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Cost Benefit Analysis of Waste in South Africa

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Abstract

Waste is a serious challenge that impacts the economy of any nation and its environment. In Africa where the even increasing population has consequently increased the production rate with a human response to generate more waste, there has not been adequate approach to reduce and manage waste properly in the continent. With this ever increasing growth comes the need to provide food and social amenities needed to sustain the growing population. However, associated with the increase in the amount of waste generated is the continual loss of capital and a social and environmental cost to the populace. In this paper, we provide an overview of the nature of waste in the South Africa, the application and utilization of waste in the South Africa context and we also look at the cost of waste generated in the society in relation to the economy, society and the environment.

Keywords: Food Waste, Cost, Waste Management, Landfill**,**

1. Introduction

As far back as 2012, South Africa generated as a high as 9 million tons of food waste in a year (Mckenzie, M, 2012). Data obtained by (Savides, 2016) shows that South Africa now generates a total of 108 million tons of waste with only less than 10 percent of the waste recycled. Waste in South Africa is classified as general waste and hazardous waste. Domestic, building and demolition, business and inert wastes constitute the general waste categories. Hazardous waste are known for its that detrimental effect on the populace. The amount of hazardous waste does matter as its inherent chemical and toxicological characteristics have lasting effect on the populace (Nkosi *et al*, 2013). Waste varies from agricultural waste, industrial waste and food waste. A high portion of waste generated in the society are from fruits, processed foods and food waste from households Some part of the food available are

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inedible i.e. peeling and bones, thus they are disposed into the land fill, constituting only 19 percent of the total food waste (De Lange, W. and Nahman A., 2015). Food waste occurs throughout the food supply chain, for example in production, storage, transportation, and processing. Also, this includes food losses that arise before food reaches the end-user and food that is thrown away by consumers. Globally, food waste throughout the food supply chain amounts to 50% of all food that is produced for human consumption (Lundqvist *et al*, 2008). Also, Food wastage is water wastage. Landfilling is the common means of waste management in South Africa, which is about 90% of waste disposal means. (De Lange,W. and Nahman A., 2015). Waste is classified into 13 key waste streams in South Africa as follows: General Waste: municipal waste (non-recyclable portion), organic waste (component of municipal waste), other (industrial and agricultural biomass waste), construction and demolition waste, paper, glass, plastic, metals, tyres; unclassified waste; electric and electronic equipment (WEEE), slag (from mineral processing), ash (from power generation); and hazardous waste: waste oils (DST 2014). About 46.8 million tonnes of general waste is generated yearly in South Africa with the largest proportion from the Gauteng (45%) and Western Cape (20%) province producing the largest part in South Africa (Savides, 2016). In addition, more than 5 million cubic meters of hazardous waste is produced annually, mostly in the provinces of Mpumalanga and KwaZulu-Natal.

Therefore, in the paper, an overview of the waste type in South Africa is discussed, with particular focus on the trend in which waste is generated. Also, we consider the ways of minimizing waste in South Africa and lastly, the cost benefit of proper waste management in economics, social and environment spheres are highlighted.

2. Types of Waste

Waste is any substance, material or object that is disposed of because it has lost its value to the user. Waste is classified into two major categories based on the risk it poses according to the National Environmental Management (NEM): Waste Amendment Act, 2014 (Act No. 26 of 2014)

2.1 General Waste

General waste are waste that do not pose an hazard to health or to environment, and this comprise domestic waste, building and demolition waste, business waste, inert waste or any waste classified as non-hazardous waste and includes non-hazardous substances. Inclusive also is agricultural waste which is generated directly as a result of the production of food. It can also be seen as waste generated in the production process and post production waste. A high percentage of this waste is seen in the food and fruit market. There is however huge pressure on the waste management facilities available in handling agricultural waste generated.

2.2 Hazardous waste

Hazardous waste is any waste that contains organic or inorganic compounds with a detrimental impact on health and the environment (NEM Waste Amendment Act, 2014). Also in this category are industrial wastes which are group of waste includes e-waste, which utilized electricity. It is imperative that this type of waste is handled properly and disposed safely to avoid the deposition of toxics into the soil. Lead, mercury, cadmium and other dangerous substance could be released into the soil in the process. Waste from the mining sector of the country in fact provides the highest quantity of waste.

