ASSOCIATION OF SOLID WASTE MANAGEMENT AND DEVELOPMENT OF KISUMU CITY-KENYA

BY

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This thesis is my original work and has not been presented for examination in any other university.

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DEDICATION

This thesis is dedicated to my parents, Mr. and Mrs. Ofwete. My uncle, Mr. Peter Ogola and Margret Denga for their utmost support and encouragement. I also dedicate it to my siblings, Angela, Robert and Wilson for their moral and financial support during the period of this post-graduate studies.

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ABSTRACT

Historically, waste has been viewed as a problem and not a resource that can offer economic opportunity. If properly managed as a resource, waste recovery and recycling can create new jobs and attract new investment in a diversified waste sector. Solid waste management is a local issue with global implications. As the world's population continues to grow, so does the amount of waste produced. In 2015, the world generated 2 billion metric tons of solid waste. This figure is expected to grow to 3.4 billion metric tons by 2050. In low-income countries, the amount of waste is expected to increase by more than three times by 2050. The composition and amount of solid waste being generated in Kisumu has been on the increase of 400 tons generated daily. This can partly be attributed to changing urban lifestyles. The objectives of the study were: to examine solid waste management strategies and their effect on development of Kisumu City; to analyze the role of stakeholder participation in solid waste management in Kisumu city; and to evaluate the influence of public participation on solid waste management and its impact on development of Kisumu City. This study is anchored on Cradle-to-Cradle theory by William McDonough. In relation to this study, the theory explains the cycle of use-waste-pollute, which suggests that certain products could be re-used endlessly to make similar products (cradle to cradle), rather than recycled into lower grade products until the last stop is a landfill (cradle to grave). The study was carried out in Kisumu Central Sub-County from which the target population was obtained. The study utilized qualitative research method where exploratory research design and purposive sampling were used in selecting respondents for the study. During the study, 42 household respondents were interviewed from both Nyalenda, and airport area. 4 waste enterprise representatives, 2 private garbage collectors, 3 environment representatives and an area leader from Nyalenda. The ultimate sample size that was determined during the study upon saturation of information. These estates were purposely selected as they are proximally located near the shores of Lake Victoria and also, to determine how households within these localities manage their waste to avoid contamination of Lake Victoria. Qualitative data collection methods used were; InDepth interviews, open-ended household questionnaire and observation. Data collected was transcribed and analysed thematically guided by identified themes of Solid Waste Management Strategies, Role of stakeholders in SWM, and influence of public participation. A broad general finding is that there is need for more awareness and sensitization on waste segregation at source. Hence, as a role of the stakeholders, through Public-Private Partnership, the County government should work collaboratively with private stakeholders to enhance public participation through frequent community trainings that will lead to local ownership of the neighborhood projects. It was also realized that active community participation leads to increased capacity to handle environmental issues. The government is the main beneficiary in cost sharing in solid waste management as it fulfills its mandate of ensuring sustainable development.

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LIST OF ABBREVIATIONS/ACRONYMS

CE: Circular Economy

CIDP: County Integrated Development Plan

CoK: City of Kisumu

C&D: Construction and Demolition

CUSH: Complex Urban System and Health

EAC: East African Community

ELVs: End if Life Vehicles

ISWM: Integrated Solid Waste Management

KCIDP: Kisumu County Integrated Development Plan

KISWAMP: Kisumu Integrated Solid Waste Management Plan

KIWAN: Kisumu Waste Actors Network

M&E: Monitoring and Evaluation

MSW: Municipal Solid Waste

MSWM: Municipal solid waste management

NCC: Nairobi City Council

NEMA: National Environment Management Authority

NSWMS: National Solid Waste Management Strategy

PPP: Public-Private-Partnerships

SWM: Solid Waste Management

SW: Solid Waste

SEACAP: Sustainable Energy Access and Climate Action Project

UDS: United Destiny Shapers

DEFINITION AND OPERATIONALIZATION OF TERMS

Household waste: This is also known as domestic waste or residential waste. It involves disposable materials generated by households. This waste can comprise of hazardous waste like batteries and non-hazardous wastes which involve food wastes, papers and bottles (Buschsystems, 2019). The point of focus in this study is going to be on the non-hazardous household waste.

Integrated Solid Waste Management (ISWM): The solid waste management hierarchy is an integrated approach to protecting and conserving the environment through implementation of various approaches of sustainable waste management. It establishes the preferred order of solid waste management alternatives as follows: waste reduction, reuse, recycling, resource recovery, incineration, and landfilling[CITATION NEM14 \l 1033].

Municipal solid waste (MSW): When the local authority which is also known as municipality collect SW, it is defined as MSW. The waste is mostly from neighborhood, commercial and institutional waste.

Solid Waste (SW): UNEP (2019), definition of wastes are substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law. Waste also refers to an item, material or substance you as an individual consider useless at a given time and place. Waste can be liquid, solid and in gaseous form. The research is focusing on SW Major types being municipal waste, solid waste, hazardous waste and, electronic waste.

Solid Waste Management: This refers to the “collection, transportation, processing, recycling or disposal of waste materials. The steps include; identification of source of waste, reduction and minimization, categorization of waste and effective waste management disposal options” (Tsai, 2007). As much as the components of SWM are similar, its practices differ from developed to developing countries, urban to rural areas, residential to industrial areas. It is recognized that waste management practices differ for developed and developing countries, for urban and rural areas, and for residential and industrial producers.

Waste segregation: This involves ‘dividing waste into dry and wet. Dry waste includes wood and related products, metal and glass. Wet waste refers to organic waste generated by eating establishments and are heavy in weight due to dampness’[CITATION The15 \l 1033]

Development: This is a process that creates growth, progress, positive change or the addition of physical, economic, environmental, social and demographic components. Development of waste management means dissemination of information relating to waste, consultation on issues concerning waste, waste management planning, or any other activities the aim of which is to prevent or reduce waste generation or improve the quality of waste management[CITATION Nat23 \l 1033].

Integrated solid waste management: This refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency.

Public participation: This is any process that directly engages the public in decision-making and gives full consideration to public input in making that decision. This is the involvement of those affected by a decision in the decision-making process.

CHAPTER ONE

INTRODUCTION

The chapter's main element entails background study that touches on current situations on waste management particularly the management of solid waste and how it impacts on development. Through the background study problem statement is generated which guides on coming up with objectives of the study.

1.1 Background to the study

Solid waste management is a local issue with global implications because as global population increases, this implies tons of waste being produced. In 2015, world's generated solid waste was about 2 billion metric tons of which by 2050, it might increase to 3.4 billion metric tons [CITATION Woe18 \l 1033]. In low-income countries, waste generation is expected to increase by more than three times. Solid waste management is a worldwide concern at different levels in various parts of the world and its magnitude is driven by various countries to solve problem of solid waste.

In the second half of the 19th century, a technological approach to solid waste management started to take shape, that was termed development in solid waste management. In the United States, the first watertight trash cans appeared, and heavier vehicles were utilized to collect and carry rubbish. The first rubbish incinerator was built in England in 1874, which was a major advancement in solid-waste treatment and disposal methods. 15% of the main American cities around the turn of the 20th century were burning solid trash. But even then, the majority of the biggest cities continued to employ archaic disposal practices like open dumping on land or in water. During the first half of the 20th century, technological

developments persisted, leading to the creation of garbage grinders, compaction trucks, and pneumatic collection systems [CITATION Nat23 \l 1033].

In developed countries, solid waste is not as alarming a problem as it is in developing countries. The disparity can be explained by the fact that in developing countries, the rate at which solid waste is generated is not in consonance or agreement with the capacity to properly manage it[CITATION Bou06 \l 1033] Human population seems to be leaving the burden of solid waste (that they generate) to the administrative units or authorities.

In most developing countries municipalities who are part of urban authorities are responsible for managing waste though they tend to face many challenges. As a result, it is estimated that at least 2 billion people live in areas that lack waste collection and uncontrolled dumpsites tends to be the immediate solution [CITATION UNE19 \l 1033]. Waste management is a major visible urban service whose effectiveness serves as an indicator for good local governance, sound municipal management and successful urban reforms. Waste management in African urban areas has for a long time been centralized [CITATION Liy111 \l 1033], where imported refuse truck (Rotich, 2006) is used to collect waste from sources or transfer point and deliver to designated waste dumps. In most African countries, land filling is the major way of managing solid waste due to high prevalence of indiscriminate waste dumping. Urban authorities who primarily bear the responsibility of cleaning cities, towns and residential areas find it easier and time saving to collect waste and transport to landfill than sorting waste for value addition through circular economy [CITATION Bar \l 1033].

Humans are the major generators of waste. In low densely populated areas, waste is negligible compared to high densely areas where biodegradable waste is highly generated which is released to ground waste environmental impact like Nor Loch [CITATION Hen16 \l 1033]. Industrialization and urbanization in England has brought about increase in cities population and waste. The increase of cities waste caused decrease in sanitation quality of urban life. Lack of regulations for waste clearance made streets to be chocked with filth (Nightingale, 1954). This led to establishment of municipal authority with waste removal powers in 1751 by Corbyn Morris in London.

The first occurrence of organized solid waste management system appeared in London in the late 18th century This is because of generation of coal ash (dust) from MSW which was mostly used in brick-making and improving the quality of soil. Thus, there was need to have an organized municipal SWM [CITATION Vel09 \l 1033]. There was also need for improving sanitation that resulted from outbreak of diseases in Europe in the mid-19th Century. This led to the debate on public health and focus was on 1842 Edwin Chadwick report on Sanitary Condition of the Laboring Population. In the report, Edwin argued explains the importance of frequent SWM as it improves people's wellbeing and health[CITATION Edw42 \l 1033].

The first incinerator was built due to increase in waste production. It was built in Nottingham by Manlove, Alliott & Co. Ltd. to the design of Alfred Fryer[CITATION Lew071 \l 1033]. In the 20th century, a number of municipal authorities arose in Europe and North America large cities to help solve waste problems. For instance, in 1895 New York City became the first U.S. city with public-sector garbage management which involved dumping, burning, recycling and reducing of waste. This was exemplified by the Mayan

Indians of Central America who had dumps which exploded occasionally and burned, they also recycled. In the current global context, waste is calculated in terms of volume as its generation is increasing. For example, in 2016, the worlds' cities generated around 2.01 billion tons of solid waste, amounting to a footprint of 0.74 kilograms per person per day [CITATION Rat92 \l 1033].

A results-based incentive program in China motivated separation of kitchen waste at household level. For recovery of energy through recycling of organic waste, $80 million loan was used to support the construction of a modern anaerobic digestion facility and 3 million people are expected to benefit from it [CITATION Xud10 \l 1033].

History of waste report sites that [CITATION RCB03 \l 1033] native Americans generated 2.4 kg waste/day/person in 6500 BC. The waste involved leftovers including buffalo bones which by that time were dumped in nature as a way of solving waste problem. By that time dumping was the main solution to manage waste but it became a problem after industrial revolution which brought in civilization and urban lifestyle. This was also accompanied with change in consumption which led in an increase in waste produced through packaging materials like plastics and papers which are toxic waste.

Environmental impacts increase due to Global increase in household waste making it a challenge for researcher to find solution to the problem. 'Meaning, percentage of waste generated from household impacts on environment and there is need to address it. For instance, waste generated in Sweden in 2014 was reported by Swedish Environmental Protection Agency reported that 83% of the total waste generated, they were from mining

industries and household wastes which corresponds to negligible fraction (2.5%)' [CITATION SME16 \l 1033].

Currently,40% of Australian waste goes to the landfill. This has been achieved by maximizing on recycling, separation, food processing and recycling organic waste through anaerobic digestion. [CITATION Jon20 \l 1033].

The Asian local governments spend around $25 billion per year on urban solid waste management. also, there is minimal information of waste generated from rural Asian part but it is assumed that waste generated from the rural area is less due to low per capita income. Rise in income in Asia led to urbanization leading to more utilization of resources that is coupled with high waste generation. People living in urban areas of India use as twice as many resources per capita than those in rural areas. There is also difference in rural and urban waste generation rates in other Asian countries like Bangladesh where waste generates from the rural population amounts to 0.15 kg per capita per day, while the urban population generate 0.4 to 0.5 kg per capita per day[CITATION Urb99 \l 1033].

In Sub-Saharan Africa, countries like Liberia, a proximate amount of $10.5 million has been set aside for waste collection and construct a new sanitary landfill and transfer stations. World Bank has supported the solid waste management in Bukina Faso with over $67 million in loans since 2005 through waste sector planning and construction of two landfills [CITATION Cod181 \l 1033]. The annual waste production percentage is expected to increase by 70% between 2016-2050 due to increase in population and rapid urbanization. People from developing countries especially from underserved areas experience effects of unsustainable SWM because of uncontrolled dumps and open burning. When waste is

poorly managed, it becomes breeding point for diseases to production of methane gas that causes climate change which in turn causes health problems and environmental consequences. Having a sustainable SWM is essential to a city but still remains a challenge to many developing countries. This is because effective SWM is costly and its budget allocation by the government tends to be low [CITATION Cod181 \l 1033].

During the colonial era, waste management was efficient because the colonial masters introduced new methods of waste management into Africa. Waste management in developed parts of East African communities like Kenya, Tanzania and Uganda where it became centralized with the use of refuse trucks for waste collection from generation point to disposing site[CITATION Oko11 \l 1033]. In early 1940-1960s, management of waste in Africa was efficient as population was low and the available resources would cater for the population. After independence, the colonialist left and most African countries could not handle the colonial master legacy leading to a decline in waste management systems [CITATION CMg16 \l 1033].

Waste was not a threat in Africa during the colonial era until urban populations began to increase rapidly. The piling up of waste led to production of odor, outbreak of diseases and contamination of water supply. In 1340s, there was a widespread of plagues known as Black Death in western part of Europe and northern part of Africa. This resulted to deaths of about seventy-five million worldwide and 30-60% of Europe population was involved. This acted as an eye opener to techniques of managing waste so as to curb issues that occurred during that period. Recycling and reusing of waste were embraced through feeding livestock with the greens, organic waste was fed to the pigs, and the remaining used for fertilizer production. Also, in construction activities timber was being reused. This approach is known

as cradle to cradle as materials are reused over and over again [CITATION Maj07 \l 1033]. 18th century brought about industrialization where raw materials and work force was available leading to rapid growth of development in Western countries especially in the sectors of trade, skills, innovation and machine/technology development. This brought about the problem of properly managing waste hence the onset of sanitation age that was meant to prevent problems associated with improper management of disposal sites. Till date, environmental sanitation has remained a monthly practice in various African countries like Nigeria and Tanzania.

In most African countries, especially in the slum areas like in Kenya, Uganda and Nigeria, residents experience poor SWM coupled with disposing waste in water bodies and open areas. At household level, the poorly disposed waste spread forming a stratified layer[CITATION Oko12 \l 1033]. As population density increases, so does the waste. In African slums and ghettoes, there tend to be limited infrastructure and land to meet the demands of the growing urban population which remains a major concern [CITATION JPi05 \l 1033].

In Kenyan towns; Nairobi, Mombasa, Nakuru and Kisumu, about 61% of generated waste encompasses household waste followed by industrial, market and others like, hospital [CITATION Oya18 \l 1033]. In Kenya, waste management started in Nairobi, it's capital city due to the increasing urbanization which was caused by rural-urban migration leading to increase in population and waste but was not accompanied with equivalent capacity to handle out annually in Nairobi alone. Nairobi waste disposal problems started long time ago in early 1990s where civil society and private actors were part of it. For example, in 2005, Nairobi city in Kenya, private companies would be contracted to collect waste and dispose

at Dandora dumpsite, Nairobi's largest dumpsite, leading to an increase of waste collected from 45% to 60% [CITATION Osm19 \l 1033]. This made a proper system of managing waste to be realized as collection and transportation of waste would be scheduled with market operators. Meaning, of specified days, market waste would be collected at speculated positions. Also, there was an introduction of weighbridge at Dandora dumpsite so as to measure the amount of waste to be disposed. In the city, enforcement officers were deployed to prevent waste disposal in notorious areas of the city and to help maintain cleanliness of the city.

In Nairobi city still, the period between 2013 – 2017 was characterized by the fast-tracking of SWM Master Plan implementation. The plan interrogated problems in Nairobi that were in line with waste management developed projects which if could be implemented, sustainable system could be achieved. This meant that the government was still the key in legalizing waste management services but the private enterprises would still assist in the implementation. It also steered buying of 30 trucks and investing in heavy equipment as a way of streamlining waste collection activities [CITATION Oya18 \l 1033].

Kisumu city being one of the three cities in Kenya developed as a result of decentralization in Kenya. Research by Carl Bro (2001) reports that, in Kisumu city daily waste generation amount to 400 tons where 10% is collected by the City authority and only 40 tons (10%) can be delivered to dumpsite by the private collectors [CITATION Car01 \l 1033]. The remaining 80% are disposed or remain uncollected in the backstreets, markets and open spaces especially in underserved areas. In addition, poor attitude towards SWM is still a problem. Meaning, residents do not view waste as a resource. There is also inadequate financial, policy and technical support to the private waste enterprises. In most cases, the

peri-urban areas are affected by the poor management. This is because of expansion rate at 7-12% annually leading to densely unplanned settlement with limited basic resources and are homes to 60% of urban population [CITATION UNH051 \l 1033].

