ORGANIC SOLID WASTE MANAGEMENT IN NAIROBI COUNTY

BY

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D61/88799/2016

A RESEARCH PROJECT PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF BUSINESS ADMINISTRATION, SCHOOL OF BUSINESS UNIVERSITY OF NAIROBI

2020

DECLARATION

I declare that this is my original work and it has not been presented in any other university.

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DEDICATION

This study is dedicated to my parents Rev. Mr and Mrs Kanja, my loving husband and sons for the unconditional support, hope and encouragement.

ACKNOWLEDGEMENTS

I would like to express my very great gratitude and appreciation to my supervisor Prof. Gituro Wainaina for his constructive, detailed and valuable guidance throughout the development of this research work. His patience with me and willingness to give the feedback on time is much appreciated.

My sincere thanks to Ms. Zipporah Kiruthu for moderating this research work and for giving very encouraging and insightful comments.

Special thanks to the Managing Director of Jupiter Energy Solutions Mr. Joseph Kigara for his support and encouragement during the research work together with the officers of institutions including Nairobi County, National Environment Management Authority (NEMA) and private companies that gave feedback on the status of Organic Solid Waste Management (OSWM) in Nairobi County.

Finally, I thank my entire family and sibling Nduta and family, Njoki and family, Mbugua, Joe, Daniel for continued support, prayers and encouragement.

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ABBREVIATIONS AND ACRONYMS

CADP	County Annual Development Plan
CBD	Central Business District
CBO	Community Based Organisations
DOE	Department of Environment
GHG	Global Greenhouse Gases
ISWMP	Integrated Solid Waste Management Plan
JICA	Japan International Cooperation Agency
KAM	Kenya Association of Manufacturers
KICC	Kenya International Convention Center
KNBS	Kenya National Bureau of Statistics
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NCC	Nairobi City County
NEAP	National Environmental Agency Plan
NEMA	National Environment Management Authority
OSW	Organic Solid Waste
OSWM	Organic Solid Waste Management
PPIs	Public Private Institutions
PPPs	Public Private Partnerships
SWM	Solid Waste Management
UNEP	United Nations Environmental Program
USAID	United States Agency for International Development

ABSTRACT

The purpose of this study was to explore the stages and practices of Nairobi County government on management of Organic Solid Waste (OSW). The specific objectives were to evaluate the process of Organic Solid Waste Management (OSWM) and determine the level of OSW resource generation and utilization in Nairobi County. The researcher adopted descriptive research design to address both quantitative and qualitative data to its simplest form. The study population included different parties involved in the handling and management of OSW in Nairobi County including Department of Environment (DOE) which has approximately five officers' in-charge, 60 private registered companies and 18 Community Based Organisations (CBOs) with the Nairobi County, 91 estate agents and six NEMA officers in charge of monitoring the status of OSWM in the county. The sample size of research was 38 respondents. Primary and secondary collection methods were employed to gather data using multiple approaches such as observation, structured interviews, literature review and existing case study. Data analysis was conducted using descriptive and inferential statistics methods. Descriptive statistics measured the average of OSW collected, segregated, recycled and disposed as per objective to evaluate the process of OSW. Frequencies, measures of dispersion and measures of central tendency were used. Data was presented in graphical and tabulated format for analysis purposes. Study findings established various processes that take place in the entire OSWM process ranging from generation, collection, segregation, recycling, treatment or reuse and dumping or disposal. The results also showed that there was low involvement of most of the stakeholders especially in the final stages which are important in ensuring that the process is sustainable and also help to accomplish the zero waste scenarios. Concerning second objective, results indicated that there was high generation of waste within the county especially market centres and residential places. The study further established that the main by-products of OSW were biogas and organic fertilizer. While the knowledge base on the by-products was there, results showed that few of them utilized them although they were willing to recommend their usage. Thus, the study recommends that efforts should be put into place to improve the management of OSW process within Nairobi County. This should be in the form of providing more resources both human and material to help in the smooth running of the processes. Another recommendation was that there should be more collaboration between the government and the private entities to address the problem.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Solid waste generation has been in existence since ancient time where communities buried waste outside their compounds or disposed in water bodies. Due to high population growth rate, these practices were no longer applicable as people were living among the dumped waste that turned to filth and favourable places for vector diseases. Development of sustainable Solid Waste Management (SWM) facilities and processes were mandatory and countries such as Greece issued a ban on waste disposal in streets leading to formation of municipal dumps and disposal police by the Chinese to facilitate implementation of the disposal law 200 BC (Ezugwu, 2015). Waste generation is part of each individual species, process or operation in form of by-products. Globally in the ecosystem humans are dominant both in numbers and ability to transform natural raw resources to new materials (Adedipe, Sridhar & Barker, 2005). The estimated solid waste collected globally is 11.2 billion tons, which contribute to 5 percent of Global Greenhouse Gas (GHG) emissions. These emissions contribute to negative climate change as well as degradation of human health (Choi, 2016).

The increasing trends in Nairobi County's population and economic welfare according to United Nations Environmental Programme (UNEP), (2010), are consistent with the rapid growth of solid waste generation in the County. Kenya Vision 2030 recognizes the importance of sustainable waste management systems as it develops into an industrialized state by 2030 therefore the impact of poor SWM systems within the cities can be disastrous with both negative environmental and health consequences. This may pose a threat in achieving sustainable development (National Environment Management

Authority (NEMA), 2014). Every person in Kenya is entitled to a clean and healthy environment and has a duty to safeguard and enhance the environment (Nairobi County Council (NCC), 2018) .

This research was based on zero waste theory that argues that waste to one person or company can be a raw material or resource to another and therefore it was important that SWM processes are more focused on resource utilization instead of dumping which was currently the most popular practice in Nairobi County. The theory was developed by Paul Palmer at the Silicon Valley and the aim was to redesign resources so that all products can be reused hence reduction of waste that ends up in incineration plants and landfills. The purpose of this research was to examine the various stages of OSWM as the largest component of waste produced in Nairobi County, the different strategies employed at each stage and the resources that can be generated from OSWM in Nairobi County.

1.1.1 Solid Waste

Solid Waste can be classified into three types of waste which include household waste also referred as municipal waste, industrial waste also called hazardous waste and biomedical waste which is also referred to as infectious waste (Edu green, 2019). This research focussed on Municipal Solid Waste (MSW) which was waste from residential (family homes, town houses and apartments), commercial (office buildings, shopping malls, warehouses, restaurants, hotels and airports), institutions (schools, medical facilities, prisons) and some industrial wastes (packaging of products and office wastes). Municipal waste includes both organic and inorganic waste. Inorganic waste in Nairobi includes waste such as plastic, paper, glass and metal. Licensed waste dealers buy inorganic waste from unregistered waste pickers and itinerant waste traders who are

mostly populated at the Dandora dump site where they sell 80 percent of recovered materials to Mukuru recycling project who in turn sell the collected materials to recycling factories. The project however faces a challenge of securing market of recovered waste paper and compost and hence the research (Kasozi & Blottnitz, 2010).

The research specifically focussed on municipal waste that is organic in nature. The waste is normally discarded in public (Tchobanoglous & Kreith 2002). In Sub-Saharan Africa the amount of solid waste generated exceeds the collection capacity due to rapid growth of urban population, breakdown of collection trucks and poor design and management of the SWM programmes (United States Agency for International Development (USAID), 2009).In Nairobi County 68 percent of the total waste generated was domestic waste while non-domestic waste from markets, roads, industries and other activities accounts for 32 percent combined (UNEP, 2010). More than 3,000 tonnes of waste was generated daily in Nairobi County where each of the 4.4 million people produces approximately between 200 and 800 grams of waste every day. The composition of generated waste was 51 percent organic waste, 38 percent recyclable waste and 11 percent residual waste (NEMA, 2014).

1.1.2 Organic Solid Waste

Organic waste is solid remains from preparation of food, remains from the market place, waste from plants, animals and packages that can decompose (Inge, 1993). Municipal waste during waste collection includes both organic and inorganic materials (Government of Canada, 2013). The OSW generation was dependent on the population as much as also

to the level of industrialization and the climate of a specific area (Gakungu, Gitau, Njoroge & Kimani, 2012). The waste was normally rich in proteins, minerals and sugar and was managed by feeding to animals, disposed to landfills or incinerated. Research has revealed that MSW in developing countries consist of fifty five percent to eighty percent of OSW (Abdel-Shafy & Mansour 2018). The SWM according to glossary of statistical terms is handling of waste material from source where the waste was generated, recovery process to disposal in a supervised manner. Both public and private sectors are active in management of organic and in-organic solid waste in developing countries, which improves efficiency and creates employment opportunities in the sector (Ahmed & Ali, 2003). The components of SWM include waste generation, handling, separation, storage and processing at source, collection, transfer and transportation, separation processing and transformation and finally disposal (Tchobanoglous & Kreith, 2002).

In Dhaka, Bangladesh, South Asia, the waste concern community organization managed to convert the business-as –usual approach of uncollected waste and open dumping encountered throughout the most populated region to value added resources such as alternative fuels and fertilizer for agricultural activities (Centre for European Policy Studies, n.d). In Germany waste was a business opportunity and using the green dot system, manufacturers pay more for more packaging hence reduction of packaging and increase recycling, thus resulting to 70 incinerators, 60 biological and waste processing factories and 800 units producers of compost from organic waste.

The German business institute estimates a saving of 3.7 billion pounds from recycling and energy production from waste (Greentumble, 2016). Closed cycle management of solid waste has been adopted not only to protect the environment but to improve the country's economic growth by creating employment to almost 200,000 people in 300 companies with an approximate annual turnover of 40 billion Euros. To minimize generation of solid waste was the priority of SWM in Germany. Other components of SWM include re-use, recycling, recovery and finally disposal only if the waste was pre-treated to ensure that the waste does not degrade in the landfills. (Nelles, Grunes, & Morscheck 2015).

Netherland's, lansink's ladder approach of avoiding waste creation , recovering valuable raw materials from the waste, generating energy and dumping what was left over in an environmental friendly manner has made the Dutch to be ranked the best in waste management practices in the world (Waste Management World, 2018).

