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The Concept of Waste and Waste Management

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Abstract

Several studies and researches have been conducted on the sources and characteristics of wastes as well as the possible adverse effect of inappropriate handling and best international practices. One thing that is still not clear however is what exactly constitutes a waste? How much do we know about what should be classed as waste? What are the historical contexts of waste managements? The present paper seeks to examine these vital questions with a view to providing answers from previous studies. The paper employed a desktop approach to provide answers to the research objectives. Specifically, the paper uses a descriptive approach to gather information from peer reviewed publications such as, journal articles, environmental organizations reports and books. It was found that, waste is to a large extent subjective in meaning as a substance can only be regarded as a waste when the owner labels it as such. This is particularly true because one individual may regard a substance as a waste, while another may view the same substance as a resource. Nevertheless, it was argued that there is a need to clearly define what constitute wastes as this form the basis for regulation.

Keywords: environment, waste, wastes classification

1. The Concept of Waste

Most human activities generates waste (Brunner and Rechberger, 2014). Despite that, the production of wastes remain a major source of concern as it has always been since pre historic period (Chandler et al, 1997). In recent times, the rate and quantity of waste generation have been on the increase. As the volume of wastes increases, so also does the variety of the waste increases (Vergara and Tchobanoglous, 2012). Unlike the pre historic period where wastes were merely a source of nuisance that needed to be disposed of. Proper management was not a major issue as the population was small and a vast amount of land was available to the population at that time. In those days, the environment easily absorbed the volume of waste produced without any form of degradation (Tchobanoglous et al, 1993).

A substantial increase in volume of wastes generation began in the sixteenth century when people began to move from rural areas to cities as a result of industrial revolution (Wilson, 2007). This migration of people to cities led to population explosion that in turn led to a surge in the volume and variety in composition of wastes generated in cities. It was then that materials such as metals and glass began to appear in large quantities in municipal waste stream (Williams, 2005). The large population of people in cities and communities gave rise to indiscriminate littering and open dumps. These dumps in turn formed breeding grounds for rats and other vermin, posing significant risks to public health. The unhealthy waste management practices resulted in several outbreaks of epidemics with high death tolls (Tchobanoglous et al, 1993). Consequently, in the nineteenth century public officials began to dispose waste in a controlled manner in other to safe guard public health (Tchobanoglous et al, 1993).

Most developed countries passed through a period when they were developing environmentally. Today, however, most of these countries have effectively addressed much of the health and environmental pollution issues associated with wastes generation. In contrast, the increasing rate of urbanisation and developments in emerging countries is now leading to a repeat of the same historical problems that developed countries have had to address in the past (Wilson, 2007).

An important question in modern day wastes management is – what exactly is a waste? Waste is the useless by product of human activities which physically contains the same substance that are available in the useful product (White et al, 1995). Wastes have also been defined as any product or material which is useless to the producer (Basu, 2009). Dijkema et al, (2000) pointed out that, wastes are materials that people would want to dispose of

even when payments are required for their disposal. Although, waste is an essential product of human activities, it is also the result of inefficient production processes whose continuous generation is a loss of vital resources (Cheremisinoff, 2003).

A substance regarded as a waste to one individual, may be a resource to another. Therefore, a material can only be regarded as a waste when the owner labels it as such (Dijkema et al, 2000). Despite this subjective nature of wastes, it is important to describe clearly, what constitutes a waste because. This is because the classification of a material as a waste will form the foundation for the regulations required to safeguard the populace and the environment where the wastes are being processed or disposed of (DEFRA 2009).

2. Statement of the Problem

Although it is generally agreed that wastes management services are essential services that must be provided in every society, nonetheless very little is known on what exactly constitute a waste. Knowing that the concept of waste is highly subjective as one man's wastes is a resource to another. Hence, it is important to have a clear guide as to what could be classed as waste. The present research therefore examines the concept of wastes and wastes management with a view to determining what waste is, how they are classified and managed.