1.2 Statement of the problem

In most parts of the world, development in solid waste is associated with its proper management which starts from separation, collection, infrastructure, technology involved in transportation and recycling. The problem of managing waste starts from waste segregation which is hardly practiced from generation points, in households to disposal sites. Hence, people fail to realize the role they can play in the process of solid waste management leading to realization of a gap in community participation by the households and solid waste management business stakeholders (Tadesse, 2006). Waste generation increases with population expansion and economic development leading to the necessity of coming up with ways of reducing and managing waste.

Many urban areas in developing countries, Kisumu for example, is grappling with increasing waste generation, problems of limited solid waste collection facilities, low efficiency and capacity in operation of existing facilities as well as the design, location of final disposal sites and overflowing dumpsite. Also, most of the solid waste is managed by the government through the city council through the top-down approach ending up avoiding the participation of solid waste management business stakeholders and communities in solid waste management for the realization of sustainable development. According to [CITATION KIS09 \l 1033], the poor management of solid waste leads to spread of foul smoke from private burning of waste and pollution of Lake Victoria through run-off. Also, scavengers

are exposed to health risks as no separation of hazardous waste fractions is practiced. This means that the present solid waste management strategies are not effectively being implemented[CITATION Cou181 \l 1033].

Most of the solid waste generated in the city remains uncollected and an estimated 25% tend to be collected. The limited practice of re-using and recycling is causing an increase in solid waste generation. The collection that takes place is carried out by the city authority and a few private collectors. They majorly concentrate in high-income areas, leaving the poor peri-urban neighborhoods largely unattended. In peri-urban and its extension areas, many households do not have the privilege of any mode of collection, and have resorted to private burning of waste or digging their own pits to bury the waste on site (Majale, 2007). It is also notable that of the total amount of waste generated in Kisumu City, approximately 60-65% is organic in character presenting enormous potential for recycling for farm use. This study therefore seeks to examine the solid waste strategies employed in Kisumu city and their possible influence on development of the city.

1.3 Purpose of the study

The purpose of this study is how solid waste management strategies influence development of Kisumu City.

1.4 Research objectives

1. To examine solid waste management strategies and their effect on development of Kisumu City.
2. To analyze the role of stakeholder participation in solid waste management in Kisumu city.

3. To evaluate the influence of public participation on solid waste management and its impact on development of Kisumu City.

1.5 Research questions

1. What are the solid waste management strategies and their effect on development of Kisumu City?
2. What is the role of stakeholder participation in solid waste management in Kisumu City?
3. How does the influence of public participation on solid waste management impact on development of Kisumu City?

1.6 Significance of the study

The study focused on how waste actors and especially households residing near water bodies in Kisumu manage their waste to avoid its contamination. This study researched on ways through which various actors like the garbage collectors, waste experts, waste business enterprise and households participate in awareness and sensitization of solid waste management activities to come up with valuable products by practice of the circular economy which in turn bring about development in Kisumu City. This information is relevant for the sustainable development of Kisumu City.

1.7 Scope of the study

The study was conducted in Kisumu City, specifically within Kisumu central area which constitutes 170,592 individuals with households of around 52331 (KPHC, 2019). For the purpose of research, a sample population of 50 household respondents and 10 key informants was used and not the population from the census study. Since the study employed purposive sampling, it involved respondents who have knowledge of solid waste

management in Kisumu and tend to engage in the practice. Communication languages used during the research were English, Kiswahili and Dholuo to enhance collection of in-depth data.

1.8 Limitations of the study

As part of human nature, the individual bias on the part of the researcher could easily influence the results when briefing and guiding respondents on how to complete the questionnaire. The researcher guided the respondents professionally and was objective at all times. Since the research employed the use of purposive sampling, it restricted the nature of research participants. This had no effect on research as purposive sampling mainly guided on nature of research participants. The study was restricted to solid waste. Hence, the meaning of Solid waste was clearly explained to the respondents before the starting interview.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

The chapter entails review of literature and theoretical framework. Literature review is the systematic study of collecting and analyzing the existing information on the research topic[CITATION kot04 \l 1033]. Literature review will be presented by introducing terminologies and literature relevant to the study. This chapter seeks to present the literature review by reviewing evaluation of documents containing information that are related to the knowledge of solid waste management and its relation to development.

2.2 Global view of Solid Waste Management

The rise of waste generation globally is due to population growth and urbanization. In 2016, the amount of solid waste produced by cities globally was 2.01 billion tons which is expected to increase to 3.40 billion tons in 2050. Having a sustainable SWM is still a challenge in developing countries due to the expense incurred which is almost 50% of municipal budget. It is through proper management that development is realized in solid waste. Therefore, there is need for an integrated SWM system for the municipal services to be sustainable. As a way of solving the issue of budget on SWM, World bank finances globally operations of SWM from production, segregation, collection, infrastructure, transportation and disposal especially in urban areas so that development can be realized in SWM sector [CITATION Wor19 \l 1033].

2.3 Continental view of SWM

2.3.1 SWM in America

In Latin America, more than 70% people live in urban areas like Brazil, La Paz, and Santiago. An estimate of 225,000 tons of solid waste is generated by 300 million city dwellers every day. Large percentage of the waste ends up in open dumps, water bodies and wetlands which contaminates ground water. As waste generation increases, the waste quality decreases due to the mixing of waste [CITATION Par00 \l 1033]. Some large cities like Brasilia, Caracas and La Paz tend to boost high coverage for solid waste collection while other municipalities like Santiago, collect from fewer of their populations (around 57%), and most smaller cities and towns have even more limited coverage for collection of solid waste.

2.3.1.1 Waste collection and transfer

A number of people do not have regular waste collection or access to disposal services in most cities in Latin America and the Caribbean. Affluence usually determines the collection frequency. For waste collection and transfer to be an effective activity in Latin America and Caribbean, the following strategies should be/are practiced: use appropriate technology which regular trucks and alternative vehicles depending with the topography of an area; Integrating the informal sector; building on the existing system; Introduce transfer activities; and develop dependable revenue collection systems. The method of waste disposal in LAC is through open and uncontrolled dumps which are not environmentally friendly. As much as best waste minimization practices at all stages can be exemplified, there is still need for having a landfill for disposal of non-recoverable waste. For a sanitary landfill to be achieved, disposed waste should be segregated to enhance proper cleanliness of the landfill.

Also, there should be control of leachate and methane during and after closure of the landfill [CITATION USA00 \l 1033].

2.3.1.2 Waste management

A small amount of waste from Latin America and Caribbean ends up in the sanitary landfill. Larger percentage ends up in the open dumps and uncontrolled landfills with no protection of ground water. Meaning there is no separation of waste and people have to be paid in order to recover recyclables by collecting them. In shanty town areas where waste accumulate along the road, they are either burnt or collected and disposed at the dumpsite. In LAC, municipal funded services are done through institutions, contract, franchise and direct service provision. For instance, in Guatemala, all SWM services are contracted privately. In LAC, hazardous wastes are disposed illegally in landfills because incinerators are expensive and also illegal though some hospitals operate them [CITATION Wor99 \l 1033].

2.3.2 SWM in Asian developing countries

Solid waste management is a major responsibility of local governments in Asian countries. The responsibilities include; collecting municipal solid waste, treat it at composting plants or energy plants, and to disposal at landfills. Despite all this, waste is still improperly disposed on open dumpsites. Developed Asian countries like China, Indonesia, the Philippines, Vietnam, and Thailand, are regarded as major sources of marine plastic debris [CITATION Yen12 \l 1033]. Production of solid waste in developing countries within Asia resulted through industrialization and urbanization. For example, when Indian population was 217 million, the daily waste generation was between 0.2-0.5kg/capita/day and organic biodegradable materials were in plenty. For examples, the biodegradable percentage was

65% in Jakarta, and 72.41% in Surabaya. In developed Asian countries like Japan, South Korea, Singapore and Taiwan the generation of organic waste is less than 45%. As time goes by, waste in Asia is increasing especially in developing countries and might remain constant or slightly reduce in the developed countries. [CITATION Mic19 \l 1033].

2.3.2.1 Waste generation in Asia

Climate, socioeconomic development and degree of industrialization are factors that contribute to waste generation rates. and climate. Therefore, the greater the economic prosperity, this contributes to the higher percentage of urban population and also, greater production of solid waste. Asia produces about 760,000 tons of municipal solid waste (MSW) per day due to growth of urbanization and economic development [CITATION Lau99 \l 1033]. The developing countries in Asia also experience increase in population and urbanization which leads to increase in waste generation. For example, in Delhi city the waste generation in 2011 was amounting 17000-25000 tons annually. An increase was also realized in Puducherry 265 tons a day in 2003 to 370 tons a day in 2008. The main component of waste being organic and others are papers, plastic, metals, glasses and clothes. The remaining waste includes leather, metal, rubber and textile [CITATION Yen12 \l 1033].

2.3.2.2 Collection and transportation of solid waste in Asia

Asian local governments currently spend in a year approximately $25 billion to manage waste from urban areas. urban solid waste. Of the collected waste, 90% is from high-income countries, 50-80% from middle income and 30-60% from low-income countries. The urban population increases with the country’s income level [CITATION Lau99 \l 1033].

For instance, Vientiane, Luangprabang, Savannakhet, and Champasak are just a few of the cities in the South East Asian nation of Lao that have well-organized municipal solid waste collection and disposal systems. The UDAA is in charge of organizing waste collection services in metropolitan areas. The responsibility for rubbish collection is often given to the private sector, mostly SMEs, by some municipalities, like the one in Luangprabang. Waste is often collected from homes once or twice a week by a number of trucks that are present in every city. Around USD 1.25-2.25 per month per household is the cost of the collection service. According to UDAA figures, the typical percentages of garbage delivered to landfill and collected range from 40% to 70% of the total[CITATION Cur17 \l 1033].

2.3.2.3 Composting of solid waste in Asia

Due to inadequate technical implementation, which results in low quality compost, minimal inputs of feedstock, and limited acceptance on the domestic market, composting is less common in Asian countries. To ensure there is enough organic waste for centralized composting facilities, it is collected from homes, companies, and a number of nearby regions. The majority of the centralized composting plants in Vietnam's north are privately run, but the government provides the necessary finance and technical support. The issue is that the compost is typically of low quality and frequently contains glass and metal shards, making it unsuitable for sale to direct customers, commercial farms, distributors, retailers, baggers, and brokers [CITATION Ngu15 \l 1033].

The majority of garbage in Hanoi, Vietnam is organic waste (60%), which has a low caloric value, high density, and high moisture content. Although landfills constitute the mainstay of the waste treatment process, they are virtually at capacity, necessitating expansion and improvement. At the moment, there isn't enough land available in the city to build landfills.

Composting has thus been deemed to be the most appropriate technique of treatment for MSW produced in the city thus far, considering the current waste circumstances and the socioeconomic conditions of Hanoi, Vietnam. However, composting now only recycles 2.5–7% of the total waste produced [CITATION Nam18 \l 1033].

There is a need for partners for an integrated SWM to be achieved in Asia and the national government should instead reduce cost on SWM related activities so as to extend the care on production. The general public, who is likely the most significant stakeholder in waste management operations, must actively contribute to the solutions by changing their behavior patterns. For instance, people must exercise self-control when it comes to sorting rubbish, making wise use of containers, and developing eco-friendly buying practices.

2.3.3 SWM in Europe

Waste management began in the early 20th century and is now seen as a government function in several European nations. Public health and hygiene were then the key reasons for government action. End-of-pipe remedies were increasingly seen as having little long-term influence in the 1980s and 1990s. Beginning in the early 1990s, numerous environmental administrations adopted source reduction and pollution avoidance objectives in the context of waste management. The preventative principle, producer responsibility and polluter pay principle, precautionary principle, and proximity principle are now the four fundamental guiding concepts of EU waste management policy [CITATION Ale07 \l 1033].

Less than 10% of the total garbage produced in the EU is municipal waste. Citizens of the EU produced 486 kg per person in 2012. Because they have more developed waste management procedures, Member States with higher GDP levels typically generated above average levels of garbage. For instance, around one-third of the municipal waste generated in the EU was carried to landfills in 2012. Half of EU Member States still have landfill rates above 50%, despite the fact that six Member States have already surpassed the landfill target for 2030. Over 35% of the waste produced by municipalities is burned in Denmark, Sweden, the Netherlands, Belgium, and France. This means that they will need to divert waste in order to meet the circular economy recycling target of 65% recycling of municipal waste [CITATION Oak17 \l 1033].

2.3.3.1 Waste collection

Currently, the amount of municipal garbage produced per person in the European Union ranges from 294 kg in the Czech Republic to 801 kg in Denmark. 20% of the municipal garbage produced in the EU is burned, 38% is recovered, and 42% is landfilled. Poorer nations frequently use landfills, but wealthier nations favor incineration. While Germany, Belgium, the Netherlands, and Austria recycle or compost the most (59% or more), Denmark, Luxembourg, and Sweden incinerate the most (47% or more), the highest amounts of garbage are landfilled in Bulgaria, Romania, Lithuania, Malta, and Poland (90% or more). [CITATION Dav10 \l 1033].

MSW burnt in the EU increased by 117% from 32 million tons (67 grams per person) in 1995 to 70 million tons (136 kilograms per person) in 2018. Additionally, landfill dumping decreased by 61% during that time, while material recycling climbed by more than 200%.

These modifications resulted from new legislation on waste and renewable energy that markedly increased the amount of energy produced from MSW [CITATION Lau20 \l 1033].

2.3.3.2 Transportation of Solid Waste

Regulations for cross-border waste transportation are included in the European Union's waste shipment statute. It carries out the Basel Convention's 1989 duties regarding the management of transboundary flows of hazardous wastes and their disposal. The terms of the OECD resolution from 2001, which established a control system for waste exports for recovery inside the OECD AREA, are also transposed. The proximity principle states that garbage should be dealt with as close to its source as possible. However, constructing cutting-edge waste treatment facilities for all sorts of waste in numerous locations might not be both economically and environmentally viable. When there are no treatment facilities nearby or in the country that allow for environmentally sound waste management, garbage must be transported elsewhere [CITATION Ale07 \l 1033].

Along with the growth of society and the economy as a whole, it is crucial in the European Union to build an effective waste management system. The waste-to-energy process, which has the ability to generate electricity from municipal and industrial garbage, may assist the economy and is environmentally, economically, and socially sustainable. A program to prevent increasing waste must be characterized by certain precise measurements due to the aim to attain these goals. Increased public understanding of environmental issues and the

kinds of materials that can be made from recycled garbage is also important [CITATION Mem14 \l 1033].

2.3.4 SWM in Australia

Implementation of recycling and waste policy through collection, processing and disposal is largely undertaken by the Australian local governments. As much as the local government have the center role when it comes to decision making, they are always far away when it comes to decision making process on policy action especially when done between the federal and state governments. Australian waste management started to be implemented in the 19th century driven by technological and sanitary advances. In Australia, waste is categorized into three streams; domestic and municipal which includes all household waste and waste collected in public places; commercial and industrial waste from all business and industrial activities and public institutions; and construction and demolition which includes all waste from the building and construction industry. Waste management hierarchy underpins waste management policy in Australia as means of dealing with waste is ranked in order of preferences. That is, from avoiding the creation of waste as the most desired outcome, while disposal is the least desired outcome. Waste management and recycling sector tend to have four main activities which involves; waste collection, transfer, waste sorting, recycling and reuse, and final is the disposal to landfill [CITATION The18 \l 1033].

2.3.4.1 Waste generation

Production of waste is closely related to population size, income of a household and economic activity which has brought about significant increase of waste generation in Australia. In 2014–15, approximately 64 million of waste (2.7 tons per capita) was

generated which included fly ash and hazardous waste. Data on waste generation by state and territory is also included in Australia's National Waste Report 2016. The most waste is produced in Queensland, Victoria, and New South Wales. When fly ash is taken into account, Queensland produced the most garbage per capita (3.3 tons). Western Australia and South Australia produced more than 2.5 tons of fly ash per person in 2014–15, while Tasmania produced the least, at 1.8 tons [CITATION Aus13 \l 1033].

2.3.4.2 Waste collection and transfer

The Solid Waste Integrated Management model is the first system model in Australia that deals with integrated waste management systems. Waste collection consist of private and government enterprises. For example, local governments manage all process of SWM that is collection, transfer and provide landfill facilities. Despite this, the local government still outsources private enterprises to conduct the SWM activities. Therefore, there is need for waste management policy to focus on reducing social and environmental risks from waste collection and disposal to acceptable levels. As a way solving these problems, the policy of systematic collection and disposal of waste to a centralized facility helped solve these problems. ‘Wheelie bins’ were also introduced in 2003 to make it easier for households to collect large quantity of waste which can easily be transported. The introduction of new collection methods led to the increase of recyclable materials in Australia[CITATION Aus15 \l 1033].

2.3.4.3 Recycling of solid waste

In Australia, private companies dominate in the recycling of solid waste. This includes; ‘Visy, Resource Co, Cleanaway, and Suez’. The recycled and re-used materials are organic waste, papers and boxes, glasses, metals, electrical waste and building material waste. The

Australian Council of Recycling states the number of employed people in line with organic recycling, compost business and tyre recycling business. Waste management system undergoes reformation to enhance a more consistent and reliable circular economy based on legislation and domestic industry [CITATION New17 \l 1033].

2.3.4.4 Waste levies

These are financials which are a requirement for the licensed waste facilities to pay for each ton of waste that they receive at the facility. The main intention of waste levy is to encourage recycling of waste instead of disposing in landfills. New South Wales, Victoria, South Australia, Western Australia, and the ACT, for instance, all impose trash taxes. Waste collection is voluntary in Tasmania. In Queensland1 and the Northern Territory, there is currently no waste levy. Depending on the kind of waste being sent to the landfill, levies differ between states and within jurisdictions. The price per ton for disposing of municipal solid waste (MSW) at a landfill is $90.55. The price per ton for the landfill to dispose of construction and industrial waste is $146.20. The price per ton for landfill disposal of mixed C&I garbage with less than 50% recyclable material is $199.20. As a result, levies frequently serve as a crucial source of money for investments in trash and recycling management projects [CITATION The18 \l 1033].