Other countries with best waste management practices include Australia (fungal enzymes in polyethylene terephthalate recycling) and Belgium (the best waste diversion rate, the ecolizer and the green event and assessment guide).In Kenya the components OSWM include waste collection, transportation and dumping at the county's landfill. There exist a small percentage of solid waste reuse and recycling. Domestic waste which is normally biodegradable was inadequately managed with most of the waste ending up in disposal sites with minimal segregation NEMA. Estimate collection of the total generated solid waste in Nairobi County was 50 percent while reuse and recycling accounts for 5 per cent

of the total waste generated. About 32 percent of the generated waste was dumped at the Dandora dumpsite while the remaining waste was illegally dumped or burnt (UNEP, 2010).

Resources that can be recovered from OSWM include but are not limited to, biogas which is a mixture of gases that are combustible and consist of mainly methane and carbon dioxide. The gases are formed due to the decomposition of OSW materials and methane which can also contribute to 20 percent of the total increase in greenhouse emissions (Jorgensen, PlanEnergi & Researcher for a dayensen, 2009). In Kenya, the utilization of biogas emerged since 1960s, where some firms such as Koru coffee research sub-centre established biogas plant that supply offices and staff houses with cooking and lighting energy. Some of the benefits of biogas include reduction of deforestation by providing alternative and cheaper sources of energy that is environmental friendly and reliable, enhances hygiene, improves nutrients circulation to the plants due to production of fertilizer as a by-product and improves human health by reduction of smoke-pollution (Karanja & Kiruiro, 2003). The private sector has also realized an opportunity of earning from OSW through vermiculture which is a process of using red worms to decompose organic waste into nutrients that are beneficial to the soil and which are sold to horticultural firms (Kenya Climate Innovation Centre, 2018).

1.1.3 Organic Solid Waste Management in Nairobi County

The County Government Act, 2012 Part (H) tasks the county government with promotion of the economic, efficient, effective and sustainable use of resources, the recycling of waste and other appropriate environment objectives. In Kenya OSWM was monitored at

both the national and county level of management. At the local county government level, Nairobi County government through the Department of Environment (DOE) was responsible for OSWM. Other players of OSWM in Nairobi County include the Ministry of Environment, Water and Natural Resources which comprises of NEMA, National Environmental Agency Plan (NEAP), Non-governmental Organizations (NGOs), Community Based Organizations (CBOs) and the private sector (Njoroge, Kimani & Ndunge, 2014).

In the 2016/17 and 2018/19 performance based budget, Nairobi County allocated KSh 1.5 billion for SWM, the county's involvement was in the management of the waste in the Central Business District (CBD) specifically collection, transportation, and dumping of the waste at Dandora Dump site. The County government was also tasked with the control and maintenance of the Dandora dumpsite. Some of the initiatives developed to mitigate the solid waste problem include the Integrated Solid Waste Management Plan (ISWMP) 2010 which entails different strategies and time lines including the introduction of the 4R principle (reduction, reuse, recycling and recover)in education curricula at all levels by 2013, three way stream separation at source in all zones by 2013 by creating awareness among the general public, streamlining of solid waste collection, increase level of transportation, create an active recycling economy and establishment of sanitary landfill. Other policies introduced in 2017 include the plastic ban where Kenya was the 11th country in the world to ban the importation, manufacturing, and use of flat plastic bags (UNEP, 2010).

The county government has also partnered with private institutions such as private owned garbage collectors who collect both organic and in-organic garbage at the residential areas in Nairobi at a fee and transport to the dumping site, CBOs collect waste from low income residential areas who are unable to pay the collection fee to the private garbage collectors (NEMA, 2014). The Kenya Association of Manufacturer (KAM) developed the responsible care programme where all the manufactures take responsibility of their solid waste through different environmental friendly techniques. The franchise system was introduced in 2014 where Sifa, a contract awarded contractor was to start collection of segregated solid waste from zone 7 of Nairobi county. The system has since then been challenged in court and non-operational due to procurement challenges (Japan International Cooperation Agency [JICA], 2010). In Nairobi county CBOs and private companies are involved in composting of the organic waste for sale. This accounts for 1 percent of the total organic waste while part of the remaining organic waste was used as animal feeds, especially pigs (UNEP, 2010). The aim of this research was to evaluate the different stages of OSWM and how the waste can be turned to resources instead of dumping.

1.1.4 Nairobi County Government

In 2013, Kenya was divided into 47 counties' through the 2010 constitution of Kenya, which included Nairobi County, the smallest yet most populous with an estimated current population of 4.4 million in 2018 (Japan International Cooperation Authority, 2014). The vision of the Nairobi County was to be a "city of choice to invest, work and live in. The

county was further divided into 17 constituencies and neighbour agricultural Kiambu County where most of the produce are consumed by Nairobi residents.

The 17 constituencies includes Westlands, Dagoretti North, Dagoretti South, Lang'ata, Kibra, Roysambu, Kasarani, Ruaraka, Embakasi South, Embakasi North, Embakasi Central, Embakasi East, Embakasi West, Makadara, Kamukunji, Starehe and Mathare (Freeman, 1991). The county has different attractive resources, for example Jomo Kenyatta International Airport which is the biggest in both East and Central Africa, three main rivers which include the Nairobi River, Ngong River and Kabuthi River.

The city has three natural forests which include Karura Forest which is 1,041 hectares located on the north of Nairobi (NCC, 2018) Ngong road Forest located on the West of Nairobi County and is 1,224 hectares (Loefler & Imre, 2016) and Nairobi Arboretum which occupy 30.4 hectares and is three kilometres from the city centre thus offering picnic sites and bird watching opportunity among others to Nairobi residents and tourists (Arboretum Forest Station, 2018).

Other county resources include Kenyatta International Conference Centre (KICC), Nairobi National Park among others (NCC, 2018). The Nairobi County was managed by the county government through the county executive committee members with sector responsibility of county operations including the environment, water, energy and natural resources sector that was responsible for management of the county's solid waste through the DOE. According to the County Annual Development Plan (CADP) 2018, the major

challenges of the county include rapid population growth, insecurity, congestion of traffic, inadequate land, water and sanitation and SWM.

Solid Waste Management was a growing challenge in Nairobi County even as the population and Gross Domestic Product (GDP) increase nationally and in the county. This was due to growth in different sectors in the economy such as agriculture, wholesale and retail trade, real estate and manufacturing (Kenya National Bureau of Statistics (KNBS) 2019). It was therefore paramount to match the growth with efficient waste management techniques so to avoid decay of the capital city.

1.2 Research Problem

Organic solid waste management was an aggregate problem brought about by both rising in waste generation and lack of adequate disposal sites. The risk of living near OSWM facilities was high due to poor management leading to air pollution and contamination of underground sources of drinking water (Prawiradinata, 2004). Nairobi County faces a higher risk in SWM as studies have shown that over half of Nairobi's residents do not receive SWM services (Karanja & Kiruiro, 2003). Only 50 per cent of the generated waste in Nairobi County was collected due to inadequate refuse trucks, frequent breakdowns of trucks, illegal dumping of solid waste, delayed payments to contractors, and court cases challenging the franchising system of waste management (NCC, 2018).

The collected waste was deposited in the poorly maintained Dandora dump site while unsegregated which is the only landfill in Nairobi County and that was declared full in 2001. Nairobi County estimates registration of more than 60 companies participating in

waste collection in an unregulated industry with no direction on what to do with the waste (Njoroge, Kimani & Ndunge, 2014). Reduction of OSW at the dump site leads to not only resource recovery but conducive environment especially for the low income communities that live near and depend on the dump site. When organic waste is dumped, dangerous gases such as methane gas is produced which is not only dangerous to the environment but the health of human beings. On the other hand careful management of organic waste can lead to generation of resources that lead to both social and economic benefit of residence in the county.

There are diverse opportunities in OSWM that can not only lead to better living environment, but also improve the social welfare of the Nairobi county residents. Composting was a value creation method of OSW for the production of fertilizer and biogas. Establishment of well-regulated biogas plants in Nairobi County can be used to reduce the resident's cost of living (Pravin & Begum, 2018). The aim of ISWMP is to improve resource recovery by encouraging composting of OSW to produce biogas and related products such as fertilizer thus converting 89 percent of waste to resources instead of dumping (Kasozi & Blottnitz, 2010). ` According to UNEP (2010) implementation of the renewable energy projects are projected to reduce greenhouse gas emission by 0.6 gigatons of carbon dioxide by 2020 annually. This made it paramount to carry out the research at the present time.

Both local and international research has been done in the field due to awareness created by international bodies about conservation of environment to improve the human

standard of living. However less research has been done to establish the effectiveness of composting OSW in Nairobi County in order to produce valuable resources. International researchers such as Choi, (2016) studied the environmental effectiveness of SWM in Oslo, Norway; the study explored different SWM strategies that are in practice and established that the strategies are more focused on the recycling for economic benefits and not to really improve environmental conditions. The strategies are more on recovery and waste recycling and not reuse and waste prevention which are more desirable when it comes to environmental impact. Mufeed, Ahmad & Vaishya, (2006) study on the different characteristics of MSW in Allahabad India and the various strategies of waste management, the research however fails to bring out how the different strategies can be well managed to ensure effective management of solid waste and especially OSW. OSWM is a key element of SWM and waste management as a whole because organic waste contributes to more damage of the environment.

Local research has been conducted on the management of solid waste in Nairobi County. Esho, 1997 assessed the role of private sector in SWM in NCC; the research found out that NCC residents are turning to private companies for SWM services. However, there are gaps in addressing SWM in open spaces and in areas with low income residents. Oduor, 2015 did research on Public Private Partnerships (PPPs) in SWM in Nairobi County revealed that introduction of PPPs in SWM makes the delivery of services more effective. The study identifies the challenge as lack of support of the partnership from the county government as a source of failure of PPPs in SWM. The research does not show whether PPPs management of solid waste will address different types of waste and the

strategies to be used for each type of waste. The research will focus on organic waste in Nairobi County and how the waste can be turned to resources such as energy and fertilizer to improve the environmental condition in the county.

1.3 Objectives

The main objective of this study was to explore the stages and practices of Nairobi County government on management of OSW whereas the specific objectives were to:

(i) Evaluate the process of organic solid waste management in Nairobi County

(ii) Determine the level of organic solid waste resource generation and utilization in Nairobi County.