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3. Application and Utilization of Waste

3.1 Source Reduction and Prevention

According to Shaffie-Jood *et. al*. (2016), source reduction and elimination of waste before it is produced is a useful approach in the utilization of waste. Materials employed in the design of goods can be reduced drastically using efficient production techniques. Other efficient ways of energy generation that reduces the emission of waste products like carbon dioxide must be utilized. Likewise, initiatives that encourage the exchange of waste products for cash has been introduced in South Africa. This is an incentive based approach to waste reduction at source. Not all waste can be in this category. The above initiative if properly managed would lead to a continuous reduction in waste dumps in landfills, reduction in waste disposal costs, introduction and utilization of a lower cost packaging materials that can be effectively recycled and significant reduction in the emission of pollutants (HUMMEL, N. 2013) . Reducing waste is inclusive of using waste from production as a useful product or a precursor or raw material for another process in order to prevent waste disposal. This far outweighs incineration, landfill and recycling because it translates to reduced energy use, lower rate of greenhouse gas emission and reduced environmental impact. Though for waste that cannot be reduced, recycling is the next alternative

3.2 Re-use of waste

Products are designed with lifespan for usage or consumption, once the period is over, there is a high chance of disposing the product. However, refrigeration as well as selling the product of at a discounted price can be used as a mean of giving back to the community and provide food for some who cannot afford the exorbitant prices. This can be applied to food waste but also industrial waste as well, although for the latter, the degree of re-use is very low. Also, waste water from industrial processes can be reused after cooling and purification. Papers can be recycled to reduce the rate of cutting down trees in forest and loss of biodiversity. Re-use of broken glasses and plastics are means of utilization of waste.

3.3 Waste Recovery: Anaerobic digestion, Combustion and Composting

Anaerobic digestion (AD) is method used for recovering energy from municipal solid waste. Food waste has a high organic content compared with sewage or manure, AD is now increasingly considered as a viable means of energy recovery. (Kelley, T., and Walker, P., 2000). The utilization of waste in South Africa is being developed to a place where anaerobic digestion (whose process produces biogas, chiefly methane and carbon dioxide) is used more. This process involves passing of a high moisture content waste, of less than 40% generated through processes like shredding, grinding and properly mixing the content in a homogenization chamber. Application of biogas include electric generation, hot water and cooler, and gas distribution for domestic use. As a bye product of the anaerobic digestion, composting of the solid extract can be passed on for making compost material when added to the soil for agricultural purposes. Disposal of waste via combustion or incineration is highly discouraged and it attracts

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penalties which have forced especially the urban dwellers to desist from such. Also, composting is been done at commercial scale which has helped in reducing waste.

3.4 Landfilling

In the South Africa context, landfills are very relevant for the waste management market since the mechanism for recycling and conversion of waste to energy is not yet on a large and nationwide scale. Most of the disposed waste are buried below and compacted to ensure the gradual decay of the waste. Not all wastes can be disposed through this mechanism. From the figure 1 below, disposal of waste to landfills accounts for about 90% of the disposal method in South Africa. In 2016, 56,041,147 tons of waste was disposed to specially engineered landfill out of a total of 65,979,566.80 tons of waste disposed in that year and the last 5 years have followed this same trend.

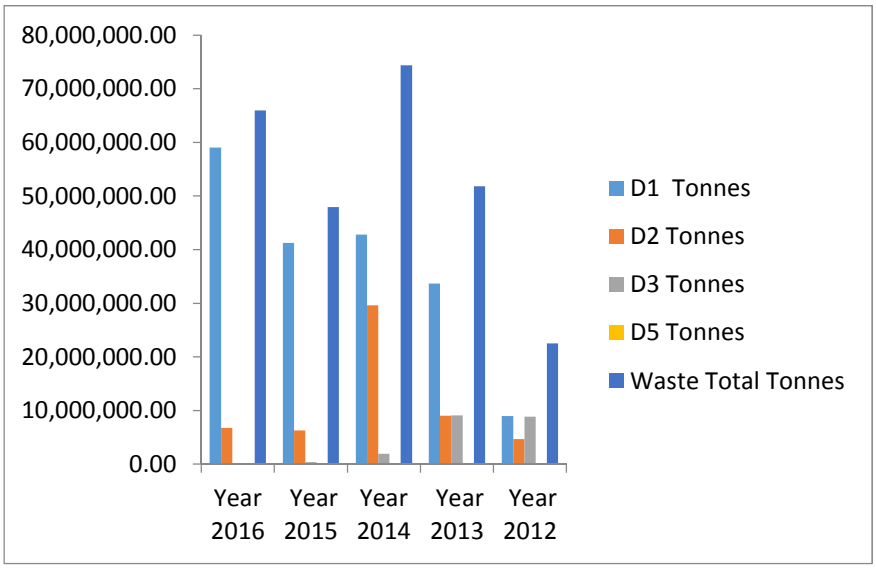

Figure 1: Waste Disposal in South Africa in Tonnes (2012 - 2016)