2.3.4.5 Waste transportation

The vehicles consist of: The rear lift truck lifts manually collected bins and brings them to the rear of the truck where they will be automatically emptied and compacted. It is best suited for areas with limited access and space. The front lift system primarily serves

commercial and industrial organizations and is affordable, adaptable, and user-friendly. The waste container is raised above the truck and emptied and compacted using automated forks that the driver has lined up. Liquid tankers offer alternatives for interstate transportation as well as a variety of liquid and hazardous waste demands. For the covert transportation of specialized waste streams like medical/clinical, quarantine and animal waste, as well as classified materials for destruction, Pantech vehicles are used. Most of our Pantech trucks include scales and a tailgate lifter, and some of them can handle chilled cargo as well. Parks, public spaces, and street trash collection are the primary uses for rear lift PUP trucks. In order to collect municipal rubbish and recycling, side lift trucks are frequently utilized. With smart technologies for simple tracking, data collecting, and increased safety, it provides municipalities and their residents with efficient and dependable service. In order to collect medical/clinical, quarantine, and sanitary waste for specialist treatment processes like sterilization or burning, SUEZ's fleet of medical solution vans provides effective and discrete collection services. Hook-Lift vehicles gather unrestrained bulk refuse containers and safely transport them on board by employing hydraulic valves and lifting equipment. Kingvac trucks are ideal for industries producing huge amounts of wet and dry waste that require safe and legal collection, transport, and disposal, like the mining industry. They have 10,000-litre debris tanks with tri-stage dust filtering and high flow wet and dry industrial vacuums. For residential and commercial site clean-ups when access is not suitable for front lift or rear lift trucks and bins, small hook trucks are utilized to service small hook compactor systems. The trucks are especially made for moving smaller, open hook bins with a three tons of waste capacity each [CITATION SUE21 \l 1033].

2.3.5 SWM in Africa

The worldwide increase in consumption at both domestic and industrial levels is the main reason for waste production. Globally, Africa is known to be the least developed region with its rate of urbanization at 38% though it still experiences rapid development and population growth of 4% yearly. This is the main reason why in Africa why generation of MSW is on high rate which has effects on human and environmental health [CITATION Sth13 \l 1033].

South Africa has a strategy that was suggested to solve SWM problems through a study on integrated pollution and waste management system. The main aim of the strategy is to minimize production of waste, its transportation, practice new technologies in line with preventing pollution, efficient use of resources and energy[CITATION Muz11 \l 1033].

In the Westen part of Africa, Nigeria is the largest country as it holds half the population of West Africa. In Abuja town for instance, most operating waste companies are private companies though their operations are inconsistent because of limited staff and inadequate vehicles for waste collection [CITATION Mic10 \l 1033].

Just like many African countries, Egypt also lacks proper waste management channels posing serious health and environmental problems for the county. By 2018, waste amounting to 80 million tons was being collected in Egypt every year. Private companies collected 55.2% household solid waste while 448% end up in the streets. Egyptian government have attempted to better the system of waste management since 1960 but it has not been sufficient until now. Though the attempt of recycling is growing, this is largely

practiced by the non-governmental people thus, there is need for the government initiatives to properly manage these systems and provide them with appropriate resources [CITATION Mah19 \l 1033].

Other forms of waste production are; Construction and demolition (C&D), end-of-life vehicles (ELVs), biomass wastes in the form of agricultural and forestry wastes, health-care waste, and electronic waste (e-waste) are further sources of waste generation. Hazardous wastes, packaging wastes, and marine litter—materials dumped during leisure, fishing, or personal hygiene activities—are occasionally grouped together as health-care wastes. For example, in Ghana's capital city, there is a group known as Agbogbloshie which is a thriving community of recyclers, innovators and artists that change the way people value waste. Agbogbloshie has been coined the 'largest electronic waste dump in the world' and may be a contributing factor why the Ghanaian government began construction of a 30-million-dollar recycling plant in 2018. The global trends in use of electronics mean that African communities like Agbogbloshie have the potential to lead in inventing innovative solutions to the fast-growing problem of e-waste [CITATION Bar19 \l 1033].

2.3.5.1 Problems in SWM

The major components of proper SWM, that is from separation, collection, storage, treatment, transportation, disposal is a problem in Africa. Low sanitation is highly experienced in Africa characterized with dumping in water bodies and open areas. As population continues to increase in Africa, the major concern is that there are inadequate facilities especially land that can meet demands in slums and African ghettos[CITATION Oko12 \l 1033].

In Ghana, activities conducted by Agbogbloshie pose an effect to the environment which in turn, affects people's health. For example, the heavy metals flow to river Odaw which pollutes it and ends up feeding the coastal waters where fishing of sea food is practiced. The metals also contaminate the air and soil where the community engages in farming. Workers engaging in the activity tend to have high concentration of lead in their blood and urine causing coma, convulsion, mental retardation that eventually leads to death. The e-waste pollution on effect on children's brain development and development of fetus through placenta when pregnant women are exposed to it. In research conducted in Agbogbloshie, some of the toxins have been found in women's breast milk. Apart from brain development, children end up growing with difficulty in breathing in that area[CITATION Bar19 \l 1033].

2.3.5.2 Waste collection and transportation

Africa has 3 existing phases of waste collection; informal, primary and secondary phases. Informal and primary phases are characterized by waste from households to waste collection points. Secondary phase involves the formal institutions like urban councils and private operators. In secondary phase, the collected wastes are transported from community transfer points to landfills. Private operators have also been utilized in waste collection as they collect waste directly from households by door-to-door approach. The community market and hospitals still rely on collection arrangements made by the urban council which is a public parastatal.

'Summon to bring' system is another waste collection system in Africa where waste collection has a week schedule and it is done by use of a truck. The truck works in such a way that when it arrives at waste collection point, the driver hoots as a way of alerting

people to bring their waste for disposal. The frequency weekly waste collection schedule is dependent on the estate's level on income whereby people from high income estates dispose more frequently unlike in low-income estates. The waste disposal is done manually by loading waste in the truck which is majorly done by government workers. For example, Abuja in Nigeria has a number of private collectors who operate in specific routes and time depending on weekly or monthly basis [CITATION Liy111 \l 1033].

In the circular economy for solid waste, organic waste can be used as raw material for biogas production and composting for organic fertilizer production [CITATION Dan12 \l 1033]. As population and living standards increases in developing countries, so does the amount of waste generated which might double in the current decade. Of the generated waste, a higher proportion could be recycled by the urban poor and in turn generate income through protecting the environment. There is a need to develop an integrated approach where the public, private and community sectors work together to develop local solutions promoting sustainable solid waste management [CITATION Ibr16 \l 1033].

2.4 Regional view on SWM in East Africa

The East African Community is made up of Kenya, Tanzania, Uganda, Rwanda, Burundi, Democratic Republic of Congo, and South Sudan. For a long time, waste in East African urban centers has been centrally controlled by urban authorities through the monopolized systems. This was made easier by use of imported refuse truck for waste collection to transfer point or dumping sites. During the colonial era, Municipal solid waste management (MSWM) system in East Africa was efficient because of the low urban population and adequate resources to the current status that displays inefficiencies. The centralized waste

management system currently has evolved into decentralized public systems involving also the private sectors [CITATION Oko11 \l 1033]. The sufficient solid waste management process which starts from proper collection, transportation, treatment and disposal of waste which is still a crisis in East Africa's urban areas. The major waste composition in these urban areas is the decomposable organic waste which comes from the kitchen, compound sweepings and the farm. To avoid environmental and health implications, there is need for developing an efficient waste collection system. Globally, there is a trend of increased use of electronic items which is becoming a threat to environment and human health especially in EAC urban areas. This results to the rapid technology advancement which makes most of electronic equipment to be out of date and rendered useless[CITATION Rot06 \l 1033]. For example, according to a report from Phenix Recycling[CITATION Amy19 \l 1033], in Tanzania, there is a town known as Dar es Salaam which is also East Africa's largest city. It is characterized by laborers who collect car batteries which have heavy lead acid, also power backup systems and solar systems. As a way of recovering useful parts from these collected items, the laborers frequently open up the items with machetes while the acid drains to the ground which contaminates soil and drains to water systems and may lead to health problems. For example, the battery acid in Dar es Salaam has contaminated river Msimbazi which is used for vegetable irrigation and when the vegetables are ingested, may lead to health problems. The batteries are sold to factories where they are recycled through melting and thereafter resold to dealers[CITATION Amy19 \l 1033].

2.4.1 Collection of waste and transportation

Methods of collecting waste majorly practiced in EAC are informal phase, pre-collection or primary phase and secondary or formal phase. Primary phase mainly takes place in households who mostly hire labor and waste collection points in communities like skips, bunkers or open roadside. The formal or secondary phase is a continuation of primary phase and it starts from waste collection points to disposal sites like the landfills. Secondary phase activities are majorly conducted by formal institutions which involves the private waste collectors and urban council. In most cases, private waste collectors collect waste from households and the fees is negotiable depending with the individual client. The contracted private waste collectors majorly collect from industries and shopping malls on contract basis. Waste generated from community markets and hospitals are collected by collectors from the urban council. “Summon to bring” s also another method of waste collection. It involves the hooting of the trucks horn to summon people to dispose their waste in the truck. This method is carried out by collectors from the urban council and it tends to be tome consuming [CITATION Kas05 \l 1033].

In comparing waste generation by 2020 in EAC cities of Kampala, Nairobi and Dar es Salaam, Kampala had least waste generation by 0.561 kg/cap/day followed by Nairobi 1.044 kg/cap/day and Dar es Salaam generates high amount of waste by 1.761 kg/cap/day.

Since private waste collectors started operating, the collection of waste is on the rise unlike when it was done solely by urban councils. This only applies to waste that have been collected at community transfer points. This implies that higher percentage of urban solid waste do not reach the legal disposal points but end up in the environment. Open dumping is

majorly being practiced in EAC urban centers especially in areas where skips ad waste bunkers are at far points. This explains why the available skips are always full with flowing and uncollected waste [CITATION Obe11 \l 1033]. In Kampala-Uganda for instance, the government banned the use of skips since 2002 as they are characterized with lack of cleanliness making most of the urban dwellers to be dissatisfied by its use. The alternative of use of skips in Kampala Uganda is the use of open ground as a way of disposing and managing solid waste which is the current operating system. The open ground disposal method involves burning, burying, indiscriminate disposal and use of organic waste as animal feeds. Kampala Uganda is also characterized by rampant littering in roads and open areas which results from indiscriminate disposal of wastes. The carelessly disposed wastes end up blocking drainages causing floods and health hazard diseases[CITATION Sko04 \l 1033].

In most cases, EAC urban council dispose waste in areas like old quarries and valleys close to wetlands that are mot prioritized for use instead, the waste helps in backfilling activities. The waste disposal areas tend to be located in environmentally sensitive areas with no fence, soil cover and compactors [CITATION Joh99 \l 1033]. For example, through World bank fund, Kampala Uganda upgraded the Kitezi waste dump to a sanitary landfill and it is being managed by private companies since 1999. Though built to standard with a leachate treatment plant, there is some leachate leakage before the treatment plant and this is polluting the surrounding environment with heavy metal [CITATION Sko04 \l 1033].

Waste generation in EAC urban centers, like Arusha in Tanzania which is the capital of EAC, is approximately 5.6 kg/cap/day and it varies in terms of levels of income. Densely populated urban areas like slums are characterized with shanty houses with people of low-

income level attributing to waste generation between 0.22-0.3 kg/cap/day. An estimate of 0.66 to 0.9 kg/cap/day of solid waste is generated from households with high income. In average, EAC urban centers waste generation varies from 0.26 (low income) to 0.78 (high income) kg/cap/day [CITATION Obe11 \l 1033]. The low waste generation in poverty-stricken households is attributed to the limited items that they purchase hence no or less wasteful consumption is realized. Also, the amount that could be used to pay waste collection fee is directed to other activities. Compared to high-income households, they purchase large volumes of goods leading high generation of waste due to practice of wasteful consumption pattern. Most of the goods tend to be associated with wastes in form of non-consumables like packaging and containers. Thus, waste generation in urban areas especially those collected by the urban council is associated with national GDP per capita making developing economies such as countries in Africa and Asia have lower waste generation rates compared to developed countries[CITATION Sch11 \l 1033].

In EAC, the low-income households prefer storing household wastes in sacks, nylon bags, reusing jerry cans, boxes and end up being dumped together with the waste. Most households do not sort waste but separate valuable waste products like vegetables and food leftover (for animal feeds; used at source or sold, sometimes given free), plastic bags (reuse), plastic or glass bottles (reuse and sale), tins (reuse and sale) and scrap metals (for sale). Waste separation is practiced at transfer stations, on transit to the landfill and at the landfill or dump sites[CITATION Oko12 \l 1033].

Uganda's Kampala city waste generation is increasing creating need for more disposal land. Kitezi landfill was created as a sanitary landfill and it occupies an area of 35 acres. The increase in waste volumes is leading to the over use of Kitezi landfill making its condition to

change from a landfill to open dumping. This is similar to Nairobi's Dandora landfill and Nyanza in Kigali Rwanda. Therefore, there is need to create new disposal sites to accommodate the rapid increase in waste volume especially in EAC cities in waste generation in EAC cities[CITATION Bri19 \l 1033].

In Rwanda's Kigali city, its economic and urban population increase is leading to increased volume of municipal waste which is similar in other developing countries. This results to increase in generation of hazardous waste which contributes to the pollution and public health hazards in the community. The rapid population growth is exerting pressure on infrastructure causing problems on settlement and management of waste which is the major concern for Kigali city. Therefore, the government of Rwanda plans to create adequate solid waste treatment system in each city and also to ensure that each household gets proper services from waste collection companies (Telesphore, 2019).

The rapid development in Tanzania's Dodoma city has brought about employment and socio-economic development. This led to environmental hazards endangering the public health as proper solid waste management was also not being practiced. The control of environmental sanitation in Tanzania has been made possible through solid waste management policies and guidelines including National Environmental Policy[CITATION Kep20 \l 1033].

It is essential for EAC cities to pay more attention to adopt the circular economy concept solid wase management policy as it has the objective of maximizing value obtained from products and minimize fee for waste collection, transportation and disposal [CITATION Bri19 \l 1033].

2.4.2 SWM in Kenya

Kenya's population is rapidly growing due to increase in urbanization. In the urban areas, most people live in informal settlements and the middle-class estates. The increased urbanization is coupled with industrialization leading to increase in waste generation. Despite the existence waste management laws and policies, implementation is still low leading to overwhelming of waste in cities that result to environmental and public health effects (NSWMS, 2019). The National Solid Waste Management Strategy, 2019 is anchored on the Kenya Vision 2030. The strategy forms the foundation for development and adoption of county solid waste management policies and strategies. The strategy includes: solid waste definitions and classifications, national context and status on solid waste management, typical waste management techniques in Kenya, difficulties in managing solid waste in Kenya, integrated solid waste management, waste management cycle, and ideal approaches suitable for Kenya.

In most of Kenya's cities, waste collection and disposal systems are inefficient. For instance, from NEMA report, in Nairobi an approximate of 30-40% waste is not collected and less than 50% of the population is served in terms of waste collection. In Nakuru, an estimate of 45% of waste generated is collected and disposed at Giotto dumpsite while 18% of the generated waste is recovered. The remaining percentage ends up in the open dumpsites. In transporting waste within Kenya, open trucks are used including hand carts and donkey carts. These modes of transport are not sufficient especially in transporting waste as they lead to road littering of waste. Through decentralization, county governments have managed

to privatize waste collection and transportation system through the Private Public Partnership [CITATION Nat14 \l 1033].

Kenya generates waste classified as follows; domestic/household waste, municipal, industrial and hazardous waste. Industrialization has brought about the generation of e-waste and waste tyre. Domestic waste is majorly compost of organic waste which is biodegradable as mostly is generated from food and kitchen waste. Non-biodegradable includes plastics, glass bottles, cans, metals and wrapping materials which ca be recycled to come up with new products. In most cases, domestic waste is not properly managed amounting to the high volume of waste disposed at Dandora dumpsite with minimal sorting/segregation [CITATION NEM14 \l 1033]. Solid waste recovery and recycling is Kenya's capital City is conducted by poor Nairobi's waste pickers and as a source of income. carried out by many of Nairobi's poor who engage in waste picking as a means of income generation. The Nairobi City Council (NCC) does not operate any transfer station or recycling company instead, they facilitate heavy trucks to dispose waste at Dandora dumpsite which is not fenced making it accessible to intruders. (Palczynski, July 2002). In Nairobi, most CBOs and NGOs practice composting as income generating activity which in turn promotes environmental management strategy.

2.5 SWM in Kisumu City

Kisumu County that was developed as a result of decentralization in Kenya. The City generates about 400 tons of solid waste where 10% is collected by the City authority, another 10% by private collectors which end up in the dumpsite. The remaining 80% ends in the backstreets, markets, road sides and open spaces [CITATION Car01 \l 1033]. The

County government of Kisumu has the mandate to implement the National Solid Waste Management policies. This is clearly stipulated in the [CITATION Hor18 \l 1033], Kisumu City's Solid Waste Management Strategies as follows:

2.5.1 Waste Reduction at Source

The objective of this strategy is to reduce environmental effects associated with city waste production and disposal. Waste reduction is also known as waste prevention and minimization. It involves the reduction of waste production at source changing the material during production process.

