle
- Zero waste

The ones highly recommended are:

Pay as you throw (PAYT)

This is a usage pricing model for disposing of municipal solid waste. PAYT is sometimes referred to as unit pricing or variable rate pricing. Users pay a variable rate based on how much waste they present for collection by the local authority or municipality. Where this system is implemented, recyclable waste is usually collected free of charge.

Waste hierarchy

The waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

Extended producer responsibility

Extended Producer Responsibility (EPR) is a strategy designed to promote the integration of all costs associated with products throughout their life cycle (including end-of-life disposal costs) into the market price of the product. Extended producer responsibility is meant to impose accountability over the entire lifecycle of products and packaging introduced to the market. This means that firms which manufacture, import and/or sell products are required to be responsible for the products after their useful life as well as during manufacture.

Polluter pays principle

The Polluter Pays Principle is a principle where the polluting party pays for the impact caused to the natural environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the waste. This should help with the industrial wastes generated along railway in Bauchi city.

Waste minimization

This is the process and the policy of reducing the amount of waste produced by a person or a society. It is part of the wider aim of waste reduction which is often described as a component of the waste hierarchy.

In the waste hierarchy, the most effective policies and processes are at the top. Waste minimization is also strongly related to efforts to minimize resource and energy use. For the same commercial output, usually the fewer materials are used, the less waste is produced. Waste minimization usually requires knowledge of the production process, cradle-to-grave analysis (the tracking of materials from their extraction to their return to earth) and detailed knowledge of the composition of the waste.

Avoidance and Reduction

Another important method of waste management is the prevention of waste material being created. Methods of avoidance include reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using disposable products (such as disposable cutlery), and designing products that use less material to achieve the same purpose (for example, light weighting of beverage cans). Researchers have found a new way to make gears of cars from Teflon. A DuPont chemist named Roy Plunkett discovered Teflon, in 1938. Teflon today is widely used in kitchenware. Plunkett discovered the material accidentally by pumping Freon gas into a cylinder left in cold storage overnight. The gas dissipated into a solid white powder. Teflon is unique because it is impervious to acids in addition to both cold and heat. Teflon is now best known for its slipperiness -- which makes it highly effective in pots and pans for easy cooking and cleaning.

5. WASTE-TO-ENERGY (WTE) OR ENERGY-FROM-WASTE (EFW)

In its strictest sense, this refers to any waste treatment that creates energy in the form of electricity and/or heat from a waste source. Such technologies reduce or eliminate waste that is traditionally streamed to a "greenhouse gas" emitting landfill, or consume waste materials from existing landfills. WtE is also called energy recovery. Most WtE processes produce electricity directly through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels.

6. CONCLUSION

It has been established that improper handling of waste brings about pollution which, if not handled properly can lead to disaster not only in terms of the people's health but also affects the economy of that nation.

Solutions have been proffered and they include recycling of waste, incineration of these wastes, proper use of landfills and biological processing. Energy can be generated from waste and if Bauchi state can invest in proper research it will hugely benefit from this venture.

The state can also tap in and promote more research work on tefflon, and also utilize the marketing potentials of the various waste management concepts listed

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