Where D1 is disposal of waste to land (e.g. specially engineered landfill),
D2 is disposal of waste to landfill (e.g. non-engineered landfill),
D3 is storage/disposal of waste in surface impoundments (e.g. placement of liquid or sludge discards into pits, ponds, lagoons etc.) and
D5 is Permanent storage (stabilization, micro-encapsulation, macro-encapsulation)

Data Source is from South African Waste Information Center (SAWIC)

4. Cost of waste

4.1 Economic Waste

Africa has been plighted by the shortage of energy generation. Power outages and well as power cut has been a recently surmounted energy issue in South Africa. This bring to mind the need to look for other alternative means of energy generation apart from the conventional network such as the dam, thermal and the coal presently been utilized. Waste disposed of in the landfills is money wasted because with the appropriate anaerobic process and

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technology, these wastes can be converted to Biogas , a renewable energy whose cost of production is cheaper compared to energy production from fossil fuels. Disposal of food waste to landfill comes at cost based on the financial and external costs associated with the landfill itself. In South Africa, household food waste costs R21.7 billion per year which is equivalent to 0.82% of South Africa's annual GDP. This cost is significant in that household food waste accounts for less than 4% of total food losses across the food supply chain (Nahman A. et. al., 2012).

4.2 Social Cost of Waste

As waste increases in the community, the availability of land required for other sustainable project are reduced. Even more significant is the fact that more tax payer money will be utilized in the disposal of the waste. Therefore, more education and insight must be applied by the industry in designing product which yield less waste for the community. Also, water used for irrigation is wasted with every tonne of food waste. South African agriculture is majorly dependent on irrigation. Thus food waste comes at a cost in terms of water loss to the nation and this is more costly now that the nation experienced drought in the last few years.

4.3 Environmental cost of waste

In a typical dumpsite, the accumulation of waste in such location without the thought of further processing gives rise to the release of methane into the atmosphere. The emission of greenhouse gas (GHG) results in the depletion of the ozone layer (Global warning). This is one of the 4 other gases released into the atmosphere. Methane as a GHG is at least 20 times more potent than Carbon dioxide despite staying for a shorter time in the atmosphere. It is directly responsible for at least 25 percent of the global warming issues. Another environmental cost is the air pollution. This is an ever prevalent issue as different emission leads to infection of humans and sicknesses such as asthma. Leachates form dump site flow into the water body, sometimes leading to the destruction of aquatic life and loss of biodiversity process (UNEP, 2009; Buzby, J.C. and Hyman, J, 2012).

Conclusion

In this paper, the waste type typical to South Africa has been highlighted. It is very clear the need to find other means of utilizing about 90 percent of the waste disposed via landfills in South Africa. Different approach has been suggested to handle this problem. In fact, waste and its maintenance are costlier than what is assumed at face value. A detailed analysis of the cost of waste makes any nation have a rethink on the generation of waste. Therefore, it is imperative that wastes need to be managed properly. If this is not done, waste that are not eliminated, reduced or recycled will continually have a negative impact on the economy and the social aspect of any nation and at large, the environment where we all live in.

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Biography

Olufunto Tolulope Jemilugba is a doctoral research candidate in Biotechnology at the University of Johannesburg She earned a. B.Sc. in Microbiology from Obafemi Awolowo University, Ile-Ife, Nigeria and a Master's of Science degree in Environmental Control and Management from Obafemi Awolowo University, Ile-Ife, Nigeria. Her research interests include waste management, pollution control, Sustainable energy, clean development mechanism and bionanotechnology.

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Charles Mbohwa is the Vice-Dean Postgraduate Studies, Research and Innovation at University of Johannesburg's (UJ) Faculty of Engineering and the Built Environment (FEBE). As an established researcher and professor in the field of sustainability engineering and energy systems, his specialisations include sustainable engineering, energy systems, life cycle assessment and bio-energy/fuel feasibility and sustainability with general research interests in renewable energies and sustainability issues. Professor Mbohwa has presented at numerous conferences and published more than 350 papers in peer-reviewed journals and conferences, 10 book chapters and three books. Upon graduating with his B.Sc. Honours in Mechanical Engineering from the University of Zimbabwe in 1986, he was employed as a mechanical engineer by the National Railways of Zimbabwe. He holds a Masters in Operations Management and Manufacturing Systems from University of Nottingham and completed his doctoral studies at Tokyo Metropolitan Institute of Technology in Japan. Prof Mbohwa was a Fulbright Scholar visiting the Supply Chain and Logistics Institute at the School of Industrial and Systems Engineering, Georgia Institute of Technology, a Japan Foundation Fellow, is a Fellow of the Zimbabwean Institution of Engineers and is a registered mechanical engineer with the Engineering Council of Zimbabwe.

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