1.4 Value of the Study

The study was important to Nairobi County government in the reduction of the increasing level of OSW in the city by evaluating each stage of SWM and applying operations management tools to make each stage efficient while increasing the resident's revenue streams through proper management of organic waste resource. The study will be important to both the public and private institutions and companies involved in the management of waste in the county government of Nairobi as they can learn alternative ways of increasing resources instead of dumping the waste. The study was important to local and foreign investors willing to invest and make profits in OSWM sector in Nairobi County government and other counties in Kenya. The study will also benefit other county governments with similar challenges. The study can be used as a reference by academicians in the field of environmental science, hygiene and business studies

especially in the field of entrepreneurship. In operations management the study can be used to improve business processes in an organization.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The chapter focused on different theories of OSWM and literature on impact of management of OSW at different stages on the social and economic welfare of Nairobi County. A review of pragmatic research studies and conceptual frameworks showing the relationship between OSW and society's social and economic welfare

2.2 Theoretical Perspective

The theories of waste management represent in-depth account of waste definition, generation, collection, transportation, recovery, disposal and management of the disposal sites (Pongracz, Philips & Keiski, 2004). Several waste management theories and models explain the importance and the various strategies of OSW which includes; zero waste theory, operations strategy model, and closed/circular economy model. The value of waste management theories and models was to describe waste, waste management options and provide guidelines on selection of waste management options (Pongracz et al., 2004)

2.2.1 Zero Waste Theory

The theory of zero waste was developed by a chemist called Paul Palmer who discovered that high value clean chemicals discarded by emerging businesses at Silicon Valley could be reused. Although his argument was more monetary and scientific rather than ecological, he reasoned that items should be used more than once thus resources should be recovered instead of burning or burying (Mauch & Christof, 2016). Zero waste

visualizes how the society relates with the production, consumption and disposal of daily products and materials. The theory recognizes that waste to one person or industry is raw material to another and can be turned to a new product. Through experiments such as biosphere 1 and 2, the theory recognizes the nature as a teacher on how different components can relate such as human beings breathing in oxygen and breathing out carbon dioxide and plants breathing in carbon dioxide and breathing out oxygen or humans feeding on plants and discarding fertilizer for the plants. The theory was limited as focus on sustainable development is challenged by the production of matter that is not nature friendly such as chemicals that cannot be changed back to nature, which end up to dust and therefore remaining with substances that cannot be changed to zero waste.

Many cities and organizations have adopted the zero waste theory in waste management and other scholars have also done more research on the theory. China in 2000 formed the slogan of ecological civilization, which meant a change of direction from economic development to scientific development with priority on social justice and equality (Mauch & Christof, 2016). New Zealand has developed a waste management strategy based on the theory. William McDonough developed the cradle to cradle theory which is now used as a standard for product design that is based on the zero waste theory stating that waste problem is as a result of product design problems. Product design should be done with an end goal of waste reuse instead of dumping (Mcdonough, 2013). The cradle to cradle aims at ensuring that the materials remains resources that can be used over and over again thus not only useful to human health but beneficial to nature and improving profitability (Mauch & Christof, 2016). The cradle to cradle theory is related

with the zero to waste theory as it aims to benefit the environment and human society by improving the way things are made, used and re-used by recognizing the biological and technical metabolism. The theories are based on Peter Ducker's notion of doing the right thing to be effective (Mcdonough, 2013).

Based on the zero waste theory, organic waste produced at residential and commercial areas can be a useful resource that can be used as an input in the production of useful resources that can improve the social and economic welfare of residents in Nairobi County. The waste should be managed from the generation point so to ensure that waste is minimized. The design of products by different companies should be done to ensure that products can be recycled. Production of products that cannot be recycled should be restricted, redesigned or removed from production (Upadhyaya & Luv, 2013).

2.2.2. Operations Management Perspective on Waste Management

The operation management perspective was based on operations strategy model developed by Nigel Slack, a professor at Warwick business school, Warwick University. The strategy is concerned with the management of operations resources and processes to attain sustainable advantage. The operations strategy analyses the business in three levels which include the input-transformation-output-model. Where there is value addition at each level of product or service life cycle. Companies such as Coca-Cola have to embrace the operations strategy despite intensive marketing as operations strategy supports product development and delivery and therefore ensures product quality and timely delivery to the customer which at the end increase the market base. Due to

changes in the external environment, operations strategy was essential to ensure that the products and services produced positively adjust to the changing external environment (Slack & Lewis, 2011). Operations strategy stipulates the procedures of using the organization's assets to achieve the competitive strategy. This involves managing company's resources including raw materials, process, technology, human resources, facilities to be used (location, type and size) in order to create sustainable competitive advantage. The operations strategies are set so as to achieve the overall company strategic goal. Slack, 2010 states that the operations strategy matrix is a tool used by organizations both profit making and non-profit making to create competitive advantage by matching its performance objectives which include cost, flexibility, dependability, quality and speed with resource usage decision areas such as organization's capacity, supply network, process technology, development and organization. For example the processes in the organization should be flexible to accommodate change of technology that improves organization performance.

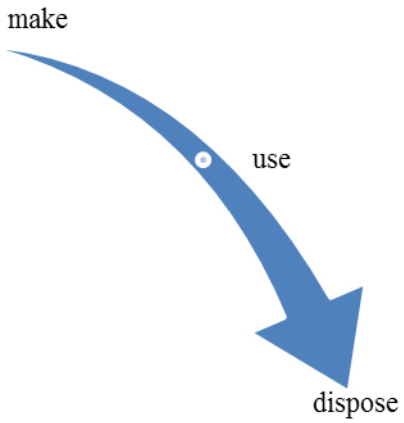
The perspective was relevant to OSWM in Nairobi County as this was by itself a process that involved different operations which include collection, segregation, transportation, recycling, dumping and management of the dump sites. The operations strategy can be developed to enhance decision making in the implementation of the CADP 2018-2019 and ISWMP 2010-2020 plans for Nairobi County.

2.2.3 Closed/Circular Economy Model

The closed economy is an economic system where focus is put on minimization of resource input and output, emission and energy leakage through applying slow, closed

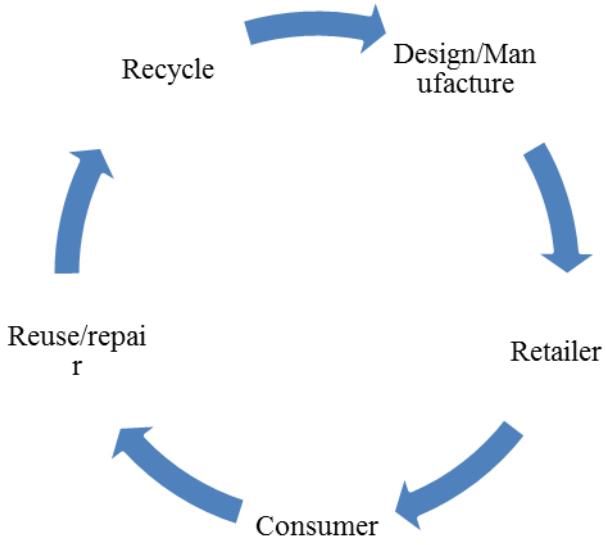
and narrowed energy loops. The system was first introduced by Kenneth Boulding in 1966 where he raised awareness of the closed economy as a circular economy where resources remain as long as possible as part of the economy. The circular economy is restorative by design and enhances highest utility and value of materials, components and products all times (Geissdoerfe, 2016).

Figure 0.1 Linear Model



Source: (Morgan & Mitchell, 2015)

Figure 0.2 Closed/Circular Economy



Source: (Morgan & Mitchell, 2015)

According to Allam (2018), the circular economy also called the closed economy replaced the linear economy where the economic processes were based on the take, make and dispose processes as shown in figure 2.1 above. The circular economy emphased on the 3Rs which include reduce, reuse and recycle processes. Companies have been able to realize profits by adapting the circular economy. For example general motors' by adapting the circular economy strategy has been able to increase monthly revenue by Usd 20,000 through sale of unwanted by-products and left over such as cardboards and steel. In the United Kingdom, the waste and recycling industry made revenue of 6.5 billion employing approximately 75,000 people in 2000. In 2010 the sales revenue from SWM increased to 19billion pounds and with 130,000 employment opportunities (Morgan & Mitchell 2015). BS 8001 is the framework that was introduced for the implementation of the principle of the circular economy in different organizations which shows the processes required and benefits of implementation of the standard in an organization (British Standard Institute, 2019).

Organic waste forms 50 percent composition of the MSW, the aim of European Union (EU) landfill directive is to reduce the landfill municipal waste to 10 percent by 2030. The concentration is highly on the MSW through composting and anaerobic digestion. Composting is used on management of Soil Organic Matter (SOM) and GHG emissions. Composting generates carbon, which has important soil ecosystem roles such as resistance of soil erosion, soil retention of water, fertility for plant in the soil and biodiversity of the soil (Razza, D'Avino, L'Abate, & Lazzeri, 2018). In Nairobi County

the closed economy would be applicable in order to reduce the amount of organic waste disposed in the landfills and turn the waste to resources that can be used to improve the county's environment and economy performance.

2.3 Organic Solid Waste Management

Extensive research both locally and internationally has been done on MSW globally focusing on management practices to reduce and recycle solid waste, however more than 50 percent of the waste generated is OSW from commercial and residential building which continuously increases with relative increase of population and due to urbanization in Nairobi County. According to NEMA (2014) OSWM consists of different components, which include waste generation, collection, segregation, transportation, recycling and reuse, land filling. The above components have evolved from the traditional components that involved waste generation, collection and dumping. The Integrated approach of SWM is meant to protect and conserve the environment.

