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ASSESSING THE ECONOMY, ENVIRONMENTAL AND TECHNICAL VIABILITY OF COMPOSTING FOR SOLID WASTE MANAGEMENT IN LIBYA

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Abstract: *The increased urbanization and growing population have dramatically increased the amount of municipal solid waste generated in Libya and other developing countries. However solid wastes when effectively manage has the potentials of reducing the environmental and economic effects that could result from the over dependent on fossil fuel. In recent times, various solid waste management projects have been introduced in developing countries with support from external agencies. In most cases such projects don't function effectively when these external agencies discontinued their support. The failure is mainly due to technical and economic factors from the developing countries governments and stakeholders. In other to develop and sustain effective solid waste management system in developing countries, the above mentioned factors should be considered. It is important to state that no single solid waste technology can yield the maximum result, even though some may be more effective than other. Thus integrated approach for waste management is the most promising. Because municipal solid waste is characterized by large amount of organic material and some proportion of inorganic. While the organic material can easily be converted to useful resource such as biogas and fertilizer through the process of composting, the inorganic parts are subjected to other form of treatment. This paper provides an overview of the potentials of composting technology enhanced by anaerobic digestion and waste reduction at source. Composting is the biological process that uses microorganisms, which transforms the organic solid waste into valuable products and turns the organic matters back to the soil under controlled conditions. Because of high amount organic material in municipal solid waste, composting when effectively applied has the potential of addressing the problems of solid waste. Some of such potentials include; relatively low operation cost, plant nutrient management alternatives, Soil improvement opportunities, greenhouse gas emission emissions reduction and the production of renewable energy.*

Ke ywords: Composting, organic waste, biogas, greenhouse, Agriculture.

1 1INTRODUCTION

Solid waste generation in many parts of the world has contributed to various environmental, health and economy problems. These problems has resulted from the poor handling and management of the increasing volume of solid waste generated especially in developing countries (Abdelsalam and Gebril 2013).

Libya is located in North Africa between 26 latitude north and 17 longitudes east,it extends over 1,759,540 km2. It is bordered by the Mediterranean Sea to the north, Egypt to the east, Sudan to the southeast, Chad and Niger to the south, and Algeria and Tunisia to the west. Both the Mediterranean Sea and the desert affect Libya′s weather (,Larrasoana et al 2003). Over the years, Libya′s population has nearly doubled. This situation places a great deal of pressure on energy demands, food supplies, and even the environment by increasing the generation of waste and residues. It has been estimated that about 3.2 million tons of municipal solid waste is generated annually. According to Hamad et al 2014, municipal solid waste, industrial solid waste, and healthcare solid waste. However, this study will focus more on municipal solid waste. Municipal solid waste consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries (Hamad et al 2014).

Understanding the nature and types of solid waste generated in an area is very important for effective waste management practice. The type of municipal solid waste produce varies with the standard of living in an area. Wastes generated in low and middle income area have a large proportion of organic waste, whereas the wastes produce in high income areas are more diversified in terms of relatively larger shares of can, plastics and papers. The changing composition of waste in turn influences the choice of technology and waste management infrastructure (Lane.T, 2016, EPA 2015, EPA 2014, Hoornweg and Bhada-Tata, 2012).

Generally, there are four methods of managing waste. These include uncontrolled illegal deposits in available land, water body and abandoned land; disposal into controlled landfills, from simple, incineration with and without energy recovery, material recycling, reuse or recovery(Lane.T, 2016). However waste recovery, reuse, recycling, incineration and other modern technologies are mostly limited to the developed countries, while illegal waste disposal in open dump site are common practices in developing countries. The poor waste management practices in these developing countries has been link to various factors ranging from human to social- economy factors (Abdelsalam and Gebril 2013, Christensen 2011). The lack of research and development activities in developing countries leads to the selection of inappropriate technology in terms of the local climatic and physical conditions, financial and human resource

capabilities. Economic and industrial developments play key roles in solid waste management. Developing countries have weak economic bases and, hence, insufficient funds for sustainable development of solid waste management systems.

Solid waste management is given a very low priority in developing countries, As a result, very limited funds are provided to the solid waste management sector by the governments, and the levels of services required for protection of public health and the environment are not attained. Poor legislation in developing countries for solid waste management is partly responsible for poor waste management. Often times, the choice of effective waste management technology can be hampered by these factors. Thus a cost effective and environmental friendly technology like composting could provide potential solution to solid waste management problem in developing countries like Libya.

2 LITERATURE REVIEW

Composting is a sustainable waste management practice that converts any volume of accumulated organic waste into a usable product. Municipal solid waste contain larger proportion of organic materials that form the basis for composting, When organic wastes are broken down by microorganisms in a heat-generating environment, waste volume is reduced, many harmful organisms are destroyed, and a useful, potentially marketable, product is produced(Seng B and H. Kaneko, H (2012). Although other technologies exist for solid waste management such as incineration, gasification, pyrolysis, Anaerobic digestion, however the high cost of operations and other environmental considerations have made composting one of the most promising technology for municipal solid waste management(Lane.T,2016, Hamad et el 2014). A major consideration for the use of composting is the low cost of operation and the environmentally friendly by product.

According to Adewale 2011, Chalmin and Gaillochet, 2009; economic, social, environmental and social economic factors are the key determinant of the most suitable waste treatment method. Thus waste treatment technology should be selected in terms of the local climatic and physical conditions, financial and human resource capabilities and social or cultural acceptability. If these factors are not considered, the technology selected can never be used, wasting the resources spent and making the project unsustainable (Lane.T,2016, Chalmin and Gaillochet, 2009).