Source reduction include reduced material use in product manufacture, increased useful life of a product through durability and ease-to-repair, material reuse, reduced/ more efficient consumer use of materials, and increased production efficiency resulting in less production of waste. Source reduction is expected to offer opportunities for cost savings for the city management which include direct savings on waste collection, transportation, and disposal costs [CITATION Hor18 \l 1033].

2.5.2 Waste Recycling and Composting

Recycling is the process by which materials destined for disposal are separated at source, collected, processed, and remanufactured or reused. According to[CITATION Hor18 \l 1033], waste recycling is increasingly being adopted by urban communities as a method of managing municipal waste and source of income for the urban poor. Waste recycling is also significant as it helps to control waste management costs by generating revenue through the sale of recyclable materials. Therefore, Kisumu County Government should continue

offering public support for establishing recycling programs. According to [CITATION KIS15 \l 1033], there is a potential of recycling about 27% (waste paper, plastics, glass and scrap metals) and composting up to 63% (organic waste) of the total solid waste produced in Kisumu city. Also, for the recycling and composting programs to succeed, the city management must aim at continually providing consistent stream of high-quality (free of contaminants) recovered waste materials that meet the standards of the marketplace and limit health risks to workers involved in the sector and therefore consider an upstream sorting of the recyclable waste.

2.5.2.1 Waste Recycling strategies

The recycling program proposed by[CITATION Hor18 \l 1033] uses systems approach where all program components are interrelated, with public participation, public convenience and support in mind as it emerged from the community forums conducted.

1. Promoting the 3R approach will lead to proper development of infrastructure that will facilitate waste separation and its recovery at source. In turn, it will promote incentives and formalize informal enterprises in the city.
2. Taka-ni-Pesa Centers

   This is a local language meaning waste is money. There should be establishment of at least 4-5 waste recycling/ business centers within the city. The centers will be branded as waste is money and will act as point of collection for recyclables. The centers are to be constructed in household collection points and the proposed sites within Kisumu are; Kasagam, Car wash, Migosi, Mamboleo and Kisat[CITATION Hor18 \l 1033]. This is expected to kick-start by constructing 2 centers in the first 2 years and monitor its impact in SWM and creation of

jobs. The main challenge is land acquisition in the proposed sites that will allow for future expansion [CITATION KIS15 \l 1033].

3. The city waste recycling park

   An investment proposal to develop a Waste Recycling Park for identified wastes in the city area is proposed at the existing Jomo Kenyatta Sports Ground waste compositing area based at the CBD or the Kachok Dumpsite after successful Decommissioning [CITATION Cou181 \l 1033]. In this park, the city shall encourage setting up of small-scale waste recycling technologies that serve as a model for local businesses. The city should act as a facilitator of the park while private investors/industrialists may own the individual recycling machines in small spaces. The support infrastructure facilities shall be provided by the city at a reasonable cost to ensure long-term sustainability. The Park will provide incubation and capacity building infrastructure to young investors from the County to set up recycling industries in other major towns in Kenya, East Africa and Africa in general. The Park will also serve as a demonstration site for civil society, especially for students and others interested to learn about waste recycling and resource recovery. The Park design should accommodate an environmental education training section with a library for research and public information. The Park should be designed in such a way that it does not create any new environmental burdens for the city or the neighboring businesses, thus emulating the model of eco-industrial parks. It should be modelled to generate some basic income at a no-profit basis to support its activities. The center should target visitors from other Counties and integrate itself to the existing western Kenya tourist circuit. The center may incorporate some services like mobile money transfer services (Mpesa, Airtel money etc.), food canteens, Eco-toilets, etc. for sustainability purposes [CITATION Hor18 \l 1033].

4. Pilot Biogas Plant & Composting Station

Development of waste-based biogas plant and composting station through private-public partneship will assist in recycling of organic waste to energy and organic fertilizer. Thus, promoting resource efficiency. The station shall be designed to use waste segregated at source to ensure availability of clean biodegradable materials for the bio- generating unit and composting station. The composting station should also be designed based on modern scientific standards and shall serve as a model training center for other counties[CITATION Hor18 \l 1033].

5. Market development for waste materials and recycled products

   This should be pursued by the city management through legislation, economic incentives, technology in recyclables, business, education, marketing and transport systems.

6. City recycling program organization

   For recycling program to be a success, it should be managed like a business, rely on trained personnel, and use the proposed institutionalized structures (Ward/ Unit/Village system) within the community. Recycling programs may be designed to be purely public (run by city management as a demonstration and source of income), public and private (run through shareholding in a public company), or purely private (non-profit or for profit).

7. Start-up plan and commencement of recycling programme

   The city management in partnership with various stakeholders should start with a voluntary or pilot recycling program, and use information and experience gained from it to plan for a large-scale recycling program. The first step will be to select one Unit in High, Medium and Low estates to pilot the waste segregation and recycling programs proposed in a period of about 6-12 months. Piloting can also be done in one Unit per Ward depending on availability of funds. Then, the city management shall use lessons learned and roll out a mandatory recycling program.

8. Implement education and publicity program

   A city-wide campaign, an environmental education awareness system, a pilot program, exhibitions, and demonstrations should be used to implement the entire system, with all city residents as the target audience. As a result, advertising, promotion, and education for the program must be ongoing.

   Monitoring and Evaluation (M&E): The entire program's elements must be regularly observed and assessed at the conclusion of each fiscal year in order to make the required reviews and adjustments to ensure success. Utilizing the indicators provided in this strategy, the City Directorate of Environment will build a monitoring system[CITATION Hor18 \l 1033].

2.5.2.2 Composting Strategies

The aim of the composting program is the biodegradable component (60%) of mixed solid waste, which includes food scraps, used paper goods, and other organic materials that can decompose. Given the high prices of other solutions, composting organic wastes can help the municipal and county government drastically reduce trash production while also providing financial benefits. The next element in the hierarchy of ISWM as source reduction is composting as a part of recycling. Kisumu city planners and managers should emphasize that the composting process is an environmentally sound and advantageous way to recycle organic materials, not a way to dispose of waste, when creating and promoting a composting program and when marketing the compost that results from it. Creating and running effective composting initiatives in Kisumu City is difficult for a number of reasons (Kisumu, 2018).

The proposed composting procedures recommended by Integrated Kisumu Solid Waste Management Plan to take place at the community/ household level, Taka-ni-Pesa Centers and at a large-scale approved county sanitary landfill are:

a) Collection of organic waste at source especially at the market where they are highly produced.
b) Develop compost pits at households and institutional centers.
c) Turning of compost, monitoring and screening the final product.
d) Package and market the produced compost.
e) Utilizing the compost in agricultural farms, urban forestry, urban agriculture and landscaping.

1. Political support

   Once composting strategy gains political support through citizens, political and organization leaders, change will be realized in SWM approach. That is why government's political and financial approval is necessary for any composting project to successfully be implemented.

2. Composting sites

   At community level, composting sites can be constructed at the backyards of households, hotels and institutions. In large scale, they can be practiced at the landfills or in small-scale at the waste is money centers. During composting, segregation should highly be practiced.

3. Marketing and use of compost

   Marketing is a vital program for the success of compost products. Market outlets for compost products include farms (located in the rural, urban and peri-urban areas), horticultural areas, tree nurseries, green house, garden parks, golf playing areas, non-cemented cemeteries, landscaping, reclamation of surface quarry material, top soil

application for forestry, playgrounds and soil cover at sanitary landfills. [CITATION Hor18 \l 1033].

4. Education, creation of awareness and capacity building on environmental programs.

   The education program in line with Solid Waste Management should involve the following:

a) It is crucial to establish an effective two-way communication between the county government, developers and the consumers who are the public especially at the early planning stages.
b) During the early stages of project development, it is important to address crucial public voices representatives. The medium of communication include; the videos, radio talk shows, newspapers, advertisement, magazine articles, television programs and public gathering.
c) Engage in continuous communication about composting sites especially between the community leaders and community members.
d) During waste collection schedule, the public should be informed about the desired and prohibited materials to be collected for composting. This will assist in enhancing good relations and in case of any complains, they should be documented and responded to promptly.
e) A site visit program of active composting sites should be developed especially within Kenya and outside the country. This will help the planners and managers of composting sites to learn new programs.

5. Involvement of the County's ministry of agriculture

   The ministry will be required to take lead in market research, come up with quality standards of compost, develop demonstration projects, involve the public especially the local farmers and offer practical assistance on sales of compost products.

6. Need, compatibility and techniques in composting

A small to medium size composting is recommended at household level and centers like at the market. For composting activity to be successful, it requires an adequate space, skilled manpower, desired tools, frequent supply of high quality and non-contaminated organic materials, enough water supply for moisturization and ready market for the compost products.

7. Organic materials collection

   Recommended collecting tools include:

a) City workers to collect waste and recyclables.
b) Private companies to collect recyclables, that is organic waste only.
c) Private haulers to collect all waste including recyclables.

8. Composting policy by the county government

   Composting standards and guidelines should be regulated by amending the existing laws. The county government should explore the possibility of setting prices for compost and provide guaranteed supply and flexible price system. The County Government should also facilitate the process by providing permits.

9. Budget and financing

   The County government to budget for about Kes 50 million every financial year (with an annual increment as per the inflation rates) to support composting programs like composting facilities at the municipal sanitary landfill and purchase marketing and supply equipment, if needed.

10. Monitoring and evaluation of composting activities

    This involves routine and frequent testing and is essential for operation of composting activities. While monitoring, recordings should be done which should be evaluated

periodically to help identify areas of improvement and need for adequate information to make the operations more efficient [CITATION KIS15 \l 1033].

2.5.3 Incineration and waste to energy recovery

This strategy involves; prioritizing incineration in Kisumu city through the process of waste to energy. There is also need to conduct analysis on investment of waste to energy plant. The process of incineration involves waste materials going through combustion where high temperature termed thermal treatment is involved. Through incineration, waste is reduced to volume by being converted to ash, flue gas and heat. The produced heat can be tapped to produce electric power. Incineration process is also coupled with benefits in that, it treats the clinical and hazardous waste where pathogens are destroyed by being exposed to high temperatures [CITATION Cou18 \l 1033].

2.5.4 Planning for a sustainable solid waste management system

Its main focus is on essential components of managing solid waste. that is; sustainable storage, collection, transport and disposal solid waste systems.

2.5.4.1 Planning for sustainable storage

The city management has planned for a three colored Waste Separation System which should be;

Water proof, fire proof, if possible, have a lid and should be washable. The systems should be cost effective especially to the city residents and should be coded with 3 approved colors. That is; green, red and yellow which are colors for promoting waste separation at source and are legalized by the law.

2.5.4.2 Planning for Solid Waste Collection

The proposed collection system should be operated in an integrated way such that all the links in the management chain should be considered when any part of the system is being designed, so that all system components are compatible. This will enable CoK to achieve this objective of collection by 2020 to the designated pilot areas and by 2030 for the whole City.

2.5.4.3 Planning for Solid Waste transportation

The factors that City Management have put in place for planning for SW transportation are; transport distance to landfill, road infrastructure conditions, vehicles durability and their cost, points of waste production and its rate, waste density, local sustainability, experts and staff experience on SWM, service availability, spare part availability of tools involved, nature and characteristic of waste.

Kisumu City still needs a variety of vehicles because of its intended three-stage collection/transfer system, even though standardization of vehicles has been considered to help the maintenance system.

2.5.4.4 Sustainable Waste Disposal Options

The decommissioning and rehabilitation of quarries in the city will be integrated, and solid waste will be used as a landfilling material. On the basis of suggestions from the CoK environmental audit consultancy report, begin the procurement process for the decommissioning of the Kachok dumpsite. In order to achieve environmental cleanup and social gain, the CoK consultancy report advised that the Kachok dump site be closed

gradually utilizing a Progressive Closure Plan. This would allow enough lead time for the land to be acquired and a new landfill to be operational [CITATION Hor18 \l 1033].

2.5.5 Institutional and Organizational Reforms in Kisumu City

After considering the advantages and disadvantages of the city's current organizational structures for managing solid waste, this approach was developed or put out. The following four areas are where the reforms are suggested:

a) The City Directorate of Environment has undergone institutional change.

b) Creation of the Nyumba Kumi/Residents Association/Ward-Unit/Community-Based System.

c) The Kisumu County Solid Waste Management Company Limited was established.

d) Reforms to ISWM policy and law.

2.5.6 Capacity building, environmental planning and education awareness

2.5.6.1 Capacity building

Capacity building through demonstration of pilot projects, it forms the core of ISWM activities. Capacity building is the leading activity when it comes to designing a comprehensive ISWM plan especially for wards within Kisumu.

2.5.6.2 Environmental planning

It involves the use of waste inventory and periodical assessment of all waste categories. The planning should be carried out after every 5 years guided by the monthly and annual data gathered from sources of waste production like households.

2.5.6.3 Environmental Education Plan

Successful City Environmental Education Plan involves: Awareness, interest, evaluation, trial, adoption and maintenance. The public involvement plan is necessary when it comes to environmental-education plan and it involves the following steps: concern, involvement, issue resolution, alternatives, consequences, choice, implementation and evaluation.

2.5.6.4 Environmental Awareness

Its main goal is to make Kisumu residents learn how to handle waste and bring about change in their waste management practices. Publicity methods in environmental awareness are divided into 2; low-cost methods and high-cost methods. In low-cost, articles, radio and TV shows and public service announcements. High-cost are the billboards and commercial TVs. Public awareness events like city environmental day also help in environmental creation of awareness. (KISWAMP U. K., Feb 2018).

2.5.7 Management of hazardous waste

Hazardous waste can properly be managed through waste segregation at source. Waste segregation is made easier by use of 3 color code bins which helps in easier identification and proper disposal of hazardous waste in the desired bin. To enhance proper management, hazardous waste should be handles using NEMA national standards hazardous waste is coupled with special waste which involves; e-waste, waste tyre and end of life vehicles (ELVs).

2.5.8 Resource mobilization

This strategy is well implemented through practicing public private partnerships and financial reforms. Public private partnership is a collaborative implementation of a project by the private sector by getting a go-ahead by the county.

2.6 Global view of stakeholder participation in SWM

In the context of SWM, stakeholders are the key people and organizations interested and participating in waste management related activities. In this case, they are people like households and organizations with an interest in participation and management of solid waste.

2.6.1 Stake holder participation in America

Stakeholders have a number of roles when it comes to MSW in Latin America and the Caribbean (LAC). The roles range from individuals to organizations to authorities. In stakeholder analysis, governance helps in bringing transparency by illustrating which stakeholders are involved, who is responsible and how to get solutions to the problems. When MSW is properly managed, that is a good indicator of measuring the effectiveness of governing structure in an urban society. For instance, waste collection can be simultaneously subjected to bureaucratic governance as well as to market governance. Bureaucratic governance in MSW management in LAC suffers severely from the weak governmental power to enforce management policies. The main obstacle being the failure to collect revenue for services rendered in line with waste management. This has made it difficult for the municipal to establish a sustainable financial plan for MSW management. MSW is highly generated from markets whose governance highly depend on the power of market

dynamics. For example, as a way of encouraging actors, contracts are used accompanied with incentives and prices. Poor attitude on MSW in LAC affects market governance leading to low business amongst private sectors working in MSW. Network governance has gained popularity in LAC due to its flexibility in MSW when it comes to forming PPP. Its also meant to encourage individual and organization participation in SWM as waste collection in LAC highly depends on the informal sector. Through network governance, waste pickers have got an opportunity to be organized and be involved in MSW activities[CITATION Hir18 \l 1033].

Transfer stations of waste is practiced by LAC cities like Rio de Janeiro, Mexico City, Caracas and Buenos Aires. A waste crisis occurred in Mexico City in 2011 where local authorities closed Bordo Poniente landfill which at one point was the world's largest landfill. Due to lack of comprehensive policy, no alternatives were provided after the closure of the landfill. As compared to Colombia where deaths occurred between 1977 and 2005 when technologies in the landfills failed, there is need for Clean Development Mechanism projects to be based Mexico. The projects are meant to reduce Green House Gas emission from sanitary landfills through capturing gas, gas burning or energy-use-systems for gas (Barreto, 2002).

The stakeholders involved in MSW in Xalapa Mexico involve:

Municipal waste collection crew

The crew recovers materials by segregating them in the transporting vehicle during the transportation to the disposal site. Money recovered from selling the materials to waste dealers is shared amongst the crew. This recovery activity is considered informal despite the fact that the crew belong to the public sanitation department. Even though municipal waste

collection workers are well aware of all the technical and operational aspects of waste collection, as well as of all the problems, the crew are left out in any decision-making process for improving the system.

Pepenadores

This is a name used to refer to informal waste/street pickers in Mexico. In most cases they engage in recovering materials like plastic bags and searching for recyclables within the urban area.

Carretoneros

This is a local name used to refer to informal waste collection services in Mexico. Their services are mostly in the low-income areas especially where the waste collection trucks cannot penetrate. In such a case, they cart being pulled by a horse or donkey. After collection the waste is segregated and the once are washed or dried depending on waste classification and the residual waste transported to the sanitary landfill. Households do pay fee for the rendered service.

Middlemen (waste dealers)

There are primary and secondary dealers in waste material recycling. Since industries require quality material for recyclable activities, middlemen come in between to purchase items from informal recyclers. The materials are thereafter sold to traders, small industries, exporters and largescale industries who finally sell the recyclables to manufacturing industries [CITATION Wil06 \l 1033].