2.3.1 Waste Generation

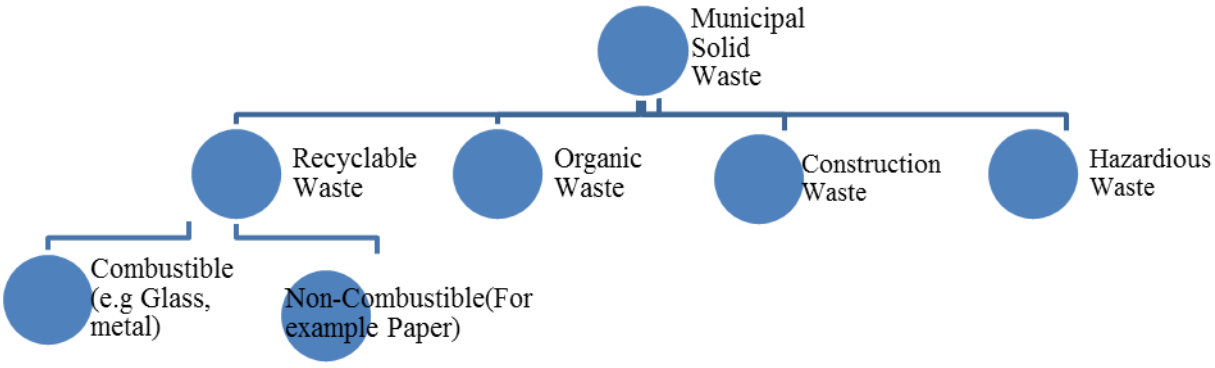
Waste generation is the measure of quantity of materials that go in the waste torrent before the waste is collected, transported, recycled, composed or placed in a landfill (ASL Environmental, 2014). According to 4-Waste removals (2016), waste generated can be in different categories such as liquid waste that include dirty water, waste detergents, wash water, organic liquids and rain water. Solid waste which include plastic, paper, tins, metals, ceramics and glass, organic waste which include food waste, animal waste and garden waste. In Nairobi County 58.6 percent of total waste generated at residential areas

was organic waste while 51.3 per cent of waste collected from business, commercial and institutional areas was organic waste (Kasozi & Blottnitz, 2010).

2.3.2 Waste Segregation

Waste segregation is an emerging desirable practice in most countries globally however very limited in developing countries. The practise is commonly admirable at the household level of waste management where the individual households are expected to separate waste according to the different waste use such as biogradable and non biogradable (edu green). According to NEMA, (2006) waste segregation can be summarized as follows which should be done at waste generation and is the responsibility of waste generator.

Figure 0.1 National Environment Management Authority Waste Segregation at Source



2.3.3 Waste Collection and Transportation

Both public and private sectors are active in the collection and transportation of solid waste globally. The government is active through the municipals and city corporations for example in Nairobi County through Nairobi county government. The challenges faced by the public sector is slow decision making due to rigid laws, high cost due to the

manual workers employed and low productivity of the workers. The private sector plays a significant role in SWM through private small-scale waste pickers, itinerant or stationary buyers, CBOs, NGOs and micro finances. The different parties do have different implementation so to maintain economic status of the surrounding society (Ahmed & Ali, 2003).

Table 0.1 Solid Waste Management Private Sector Group

Private sector group	**Description**	**Effectiveness**
Waste pickers	(i) Informal sector from low income areas. (ii) Not registered by the NCC (iii) Collect solid waste for reselling purposes	i) Effective in low income areas
Itinerant/stationary buyers	(i) Purchase waste for recycle from waste pickers (ii) Use waste as raw materials for new products (iii) Exist as per customer product need	i) Effective to sustain waste pickers
CBOs	(i) Organized by community for purpose (ii) Collect waste at a very low cost (iii) No co-ordination with county government	ii) Creation of new dump site iii)Exist in low income sector
Micro finances	(i) Privately owned and established companies (ii) Collect and transport waste at a cost	(i) Very effective in medium and high income areas.

2.3.4 Disposal

The final objective of SWM is nontoxic disposal of solid waste. There are different methods of disposing which include land filling both sanitary land filling and open

dumps, composting, incineration and recycling. There is a major problem globally regarding the disposal of final waste leading to great consequences for countries such as Malaysia have vowed to ship back 450 tons of waste claiming not to be a dump site after different countries including Australia, Bangladesh, Canada, China, Japan, Saudi Arabia and United states shipped containers to the country's main port. The country did consider burning importation of plastic waste which will follow China who also burn importation of plastic waste that they recycled and used to make raw materials including building materials in the construction industry (News.com.au, 2019).

Land filling is a way of dumping that is commonly practiced in urban areas where a large amount of generated waste is dumped in one pit in the ground that is later covered to prevent human risks such as diseases. Landfills are filled with waste then covered with a thick layer of mud. The area can later be used as a public place such as a parking space. The problem associated with land filling is majorly leaching which is the contamination of underground water that is health hazard for human consumption which can be addressed by construction of sanitary landfill that have a covering layer. However, sanitary land filling is very expensive and not reliable as the covering may crack due to chemical composition of the solid waste and also it prevents decomposition of waste due to limited oxygen concentration. In Nairobi County, the Dandora dump site exists as an open dump site where most of the collected solid waste is disposed. Efforts by the Nairobi County leadership to upgrade the site have not yielded any fruit (Mueni, J. 2018).

Incineration is the burning of solid waste in high amount of furnace after separation of waste that can be recycled. During the process, waste is converted into flue gas, ash and heat. The flue gas is disposed in the air and if not treated can be a pollutant as the gas contains dioxins and heavy metals (edu green).Incineration has benefits in the treatment of clinical waste materials. The reduction rate of solid waste using the process is 80-85 per cent which is dependent on the composition of the waste (Wikipedia).

Recycling is the process where disposed waste is collected and re manufactured as new products using different processes. The above is highly done with items that are composed of single material such as paper and plastic as compared to electronic equipment which has different material components that require segregation (Mukankomeje, 2010). There are two different types of recycling in Kenya where we have the small scale recycling industry who purchase items from waste pickers, stationary waste buyers and itinerant such as glass, plastic and metal cans and re manufacture to new products and large scale recycling industry that use bulk waste material for their manufacturing processes by buying large quantities of materials (Ahmed & Ali 2003). According to Kasozi and Blottnitz (2010) the active recycling sector in Kenya accounts for 300 tons of waste per day which consist of 18 percent paper waste, 20 percent plastic waste, 1 percent of organic waste and the highest percentage of metal waste.

2.3.5 Composting as a Waste Management Process

Composting is a waste management process for OSW using biological process. The method is considered to be appropriate, cheaper, and environmental friendly and beneficial. Composting is a recycling method for the OSW to useful products. The process also benefits the soil content by improving the soil structure, water maintenance and penetration rate and tilth. The process is used to preserve soil fertility by recycling organic waste back to the soil. The two types of composting include the aerobic composting where decomposition of the waste is done in the presence of air and anaerobic composting where the waste decomposes without air (Gonawala & Jardosh, 2018). The fertilizer that is produced is organic can be used to replace the chemical fertilizer. The process is cheap as one need to dig a 3 feet deep pit where the aerobic composing takes place after 45 days then the waste is ready to be used as manure (edu green). Unlike the natural decomposition of OSW in the open dumps in landfills, composting has controlled conditions of temperature, moisture and aeration. Biogas is a product of the anaerobic composting which was first started in the 19^{th} century with the septic tank as a way of treating waste during which biogas was not collected and used. In 1890s, Donald Cameron constructed a septic tank where biogas was collected for use of street lighting. There was a large increase in the use of biogas after the Second World War with the main purpose of increasing agricultural production. Around the world, biogas is currently used in households for cooking and fertilizer (Jorgensen et al., 2009). The research will focus with production of biogas and its by-products as an efficient means of OSWM while improving the environmental condition in Nairobi County.

2.4 Empirical Review

Local and international researchers have studied the field of OSWM in an attempt to improve the environmental condition globally due to the current status of SWM and as detailed in the study. The topic of SWM has become popular not only to academicians but also relevant government bodies, nonprofit making organizations and private companies in a bid to improve the surrounding environment. Globally Fernando (2018) studied on SWM of local governments in the western province of Sri Lanka. The aim of the research was to examine the major factors that hinder the implementation of the various SWM policies. Qualitative and quantitative methods of data collection were used to collect both primary and secondary data including interviews and in-depth discussion with different officers involved in the implementation process who were selected using the stratified random sampling method and a filed survey with structured questionnaires. The researcher concluded that the SWM policies implementation stage was not successful due to various administrative factors such as motivation of staff, commitment and operational factors which included lack of sufficient land for composting, recycling and final dumping. However the study failed to bring out the management of OSW and what percentage of the problem would be solved if management of organic waste was put into consideration.

According to Guerrero, Maas & Hogland (2013) studied the SWM challenges for cities in developing countries with a focus on thirty urban areas in 22 developing countries in four continents. The objective of the research was to analyse the influencing factors in waste management systems and the stakeholder's behaviour that affect the system. Primary data was collected through observation and structured interviews while secondary data was

collected from scientific literature and existing database. Data analysis and conclusion was made using descriptive and inferential statistics. The outcome of the research was the various factors that affect the waste management system and key stakeholders involved which can be used in planning and implementation of the waste management system. However the research paper did not show the impact of the various factors and stakeholders on OSWM.

Ababio (2013) studied SWM in African cities with focus on Accra, Ghana. The objective of the study is to illustrate the importance of essential waste stream composition data and the informal waste pickers to investors in SWM. The research examines the management of waste both in low density, high income areas and high density, low income areas. The data is collected by observation of the waste in both areas, sampling of different households by collecting waste from the households for analysis and interviews. Descriptive and inferential statistics methods were used to analyse the data. The results of the findings were that SWM is more effective for middle and upper income, low density areas while less is done for low income, high density areas where waste is left unattended for 2-3 weeks and therefore resulting in dumping by residents. The research recommends that the low income informal waste pickers should be legalized. However it is not clear on the technology to be used by the informal sector on how to manage the OSW while minimizing the level of dumping which end up clogged in the water drainage systems and therefore becoming health hazards to the society.

Muriki, S.W. (2014) analyses biogas technology for household energy, sustainable livelihoods and climate change mitigation in Kiambu County in Kenya. The objective of the study was to determine the role and potential of biogas energy technology in improving Kiambu county livelihoods. Both primary and secondary data was collected using oral interviews, focused group discussions and action learning case studies for example feeding of cows with different combination of feeds and test the biogas produced by the cows. Collected data was analysed using computer software which include statistical package for social sciences (SPSS) and statistical analysis systems (SAS). To determine the relationship between the different variables, descriptive statistics which is representation of the entire population sample such as measures of central tendency and measures of variability, tests of significance and logical regression. The research found out that biogas technology is a major driver of livelihoods in Kiambu County and has environmental benefits. The research however failed to show how to effectively manage the waste to enhance generation of biogas throughout the OSWM process so to increase productivity.

Oduor (2015) studied PPPs in SWM with a focus on Nairobi. The focus of the study was on the PPPs in SWM in Nairobi County. Qualitative research methods were used which included primary data from previous research studies of Nairobi and other cities around the world and primary data that was obtained from face to face interviews and structured questionnaires from existing stakeholders to establish the progress of PPPs implementation in Nairobi. The results of the study is that PPPs make SWM more

effective however the research did not establish the different types of waste and how PPPs can make OSWM in specific more effective.