The nature and composition of solid waste largely determine the most cost effective and environmental friendly technology to be applied. Hamad et el 2014, explained that municipal solid wastes in developing countries contains a large portion of organic materials , thus making composting of such waste the best sustainable option that would reduce waste volume.

Composting of solid waste with high proportion of organic wastes provides a cost effective way of solid waste management following source reduction and reuse.they further explainef that through the process of composting, yard waste and other source separated organic wastes can be recycled into mulch and compost.

Composting plant when integrated with Anaerobic digestion presents an additional organic waste processing solution that falls into the energy recovery category for waste management(EPA 2015 ,EPA 2015, Hamad et al 2014, Christensen 2011). Some of solid organic material that could be processed by these technology may include animal manure, organics separated from mixed municipal solid waste, food scraps, food production residuals, agricultural residues. USDA, 2014 explained that two major products can be derived from this process; biogas and digestate. The biogas can be used to create energy in the form of electricity, heat or vehicle fuel, while the digestate may be used in by products such as fertilizers and feedstock for plastics and chemicals.

That compost quality is a major factor that could affect both societal acceptability and economic value of compost.

Under the influence of water, air and heat, the controlled aerobic fermentation and decomposition of organic waste (green waste, kitchen waste, paper) by micro and macro-organisms can take from a few weeks up to a few months to form compost or black humus of varying richness. This process reproduces organic components in soil by speeding up the natural decomposition cycle. This compost can be used to improve crops. Its degree of maturity, biological stability and harmlessness will define its agronomic qualities. Produced using a biological process and depending on basic organic waste, several types of compost can be produced (Lane.T 2016, EPA 2015).

3 RESEARCH METHODOLOGY

The method use for this study was systematically design from previous research work carried out by the author in relation to solid waste management. This study was conducted through various field visits to several neighborhoods within three major cities in Libya; Benghazi, Tropoli and Serte to physically assess the nature and types of solid waste generated in these areas. Secondary data from desk top studies collected and technically analyse. The process of data collection was in line with the research problem and the study design. Inferences and conclusions were drawn from the secondary data collected and field inspection.

Qualitative approach was adopted for this study so as to provide a view point of the present situation and thus enhances a well written technical report.

4 RESULTS AND DISCUSSION

Composting as a biological process involve the use of microbial organism to reduce waste organic materials to a more valuable and useful materials by

regularly introducing air through mechanical turning to stimulates the aerobic microorganism. It is a controlled method of using microbial organisms to decompose the organic fraction of solid waste (EPA 2015 ,EPA 2015, Hamad et al 2014 Seo et al., 2004). Composting is very suitable for recycling organic wastes without any environmental effect. Because of the high proportion of organic materials found in solid waste generated in developing countries such as Libya, composting provides itself as very promising option for effective waste management (Hamad et al 2014, Adewale 2011). A more viable option to manage wastes in developing nations like Libya is composting because of the lower operational cost, decreased water pollution and the usefulness of the end products.

5 ENVIRONMENTAL CONSIDERATION OF COMPOSTING

Composting of solid has been considered to be more environmentally friendly due to the facts that there is a reduction in landfill space where composting is operated as waste management technique. This inturn reduced surface and groundwater contamination which is usually associated with landfill that usually result from landfill operations(EPA 2015 ,EPA 2015, Hamad et al 2014, Awomeso et al., 2010).

Ground water and surface water pollution resulting from the use of chemical fertilizer could be control by the use of the organic fertilizer produced from the composting of waste.

Composting technology has been employed for bioremediation of polluted soils and sites. In composting there is a minimal emission of greenhouse gases with subsequent effect on climate change and global warming (Lane 2016, Seo et al., 2004). Also the addition of compost to soil reduces soil erosion as well as improvement of soil's structure.

6 USE THIS STYLE FOR LEVEL THREE HEADINGS

It allows the development of dynamic analysis. It allows integrating in the project evaluation the value of the flexibility. It allows the definition of optimal decision taken structures in innovation projects. It allows simulating and incorporating, evaluation management decisions, to the project. It allows the simulation of the decision process along the life of the project.

7 TECHNICAL CONSIDERATION FOR COMPOSTING

In order to facilitate composting, a certain conditions must exist. The microorganisms which degrade organic wastes will require carbon for energy, and nitrogen for protein. Although this will be provided by the organic matter to be compost. However the ratio of carbon to nitrogen must be regulated for optimum performance. The recommended Carbon to Nitrogen ratio of a good compost should be between 25:1 and 40:1. Ideally 30:1.This because too much carbon or very large particle size slows the composting process. Also when too much nitrogen is present, the compost may become too hot, killing the composting organisms. Thus inappropriate use of wastes with high carbon to nitrogen ratio may lead to reduced soil fertility. Similarly, a warm, damp and well aerated environment is most suitable for the microorganisms (bacteria and fungi) to operate.. Thus it is important to have a large volume of composting material to create a warm interior and regularly mix up the pile of organic material periodically (Lane.T, 2016, Adewale 2011, Harris et al 2001). Compost must be of high quality such that no leaching or heavy metal uptake by plants can occur even under acidic soil conditions. Compost should be directed to develop and maintain soil structure, improve physical properties of soil, decrease soil-susceptibility to erosion, encouraging microbial activity as well as providing potentially available plants nutrients. Thus composting requires proper handling and appropriate technology for its sustainability.

8 CONCLUSION

Sustainable and effective solid waste management requires technological options that is environmentally friendly and cost effective. Composting when properly handled is sustainable with various advantages such as production of fertilizer, relatively low air and water pollution, low operational cost and income generation. Though composting has proven to be a very promising technology especially for solid waste with high organic material, However, no single approach can be employ to effectively manage waste. Integrated approach for waste management remain the best option for effective waste management.

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