Municipal street sweepers

They mostly offer their services within the city center and its surrounding. This involves material recovery through street and sidewalk sweeping[CITATION And17 \l 1033].

2.6.2 Stake holder participation in Asia

Due to inadequate skilled personnel and overwhelming stakeholders, recycling and waste diversion is a major problem to the society. This is coupled with problems like explosive population, urbanization and industrialization. These are the main causes of overflowing landfills worldwide as there are no regulations are put in place or poorly implemented to control recycling nor to diverse incoming waste for disposal. For example, in Pakistan, the formal structures are bringing about mismanagement of waste. This involved the municipal council are the formal authority who handle waste and due to the overwhelming production, they have left it to be handled with informal enterprises who are hardly monitored[CITATION Muh21 \l 1033].

SWM is a major concern universally. Historically, countries managed their waste through burying which was not a sustainable method. This brought the need to have an integrated waste approach for sustainability to be achieved. The integration approach involves collection, treatment and stakeholder participation. Waste processors/recyclers (both formal and informal); waste generators who involve the households, markets and industries; government personnel (regulation authorities, waste managers and urban planners); and private institutions (NGOs and CBOs). In Pakistan, the formal sector of MSWM both the public (formal) and private (informal) companies where the formal look down upon the informal as unhygienic and backward as they do not align with the current MSWM systems[CITATION Muh21 \l 1033].

Local authorities know the health risks associated with mismanagement of waste. This makes the local authorities to find ways to work collaboratively with other stakeholders. The

main role of local authorities is to make policies, support communities and enterprise roles in waste management. They also participate in information and awareness creation, campaign, providing disposable facilities and participating in waste management activities. Therefore, a balance in technical, environmental, legal, financial and social aspects need to be attained for sustainability in SWM to be achieved. The community are an important aspect of stakeholder in sustainable SWM. There is need for creation of awareness on waste reduction, segregation and recycling. Organizations like CBOs, NGOs, local government come in handy in providing social intermediation through partnership in SWM activities like community service, education and environmental health. The private institutions also have the responsibility of mobilizing households in SWM activities by offering supervision and working collaboratively with the local authority [CITATION SUE18 \l 1033].

2.6.3 Stake holder participation in Europe

Categorization of stakeholders depends on the specific project objectives being carried out. The stakeholders can be categorized into 3 categories as follows:

Primary stakeholders include the households and individuals receiving waste management services. They are known as primary stakeholders as they are affected by implementation of SWM strategies.

Secondary stakeholders involve the waste management service providers. That is; municipalities, government departments, NGOs, CBOs, waste pickers, sweepers, entrepreneurs and contractors.

External stakeholders are not directly affected by waste management instead, involved indirectly in its activities. These are the waste product buyers, middle men, recycle traders and waste recyclers [CITATION DrM99 \l 1033].

Europe's government is organized through an association termed, "CEMR (The Council of European Municipalities)" which started in 1951 in Geneva Switzerland and represents 100,000 authorities both from local and regional levels. It has members from municipalities and towns which are over 50 national associations also regions from 39 countries[CITATION Mem14 \l 1033].

2.6.4 Stake holder participation in Australia

According to laws, regulations, policies, and programs, the Australian government manages waste. It is in charge of the international agreements' measures as well as the framework for the waste policies and plans. According to the regulatory framework of each state or territory, local governments are in charge of managing garbage in their local communities. In addition to managing and operating landfills, delivering education and awareness campaigns, and supplying and maintaining litter infrastructure, local governments also play a significant role in providing services for the collection and recycling of residential garbage. Governments are not the only ones responsible for managing waste. Waste management and resource recovery involve a variety of enterprises and industries, as well as local governments, households, and people. [CITATION Aus13 \l 1033].

For a long time, the Australian government has had collaborative efforts on policy on waste and actions. The Council of Australian Governments (COAG) adopted the first comprehensive national approach to waste management in 1992 as part of the National

Strategy for Ecologically Sustainable Development (the National Strategy for ESD), which committed Australia to increasing resource efficiency, reducing the environmental impact of waste disposal, and improving the management of hazardous wastes by preventing their generation and addressing clean-up issues. To date, government policies and programs have been based on this commitment, and it has served as the foundation for cooperation among environment ministers on national waste concerns. The primary responsibility for controlling and managing waste falls to state and territorial governments. This includes planning for waste management and waste avoidance, minimization, and reuse, as well as licensing and regulation of waste transport, storage, treatment, resource recovery, and disposal, as well as managing the impacts of waste management activities. Every state and territory have passed extensive laws and policies to safeguard the environment and preserve natural resources [CITATION Aus15 \l 1033].

2.6.5 Stake holder participation in Africa

Reduction, reuse, and recycling are given precedence over disposal in the waste hierarchy. It sees recyclable materials like solid waste as a source that may be used again and create jobs that could help reduce poverty. To further sustainability, proper solid waste management is required. Sustainability is the ability to satisfy current needs without compromising the capacity of future generations to satisfy their own needs. By reducing trash, recovering it, using it again, reusing it, and composting it, a sustainable SWM reduces waste generation and disposal. Stakeholder involvement is advised in order to develop a sustainable SWM. This is so that stakeholders can affect SWM systems including waste generation, transportation, reduction, reuse, recycling, recovery, treatment, and disposal while taking

into account the environmental, financial, institutional, legal, and social aspects of sustainability. [CITATION Pri20 \l 1033].

A person or organization with an interest or stake in solid waste management is referred to as a stakeholder. According to (Klundert, 2001), the national government, municipal governments, the formal private sector, the informal private sector, CBOs, NGOs, individuals, and households are the key stakeholders in solid waste management in developing countries. There are various solid waste management stakeholders in each city Principle 10 of the Rio Declaration, which states that "environmental issues are best handled with the participation of all concerned citizens, on a relevant level" (Steurer, 2009), emphasizes the necessity for effective stakeholder participation in SWM. Stakeholders must, moreover, have appropriate access to environmental information and a chance to participate in decision-making processes. As a result, collaboration and coordination among the various SWM stakeholder groups ultimately results in a sustainable SWM. But disregarding these stakeholder groups will lead to ineffective solid waste management [CITATION CSa12 \l 1033].

Stakeholders are divided into four categories by (Freeman, 2010): swing stakeholders, offensive stakeholders, hold stakeholders, and defensive stakeholders. Swing stakeholders are fiercely competitive, have a great potential for cooperation, and have the power to significantly change the course of an event. Offensive stakeholders can be very helpful in accomplishing goals and present little relative threat, but they also have strong cooperation potential and low competitive threat. Hold stakeholders can do relatively little additional good or harm and have minimal cooperation potential and competitive danger. Defense stakeholders pose a strong competitive threat with little room for cooperation. Secondary

stakeholders are those who play an intermediary role, while external stakeholders are those who are not directly involved but may still be impacted by a particular project or program. Primary stakeholders are those who are ultimately affected, whether in a positive or negative way. The Municipal Assembly, food processors, scavengers, market vendors, homes, private trash operators, skip operators, schools, compost and recycling plants, transit hubs, and disposal facilities are among the stakeholders in Ghana [CITATION MRe08 \l 1033].

(P O'Sullivan, 2016) highlighted six different ways that stakeholders might participate: passive participation, information-giving participation, consultation participation, functional consultation, interactive consultation, and self-mobilization. The other sorts of participation are controls and partnerships. These stakeholders participate in SWM at various stages, from problem identification to decision execution. Mostly, stake holder analysis tool is mostly preferred and efficient in analyzing stake holder participation. A powerful qualitative method for understanding the objectives, significance, and influence of stakeholders is stakeholder analysis. Additionally, it offers a framework for identifying areas of conflict of interest and helps with a better knowledge of the links and interdependencies across various stakeholder groups so that both current and future collaborations may be discovered [CITATION RAn13 \l 1033].

2.6.6 Stake holder participation in East Africa Region

Participation of stakeholders is essential to enhancing municipal solid waste management (MSWM) in metropolitan regions of low-income countries. Low garbage collection percentages result in littering, illicit disposal, burning, and detrimental effects on public health. Frequently, untreated open dumps are used to dispose of accumulated waste. The

explanations for this circumstance state that it is a result of stakeholders' lack of commitment and scarce financial resources [CITATION UNE02 \l 1033].

The level of public involvement in the management of solid waste in Kira Town Council, Uganda, is low, and the best way to begin addressing the solid waste problem is for the Town Council authorities to demonstrate to the populace their value by including them in the initial planning stages of solid waste management. The current domestic waste situation in the area could be improved, in accordance with (Mwangi, 2011), by combining the efforts of all parties involved in handling domestic solid waste in Makina, Kibera, Kenya, such as the Makina residents, civil societies, international organizations, private firms, and the Local Government.

2.6.7 Stake holder participation in Kenya

Without a collaborative approach to waste concerns and the participation of a wide variety of stakeholders in their implementation, the steps outlined in this strategy cannot be implemented. In order to systematically enhance waste management in Kenya, this National Solid Waste Management Strategy (NSWMS) aims to create a shared action platform for stakeholders. Because of this, NEMA and other stakeholders evaluated the waste management procedures in five municipalities—Kisumu, Eldoret, Thika, Mombasa, and Nakuru—to serve as the foundation for the creation of this strategy. The plan establishes the groundwork for better waste management across the nation[CITATION NEM14 \l 1033].

For the successful implementation of the solid waste management strategy in Kenya, there is need for the collaborative involvement of various stakeholders whose roles are as follows;

Ministry of Environment, Water and Natural Resources

The Ministry of Environment and Forestry was created vide Executive Order No. 1 of 2018 on the organization of government of Kenya. It is mandated to undertake National Environment Policy and Management, Forestry development policy and management, Development of re-afforestation and agro-forestry, Restoration of strategic water towers, Protection and conservation of Natural environment, Pollution control, Lake Victoria management programme, Restoration of Lake Naivasha basin, Kenya Meteorological department, Kenya meteorological training, Conservation and protection of wetlands and Climate change affairs.

The Ministry is committed to facilitating the enabling policies, legal and regulatory reforms for promoting sustainability of the environment and forest resources, while at the same time, mitigating the effects of climate change.

The Ministry has the following directorates and departments:

1. **Directorate of Environment**

The Directorate offers policy direction, coordination, oversight, and advice on matters relating to the Environment and related statutes, as well as on how they should be interpreted, used, and affected. It facilitates collaboration on environmental issues between the Ministry and numerous organizations, including regional and international organizations. The following departments make up the Directorate:

i) Department of Policy Formulation, Interpretation and Implementation

The Department's mandate is to supervise the development, interpretation, and application of environmental and forestry policies. Additionally, in collaboration with other pertinent departments and agencies, the department manages the review and harmonization of all Acts, statutes, policies, rules, and regulations connected to the environment and forestry.

ii) Department of Multilateral Environmental Agreements (MEAs)

The department's responsibilities include providing technical advice to the government on its responsibilities and implications with regard to ratifying environmental conventions, treaties, and agreements within the context of Chapter 1 Article 2 subsection 6 of the Constitution. These responsibilities include providing leadership and guidance on negotiation and implementation of Multilateral Environment Agreements (MEAs), treaties, protocols, strategies, and other global environment governance initiatives. Additionally, the department manages and oversees the nation's involvement in multilateral talks and other processes at the international, regional, and national levels, as well as mobilizing the financial and technical resources made available through global MEA financing structures.

iii) Department of Programmes, Projects and Strategic Initiatives

The department's mandate calls for technical oversight, program and project coordination, strategic environmental intervention proposals, resource mobilization for programs and projects, coordination of environmental donor activities, and stakeholder forums for environmental issues. Additionally, the department takes the lead in organizing and overseeing international environmental and natural resource projects and activities.

iv) Department of Ecological Restorations

The agency is in charge of directing the rehabilitation and restoration of urban river basins and overseeing their execution.

v) Kenya Meteorological Department

The agency is in charge of providing weather and climate data and services to a number of industries, including agriculture, energy production, aviation, marine transportation, health, disaster management, and the development and management of water resources, among others.

2. **Directorate of Forestry Conservation**

The department's responsibilities include developing, reviewing, and overseeing the implementation of the national forestry conservation and management strategy; formulating, interpreting, monitoring, and coordinating strategic policies for forestry conservation; ensuring sustainable exploitation, utilization, management, and conservation of forestry resources; and ensuring equitable sharing of the benefits that accrue.

3. **Directorate of Climate Change**

Under the Climate Change Act of 2016, the Directorate was founded with the responsibility of providing leadership, vision, coordination, and advice for national climate change issues. In order to provide operational coordination for national climate change strategies and initiatives, it serves as the government's principal agency.

1 **Administration and Support services**

The department coordinates and provides support services to facilitate the realization of the strategic objectives of the ministry. It comprises of the following departments: Administration, Planning, ICT, Finance, Accounts, Records Management, Human Resource Management, Human Resources Development, Public Communications, Internal Audit, and Procurement.

NEMA

The National Environment Management Authority (NEMA), is established under the Environmental Management and Co-ordination Act No. 8 of 1999 (EMCA) as the principal instrument of Government for the implementation of all policies relating to environment. EMCA 1999 was enacted against a backdrop of 78 sectoral laws dealing with various components of the environment, the deteriorating state of Kenya's environment, as well as increasing social and economic inequalities, the combined effect of which negatively

impacted on the environment. The supreme objective underlying the enactment of EMCA 1999 was to bring harmony in the management of the country's environment.

The mandates of NEMA involve:

Create laws, regulations, and economic tools that are necessary for sustainable garbage management.

Create and distribute public education about Kenya's legal requirements for garbage management.

benchmarking on suitable waste management technology at the regional and global levels.

Increase the county governments' knowledge of the waste management strategies that work in their own counties.

Utilize social media to increase stakeholder participation and alter national perceptions about trash management.

Hold public education sessions on trash management initiatives (such as school seminars, public consultation exhibitions, and public events).

Encourage the dissemination of research and development findings in waste management.

Use mass media dissemination strategies, such as the release of press releases and news articles, to guarantee coverage in both print and online media.

Implement SWM law enforcement and surveillance efforts against unlawful waste activities.

County Governments

County governments were developed through decentralization of Kenyan local government in August 4, 2010 referendum where more than two-thirds (67%) Kenyans voted for the new constitution. The Kenyan 2013 elections brought about the devolved government with creation of 47 counties accompanied with elected governors and assemblies.

The county government mandates involve:

They are in charge of creating action plans for putting in place the necessary solid waste management systems within respective counties.

Obtain sufficient resources to create programs for sustainable waste management throughout the cycle.

Take action to improve public-private partnerships (PPPs).

benchmarking for relevant technology best practices.

engage in recurring cleanup efforts inside their counties.

provision of garbage transportation and segregation equipment.

To manage garbage, divide the areas.

Continuous management of operations and facilities to guarantee that all trash is quickly transferred to the appropriate waste disposal locations.

monitoring and assessment of the plan.

Improved collection techniques and facilities will provide thorough coverage and no garbage littering.

Improve the authorized county disposal site gradually in the direction of a sanitary landfill.

The National Treasury

The National Treasury provides financing to the relevant governmental organizations and agencies for the creation of waste management programs and facilities.

Civil Society Organizations (CSOs) and NGOs

Promote income-generating activities related to trash management programs.

Represent the interests of the public in the national solid waste management agenda and in assisting in the detection of unlawful waste-related activities.

Encourage the public to alter their understanding, perspective, and behavior on sustainable waste management.

Private Sector

involvement in the creation of solid waste management facilities through public-private partnerships.

Give garbage management corporate social responsibility (CSR) priority.

Educate and assist communities and other stakeholders in identifying problems with waste management and finding solutions.

The Citizens/Public

Adopting the idea of a waste generator's responsibility by ensuring trash is properly managed at the source and/or throughout the whole waste management cycle requires a change in mindset and behavior.

Adopt an integrated solid waste management strategy and/or the 7 R's (Reuse, Recycle, Reduce, Rethink, Refuse, Refill, Repairing) while managing all waste streams.

Work together in waste management through the PPP model with other governmental organizations, CSOs, NGOs, and other informal groupings.

One method for addressing the difficulties in managing household garbage has been highlighted as stakeholder involvement. Given that managing garbage has always been the job of the county council or government, one of the primary issues in managing solid waste in Kenya is household apathy. The continued growth in unsustainable SWM in Nairobi is mostly due to a breakdown in stakeholder commitment and communication. Building public-private partnerships is therefore necessary to increase garbage collection and recycling services, resulting in improved home waste management [CITATION Mut14 \l 1033].

The NWMS offers the context within which various stakeholders' actions are situated. This strategy is directed at all relevant parties, including those in business, labor unions,

community-based and non-governmental groups, and the general public. It outlines the many duties and obligations that each stakeholder and level of government must assume. (NSWMS, February 2015).

2.6.8 Stake holder participation in Kisumu

In the KISWAMP document (KISWAMP U. K., Feb 2018), stakeholder participation falls under the existing institutional, governmental, and legal foundations for SWM. The following parties are involved in SWM in Kisumu City:

National Administration

Federal Reserve

Lands, Housing, and Urban Development Ministry

Regional Authorities, Natural Resources, and Environment Ministry

NEMA is the National Environment Management Authority.

Ministry of Planning and Devolution

County Administration of Kisumu

Ministry of Environmental Management - City of Kisumu Management

Water and sewerage company in Kisumu

Donors/Project Partners

Private businesses and/or waste collectors

Informal Waste Pickers from the Street and Dumpsites

NGOs (Non-Governmental Organizations)

Youth and women's organizations are examples of community-based organizations (CBOs).