3. Methodology

This paper which is a review of literatures relied heavily on secondary data as is the case with most desktop study where existing information are used for analysis and to draw vital conclusions. Some of the specific sources of data for the study includes books, journal articles, unpublished papers, government reports, organizational and private webpages. This type of research approach is employed when a substantial amount of work has been done on a research topic and when the intention of the study is to answer specific questions based on previous works. It is for these reasons that the present paper utilized this approach to examine what different researchers have said on wastes, its classification and management.

4. Classification and Types of Waste

Waste arises in many different forms and its characterisation can be expressed in several forms. Some common characteristics used in the classification of waste includes the physical states, physical properties, reusable potentials, biodegradable potentials, source of production and the degree of environmental impact (Demirbas, 2011; Dixon & Jones, 2005; White et al., 1995). White et al. (1995) stated that waste can be classified broadly into three main types according to their physical states; these are liquid, solid and gaseous waste. Although it is clear that several classifications exists in different countries. The most commonly used classifications are illustrated below.

- Physical state
  - Solid waste
  - Liquid waste
  - Gaseous waste
- Source
  - Household/Domestic waste
  - Industrial waste
  - Agricultural waste
  - Commercial waste
  - Demolition and construction waste
  - Mining waste
- Environmental impact
  - Hazardous waste
  - Non-hazardous waste

Due to the limited scope of the research study, liquid wastes, which can be disposed of via sewer networks or lost to ground water, and hazardous wastes, which require tighter environmental controls, because of their potential to cause environmental harm, are excluded. Only solid waste will be discussed in detail, excluding hazardous solid waste.

Tchobanoglous et al. (1993) describes solid waste as the waste produced by human activities that are in a solid or

semisolid form and are thrown away as useless products. Beranek (1992) submitted that solid wastes are a broad group of wastes produced as a result of various activities such as agricultural activities, landscaping activities and other processes including domestic and commercial processes. He argued that solid wastes are distinctly different from waste water and gaseous waste emissions. His view is that, solid wastes are any wastes that people would normally consider fit for land disposal. Basu (2010) added that, solid waste includes municipal waste, some biomedical waste, electronic waste and some hazardous waste. Basu stated that solid waste could be putrescible and non-putrescible. Similarly, Kaseva & Gupta (1996) noted that solid wastes are waste materials from municipal, industrial and agricultural activities. Tchobanoglous et al. (1993) concluded that unlike other wastes, solid wastes do not disappear easily. They argued that, where they are thrown today is where they will still be found in future.

4.1 Some Common Sources/Types of Solid Waste

Since solid waste consist of several types of waste, it is important to briefly examine the various forms and types of solid waste.

4.1.1 Municipal Solid Waste (MSW)

Municipal solid waste (MSW) is an important waste stream and also one of the most studied. White et al. (1995) reported that, MSW has several implications. They argued that being the waste stream that people often come in contact with, their collection, treatment and disposal is considered as an important service by politicians and local government. Kaseva & Gupta (1996) describe municipal solid waste as the waste collected by the city authorities which include refuse from household, non-hazardous solids from industrial, commercial, institutional and non-pathogenic hospital waste. Buah et al. (2007) describes MSW as wastes collected for local authorities from domestic and commercial sources. White et al. (1995) described municipal solid waste (MSW) as waste produced from household and commercial premises. They added that municipal solid waste is only a small fraction of the total solid waste arisings. Vergara & Tchobanoglous (2012) observed that municipal solid waste reflects the lifestyles and customs of the people that produces it. They added that, MSW can have a negatively impact on the well-being of the public and the environment if not properly managed.

The European Union, for legislative purposes, has set out its legal definition of municipal waste in the Directive on the Landfill of Waste 1999/31/EC - Municipal Waste as *waste from households, as well as any other waste which, because of it nature or composition is similar to waste from households*. This broader definition therefore considers waste from commercial premises to be municipal, where it is similar in composition to household waste.