Ngunju, (2018) studies on Municipal Solid Waste Management (MSWM) with a focus on the contribution and challenges of the private sector in SWM in Nairobi County. The objective of the study was to assess the contribution and challenges of private SWM companies in Nairobi County. The study adopted quantitative data collection techniques using self-administered questionnaires. The analysis was done using descriptive statistics. The research concluded that private companies operated mostly on high and middle income areas in Nairobi and that most of the collected waste was dumped at the Dandora dump site and others did open dumping. The research also realized that the private sector did experience challenges in finance so to acquire proper transportation services for the collected waste and that the local government was not keen in monitoring the waste management process as required. The research however did not show management of waste in terms of the various categories as the waste cannot be managed as one and did not show what role and challenges faced by the private sector in segregation, recycling and reuse of waste in Nairobi County.

In conclusion different studies have shown the gap in SWM that result to non-conducive environment and a risk to the human beings. The research will focus more on the management of OSW at different levels of OWSM in Nairobi County which forms a high percentage of the dumped waste materials with the increasing population. Table 2.1 gives a summary of the empirical review.

Table 2.2 Summary of Empirical Review

Author(s)	Study	Objective	Methodology	Findings	Knowledge Gap (s)	Focus of Current Study
R. Lalitha S. Fernando	SWM of local governments in the western province of Sri Lanka: An implementation analysis	Examine major factors affecting successful implementation of SWM policies in western province of Sri-Lanka.	Primary and Secondary data was collected using both qualitative and quantitative methods	Implementation of SWM policies is in- effective due to administrative challenges, community contribution, political leadership and business community.	The research did not demonstrate the impact of management of OSW.	The current study shows how OSWM can bring change to Nairobi County residents both socially and economically
Guerrero et.al. (2013)	SWM challenges for cities in developing countries	Analyse the influencing factors in waste management systems and the stakeholder's behaviour that affect the system	Adapted descriptive and inferential statistics methods on secondary data	Relevant list of stakeholders in the waste management systems and the factors that cause failure of the system	The research failed to show the impact of the various factors and stakeholders on OSWM	The research will focus on OSWM, how different stakeholders are involved in the process.
Ababio et al. (2013)	SWM in African cities: Sorting the facts from the fads in Accra, Ghana	Illustrate the importance of requisite waste streams composition before investments in SWM	Data collection was done using observation of the main urban areas, sampling of household and interviews of the household	The results of the findings were that SWM is more effective at the middle and upper income, low density areas.	The research recommends the informal sector to be formalized to manage waste but does not technologies for OSWM	The study will demonstrate the different techniques of OSWM that can result in generation of biogas and its by products such as organic fertilizer

Table 2.2 Continued…

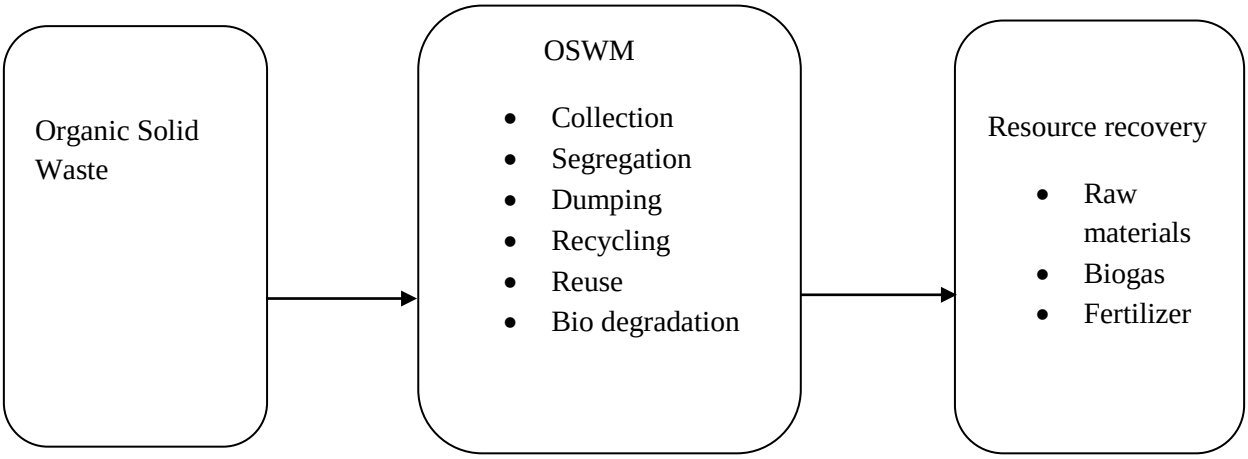
Muriuki Salome Wamuyu (2014)	Analysis of biogas technology for household energy, sustainable livelihoods and climate change mitigation in Kiambu County, Kenya	The researcher determined the role of biogas energy technology in improving livelihoods of Kiambu area.	Data collection was done using oral interviews, focused group discussions and action learning case studies. Descriptive statistic and logical regression techniques were used to analyse data.	Biogas technology demonstrated great potential in improving livelihood of Kiambu County	The study failed to show how to effectively manage OSW to enhance generation of biogas throughout the OSWM.	The study will assess the impact of OSWM to generate biogas and by products and the environmental impact.
Odour J, (2015).	PPPs in SWM with a focus on Nairobi.	The focus of the study was on the PPPs in SWM in Nairobi county.	Qualitative research methods were used including primary data techniques such as face to face observation and semi structured interviews and secondary data collection techniques	The results of the study is the PPPs make SWM more effective	The research did not establish the different types of waste and how PPPs can make OSWM more effective.	The study gives the various categories of waste and in specific organic waste and Waste management techniques that can be adopted by the private sector.
Ngunju, (2018)	MSWM	The objective of the study was to assess the contribution and challenges of private SWM companies in Nairobi County.	The study adopted quantitative data collection techniques. The analysis was done using descriptive statistics.	The research concluded that private companies operated mostly on high and middle income areas in Nairobi	The research however did not show management of waste in terms of the various categories	The study gives the various categories of waste and Waste management techniques that can be adopted by the private sector.

2.5 Conceptual Framework

The conceptual framework was based on an input output relationship of variables. The OSWM practices are the independent variable managed by both the Nairobi County and the private sector while the dependant variables is resource recovery as illustrated in Figure 2.4 below. The OSW generated at source is subjected to the various strategies of OSWM in order to achieve a specified output which includes resource recovery.

Organic waste from different waste generators such as households and institutions is collected and segregated so to put to different purpose such as recycling, reuse, bio degradation and dumping as the last priority. The SWM process determines the output of the waste where for recycling, reuse and bio degradation, resources such as biogas and fertilizer can be recovered.

Figure 0.1 Conceptual Framework



Source: Researcher (2019)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlights the research methodological techniques and procedures that were adapted in data collection, processing and presentation. The chapter brings out the techniques of data collection and data analysis, the population of the study, sampling techniques and data presentation used in the research study.

3.2 Research Design

The study adopted descriptive research design in order to describe the characteristics and trends of the sample population involved in management of OSW in Nairobi County. This included collection of both primary and secondary data with a focus on the Nairobi County in specific DOE and related parties in OSWM. Primary data was collected by administering questionnaires to selected population and observation of the current level of organic waste in the area, while secondary data was collected from existing literature on the study such as research reports and books. Case study of how OSW is managed in Nairobi County was relevant as described by Zainal, (2007), the case study goes beyond quantitative methods by providing in-depth and holistic explanation of the social problems.

3.3 Population and Sampling Techniques

The population of the study on OSWM in Nairobi County included different parties involved in the handling and management of OSW. Starting from collection, DOE which has approximately 5 officers in-charge, 60 private registered companies and 18 CBOs with the Nairobi County, estate agents who are 91 according to the yellow pages

directory and NEMA officers who are 6 in Nairobi County in charge of monitoring the status of OSWM in the county. The area of study was Nairobi County which included 17 constituencies. The research involved study of the sample population as described below.

Table 0.1 Population and Sampling Technique

Unit of Study	Population Size	Sample Size
DOE officers	5	1
NEMA officers	6	2
Private companies in SWM- operations managers	60	12
Estate managers	91	19
CBOs – operations manager	18	4
Total	180	38

3.4 Operationalization of Variables

The research focused on OSW as the independent variable that can be defined as the level of organic waste from residential areas, market, institutions and commercial areas in Nairobi County. The conditional variable was OSWM processes that are taking place in the different areas with OSW in Nairobi County which include the level of collection, segregation, and dumping, recycling, reuse or bio degradation. The dependant variable was resource recovery which was a measure by the level of biogas and by-products generated in Nairobi County

Table 0.1 Operationalization of Variables

Variables	Operational Definition	Type of Scale
OSW	Organic waste from residential areas in Nairobi County	Ordinal
	Organic waste from market places in Nairobi County	Ordinal
	Organic waste from institutions in Nairobi County	Ordinal
	Organic waste from commercial areas in Nairobi County	Ordinal
OSWM	Level of organic waste collected	Ordinal
	Level of organic waste segregated	Ordinal
	Level of organic waste dumped	Ordinal
	Level of organic waste recycled or reused	Ordinal
	Level of organic waste biodegraded	Ordinal
Resource	Level of biogas produced	Ordinal
recovery	Level of by products such as fertilizer produced	Ordinal

3.5 Data Collection

Primary and secondary data from the selected sample of population was collected using multiple techniques which included observation, structured interviews, literature review and existing case study. Observation on the level of OSW in the specific areas was done and evidence in terms of images taken in the specified sample constituencies. Observation on the behaviour patterns of the community towards OSW was also done. As per Section A The general information of the respondent, Section B covered objective one which was to evaluate the process of OSWM in Nairobi County detailing the level of awareness, Section C evaluated the current practices in OSWM and Section D covered

objective two which determined the level of OSW resource generation and utilization in Nairobi County

3.6 Data Reliability and Validity

The Cronbach's alpha technique was used to measure the internal consistency and reliability of the scale and tests that were used to collect information from the sample population. The questionnaires were on the scale based depending on the feedback of the respondent. If the Cronbach's alpha was above 0.65 an indication that data collected was consistent. According to Mohajan (2017), it is vital to establish the reliability and validity of research in order to ensure sound and replicable data and accuracy of the results. The research used various ways of data collection such as questionnaires, observation and case study to ensure collected data was valid and reliable.