Waste Producers

Waste traders, buyers, and brokers

Importers and exporters are traders.

Industries for Waste Recycling (WRIs)

Residents, businesses, neighborhood associations, and community organizations

Households/ waste generators

Households appreciate receiving effective waste collection service at reasonable price. In low-income areas, the residents do not give priority to SWM that is why open dumping is common in such areas.

Ministry of Environment within County government of Kisumu

The major role of ministry of environment is to formulate, integrate, coordinate, supervise and implement policies. They also engage in project activities related to conservation, and management of environment within Kisumu County. This County Ministry is mandated by law to create county-level environmental and waste management legislation and policies. Additionally, it creates, facilitates, and manages county-level annual budgets for SWM activities. Additionally, it serves as a conduit between the County Assembly and the City of Kisumu. The County Ministry of Environmental Management is specifically responsible for managing solid waste, reducing noise and air pollution, managing and maintaining county parks, protecting the environment by restoring degraded sites and rivers, and county afforestation and tree planting.

City of Kisumu Department of Environment

The department has three key Divisions; Environmental Planning and Management, Environmental Regulation, and Urban Aesthetics. The operations of these three sections are limited due to the existing financial and human resources. The main activities of city

environment department in terms of waste management are: waste collection, street sweeping, waste transportation, waste disposal, site management, waste recycling and treatment. The Directorate of Environment within the City of Kisumu is the legal owner of waste once it is collected or put out for collection. The main limitations of the department are human and financial resources. This is accompanied by the following challenges; Lack of personal protective equipment, inability to reach slum regions, low priority of the Department, staff and vehicle shortages, insufficient motivation, inadequate compensation. Only 15% of the technical employees are reportedly accessible to assist the Department at the moment. Additionally, 28% of the department's workforce is comprised of technical personnel. In comparison to the UN-recommended standard ratio of 1 to 500, a city with 500,000 persons means that 1 support staff supports almost 10,000 residents (Kisumu City, 2014). As a result, the Kisumu city's current organizational setup offers it limited power to implement efficient solid waste management within the city limits. In particular, this is due to the lack of strong planning and development control frameworks and the inability to effectively implement environmental legislation. Environmental planning and sanitation are not supported by the institutional rules, which are poor. Additionally, because the City Engineer's Department is in charge of all waste collecting and transportation equipment, garbage truck procurement, maintenance, and administration are ineffective and inefficient. [CITATION Hor18 \l 1033].

Solid Waste Collection Private Companies

According to Kisumu Solid Waste Management report (KISWM-baseline-survey, 2015), there are between 16–20 private waste collection businesses in Kisumu, both registered and unregistered. The primary goal of the private sector businesses is to recoup their initial

investment through the sale of garbage collection, transfer, treatment, recycling, and/or disposal services. However, they drive outdated, poorly maintained trucks with a tonnage range of 0.5 to 1 and 3-6 tons. Private sector businesses like households, industries, CoK, institutions, and restaurants typically hire collectors directly. The following factors restrict the private sector's ability to operate: limited support from CoK beyond the payment for a disposal license; lack of legal protection; a lack of institutional procedures that all companies interested in providing SWM services must follow; and difficulty finding suitable sites for the secondary containers, that is, skip since each large skip requires large space. There is also lack of legal framework on Public Private Partnerships (PPP).

The Informal Sector

The (KISWM-baseline-survey, 2015 report shows that there exist a lot of opportunities for informal waste pickers in Kisumu. This is determined by the high percentage pf recyclable and reusable waste items. The informal private sectors who are unregistered to carry out the activities are the CBOs, NGOs, Jua Kali artisans, waste pickers and traders, waste recyclers and waste salvagers. Activities conducted for income generation include composting, waste collection and small-scale recycling. The private sectors actively participate in awareness creation on waste management through open channels between the CBOs and the government. Waste salvagers obtain all types of waste materials and they operate in commercial, residential and industrial zones. Waste dealers are brokers between waste pickers and small-medium enterprises within Kisumu. Waste pickers encounter the following problems: Lack of operation land, poor access roads, harassment, lack of policy and punitive regulation, competition is high and there is lack of economical recyclables/equipment [CITATION Hor18 \l 1033].

Individual Households/ Waste Generators

Households are mainly interested in receiving effective waste collection services at affordable low price. In low-income areas, households do not prioritize paying for waste collection services instead, give priorities to bills like water, sanitation facilities and drainage. This explains why most illegal dumpsites are present in the slum area coupled with poor and clogged drainage systems [CITATION Hor18 \l 1033].

2.7 Influence of Public Participation on SWM

Public participation major's role especially in Solid Waste Management, is waste collection at source and the treatment process of the waste is majorly practiced through Public Private Partnership. Therefore, the rationale of effective public participation is based on the fact that everyone generates waste which affects them directly or indirectly if not properly managed. A circular economy when employed, leads to development of new industries and jobs by reducing emissions and instead increase efficient use of natural resources like water and energy. Through this, waste becomes a resource through which employment is created that contribute to poverty alleviation if people are education and informed in the decision-making process of SWM.

Public participation involves interaction between stakeholders, government and non-government agencies who participate direct and indirectly through implementation and decision making of projects. Therefore, it is necessary through participatory approach to involve the public and private sectors in SWM to manage and own the projects for it to be an effective approach.

2.7.1 Circular Economy towards SWM

Circular Economy (CE) is a concept that illustrates how an industrial economy promotes the production of resources through reduction of waste and pollution. According to Ellen MacArthur Foundation, (2015), ‘circular economy aim is to rely on renewable energy to minimize toxic waste which is considered to be of no value. In a resource-efficient economy or society, waste refers to residual materials which cannot further be utilized as they have no more value. Valueless waste like hazardous or toxic materials can be recovered through greater efficiency and management at every stage of production and consumption. [CITATION Ell15 \l 1033].

Nearly all outputs in the circular economy process are converted into either input in production processes or returned to the environment as benign emissions rather than pollutants. A closed-cycle processing facility, for instance, uses fresh water input and does not discharge any liquid effluents. Instead, as seen in the following graphic, water is continuously recycled and may even be used in the finished product itself:

Figure 2.1: Sustainable Resource-Efficient Economy with 3Rs

The circular economy's "3R" (Reduce, Reuse, and Recycle) principles are involved here. A sustainable resource-efficient economy entails increasing the proportion of recyclable materials, recycling manufacturing wastes and raw materials, and reducing the number of resources and energy consumed overall (Foundation, 2015). These concepts are applied throughout the complete lifecycles of goods and services, from raw material extraction and product design to transportation, manufacturing, usage, disassembly, and disposal. (Mohanty, 2011).

Linear economy is based on exploitation of resources through ‘take-make-dispose’ which leads to negative and societal impact. Also, little effort is made to reuse or recycle wastes that end up in the landfill.

“Circular systems of production were popularized through the Cradle to Cradle (C2C) concept developed by McDonough and Braungart (2002). Both C2C and CE aim to reshape the productive cycle of consumer products through a transition to an industrial system beneficial to ecological, as well as human wellbeing. Cradle to Cradle and CE are centered around the concept of material cycling which avoids degradation or downcycling, but promotes upcycling where materials, once they reach the end of their lives, become either ‘biological nutrients’, re-entering the environment, or ‘technical nutrients’, re-used in a new industrial cycle”[CITATION McD021 \l 1033].

In the waste hierarchy, reuse and recycle are the second step. Their main aim is to reclaim material from waste stream and reduce volume of waste generated as it moves down the

waste hierarchy. (NSWMS, 2015). Therefore, for the circular economy to be successful implemented, all stakeholders especially households must fully be implemented from development to implementation stage to achieve effective results.

In the Reduce principle, it is advisable that individuals Purchase goods that they need and in right amount is the most significant option to manage waste. For example, when coming up with products, goods should be manufactured from scratch, come up with shipping materials, utilize additional resources for shipping, and then devise ways of disposal. Therefore, it is necessary for households to analyze what goods are required in their homesteads and how effectively to dispose-off unwanted goods.

CE is particularly focused on circulation of materials that are produced, used and discarded in the system of production. In Solid Waste Management, the aim of the concept of Circular Economy is to keep all components within the value chain throughout the time in closed loops. In Solid Waste Management, the concept of circular economy is integrated to ensure that a sustainable development is achieved. United Nations Environmental Program propose the shift of waste management to resource management as a policy initiative to prevent waste and enable resource efficiency [CITATION UNE19 \l 1033].

2.7.2 Global view of influence of public participation on SWM

Globally, public participation is a major concern in matters relating to democracy as many democratic governments have devised ways through which citizens participate in decision making and implementation of projects like solid waste management. World bank indicates that solid waste collection services provided by private sectors cost between 25-41% more than contracted services (Worldbank, 2004).

In Latin America, cost of service provided by private sectors has been reduced by half due to higher labor and productive vehicles that promote the development of micro-enterprises. In Asian countries of Sri Lanka, Bangladesh and Pakistan, through "University of Loughborough's Water, Engineering and Development Centre (WEDC)," they came up with recycling cooperatives which improved people's living standards and reduced poverty by increasing employment opportunities and reduced socio-cultural disruption. China, the largest waste generator worldwide generates, in 2016 it generated 18.68 million tons of municipal solid waste. It launched promotion law of CE in 2009 so as to pursue sustainable development. The law aims at improving the efficiency of resource mobilization to protect the environment and achieve sustainable development. As a way of managing solid waste, the start point embraced is separation, reuse and then recycle which aims at reducing the volume of solid waste. This method embraces household participation as a way of achieving high recovery rate and to transit towards Circular Economy [CITATION Lie16 \l 1033].

2.7.3 Influence of public participation on East African Region

Public participation and awareness are significant in ensuring the success of waste management. In SWM, the public plays a vital role in waste collection, sorting, transportation, reusing and recycling. Public participation in Kenya has attracted much attention since the promulgation of the Constitution in 2010 and is a critical principle in devolution. In Kenya, studies show that between 59-79% excreta from cities are not managed safely and end up disposed in environment in a poor manner as most of the waste end up in the dumpsites. The expansion of agro-industrial sector in Kenya has led to increase in generation of solid waste. Through the drafted SWM policy and proposed

climate change mitigation actions, Kenya aspires to deal with its waste challenges by becoming sustainable in circular economy[CITATION Min19 \l 1033].

According to Kisumu County Solid Waste Management Policy (2020), solid waste management is complex due to social, economic and environmental determinant factors and stakeholders. There also exist weaker stakeholder management process in SWM because users and non-state providers of solid waste management services are usually excluded from active participation in the management process. Therefore, there is need for inclusivity of diverse stakeholders in solid waste management processes so that they can partner and collaborate in order to deal with all aspects of solid waste management. All the stakeholders should be involved in identifying policy options and implementing Programmes related to solid waste management. [CITATION Cou201 \l 1033].

2.8 Challenges of SWM and waste Segregation

1. Poor financing

Waste management receives inadequate funding because it is not a top priority in all EAC urban councils. Over 50% of the money used to operate urban councils comes from outside sources, primarily donations from donors and the federal government. According to J. Okot-Okumu and Nyenje (2011), the EAC urban councils have not achieved fiscal autonomy as a result. The decentralized environmental management operations carried out by the urban council are not sufficiently cost-evaluated by the central governments. National goals typically diverge from environmental management efforts by the federal governments that result in little reduction in these areas. In order to help waste management towns, who are

frequently ill-equipped to deal with quick collection and disposal of garbage, there is a need to have access to funds and technical knowledge. Inadequate budgetary allocation for waste management in Kenya is the result of a lack of prioritizing. As a result, the collection, transportation, and disposal phases of the waste management cycle are difficult to manage. Effective solid waste management procedures in Kisumu are severely hampered by the lack of resources, including financial, technical, and logistical ones.

(Liyala, 2011) suggests that the City's Department of Environment has limited revenue sources and low annual budgets. This is further worsened by the fact that a significant proportion of the urban poor is unable to pay for waste collection services. The limited available funds means that the City is not able to purchase new vehicles and the existing fleet is poorly serviced.

2. Poor public attitude towards SWM

Urban communities hardly participate in SWM practices and this is worsening because of poor attitude towards waste and urban councils failing to enforce the existing SWM policies (Liyala, 2011). The main factors contributing to the unwillingness to participate in public management matters by community members are; low living standards due to poor and low-income, low education due to high illiteracy levels and low GDP per capita. Other factors include weak urban council leading to failure in SWM. These factors are the main reason for waste accumulation in the community resulting to environmental degradation and spread of diseases (Rotich, 2006). People rarely segregate waste at source leading to mixed wastes which end up in the dumpsites. Where sorting is done, the problem is compounded by the

lack of compartmentalized vehicles for transportation of the sorted waste leading to the remixing. This hampers material recovery, reuse, and recycling. The sorting has largely been relegated to the lowly in society such as the waste pickers and street urchins (NEMA, 2014).

3. Inadequate policy and legislation

All countries have regulations and policies which dictates how waste should be managed. In Africa, there is the challenge of creation of enough capacity not only limited to monetary terms but also in technological and infrastructural advancement. This is required so as to drive at an environmentally sound waste management in recovery and recycling of waste streams across Africa to be achieved (Wilson, 2006).

Political interference caused by personal interests has in some cases obstructed opportunities to implement ordinances or bye-laws. Political interference weakens environmental management institutions and creates a community that is difficult to work with for environmental management (J. Okot-Okumu and Nyenje, 2011).

The poor implementation of policies and by laws has led to lack of systematic approach of waste management in Kisumu City. In spite of the availability of suitable land within Kisumu County, the lack of a success story in solid waste management in the country has made local communities frustrate efforts by the County to relocate Kachok dumpsite to suitable disposal areas outside the city boundaries (Gutberlet, 2017).

4. Poor Accessibility to Temporary Waste Collection Areas

This is a major challenge and hindrance to waste service providers to achieve effective solid waste management in Kisumu City. Some of the informal settlements are located in densely populated areas with close-knit houses and poor road infrastructure. In these areas, most of the licensed waste operators tend to make use of handcarts for collection as vehicles cannot access the areas (Kain, 2016).

5. Poor law enforcement and governance

In the EAC, environmental policy making is majorly performed by the central government but its implementation is devolved to the local/ county government. Due to poor enforcement of existing waste management policies, this has made communities to operate with minimal or no waste regulations (Liyala, 2011).

The private sectors in most cases are willing to participate in SWM but inhibited by laws which gives most of waste responsibilities to government bodies[CITATION Tuk11 \l 1033]. Poor enforcement of waste policies and laws contributes to inefficient management of solid waste in Kisumu City. Inability of ministry of environment to enforce SWM laws is due to limited personnel, limited logistics and lack of legal understanding. Also, the City's inability to implement existing by-laws on waste disposal results in a 'throw-it-where-you-like' attitude and general disregard of waste disposal regulations. Thus, most households, traders and businesses resort to indiscriminate waste dumping in open spaces, streams, drains and drainage channels. This creates unsanitary living conditions, blocks existing drainage channels and creates breeding ground for mosquitoes and rodents (Baabereyir, 2009).

6. Lack of awareness and knowledge

There is limited awareness and knowledge on the importance of a clean and healthy environment. This has led to poor practices by the Public towards waste management which has led to environmental pollution. As such there is poor handling of waste at the household level including lack of segregation, reuse, reduce and recycling. In addition, negative attitude towards waste management and failure to take individual responsibility has contributed to poor practices such as littering, illegal dumping and open burning.

Apart from poor financing, poor community attitude towards SWM is contributed by low awareness of SWM, poor political and institutional support bringing about challenge in SWM in Kisumu City (Kain, 2016). According to (Zurbrugg, 2003), stages of solid waste management from 'household waste storage, to waste segregation, recycling, collection frequency, the amount of littering, the willingness to pay for waste management services, the opposition to the siting of waste treatment and disposal facilities, all depend on public awareness and participation. The amount of litter and indiscriminate dumping in Kisumu suggest that there is a poor waste handling attitude in most areas. This coupled with inadequate infrastructure for disposal and infrequent or no waste collection services results in open dumping of waste. There is therefore a need to improve public awareness and increase the participation of communities in waste management issues. This will help promote environmental citizenship and sensitize communities to work together towards efficient waste management.

There is need to explore the opportunities for the 3Rs and composting in urban waste management among urban communities to minimize waste and also providing social (clean and healthy neighborhood) and economic (sale of recycled materials) benefits. (Mbeng, 2009) suggests that to successfully adopt sustainable methods of waste management by communities, there is need to make awareness Programmes simple and accessible to change the mindset of urban residents to perceive waste as resources rather than valueless. To address community level waste problems, pre-collection or primary collection needs better organization and strengthening by communities working together with urban councils and CBOs to chart the most suitable waste minimization and collection methods. Also, Integrated waste management approach that employs decentralized community-based

systems involving NGOs or CBOs targeting the peri-urban poor and the more centralized urban council and private operator systems that target the central business areas and the rich and middle-class estates should be explored by the urban councils. Such systems can be promoted through community participation and education involving CBOs and the informal sector. Hence, there is need for political support for such initiatives of waste management strategies to succeed.

7. Disposal sites

Availability, siting and management of disposal sites that the county governments are expected to designate waste disposal sites/facilities within their areas of jurisdiction. However, the availability of public land for the purpose of a disposal site remains a challenge. In situations where the land is available, the neighboring communities are opposed to it being in their backyard. This is as a result of poor management of the existing sites. This has culminated in dumpsites being sited on environmentally sensitive areas such as river banks, forests and wetlands.