White et al. (1995) added that, MSWs are difficult to manage as the components are diverse, with materials such as metal, paper, glass and other organics mixed together. *Similarly, a study* (Berkun et al., 2011) *revealed that the characteristics of MSW depend largely on the source however, in some countries, Turkey for example; nearly more than half of all MSW are putrescible materials while the recyclable constituents such as cardboard, paper, glass and plastics make up a significant percentage of the total municipal solid waste.*

Dixon & Jones (2005) reported that, the compositions of municipal solid include materials such as soil, garden and food waste, wood, paper, ashes, plastics, textiles and rubber. They concluded that, municipal solid wastes are a collection of wastes that are mainly from household and commercial sources. Similarly, Buah et al. (2007) added that, MSW mainly consist of food and garden waste, textiles, paper or cardboard, plastics, glass and metals. They argued that, due to the composition of MSW, the waste could easily be used for energy recovery or the production of fuel. White et al. (1995) argued that, unlike other waste streams that are more homogeneous with a good percentage of each material, the composition of municipal solid waste are diverse and are generally prone to changes from city to city and country to country.

4.1.2 Construction Waste

Solid waste from the construction industry one of the main waste streams in many countries. Poon et al. (2001) reported that in Hong Kong, construction waste amounted to about 29,674.013 metric tonnes per day. They pointed out that, most of the construction wastes produced in the country included both inert and non-inert materials. Furthermore, Jaillon et al. (2009) pointed out that the huge volume of solid waste generated by the construction industry in Hong Kong is as a result of the limited availability of land in the country. They added that as a result of the boom in the construction of multi-story buildings in the city about 21.5 million tonnes of construction waste was produced in 2005.

Similarly SEPA (2011) *reported that although the construction industry contribute about £10 billion to the Scottish economy yearly, the sector also produced a large percentage of solid waste which range from concrete,*

wood, metals, plastics, soils, glass among other materials. SEPA estimated that the industry generate about nine million tonnes of waste annually. A similar trend is observed across the EU, the volume of construction waste is on the increase and the wastes produced are significantly high when compared to the total waste generated. For instance, figures from Eurostat, (2014) *revealed that in 2008 Construction waste in the UK account for about 100,999,493 tonnes while in 2010, the sector contributed about 105,560, 291 tonnes of waste. Similarly, France produced 252,979,840 tonnes and 260,225,886 in 2008 and 2010 respectively while construction waste in Germany was 197,206,500 and 190, 990,217 tonnes in 2008 and 2010. Cumulatively the 27 member countries of the EU produce about 871,370,000 and 859,870,000 in 2008 and 2010 respectively. European Environment Agency (2009) reported that overall about 31% of all waste produced in the EU annually are construction waste. A report (Eurostat, 2009) revealed that construction and industrial waste amounted to about 50% of all waste produced in the EU in 2006.*

A study (Mcdonald & Smithers, 1998) found that on the average about 15% of solid waste landfilled in Australia are generated from construction activities annually. Faniran & Caban (1998) reported that the huge waste produced by the construction industry in Australia adds to the cost of construction projects, mainly due to the strict control of landfills in Australia. Faniran & Caban found that, most construction waste are produced from design/detailing errors, design changes, packaging waste, unused scrap materials among others. Similarly, Barros et al. (1998) observed that a good percentage of construction waste produced in the Netherland includes plastics, metal, wood and stones mainly from demolition and re construction activities. Furthermore, Barros and others found that apart from other waste produced during construction, about 1 million tons of sand is produced as waste annually, some of which are recycled.

4.1.3 Industrial Waste

Ngoc & Schnitzer, (2009) described industrial wastes as waste produced as a result of the processing of raw materials for the production of new products. They pointed out that these could be in factories, mines or even mills. It has been reported (Shafigh et al., 2014) that in Malaysia, Indonesia and Thailand a large percentage of the total solid waste arisings is from palm oil processing. The report found that, annually about *3.2 million metric tons* of solid waste is produced in Thailand from the palm oil industry. The corresponding value for Malaysia and Indonesia 47 and 40 million tons respectively, the waste produced by the industry includes bunches, fruits shells and palm fibre. Ngoc & Schnitzer (2009) reported different types of wastes produced by the industries; they added that some of the wastes are toxic while others are non-toxic.