3.7 Data Analysis

Descriptive and inferential statistics method was used for data analysis. Descriptive statistics was used to measure the average of OSW collected, segregated, recycled and disposed as per first objective to evaluate the process of OSWM in Nairobi County. Measures of frequency, measures of dispersion and measures of central tendency were used. Data was presented in graphical and tabulated format for analysis purposes. Descriptive statistics was used to analyse the level of biogas and by products production in the selected samples and as per the second objective to determine the level of OSW resource generation and utilization in Nairobi County. Other statistical methods included inferential statistics such as estimation and hypothesis testing.

3.8 Summary of Research Methodology

Table 0.1 Summary of Research Methodology

Objectives	Data Collection	Questionnaire	Data Analysis Method
1. To evaluate the process of OSWM in Nairobi County	Primary methods of data collection which include questionnaires, face to face interviews and observation. Secondary methods by using literature review	Section B and C	Descriptive Statistics
2. Determine the level of organic solid waste resource generation and utilization in Nairobi County.	Primary methods of data collection which include questionnaires, face to face interviews and observation. Secondary methods by using literature review	Section D	Descriptive and inferential statistics methods

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents results and detailed discussion of the study, which set to evaluate the process of OSW in Nairobi County and to determine the level of OSW resource generation and utilization in Nairobi County. On the evaluation of the process, the study keyed in on the five key stages of generation, collection, segregation, recycling/treatment and dumping. On the second objective, the study focused on the resource generation in terms of by-products of the processes and their utilization. The data analysis was on the basis of the data gathered which was collected through questionnaires and observation. Due to the COVID-19 situation in the country, the questionnaires were sent out to the respondents using an application and any clarification done on phone.

4.2 General Information on the Respondents

The study first sought to establish some general information on the respondents. These were key in understanding the roles that they play when it comes to OSWM. These included the organization or company that they worked for and their position there in, the constituency, their position that they play in OSWM, their work experience within SWM industry and their current area of operation.

The particular organizations that the respondents worked for were established and the results presented in the Table 4.1 below. The results show that the majority of the respondents at 44.7 percent were estate managers followed by private companies in SWM at 31.6 percent. Those working at NEMA were 10.5 percent, CBOs made up 7.9

percent while DOE was represented by 5.3 percent of the respondents. The results show the percentages of the calibre of the respondents in the study.

Table 0.1 Organization/Company that the Respondents Worked

Organization/Company	Frequency	Percent	Valid Percent	Cumulative Percent
DOE	2	5.3	5.3	5.3
NEMA	4	10.5	10.5	15.8
Private companies in SWM- operations managers	12	31.6	31.6	47.4
Estate managers	17	44.7	44.7	92.1
CBOs – operations manager	3	7.9	7.9	100.0
Total	38	100.0	100.0	

In order to ascertain the knowledge of the respondents on OSWM process, the study sought to establish the positions which they held within their organizations. Table 4.2 below shows that 38.6 percent of the respondents held a managerial position while 28.9 percent were made up of support staff 15.8 percent were programme officers, 10.5 percent environmental officers while 7.9 percent were executive directors. This, therefore showed that since OSWM is a process carried out by various ranking workers, the respondents were in a position to offer reliable information.

Table 4.2 Respondents Position within Organization

Position	Frequency	Percent	Valid Percent	Cumulative Percent
Environment Officer	4	10.5	10.5	10.5
Executive Director	3	7.9	7.9	18.4
Program Officer	6	15.8	15.8	34.2

Manager	14	36.8	36.8	71.1
Support Staff	11	28.9	28.9	100.0
Total	38	100.0	100.0	

The study established the role that the respondents played in OSWM and it is presented in the Table 4.3 below. From the results, it is evident that 81.6 percent are involved in capacity building while 18.4 percent participated in research.

Table 0.1 Role played in Organics Solid Waste Management

	Frequency	Percent	Valid Percent	Cumulative Percent
Capacity building	31	81.6	81.6	81.6
Research	7	18.4	18.4	100.0
Total	38	100.0	100.0	

The study further sought to establish the particular period of time that the respondents had worked within the SWM industry and the results are presented in the table 4.4 below.

Table 0.2 Work Experience in the Solid Waste Management Industry

	Frequency	Percent	Valid Percent	Cumulative Percent
0-5years	10	26.3	26.3	26.3
5-10 years	17	44.7	44.7	71.1
More than 10 years	11	28.9	28.9	100.0
Total	38	100.0	100.0	

From the results as presented in Table 4.4 above, the biggest proportion of the respondents at 44.7 percent have a work experience within the industry of between 5-10 years. 28.9 percent have more than 10 years of experience while 26.3 percent have between 0-5 years of experience. The results indicate that majority of the respondents have adequate knowledge on the SWM industry and institutions and thus will provide reliable information.

Table 0.3 Area of Operation in Nairobi County

	Frequency	Percent	Valid Percent	Cumulative Percent
Urban slums in Nairobi.	14	36.8	36.8	36.8
South B	5	13.2	13.2	50.0
Nairobi County	14	36.8	36.8	86.8
Mathare	3	7.9	7.9	94.7
CBD	2	5.3	5.3	100.0
Total	38	100.0	100.0	

The study further sought to establish the specific area of operation for the respondents within Nairobi County. Those whose operations are based within various urban slums tied with those who operate within the entire county at 36.8 percent. This was followed by 13.2 percent in South B, 7.9 percent in Mathare and 5.3 percent in the CBD. The results hence show that information received is a good representation of the SWM process within the county.

4.3 Situation Analysis to evaluate the process of organic solid waste management in Nairobi County

The study sought to establish the situational analysis as a way to help in the evaluation of organic solid waste management within the county. To achieve this, the study sought to understand the contribution of various stakeholders within various stages of the solid waste management process, that is: - generation, collection, segregation, recycling/reuse, dumping. Respondents rated stakeholder involvement on a five point Likert scale ranging from 1=very low, 2= low, 3=neither low nor high, 4=high and 5=very high. The results are indicated in the tables below.

Table 0.4 Generation of Organic Solid Waste by Stakeholders

	PPIs	RESIDENTS	COMMUNITY CENTERS/MARKETS	OTHERS
Very Low	13.2	2.6	0	7.9
Low	31.6	7.9	0	13.2
Neither Low Nor High	28.9	28.9	5.3	50.0
High	10.5	28.9	18.4	15.8
Very High	15.8	31.6	76.3	13.2
Total	100	100.0	100.0	100.0

Table 4.6 above shows results for contribution in generation of OSW in percentages by the various stakeholders. Based on the results, community and market centres are the largest contributor with a rating of very high of 76.3 percent. PPIs and residents follow close behind with most PPIs generating low OSW at 31.6 percent and neither low nor

high at 28.9 percent. For residents, distribution in terms of generation was most concentrated at neither low nor high both at 28.9 percent while those generating very high OSW are 31.6 percent. In this case, others could include office buildings and other establishments that do not fall within the first three categories. For these, generation is mostly concentrated at neither high nor low rating at 50 percent while the rest was evenly distributed amongst the other scales.

Table 0.5 Collection of Organic Solid Waste by Stakeholders

	PPIs	RESIDENTS	COMMUNITY CENTERS/MARKETS	OTHERS
Very Low	0	0	0	26.3
Low	2.6	7.9	55.3	23.7
Neither Low Nor High	26.3	52.6	34.2	39.5
High	31.6	36.8	10.5	2.6
Very High	39.5	2.6	0	7.9
Total	100.0	100.0	100.0	100.0

In order to further understand the process, the study sought to establish the level of collection by various stakeholders. Table 4.7 above presents the results. The results indicate that most stakeholders' involvement is neither low nor high at 52.6 percent for residents, 39.5 percent for others, 34.2 percent for community centres and markets and 26.3 percent for Public Private Institutions (PPIs). On the lower scale, the respondents stated that collection by PPIs, residents and community centres was very low at 0 percent.

This therefore shows that PPIs are the ones most involved in collection at a high rate of 31.6 percent and very high at 39.5 percent.

The study further looked at the frequency of waste collection in the various areas. Table 4.8 shows the results. Most of the collection happens weekly at 60.5 percent, followed by twice a week at 31.6 percent, daily at 5.3 percent and monthly at 2.6 percent.

Table 0.6 Frequency of Waste Collected Area of Operation

	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	2	5.3	5.3	5.3
Weekly	23	60.5	60.5	65.8
Twice a week	12	31.6	31.6	97.4
monthly	1	2.6	2.6	100.0
Total	38	100.0	100.0	

In order to further understand this concept, the study looked at the level of education for those involved in collection and the results are indicated in table 4.9 below. Majority of those who carry out collection have attained primary education at 63.2 percent while those who have secondary education are 21.1 percent. Those with university education make up 7.9 percent, those with below primary education are 5.3 percent while others are 2.6 percent. This therefore shows that the level of management of OSW at the collection level is quite limited due to the low education levels by the waste collectors.

Table 0.7 Level of Education of the Stakeholders

	Frequency	Percent	Valid Percent	Cumulative Percent
None	2	5.3	5.3	5.3
Primary Education	24	63.2	63.2	68.4
Secondary Education	8	21.1	21.1	89.5
University Education	3	7.9	7.9	97.4
Other(Specify)	1	2.6	2.6	100.0
Total	38	100.0	100.0	

Table 4.10 below indicates the involvement of stakeholders in the segregation process. Generally, it is evident there is low involvement in the process with it being non-existent to some of the stakeholders. PPIs are the most involved with those ranking high at 36.8 percent and those ranking very high at 31.6 percent. Residents ranked very low at 63.2 percent and low at 36.8 percent. For community and market centres, those ranked very low were 52.6 percent, low were 36.8 percent. The same applied for others whereby 65.8 percent ranked very low and 34.2 percent were low. This is evident that even the stakeholders have little knowledge on the need to actually segregate waste and therefore putting it all together without sorting out.