8. Slow adoption of modern technological options

There are many waste management technologies in the country however, there has been low adoption of the same by the relevant practitioners. This as a result of diverse factors including inadequate financial resources to purchase the equipment, lack of incentives including tax waivers, resistance to change, lack awareness, unavailability of land and weak enforcement (NSWMS, 2015).

9. Extreme poverty level

High poverty level especially in informal and low-income settlements has compromised the ability to pay for waste management services. This has led to lack of collection leading to illegal waste dumping in undesignated areas sites, streams, rivers and highways. The

situation is further compounded by lack of access and waste management infrastructure (NEMA, 2007).

10. Limited available land

The problem of MSWM in East Africa is compounded by the rapid urban population growth caused by rural to urban migration overstretching resources. The rising urban population and increasing industrial activities means larger volumes of wastes that pose threat to public health and the environment since they are predominantly decomposable organic and E-wastes are also increasing in the waste stream. Municipal wastes therefore constitute one of the most crucial health and environmental problem of African urban councils (Zurbrugg, 2003).

As urban areas and populations continue to grow, the amount of available space for solid waste facilities, local collection locations, and transfer stations decreases. There may not be space, the available parcels may be too expensive, or local residents may prevent facilities from being developed due to fears of smell depreciating their living conditions or property prices. However, siting these facilities at a distance from cities, where land is more available and less expensive, creates a new set of challenges because hauling waste long distances can be time-consuming and expensive. Solid waste managers can work with local and regional leaders to create a solid waste management plan that emphasizes the importance of route and city planning. Diversion or separation programs will also play a large role in reducing the amount of waste that needs to be collected at one time.

11. Socioeconomic factors

Inadequate solid waste management can be costly, both in terms of direct expenses and indirect costs. Mismanaged solid waste systems are a missed opportunity for economic

growth, including increased property values and tourism benefits from having clean streets and beaches. Programs reducing waste can lead to cost savings in transportation and fuel costs, and cost recovery if implemented correctly. Improved solid waste management can especially benefit highly vulnerable populations through cost savings on public health systems by preventing respiratory issues, skin diseases, and other health care concerns associated with inadequate solid waste management (ISWA, 2015).

12. Limited access to and technical knowledge of equipment

Some solid waste handling equipment may need to be imported, and operators might not have the resources or technical know-how for consistent and proper maintenance. If the equipment is not compatible with the environment where it is used, regular repairs may be required and it may be challenging to locate replacement parts. In tropical regions, regional factors like humidity and heat can negatively affect equipment, leading to frequent repairs. Local governments often lack the expertise needed to evaluate technologies or solutions in order to identify the most appropriate ones for their situation. Difficult situations can arise when private companies contract with cities to provide a technology or implement a project but abandon the project if the city cannot meet the terms of the contract leading to failure of the project.

13. Difficult working conditions

In developing countries most workers in the field of SWM are untrained and in most cases, underpaid. They also lack personal protective gears risking the danger of being injured or diseases. Solid waste management workers in developing countries may be underpaid and undertrained. This explains why individuals living near disposal sites or who work at the disposal sites are at a risk of being infected with parasites [CITATION UNE19 \l 1033].

2.9 Theoretical Framework

The study is anchored on William McDonough (2002) cradle-to-cradle theory. In his book of “Remaking the way we make things” and the theory is based on the thinking of recycling economy. The Cradle-to-Cradle approach is an approach introduced by German environmental scientist Michael Braungart and the American Architect, William McDonough. In 2002 these founders of the Cradle-to-Cradle approach launched their first book “remarking the way we make things” about the approach and how to achieve this approach in an organization. William McDonough designed a framework characterized by three principles derived from nature which are: Everything is a resource for something else, use clean and renewable energy, and celebrate diversity (McDonough, 2002).

The first principle is the principle of ‘Everything is a resource for something’ else explains how in nature, “waste” one system becomes food for another. This principle is also known as waste equals food and takes its inspiration from nature which is illustrated by life cycle of a cherry tree. ‘Cherry trees draw nutrients from the environment, blossom, scatter leaves which thereafter decompose into new soil and thus form food for other living things.’ This explains how nature has a continuous cycle of birth, decay, and rebirth. Hence, the nature does not take a linear growth model ("cradle to grave"), but a "cradle to cradle" cycle development model. Hence, with desired products and services when correct systems are put in place, communities and entire city can create an interdependent and synergistic relationship with the surrounding ecosystem. Relating this principle with the 3R’s (Reduce, Reuse and Recycle) of circular economy, a lot of emphasis is put on technical cycle materials that circulate within the closed-loop system of production, reuse, recovery, and

remanufacture. This elaborates how concerting to waste to wealth through the 3R's concept brings about development[CITATION Lie16 \l 1033].

Cradle-to-cradle second principle is principle of 'use clean and renewable energy, from construction to manufacturing.' This principle explains how living things thrive well on solar energy. Wind, water and sun are naturally produced and thus used as renewable energy. As their harnessing, storage and transfer technology becomes more advanced, these renewables become increasingly cost competitive. The theory's main goal is to create a recycle system of natural resources and physical materials. On one hand, the renewable energy provide power to meet human needs and in turn reduce environmental and energy problems. Also, human beings can utilize clean and renewable energy by investing on the abundant resources while supporting human and environment health (Xiaojuan, 2011).

'Celebrate diversity' principle is the third principle. It responds to 'challenges and opportunities offered by each place fit elegantly and effectively into their own niches.' Through the utilization of natural diversity and locally adaptable systems, this brings about a healthy ecosystem. Hence, 'principle of celebrate diversity preserves natural environment and biodiversity, respects cultural diversity and improves urban and community development.'

These three principles; principle of Everything is a resource for something, principle of use clean and renewable energy, and Celebrate diversity principle are translated to C2C certified schemes. Products that meet the three principles are termed cradle to cradle certified. Thus, through the three principles, manufacturers can demonstrate efforts to improve their products for development to be realized. The cradle-to-cradle idea proposes that certain

products could be reused forever to manufacture comparable products (cradle to cradle), rather than being recycled into lower quality products until the last stop is a landfill (cradle to grave), in an effort to break the cycle of use-waste-pollute. This indicates that things can be used, recycled, and reused repeatedly without sacrificing their original material quality. Therefore, rather than using more and more virgin materials, it can be a good strategy to reduce the waste from the raw components of the products. Therefore, this theory presents the potential for a solution to the municipal solid waste challenges. Overall, "cradle to cradle" plays a significant role in the development and enhancement of product quality.

increase value and spur innovation. The scope of the principle of “Cradle-to-Cradle” (C2C) is to close the material cycles within the production, so that no more wastes are generated and the resulting residues are returned to other production steps, following the example of nature [CITATION McD021 \l 1033].

Cradle to Cradle (C2C) is about seeing garbage as an eternal resource and doing the right thing from the beginning. It is about making community and product development function in the same way as a healthy ecological system where all resources are used effectively, and in a cyclical way (as opposed to the current linear system that can be better described as a Cradle to Grave system). In order for the C2C system to be sustainable, all materials in products need to be kept clean and should not be mixed. Alternatively, there needs to be a separation system in place that can be applied after the item is discarded. C2C methodology builds on the concept that “waste is food”, meaning that what is considered waste can become food in a new product cycle[CITATION Eco18 \l 1033].

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter entails research design, the study where the research was conducted, source of data, unit of analysis, target population, sampling, data collection tools, data analysis, reliability and validity and finally, ethical considerations.

3.2 Research design

Kothari (2004), refers to research design as an arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance with the research purpose. The study employed exploratory research design as a strategy for conducting qualitative research. The design gives respondents an opportunity to participate in the research that is being carried out and gives the researcher an opportunity to explore phenomena and activities that explains and clearly brings picture of SWM in Kisumu in detail. Exploratory research design is flexible and adaptable to change. Its main focus is to find out what is happening and addresses various research questions and objectives (Boru, 2018).

3.3 Study site

The study was conducted in Kisumu city, within Kisumu County in Kenya. This is because of the debate on let Lake Victoria breathe because of contamination by solid waste especially the plastics that affect aquatic life by suffocating them and filling the wetlands which acts as the cleaning agent for the lake and breeding point for fish. Kisumu County is one of the Counties that was developed as a result of decentralization in Kenya. Historically, the city started as a railway terminus and an internal port in the 1901and has progressively been developing to the leading communications and trading confluence for the Great Lakes region (Tanzania, Uganda, Rwanda and Burundi). Surrounded by an agriculturally rich hinterland mainly supporting large-scale sugar industry and rice irrigation, Kisumu's contribution to the national economy is significant. Its borders follow those of the original Kisumu District, one of the former administrative districts of the former Nyanza Province in western Kenya. Kisumu County's neighbors are Siaya County to the West, Vihiga County to

the North, Nandi County to the North East and Kericho County to the East. Homa Bay County is its neighbor to the South West. It's headquartered in Kisumu city. Kisumu city is located within Kisumu Central Subcounty which has a total population of 170,592 people and total number of 52331 households (KPHC, 2019). The Sub-County has 7 wards which include: Market Milimani, Nyalenda B, Shauri moyo, Kondele, Kaloleni, Migosi and Railways (KPHC, 2019). These wards are made up of estates. Railways and Nyalenda B are the selected wards where interviews were conducted as they are situated on the Shorelines of Lake Vitoria. Riat-Airport, an estate within Railways Ward and Nyalenda within Nyalenda B Ward were purposely selected because of the active SWM activities being conducted in these areas to bring about development and also, to determine how households within these localities manage their waste to avoid contamination of Lake Victoria due to their close proximity. Questionnaires were administered to household respondents in the selected estates. Airport estate largely comprise of middle-income households and low-income households in Kombedu slums while Nyalenda majorly comprises low-income and peri-urban households. The households in airport were purposely selected in line with their proximity to water bodies. For example, River Kisat passes by Kombedu slums which is in Railway ward and River Wigwa passes by Nyalenda slums in Nyalenda B ward. Both rivers drain their water into Lake Victoria, the pride of Kisumu City.

The population of the city has rapidly been increasing, at a growth rate of 1.86%. Its current population is estimated at 500,000 people which is about 45.5% of the County population. The peri-urban area houses 50% of the total population, followed by the urban areas at 1,500 to 3,000 people per km^2 and the rural areas at 170 to 680 people per km^2(Kisumu C. G., 2014). The land area of Kisumu County totals to 2,085.9 km^2. The County has a shoreline on

Lake Victoria, occupying northern, western and a part of the southern shores of the Winam Gulf. Railways and Nyalenda B wards tend to be situated on the Shorelines of Lake Vitoria. For Kisumu city, it is situated on the shores of Lake Victoria and as the third largest city in Kenya, covers a total of 417 km^2. Of this, 297 km^2 is dry land and the remaining 120 km^2 is under water (Onyango, 2008). This explains the high-water table and loose soil in Kisumu that brings about the problem in management of solid waste especially human excreta that end up contaminating water bodies. In terms of location, Kisumu is a port city in Western Kenya and is located between 0º6'S and 34º45'E at an altitude of 1,131m (3711ft). As a result of the rapid population growth and the changing urban lifestyles, resource consumption patterns, improving income levels and uncontrolled industrial development, the urban environment in Kisumu is seriously being degraded. In Kisumu County, the problem of solid waste management is encapsulated in Kachok dumpsite which is less than 2 km from the center of the Central Business District of Kisumu City.

Figure 3.1: Kisumu Central Constituency Map (google map 2022)

3.4 Sources of data

The sources of data used by the researcher were primary and secondary data. According to Higson-Smith (2004), primary data is the data which the researcher collects and are original in character. The primary data was recorded and it was the first-hand data collected from in-depth interviews conducted from Key Informants. Open-ended questionnaire was administered to the selected households and observation list was used during fieldwork conducted in the selected Kisumu estates, Dunga beach and Kisumu Central Business District (CBD). Secondary data on the other hand includes the data that has already been collected and compiled by someone else and are available for use by the researcher (Lincoln, 2005). Secondary data was used to supplement primary data and to validate it. The

secondary data that was used is the published literature and reports on waste management in various countries and in Kisumu City which helped the researcher determine what is already in existence in relation to strategies of managing solid waste used to address the problems and challenges.

3.5 Unit of analysis

The unit of analysis refers to the person, collective or object that is the target of the investigation. In this study, the unit of analysis was active participants of SWM located within Kisumu Central. For household respondents, they were household heads responsible for managing household solid waste. In the category of key informants, this involved the garbage collectors and waste enterprises. Understanding the unit of analysis is important because it shapes what type of data researcher should collect for study and where to collect it from (Bhattarchejee, 2012).

3.6 Target population

The target population is the population under study and is Kisumu Central Sub-County. According to KPHC (2019) the total population of Kisumu Central Sub-County of Kisumu city is 170,592 people and 42 household respondents were interviewed from Railways and Nyalenda B ward. Also, 10 Key informants were interviewed. The Key Informants involved; waste entrepreneurs, garbage collectors, area leader, Ministry of Environment that is county and city, and NEMA. Primary data was also gathered from direct observations from the households, the municipality, Dunga beach market, garbage collectors and waste entrepreneurs. Items to be observed was guided by observation list.

3.7 Sample selection and Sampling procedure

‘The sample size is a subset of the total population that is used to give the general views of the target population. The sample size must be representative of the population in which the researcher would like to generalize the research findings’ [CITATION Kot04 \l 1033]. The study used purposive sampling technique in determining the people to participate in the study. The interviewees or respondents were purposely selected as they are residents within Kisumu city who actively participate in the process of solid waste management to ensure that sustainable development is achieved within Kisumu through the influence of solid waste management. Glaser and Strauss recommend the concept of saturation for achieving an appropriate sample size in qualitative studies (Srauss, 1967). The sample size was a total of 52 where 42 were household respondents and 10 identified key informants. The breakdown of the household respondents was as follows; 18 household respondents from Nyalenda, that is; 5 from Nanga a middle-income area and 13 from Nyalenda slums, a low-income area. While 24 household respondents from airport area that is; 12 were from Kombedu slums, a low-income area and 12 from Kanyamedha, a middle-income area. The breakdown of the 10 key informants was as follows; 4 waste enterprise representatives were interviewed, 2 private garbage collectors, 3 environment representatives and an area leader from Nyalenda. Since Nyalenda also comprises the rural set-up households who mostly engage in the burning of waste as a method of disposal, the researcher was guided to those households by the help of the area leader who purposely identified them. The garbage collectors also assisted the researcher with a list of households from where they actively collect waste that guided in purposive selection of the households to interview.

Solid waste in Kisumu city is increasing due to urbanization which is leading to population increase hence high consumption and purchase of items that leads to increase in generation of waste. From the study, the interviewed respondents from where data was gathered was as follows;

Table 3.1: Sample selection

KISUMU CENTRAL CONSTITUENCY SAMPLE SELECTION

KEY INFORMANT	SOURCE	SAMPLE SIZE
Waste enterprise	Fab lab Winam, Flexi biogas company, United Destiny Shapers, Dunga Innovation hub/precious/ Streamline recycling company.	4
Ministry of environment	NEMA, Couty Director & City Director	3
Garbage collector	Airport & Nyalenda	2
Area leader	Village elder	1
TOTAL		**10**

(HOUSEHOLD) WARD	LOCATION	SAMPLE SIZE (HH)	
		Number	Percentage
Railway	Kombedu slums	12	(28.5%)
	Kanyamedha	12	(28.5%)
Nyalenda B	Nyalenda slums	13	(31%)
	Nanga	5	(12%)
TOTAL		**42**	**(100%)**

In Kombedu slums, most of the houses are made of iron sheet while in Nyalenda slums most are muddy houses. The nature of the houses and organization explains why they are categorized as slums. Most of the household respondents from Nyalenda slums reside near or next to river Wigwa while from Kombedu slums most reside near river Kisat both of which drain their water to Lake Victoria.

3.8 Data collection instruments

The data collection methods which were used in this study were; in-depth interviews, open-ended questionnaires and observation. The data collection tools that were used were (1) in-depth interview guide that was used to collect data from Key Informants (2) open-ended questionnaires was self-administered by the researcher to the selected household respondents 3) observation list that was used to give guideline on items to be observed during the research.

3.8.1 In-depth interview

In-depth interview is a qualitative research technique that involves conducting intensive individual interviews so as to explore perspectives, thoughts and behaviors according to the research topic. The tool that was used is the in-depth interview guide among key informants. This helped to assess their responsibility in solid waste management in order to attain sustainable development through its influence in Kisumu city. During the interview session, recorder was used for capturing in information for analysis purposes.

3.8.2 Open-ended questionnaire

A questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from study subjects. Open-ended questionnaire is termed 'self-administered' if administered by researcher to the participant. The data collection tool that was used is open-ended questionnaire. It was administered by researcher to the selected households to collect data from the household respondents. This type of questions gives respondents opportunity to explain further their answers in their own words (Lavrakas, 2008).

3.8.3 Observation

Observation is a qualitative research technique employed by researchers to observe participants' ongoing behavior in a natural situation in line with the objectives of the study. The data collection tool used was the observation list. This tool helped in guiding the researcher on the type of pictures to be taken, behavior to be observed and features to be observed during field research.

3.9 Data analysis

Data was analyzed through content and critical analysis of data collected from open-ended questionnaire, observation and in-depth interviews. Audio recorded from the in-depth interviews were edited to get the clear response of the interviewees' views and the notes were typed in the computer. The typed collected data was reviewed to select data with content and classified according to the themes in line with the units or categories of analysis. The identified themes in line with waste management strategies were assigned codes which were summarized to get general emerging trends, patterns and concepts. Classification and interpretation of the findings was done with regard to the study objectives.