4.1.4 Agricultural Solid Waste

Generally, Agricultural solid wastes are many and are beyond the scope of this study. However, Tchobanoglous (1993) noted that agricultural wastes are wastes arising from activities such as the rearing of livestock, sowing of plants and from milk production. Williams (2005) reported that agricultural waste materials include animal manure, various crop residues and silage effluent. Agricultural wastes are mostly reusable in the energy and industrial sector. Seadi & Holm-Nielsen (2004) however, reported that inappropriate management of agricultural waste may lead to environmental hazard for example; high application of manure on land could pollute surface and ground water.

4.1.5 Commercial Waste

Commercial waste is an important waste stream especially considering the vast amount of solid waste generated from this sector. The Environment & Heritage Service, (2005) reported that, in Northern Ireland, about 1.5 million tonnes of solid waste was generated by commercial and industrial activities in 2005. The report added that, commercial activities produced more than half of the total solid waste produced for that year. The result of a survey of industrial and commercial businesses in England (DEFRA, 2009) shows that commercial waste accounted for about 11% of the total waste produced in 2002.

Similarly, in Scotland, a survey (SEPA, 2008) *showed that retailing, wholesales, hotels and restaurants produced the largest volume of commercial waste in Scotland in 2006. The survey revealed that some areas of the country with a large concentration of businesses produced more business waste than other areas with fewer businesses. Glasgow and Clyde particularly produced higher percentages of waste than other areas. On the overall (SEPA, 2011) revealed that in 2009, the commercial sector contributed about 29% of the total waste to the total volume of controlled waste generated in Scotland.*

Commercial solid wastes are solid or semi-solid wastes produced as a result of activities in stores, restaurants, markets, offices, hotels, motels, print shops, service stations, auto repair shops among others (Tchobanoglous, 1993). Literatures (Buah et al., 2007; Ogwueleka, 2009; White et al., 1995) revealed that commercial waste is often discussed or grouped under municipal solid waste. However, Williams (2005) noted that, in most cases

information on the breakdown of wastes into domestic and commercial are not readily available. McLeod et al. (2011) argued that, solid waste produced from commercial and domestic activities have similar constituents. However, they observed that the wastes are not collected together for disposal in the UK. Generally, the most common waste produced by the commercial sector include, consumer electronics, batteries, tires, white goods, paper, cardboard, metal, plastics, food waste, wood, glass among others (Tchobanoglous, 1993).

Sustainable solid waste management requires an adequate understanding of the characteristics, sources and generation rate of solid waste in an area (Tchobanoglous, 1993). It is therefore important to address waste from commercial activities separately in other to understand the composition, volume and generation rate from the various segment of commerce. A breakdown of the different sources of commercial waste reveals that several thousand tonnes of waste are generated from various commercial activities yearly all over the world as illustrated below.

- **Traditional/open Markets:** Open market trading is a popular practice in many developing countries for general buying and selling of goods. Sridhar & Adeoye (2003) reported that the items sold in these markets include textile, household goods, foodstuffs, herbal medicines, pharmaceuticals, electrical goods, building materials, stationaries among others. Adekunle (2012) revealed that, although these markets attract growths to the local economy, the inadequate management of waste in these markets means that they contribute to environmental degradation. Aye & Widjaya, (2006) reported that market wastes are the second largest contributor to the total municipal solid waste generated in Indonesia after household waste. A study conducted in India (Rajeshwari et al., 2001) revealed that waste from these markets are usually very rich in organic matter. However, Rajeshwari and others reported that, these organic materials are often dumped indiscriminately. Sridhar & Adeoye (2003) observed that most of the solid wastes produced in these traditional markets are food waste.