Table 0.8 Segregation of Organic Solid Waste by Stakeholders

	PPIs	RESIDENTS	COMMUNITY CENTERS/MARKETS	OTHERS
Very Low	5.3	63.2	52.6	65.8
Low	15.8	36.8	36.8	34.2
Neither Low Nor High	10.5	0	7.9	0
High	36.8	0	2.6	0
Very High	31.6	0	0	0
Total	100.0	100.0	100.0	100.0

Table 0.9 Recycling of Organic Solid Waste by Stakeholders

	PPIs	RESIDENTS	COMMUNITY CENTERS/MARKETS	OTHERS
Very Low	28.9	34.2	60.5	57.9
Low	15.8	42.1	31.6	23.7
Neither Low Nor High	34.2	23.7	7.9	5.3
High	10.5	0	0	13.2
Very High	10.5	0	0	0
Total	100.0	100.0	100.0	100.0

On recycling, the study noted that generally, the level of recycling was also quite low and that the PPIs were the ones who were mostly involved in the process. For PPIs, 34.2 percentage of the respondents noted that their involvement was neither high nor low. Further they scaled low at 28.9 percent, low at 15.8 percent, high at 10.5 percent and very

high at 10.5 percent. For residents, community centers and markets and others, their involvement was quite low with most being very low for community centers and markets at 60.5 percent, 57.9 percent for others and 34.2 percent for residents. From the results as indicated in table 4.11 above, it is therefore evident that just like segregation; there are low recycling levels of OSW among stakeholders.

Table 0.10 Amount of Solid Waste Recycled/Reused

	Frequency	Percent	Valid Percent	Cumulative Percent
10% and below	13	34.2	34.2	34.2
20%-30%	12	31.6	31.6	65.8
30%-40%	12	31.6	31.6	97.4
40%-50%	1	2.6	2.6	100.0
Total	38	100.0	100.0	

Table 4.12 above shows the percentage of collected waste that is either recycled or reused. This seeks to understand the amount that actually gets to the final stage and turns out to be beneficial to the community**.** According to the respondents, 10 percent and below of the collected waste is either recycled or reused at 34.2 percent. 31.6 percent of the respondents stated that 20-30 percent of the waste underwent the processes, 31.6 percent noted that it was 30-40 percent. Only 2.6 percent of them stated that 40-50 percent of the collected waste underwent these processes. This is therefore evident that there are very low levels of recycling and reuse of collected waste and as such more efforts need to be put in by relevant authorities to enable revamping of the same.

Table 0.11 Dumping of Organic Solid Waste by Stakeholders

	PPIs	RESIDENTS	COMMUNITY CENTERS/MARKETS	OTHERS
Very Low	15.8	2.6	0	18.4
Low	15.8	15.8	0	18.4
Neither Low Nor High	28.9	21.1	5.3	42.1
High	10.5	26.3	36.8	13.2
Very High	28.9	34.2	57.9	7.9
Total	100.0	100.0	100.0	100.0

On dumping, the residents scaled the various stakeholders whereby community centres and market ranked highest at 57.9 percent at very high and 36.8 percent at high. Residents also contributed high in dumping where the very high scale was 34,2 percent, high 26.3 percent and neither high nor low at 21.1 percent. For PPIs, they scaled as very low at 15.8 percent same as low, neither high nor low at 28.9 percent, high at 10.5 percent and very high at 28.9 percent. From the results, it is evident that community centres are most involved in dumping followed by the residents and PPIs. However, it also shows that more needs to be done in terms of educating the various groups more on dumping and disposal of solid waste as well as the relevant authorities provide more options for sustainable disposal methods such as landfills, incineration and composting.

4.4 Current practices in regard to treatment of organic solid waste

The study further sought to understand the various practices that are employed in regard to treatment of organic solid waste. To establish this, respondents were asked a few questions regard the handling of waste post collection. This sought to bring a clear picture on the entire process of recycling, reusing or treatment. This included the amount, organizations involved, by products and level of sensitization. The tables below indicate the results of the study.

According to the table 4.14 below, 34.2 percent of the respondents said that only 10 percent and below of the collected solid waste is treated, recycled or reused. 31.6 percent said that it was 20-30 percent, and another 31.6 percent of them stated that it was 30-40 percent while 2.6 percent stated that it was 40-50 percent of the waste that actually undergoes the said processes. From the results, we can deduce that most of the collected waste does not actually end up to the final stages of treatment, recycling and reuse.

Table 0.1 Percentage of Collected Solid Waste is Treated/Recycled or Reused

	Frequency	Percent	Valid Percent	Cumulative Percent
10% and below	13	34.2	34.2	34.2
20%-30%	12	31.6	31.6	65.8
30%-40%	12	31.6	31.6	97.4
40%-50%	1	2.6	2.6	100.0
Above 50%	0	0	0	100.0

The study further sought to establish the knowledge of the respondents on the companies, individuals or organizations that were involved in the recycling, re use and treatment of organic solid waste management.

Table 4.15 below shows the results whereby majority of the respondents at 42.1 percent had knowledge of between 1-5 such entities. This was followed by 10-15 at 18.4 percent then those who had no idea of any such entity and those who knew at least 5-10 came closely at 15.8 percent. The least were those who knew above 15 at 7.9 percent. The results are indicative of the fact that while there are a number of companies carrying out these processes, they are limited and thus the need to have more of them to cover the gap and meet the demand.

Table 0.2 Knowledge of Companies, Individuals and Organizations Involved in Recycling, Reuse and Treatment

	Frequency	Percent	Valid Percent	Cumulative Percent
0	6	15.8	15.8	15.8
1-5	16	42.1	42.1	57.9
5-10	6	15.8	15.8	73.7
10-15	7	18.4	18.4	92.1
Above 15	3	7.9	7.9	100.0
Total	38	100.0	100.0	

While focusing on the beneficial side of OSWM process, the study sought to establish the byproducts produced. Table 4.16 below has the results which indicate that livestock feed is the biggest byproduct at 39.5 percent followed closely by organic fertilizer at 26.3 percent. Biogas generation was at 18.4 percent and paper at 15.8 percent. The results

show that there are various by products that can be obtained from the OSWM process. However due to lack of processing, only a small percentage of the generated waste actually goes through the chain to the last stages. As such, there's need to get waste till the end process of either treatment or recycling so as to be in a position to benefit from the various byproducts.

Table 0.3 By-products of Organic Solid Waste Treatment

	Frequency	Percent	Valid Percent	Cumulative Percent
Organic fertilizer	10	26.3	26.3	26.3
Livestock feed	15	39.5	39.5	65.8
Biogas generation	7	18.4	18.4	84.2
Paper	6	15.8	15.8	100.0
Total	38	100.0	100.0	

In order to understand the respondents understanding of the process form an in-depth perspective, the study sought to establish the sensitization levels as pertains the respondents. This was in order to get whether they are well aware of the benefits as a results of byproducts such as biogas. Table 4.17 below show the obtained results.

Table 0.4 Level of Public Sensitization

	Frequency	Percent	Valid Percent	Cumulative Percent
10% and below	14	36.8	36.8	36.8
20%-30%	13	34.2	34.2	71.1
30%-40%	7	18.4	18.4	89.5
40%-50%	2	5.3	5.3	94.7
Above 50%	2	5.3	5.3	100.0
Total	38	100.0	100.0	

According to table 4.17 above, the vast majority of the respondents at 36.8 percent have a 10 and below sensitization level while 34.2 percent of them have between 20-30 percent level. 18.4 percent of the participants have between 30-40 percent sensitization levels. Those who have been sensitized at between 40-50 percent and above 50 percent both are 5.3 percent of the respondents. While there is some bit of sensitization according to the results, much more need to be done in ensuring that people are actually aware of the byproducts of the whole OSWM process and their benefits.

4.4.1 Organic solid waste treatment byproducts

This section sought to look deeper in the byproducts realized from the process and more specifically focus on biogas and organic fertilizer. The study sought to first understand whether the respondents were aware of what biogas was. Table 4.18 below shows the results whereby 84.2 percent of the respondents had knowledge of it while 15.8 percent didn't have knowledge of what biogas was.

Table 4.4.1.1 Knowledge Level of Biogas

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	32	84.2	84.2	84.2
No	6	15.8	15.8	100.0
Total	38	100.0	100.0	

Focusing on the population that was familiar with what biogas was, the study further sought to establish how many plants that they had knowledge of were within the locality. 100 percent of them only had knowledge of between 0-5 such plants as presented in the Table 4.19 below.

Table 4.4.1.2 Number of Biogas Plants within their Localities

	Frequency	Percent	Valid Percent	Cumulative Percent
0-5	38	100.0	100.0	100.0

Additionally, the study focusing on organic fertilizer as a byproduct sought to understand the amount of it that is used by farmers within and around Nairobi County. Table 4.20 below indicates the results from the study.

Table 4.4.1.3 Percentage of Organic Fertilizer used by Farmers

	Frequency	Percent	Valid Percent	Cumulative Percent
10% and below	17	44.7	44.7	44.7
20%-30%	13	34.2	34.2	78.9
30%-40%	2	5.3	5.3	84.2
40%-50%	4	10.5	10.5	94.7
Above 50%	2	5.3	5.3	100.0
Total	38	100.0	100.0	

From Table 4.20 above, majority of the farmers at 44.7 percent use only 10 percent and below of organic fertilizer, followed by those who use between 20 percent -30 percent at 34.2 percent. Those who use between 40-50 percent are 10.5 percent while those who use between 30-40 percent are 5.3 percent, same as those who use above 50 percent. The results clearly show that there is a low utilization of organic fertilizer as a by-product of organic solid waste treatment within Nairobi County.

Lastly, the study sought to establish the likelihood of the respondents recommending either biogas or organic fertilizer as a way to reduce organic waste within their localities. Table 4.21 below presents the results. As shown, all the respondents overwhelmingly answered to the affirmative making it a 100 percent. This therefore shows that although there may be gaps within the sector, there is a complete willingness of the involved parties to lean towards the beneficial side of the process.

Table 4.4.1.4 Likelihood to Recommend Biogas and Organic Fertilizer

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	38	100.0	100.0	100.0

4.5 Discussion of Results

This section presents a discussion of the findings of the study based on the set objectives. It also compares the results to other previous studies focusing on the similarities and differences and thus forms the basis of the conclusions and recommendation of the study. The study findings indicate that there is an intricate web of activities, processes and stakeholders that are involved. However, the manner in which the various processes is carried out shows that while there are some efforts put into it, the management of these processes still requires a lot more revamping from various stakeholders, mostly the government, PPIs and also residents who are mostly involved in the generation of waste.

A general look shows that while there are many respondents at 81.6 percent involved with capacity building, the trickle-down effect is not evident. This is considering that there are high numbers of generation but quite low in terms of recycling/reuse or treatment. Also, segregation which is a huge part of the OSWM process seems to be nonexistent for most of the respondents which is not representative of capacity building and shows that more public engagement and education needs to be done to make the process more efficient. The whole process starting from generation, collection, segregation, recycling, reuse or treatment and dumping or disposing of OSW shows that PPIs are highly involvement. This is consistent with Oduor (2015) who notes that PPPs are highly important and play a great role when it comes to the whole process.