- **Hotels and restaurants**: The hotel industry can negatively impact on the environment due to the large volume of solid waste they produce (Scanlon, 2007). A survey of solid waste management practice of small hotels in the UK (Radwan et al., 2010), revealed that most hotel operators are not environmentally conscious; the survey showed that most of the hotels do not reuse their waste. Hence, they contribute to environmental degradation as a result of the huge volume of solid waste they generate daily. Similar, Erdogan & Baris (2007) reported that most of the hotels that participated in a survey to determine environmental practice of hotels in Ankara, Turkey do not sort or recycle their waste. They added that, some of the hotels that sort their waste had inadequate system for waste separation. A survey in Hong Kong (Chan & Lam, 2001), revealed that the lack of interest to reuse waste in the hotel industry is as a result of the cost associated with the purchase of recycling materials. Furthermore, the survey revealed that the lack of information on the impact of solid waste generated by hotels on the environment added to the lack of interest to reduce solid waste by the hotels. Kasim (2007) pointed out that on the average a hotel will produce more solid waste than a household. He further stated that, the characteristics and the volume of waste produced in a hotel would depend on the number of rooms available in the hotel and their involvement in events hosting.

A survey (Trung & Kumar, 2005) reported that a typical hotel will produce waste from various sources such as Kitchen and restaurants, rooms, offices, laundry and gardens. Trung and Kumar argued that the typical waste composition will include food waste, plastics, paper, paints, used batteries, garden waste among others. Erdogan & Baris (2006) noted that most of the solid waste produced by hotels in Ankara include paper, plastic, metals, glass and food waste. Chan & Lam (2001) reported that, about 53,070 tons of solid waste was produced by hotels in Hong Kong in 1996 costing about 3.02 million Hong Kong dollars. The waste materials included plastic toiletries, unused soap, slippers and newspapers. They added that, between 1986 and 2000 the hotel industry contributed about 1.5% of the total solid waste generated in Hong Kong.

- **Retail waste**

A report (DEFRA, 2011) pointed out that the retail sector covers various commercial activities from the sales of vehicles to household items in or outside stores. The report added that, most wastes produced from the sector are non-metallic with composition ranging from packaging materials to animal and vegetable waste. Generally, the type of materials sold influences the type of waste produced. A survey of grocery stores in Quebec, Canada, (Norrie et al., 1997) revealed that materials such as fruits, baked products, seafood, packaging materials and other frozen products make up a large amount of waste from grocery stores.

A report (WRAP, 2011) pointed out that in 2008 alone, the retail sector generated about 1.4 million tonnes of packaging and food waste in the UK. Environment & Heritage Service (2005) reported that in 2005 commercial activities such as retailing, wholesaling, public administration, real estates and other business activities produced

about 459,285 tonnes of waste in Northern Ireland. A survey in Mexicali, Mexico (Ochoa et al., 2010) revealed that a single store in Mexicali generated about 5,375kg of cartons and 339kg of plastics per week.

A survey (Norrie et al., 1997) pointed out that, one supermarket chain in Quebec spends about $6 million for waste disposal. Hence, Ochoa et al. (2010) suggested that, supermarkets should consider recycling and reusing as a waste management tool in other to recover some operational cost.

5. Waste Management

Human interactions with the environment (human activities) have always resulted in waste production. However, Giusti (2009) reported that waste production and management was not a major issue until people began living together in communities. Vergara & Tchobanoglous (2012) reported that as population and purchasing power of people increases worldwide, more goods are produced to meet increasing demand, thereby leading to the production of more waste. Marchettini et al. (2007) pointed out that, these continuous flows of waste resulting from human activities, overburdened the environment.

Vergara & Tchobanoglous (2012) reported that proper planning and control is required in other to prevent the negative impact of waste on the environment. As a result, Ghiani et al. (2014) added that, a proper organisation of solid waste management has become an essential task needed to safeguard the environment.

Beranek (1992) argues that the provision of an efficient solid waste management system is now as important as other essential amenities such as electricity, airports, and highways. Basu (2009) pointed out that due to the increasing volume of waste. The continuous disposal of waste to landfill is unsustainable. Hence, Basu argues that the processing of waste is a necessary step needed to safeguard public health.

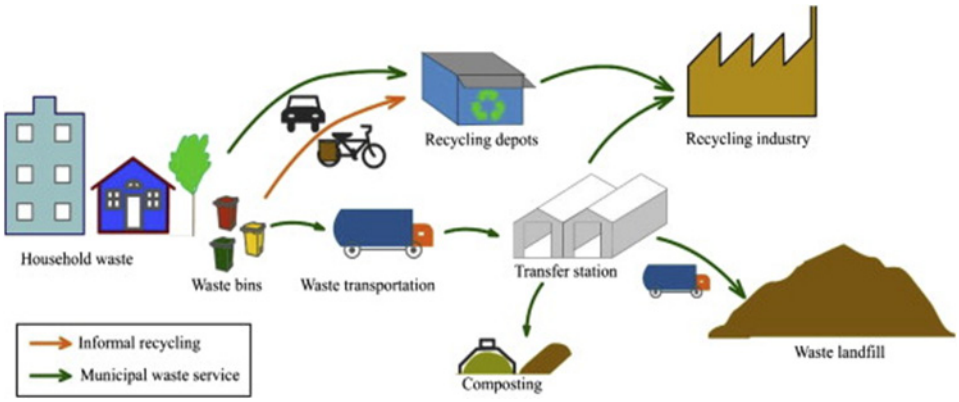

Figure 1. The waste management cycle

Source: Zaman, 2014.

Demirbas (2011) describes waste management as a process by which wastes are gathered, transported and processed before disposal of any remaining residues. Similarly, Tchobanoglous et al. (1993) describe solid waste management as the effective supervision and handling, keeping, collection, conveying, treatment and disposal of waste in a manner that safeguard the environment and the public. Tchobanoglous et al added that, solid waste management utilizes skills and knowledge from various discipline such as legal, financial, administration among others in the day to day running of waste management issues. Demirbas (2011) suggested that the main reason for managing waste is to ensure a safe environment.

Troschinetz & Mihelcic (2009) pointed out that some waste management methods are often preferred than others. For instance, reuse, recycling, composting and energy generation from incineration are often preferred to landfills. However, Dijkema et al. (2000) argued that even some of the preferred management methods, often produce some hazardous materials such as incineration residues. Strange (2002) reported that landfilling is the final destination of most waste produced from waste treatment and processing facilities. Strange, added that, other technologies merely serve the purpose of volume reduction or treatment before final disposal.

Cheremisinoff (2003) reported that, there are different forms of approach to waste management. He added that, wastes streams with different characteristics may require different management approach. For instance, industrial waste might contain more hazardous materials than municipal waste streams. Hence, the management of these two waste streams might differ. Vergara & Tchobanoglous, (2012) found that, although waste management might

differ between countries, there are some basic processes or paths that waste management needs to follows. These paths are illustrated in Figure 1, the study reported that, wastes generated must be gathered and stored by the generator in a place. The municipal authorities or their agents collect the waste from the point of storage, for transportation to processing or disposal sites. The study added that, in some instances, the waste generators separate the waste into various materials from where they are collected for recycling by the recycling industries.

6. Conclusion and Recommendation

It is agreed that wastes is a direct result of human interaction and activities. Nevertheless, there seems to be several opinions as to what constitute a waste. Several researchers however agreed that wastes are materials whose owners no longer have a need for. Therefore, it is obvious that wastes is indeed subjective in meaning, as the term is open to several interpretations and also influenced by personal opinion. Nevertheless, it is important to provide a definition or at least a guide for the purposes of policies andlegislations. This is evident from the fact that, it is the knowledge of what specifically constitute a waste and the categories of wastes that determines how wastes are dealt with or managed.

Waste management involves a process whereby wastes are collected, transported and disposed of in the best possible way of limiting or eliminating the harmful effect of wastes. This aspect of environmental management is as important as other public amenities or infrastructures without which the life of contemporary man would be extremely difficult. This is because studies have shown a direct link between air, water and land pollution and diseases such as lung cancer, heart disease, cholera and hepatitis. In addition, climate change and eutrophication are a direct result of water and air pollution. Little wonder why there is a huge disparity in the life expectancy of people in developed and developing countries.

Since factors such as population increase and the coming together of people to form communities lead to increase waste generation. Efforts should be directed towards making projections far ahead in order to ensure that new and existing settlements are adequately planned so as to accommodate possible increase in the volume of waste generation in future. Effectively planning ahead will prevent indiscriminate disposal and other harmful practices so as to prevent the build-up of open dumps and breeding ground for rats and other vermin which poses health risk.

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