The level of education of stakeholders is also of a great concern whereby 63.2 percent as the majority only have the basic primary education. The study notes that this is a big proportion of the waste collectors and thus contributes to the low knowledge gap on the further steps after collection. While education does not have to be very high for the waste collectors, they should be in a place to be educated on how to handle the waste from segregation and treatment or recycling so as to gain value from it. The study therefore notes that there is need to bridge the knowledge gap by either having more educated people to carry out the tasks or carry out constant trainings to those who conduct waste collection in order to make the process more efficient.

While there are efforts to convert collected waste into useful byproducts, the study findings showed that the levels of this are quite low and therefore most of the generated waste ends up being disposed without realizing any much value from it. These findings differs with Mauch (2016), who brings about the concept of zero waste whereby one person's waste is another person's raw material and thus all waste can be utilized to produce a beneficial product. However, on a positive note, while the conversion is not too high, the study found out that biogas and organic fertilizer are the two products that were realized from the recycling and reuse and treatment processes. It was also realized that the respondents had a substantial amount of knowledge on them and positively considered using them or recommending them for use.

Finally, to confirm the reliability of the data collected and used in the analysis, Cronbach's alpha was used. This was obtained from the situation analysis results which were rated on a Likert scale. The Cronbach's alpha from the various results came to an average of 0.74 which therefore confirms the reliability of the collected data.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the findings, draws conclusions and offers recommendations for further action. Additionally, it provides specific recommendation on the subject matter and offers views on further areas that should be explored for further study.

5.2 Summary of Findings

A general look at the various chapters shows that chapter one introduced the topic and background of the study and discussed various concepts. It then introduces the problem of the study, the study objectives as well as the value gained from the study. Chapter two discusses various theories and looks in-depth at different literature contexts that relate to the study. It further presents an empirical review and summarizes the concept of the study through a conceptual framework. The third chapter indicates the research procedures and methodologies that were applied in the study. It establishes the target population, sample size, data collection and research instruments used thereof and the data presentation methods used. Chapter four presented the data analysis, results and well as discussion. The results were tabulated and well-presented and explained in the discussion of results.

The findings showed that there are various processes that take place in the entire organic solid waste management process. They range from generation, collection, segregation,

recycling, treatment or reuse and dumping or disposal. From the results, while there is high generation of waste especially form community and market centres as well as residents, their involvement in the subsequent processes is limited. The results also showed that there is low involvement of most of the stakeholders especially in the final stages which are important in ensuring that the process is sustainable and also to help accomplish the zero waste scenarios. Only public private institutions are seen to have a moderate to high involvement in the entire process which is worrying and shows that more needs to be done in order to bridge the gap.

Focusing on the second objective that sought to determine the level of OSW resource generation and utilization in Nairobi County, the findings show that there is high generation of waste within the county especially within market centres and residential places. The study further established that the main by-products of the OSW were biogas and organic fertilizer. As such, it sought to understand their utilization. While the knowledge base on the by-products is there, the findings show that few of them utilize them although they are willing to recommend their usage.

5.3 Conclusions

The study concludes that organic solid waste management is an intricate process that involves a number of players to take part in order to make it a success. However, it notes that the process within Nairobi County hardly achieves the zero waste scenarios since most of the generated waste is never processed and turned into beneficial products. The results show that while generation rates and collection rates are high, conversion through recycling, reuse or treatment is minimal. Also while there is knowledge in the two by

products of treatment as biogas and organic fertilizer, their utilization within the county is low.

It can also be concluded that PPIs are the stakeholders that are most involved across all the processes from generation to disposal. While the involvement of others keeps fluctuating, PPIs are constant and thus the study concludes that their role is crucial and has a far reaching effect. The study also notes that segregation of the waste is almost nonexistent and this could be as a result of lack of knowledge of the same. In this light, it notes that while capacity building was noted to be high by the respondents, the ground truth is quite the opposite.

The study finally concludes that while there are no magic bullets to achieving a completely efficient and seamless process, proper management consisting of collaborative and joint efforts thereby having all stakeholders on board and coupled with consumer education and public sensitization and is definitely likely to bring forth a sustainable and beneficial OSWM process.

5.4 Recommendations

The study recommends that efforts should be put into place to improve the management of the organic solid waste process within Nairobi County. This should be in the form of providing more resources both human and material to help in the smooth running of the processes. Some of these should be in form of waste disposal points with clear markers on how to segregate the waste, revamping existing treatment and recycling facilities and have them in strategic places within the city and offering more consumer knowledge on

recycling and reuse. Additionally, there should be consumer education and residents' sensitization on the process and how they can participate in various stages. It should also focus on educating them on the byproducts, their usage and also how they can be beneficial to them as well.

Considering the critical role played by PPIs in the process, the study recommends that there should be more collaboration between the government and the private entities by offering more resources specifically to them. The specific government entities that are entitled with OSW management that the study proposes should actively be part of the collaboration are NEMA and the department of environment (DOE) OF Nairobi County. These resources should be used to try and ensure that the OSWM process is sustainable through achieving the zero waste status.

5.5 Areas for Further Study

Based on the findings of this research, the study proposes a study specifically honing in on PPIs and their role in the organic solid waste management as an area for further intervention. This has been informed by the critical role that seems to be played by these entities in the entire process and specifically in the recycling and treatment processes since these are critical in ensuring zero waste is achieved. The study should focus on their specific management process and take note of the specific measures that they employ throughout the process. The results of the study are then likely to be used by policy makers in providing a lasting and sustainable solution to the perennial menace of organic solid waste management.

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Appendix 1: Letter of Introduction

Dear Sir/Madam,

RE: REQUEST FOR RESEARCH PROJECT DATA FOR MASTER OF BUSINESS ADMINISTRATION

I am a postgraduate student in the school of business at University of Nairobi pursuing a Master of Business Administration with a specialty in operations management. As part of the fulfilment for the award of this degree, I am carrying out a research on "Organic Solid Waste Management in Nairobi County". I therefore kindly request for information relating to the status and level of OSWM in Nairobi County

The information that you will provide will be solely for academic purposes. Any additional information, suggestions and comments that you would deem necessary to better my research project will be highly appreciated.

Thank you.

Sincerely,

Caroline Wamucii Kanja

Student- Master in Business Administration

University of Nairobi

Appendix II: Questionnaire 1

The below questionnaire is made for purposes of collection of data for the research on "Organic Solid Waste management in Nairobi County ".The questionnaire is designed to collect information as per the research objectives which include: to evaluate the process of OSW in Nairobi County and to determine the level of OSW resource generation and utilization in Nairobi County.

Section A: General Information

1. Organization/Company……..
2. Constituency …….
3. Position……
4. What role do you play in OSWM……
5. Work Experience in the SWM industry (Pick Tick where necessary)

    0-5years ( )

    5-10 years ( )

    More than 10 years ( )

Area of operation in Nairobi County ……

Section B: Situation Analysis to evaluate the process of Organic Solid Waste Management in Nairobi County

6. Stated below are the different stages of OSW management, kindly scale the contribution of the given parties in each of the stage in the format below

Stage One-Generation

7. Please scale the different stakeholders in relation to their contribution in generation of organic waste in Nairobi County

Stakeholders	Very Low	Low	Neither Low Nor High	High	Very High
Public/private institutions					
Residents					
Community centers for example markets					
Others (Comment)					

Stage Two – Collection

8. Please scale the different stakeholders in relation to their contribution in collection of organic waste in Nairobi County

Stakeholders	Very Low	Low	Neither Low Nor High	High	Very High
Public/private institutions					
Residents					
Community centers for example markets					
Others (Comment)					

9. How often is waste collected in your area of operation? (Tick where necessary)

Daily	Weekly	Twice a Week	Monthly	Others(Comment)

10. What is the level of education of the stakeholders involved in the collection of waste in Nairobi County? (Tick where necessary)

Primary Education	
Secondary Education	
University Education	
Other(Specify)	

Stage Three -Segregation

11. Please scale the different stakeholders in relation to their contribution in Segregation (This involves separation of waste into for example paper, plastic, organic) of organic waste in Nairobi County

Stakeholders	Very Low	Low	Neither Low Nor High	High	Very High
Public/private institutions					
Residents					
Community centers for example markets					
Others (Comment)					

Stage Four- Recycling/Reuse

12. Please scale the different stakeholders in relation to their contribution to recycling of organic waste in Nairobi County

Stakeholders	Very Low	Low	Neither Low Nor High	High	Very High
Public/private institutions					
Residents					
Community centers for example markets					
Others (Comment)					

13. What percentage of collected solid waste is recycled or reused? (Please tick where necessary)

10% and below	20%-30%	30%-40%	40%-50%	Above 50%

Stage Five- Dumping

14. Please scale the different stakeholders in relation to their dumping of organic waste in Nairobi County

Stakeholders	Very Low	Low	Neither Low Nor High	High	Very High
Public/private institutions					
Residents					
Community centers for example markets					
Others (Comment)					

Section C: Current practices in regard to treatment of organic solid waste in Nairobi County.

15. What percentage of collected organic waste is treated, recycled or reused?

(Please tick where necessary)

10% and below	20%-30%	30%-40%	40%-50%	Above 50%

16. . How many companies, individuals or organizations do you know that are involved in the recycling, reuse or treatment of organic waste? (Please tick where necessary)

0	1-5	5-10	10-15	Above 15

17. What are some of the by-products of organic solid waste treatment currently produced in Nairobi County?

	List below
Organic by products	1. 2. 3. 4. 5.

18. What is the level of public sensitization regarding the treatment of organic waste to produce resources such as biogas and other byproducts?

10% and below	20%-30%	30%-40%	40%-50%	Above 50%

Section D: Production Level of Biogas and By Products

19. Do you know what Biogas is?

    Yes ( ) No ( )

20. How many biogas plants are you aware of that exist in your locality

    0-5 ( )

    5-10 ( )

    More than 10 ( )

21. What percentage of organic fertilizer is used by farmers in or around Nairobi County

10% and below	20%-30%	30%-40%	40%-50%	Above 50%

22. Would you recommend use of biogas plants and organic fertilizer to reduce the level of organic waste in your locality?

    Yes ( ) No ( )