3.10 Reliability and Validity

Reliability is the degree to which instruments used for data collection are free from errors and thus can provide consistent results whereas validity is the degree to which results obtained from the analysis of the data actually represents the phenomena under investigation (Orodho, 2009). In determining the validity and reliability of the study, pilot study was conducted. A Pilot study is a smaller version of a larger study that is conducted prior to the

study or to field test the survey thus provides a rationale for the design. The instruments were pilot tested to determine whether the results obtained are valid and can be relied upon. Validity of the instruments was realized by subjecting the research instruments to rigorous critic by the research supervisors and other experts of research. Where necessary the questions were modified to improve validity and reliability of the study (Orodho, 2009).

3.11 Ethical considerations

The major ethical considerations that were addressed in this research were: informed consent, privacy and confidentiality, anonymity and researcher's responsibility. In this study, the researcher got research permit from NACOSTI and sought consent from the respondents prior to administering the questionnaire. When conducting a qualitative study, it is very important to make sure the subjects are well informed about the research, what it is about and that their participation is voluntary. Therefore, the researcher verbally and in written form acquainted the respondents of the purpose of the research before interviewing the respondents and emphasized on voluntary provision of information. The respondents were assured of privacy and confidentiality of the information and their identity would not be revealed, hence anonymity. To add on, the research was conducted in a convenient place where there was assurance of security to enable the respondents not to suffer physical and psychological harm.

CHAPTER FOUR

DATA PRESENTATION, FINDINGS AND DISCUSSIONS

4.1 Introduction

This section presents the study findings of the influence of solid waste management on development of Kisumu city. Transcription of the recorded data and coding was done by using qualitative software, Atlas to. Thematic analysis was exemplified which involved analyzing and identifying emerging themes from the qualitative data. As highlighted in chapter one, this study had three study objectives; to examine solid waste management strategies and their effect on development of Kisumu City; to analyze the role of stakeholder participation in solid waste management in Kisumu city; and to evaluate the influence of public participation in solid waste management on development of Kisumu City. Therefore, the main identified themes during qualitative analysis of data were; Solid Waste Management Strategies, Role of stakeholders in SWM, and Circular economy.

4.2 Demographic characteristics

The study was conducted in Riat-Airport, an estate within Railways Ward and Nyalenda within Nyalenda B Ward which were purposely be selected because of the active SWM activities that bring about development and also, to determine how households within these localities manage their waste to avoid contamination of Lake Victoria due to their close proximity. The average size of households in slums ranges from 2 being the lowest to 10 being the largest number of people in a household. In Nyalenda, most households tend to

have larger household number size which ranges from 5-10 per household compared to Kombedu slums in Riat-airport area of 2-5 people per household. This is because of the peri-urban setup in Nyalenda whereby most homestead tend to be people's rural home explaining the high population in that set-up. Nyalenda also contains a population of people who reside in gated apartments around Nanga area, this constitutes the middle-income class people. Therefore, data was gathered from 5 middle-income households and 13 low-income households in Nyalenda. In Kombedu slums, due to the limited space and high-water tables, it constitutes iron sheet suit houses. For the households in Kanyamedha, a middle-income area in Riat-airport area, a few households live in their own homestead where they highly practice burning of solid waste while for the households living in apartments, their household solid waste are collected by garbage collectors.

Table 4.1: Type of waste generated in Kisumu City

Type of waste	**H.H Percentage (%)**
Metals	14.5
Plastics	13.9
Food scraps	13.5
Clothing	12.1
Sanitary & pampers	11.9
Paper & box	11
Glass	10.2
Electronics	6
Garden & animal waste	4.9
Medical waste	2
TOTAL	**100**

N/B: Due to rounding effect, the percentage can be plus (+) or minus (-) 100%

4.3 Types of waste generated within Kisumu City

Table 4.1 illustrates percentage of waste generated from households. The highly generated waste was metal waste (14.5%). This is because most of the households classify certain items under metals. These items are: stoves, jiko, bicycle, motorbike, metallic basins and bicycles which are still kept at home due to the high treasure and value attached to them. This waste is highly generated in Nyalenda and Kanyamedha where people live in their own homesteads and have space compared to those living in rental houses. The metal waste is collected and taken to scrap yard collection point in Kibuye which are there after transported to steel company in Kibos for recycling to make new products. Scrape collection is a booming business especially involving the youth in the collection making it a threat especially to residents in Nyalenda slums to live any metal made products outside in the compound as they are easily stolen.

Despite the ban of plastics, each household that was interviewed still generate plastic waste. This is because most of the utensils are made of plastics and also most of packaging materials in Kenya are still made of plastics. Hence, the percentage of plastic waste amounted to (13.9%). The plastic pollution is still an alarming problem in City of Kisumu due to its effect like on aquatic species, and climate system. Plastic items are highly used especially in the slums due to their affordable nature and the fact that most people especially in slums have low income hence end up buying items economically friendly to them. For water, and most liquified goods, they are in most cases packaged in plastics. After the plastics have been used, they end up being disposed in open spaces leading to creation of illegal dumpsites near neighborhoods. The poorly disposed plastics in the environment end up in water streams or washed away with run-off water. They end up affecting the aquatic

species leading to the reduction of fish species especially in Lake Victoria or production of fish which are hazardous to human consumption as they feed on micro plastics. For the collected plastics, they end up in the landfills where they are burnt leading to production of toxic gases which affects the climate system. For most households, as a way of reducing plastic pollution, they reuse the plastics for packaging and storing things in the house.

Food waste followed with (13.5%). Each household produces food waste on daily basis because of feeding process. Due to the low income of households living in the slums, most households live from hand to mouth reducing the amount of food being produced as waste. Most of the food scraps from households are generated from middle-income localities who dispose-off the food remains as in most cases they buy plenty of it and may not be able to consume all of it. Hence, ending up being a waste.

According to table 4.1, clothing was 12.1%. This is due the increase of disposed clothing and rugs that result from the emergence of fast fashion culture and the throwaway attitude of consumers build up mountains of unwanted fashion clothing disposed-off in landfills. As the fashion industry continues growing and changing trends every day, this leads to the large amount of clothes being bought and disposed as people struggle to keep up with the latest market trend. The second-hand clothes “Mitumba” also give an opportunity to developing countries especially to people with low income to manage to buy clothes at a cheaper price and fit in the current market trend. Thereafter, the old and rugged clothes are burnt or some used for cleaning activities at household level. The smoke from burning of clothes ends up producing toxic gases which are hazardous causing breathing problems and also, affecting the climate system. The production of textile from recycling of products like fish leather through tanning process and polyester products through recycling of light plastics is

bringing about development in Kisumu. For example, the fish skin is recycled to fish leather which is used in making clothes and shoes mostly sold at Dunga beach to both locals and tourists.

Sanitary towels and pampers has a percentage of (11.9%) as most of respondents were female who are in their reproductive age. Domestic hazardous waste especially the pampers cause harm to the environment as they do not decompose easily. Hence, a nuisance to the environment. For used sanitary towels, they easily burn out and can be disposed-off in the pit latrines. However, some end up in the landfills and illegal dumpsites within the neighborhoods causing environmental pollution. Pampers disposal is a big menace to the Kenyan society as it fills the pit latrine since it does not decompose. Also, it takes time to dry and burning is not a solution. Some households go to an extend of paying bodaboda riders to go and dispose for them the pampers in illegal dumpsites which are far away from their neighborhood. In case of any open and unused land in the neighborhood, these are used as pampers disposal sites and easily become illegal dumpsites.

Papers and corrugated boxes amounted to (11%) because of the packaging materials after the ban of plastic packaging bags. Since the ban of polythene bags in Kenya by NEMA, mostly the brown papers and magazines are used for the packaging of small quantity items while boxes are used for packing high number of items. The ban of plastic paper bags has helped in the reduction of its pollution in water streams that used to suffocate aquatic life and clogging of drainages leading to over flow that contaminates water hence the spread of water borne diseases. Currently, most households tend to burn the papers and boxes as a way of totally disposing them. For the unburnt papers and boxes, they end up decomposing in the soil as they are biodegradable.

Glass waste (10.2%) is produced in the house when a glass material breaks. According to the casual researcher's observation and formal discussion with Key Informants and household respondents, the broken glasses are used for security purposes whereby they are placed around the wall for purpose of harming intruders and thieves. At Dunga Innovation Hub, the wine glasses are recycled to glass cups as new products.

The percentage of electronic waste was (6%) because they are the most treasured type of waste as they are rarely disposed-off due to the monetary value and sedimental value attached to them. Therefore, most of them end up being kept in the household like the outdated and spoilt TVs, radios, computers, cables and batteries.

Garden and animal waste was (4.9%) and medical waste was the list produced waste (2%). This includes the syringe, bandage and drugs.

The researcher during market visitation in Kombedu market and Dunga fish market observed that fish remain is the major waste. This is because of the high number of fish mongers and consumers. Also, the proximity of Dunga beach to the lake, and it being the only beach in Kisumu city has brought about development of many hotels where the major meal is fish since it is the staple meal of people around the Lake city. People end up buying the fish remains for their dogs at home and stray dogs are always roaming around the beach to get something to feed on. Some of these fish waste end up in the lake when they are being cleaned.

On the road around the markets and households, the researcher also observed tyre is a type of waste that is rarely produced at household level except for households that have garage and do repairs at home. At Dunga beach, tyre wastes are recycled used to make furniture. The tyre is recycled to make open shoes mostly bought by both the locals and the tourists.

The tyre is also used as planting kits at household level. At Dunga innovation hub, tyre is used for landscaping in steep areas whereby they act as staircase. The waste tyre is used to prevent soil erosion and backflow of water along Dunga beach.

4.3.1 Waste disposal

Table 4.1 shows waste produced by 42 households surveyed. Various waste disposal methods practised are: 55% (23 households) dispose-off their waste through open burning, whereas 15% (6 households) dispose of their waste unconventionally (dumping on-road/riverside). Only 30% (13 households) dispose-off waste through waste collectors.

According to researcher's observation and the response from Key Informants and household respondents, most households located in Nyalenda slums tend to dispose-off their generated waste through burning. As a way of identifying the households who burn waste in Nyalenda, the researcher was guided by the area leader who identified the households. In most cases, these households do practice waste segregation in terms of determining what type of waste to burn. For the biodegradables like food remains, in most cases they are used as feeds for domestic animals like the cats, chicken and pigs. Before burning of waste is done, waste is first dried up and fire stimulator like paraffin is used to enhance the burning of waste. For the middle-income households in Nyalenda, that is in Nanga, garbage collectors are the once who collect waste from houses. The garbage collectors are the once who provided a list to the researcher showing the households from where they collect waste from. Therefore, most of the households from where waste is collected by garbage collectors, they tend to mix all the waste as they are only provided with one sack or recycling bag hence, they rarely practice waste segregation. In Kombedu slums, due to the limited space, most households are taken care of by a care taker who guides the tenants on how to manage the waste that

they generate. The disposal method practiced is burning and burying whereby a pit is dug and when it is full the waste is turned down and another pit is dug at the same place. In turn, the households use soil to practice urban agriculture due to the fertility of the soil. For the households in Kanyamedha, a few who have their own homestead practice burning while most of the household apartment waste are collected by garbage collectors.

4.3.2 Community dumpsites

In Kisumu City, there is only one legal dumpsite, that is Kachok dumpsite. According to Netoya waste collector, about 20% of waste collected is transported to Kachok dumpsite. To add on, Vuka Sasa waste collector, said that about 80% of waste generated from households especially from slums end up in illegal dumpsites. This is due to the ease of access and no charges incurred at illegal dumpsites.

From the study, going by the casual researcher's observation and formal discussion with Key Informants and household respondents, the average waste generated from households range from a quarter to half a kg in a day. This information is determined by the researcher by observing the size of the dustbin being used in each household that almost gets half-filled in a day. The volume of waste is determined by number of people in the household including their income level. For example, in slums, the amount of waste produced is minimal compared to middle-income areas.

THEMATIC DISCUSSIONS

4.4 Solid Waste Management strategies

The first objective of this study was to examine the solid waste strategies employed within Kisumu city and how they influence development. According to the (KISWAMP U. K., Feb 2018) document, the current implemented SWM strategies in Kisumu city are as follows;

1. Waste reduction at source

   Source reduction implies reducing the volume of waste at the source/ point of generation by changing the material-generating process. Source reduction is expected to offer opportunities for cost savings for the city management which include direct savings on waste collection, transportation, and disposal costs. At household localities especially within slums like Nyalenda, the city management has placed skips which are transfer points along the roads whereby by the help of garbage collectors, they collect waste from the interior parts of the slums where the roads are impassable and bring them to the transfer points where they can easily be collected and transport by the municipal to Kachok dumpsite. Currently, all the waste in Kachok have been relocated to fill the quarries in Chiga which is the current Kisumu's dumpsite. Also, in town, the city has placed the three-bin to make it easier for people to dispose of waste. These are strategies meant to keep the city clean.

2. Waste recycling and composting

   The environmental department in Kisumu promotes circular economy through the 3R approach which is expected to lead to the development of appropriate infrastructure to facilitate waste separation and recovery at source, promotion of incentives as well as formalizing informal waste entrepreneurs in the city through the Kisumu Waste Actors Network (KIWAN) association. In market development for waste materials and recycled

products, through the Directorate of Environment, Kisumu County has the pilot biogas plant in Ahero market and Maseno whereas in Dunga market Flexi biogas has placed a biogas plant where biodegradable waste from Dunga fish market is used for biogas production together with water hyacinth.

3. Incineration and Waste to Energy Recovery

   Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high-temperature waste treatment systems are described as "thermal treatment". The incineration process converts waste into ash, flue gas and heat. The heat in some cases can be used to generate electric power. This means that incineration process helps in reducing the waste volume. The process is also coupled with benefits in that, in treats the clinical and hazardous waste infested with pathogens and toxins that are destroyed by high temperatures Pampers is a convenience to few, to most ladies but daily inconvenience to the general public, and it is not sustainable. It has been discussed in different forums, is another line of waste that managing it can become challenging. Some places they are saying that it should be treated as medical waste, meaning it should be incinerated. It is still a challenge, because they are imports, and there are locally made ones, all of them are non-biodegradable.

4. Planning for a Sustainable Solid Waste Management System

   The main focus of this strategy is on essential components of solid waste management. that is; planning sustainable storage, collection, transport and disposal solid waste systems which are elements of solid waste management.

5. Institutional and Organizational Reforms.

   This strategy was formulated after reviewing the strengths and weaknesses in the existing organizational set-ups to manage solid waste in the city.

6. Development of capacities, environmental planning, awareness-raising, and education.

   Building capacity, planning for the environment, educating people, and raising awareness are all necessary for developing comprehensive solutions to the city of Kisumu's waste management issues. No matter the strategy chosen—separating recyclables from non-recyclables, employing community-based composting, or using color-coded waste storage and pickup containers—effective waste management programs depend heavily on the cooperation of generators. The public must fully understand the intended behaviors from them and the reasons behind those behaviors in order to sustain long-term program support and prevent social and legal disputes. Public education will pique interest in the processes used to make waste management decisions.

   And, when citizens become interested in their community's waste management programs, they frequently demand to be involved in the decision-making process. The goal of the environmental awareness is to let Kisumu residents know that a different way of handling waste being implemented is preferable to the historical way and that good reasons for considering a change in their waste management practices do exist.

7. Management of Hazardous and Special Wastes: E-Waste, Medical Waste, Waste Tyres and End of Life Vehicles (ELVs).

   All hazardous waste should be handled using NEMA national standards, Waste Regulations of 2006 and guidelines during the strategic period. For batteries, although some alkaline batteries can be disposed of as domestic waste, rechargeable batteries and silver oxide batteries can contain heavy metals such as mercury and cadmium which are classified as hazardous substances and may present an environmental threat when disposed of to the landfill.

When it comes to medical waste, Health Care Waste (HCW) is generated in varying quantities at healthcare facilities and because of its pathogenic characteristics, there is need to treat it before disposal. Systems to support the proper segregation of HCW are not always in place in hospital wards and clinics in Kisumu city. The wastes are disposed through incineration and some find their way to the Kachok dumpsite. The National Ministry of Health has developed guidelines on the management of health care waste which the County Government must embrace in all its health facilities.

There are no established formal systems for collection and recycling of tyres with the exception of re-trading. The bulk of the tyres are informally collected and often illegally burnt on open land to recover steel for recycling, presenting a health hazard and leaving environmentally damaging residues in soil. It is recommended that the city applies the NEMA Waste Tyre Management Regulations of 2013 regulations and any national guidelines on management of this type of special waste.

A vehicle is considered ELV simply due to the condition it is in. According to the Kenya Traffic laws, such vehicle may not be roadworthy. Today, however with material prices on the rise, end-of-life vehicles are considered a valuable resource for many different materials rather than waste. The large space recommended for Taka-ni-Pesa in Mamboleo is recommended for a large scale ELVs recovery center. The Kisumu County Assembly ought to make regulations on ELVs to reduce their numbers in the city.

8. Resource Mobilization through Public Private Partnerships (PPPs) and Financing Reforms.

Using the Public Private Partnerships (PPP) concept and implementing different funding changes at the CoK and county levels, this strategy recommends resource mobilization. An agreement between a county government of Kisumu and a private party under which the

latter agrees to carry out a public duty or deliver a service on behalf of the contracting authority is referred to as a "public private partnership- PPP" in ISWM projects in CoK. The CoK administration should encourage private sector involvement in waste management in the following sectors using PPP options as described in the PPP Act (2013) for a variety of specialized projects and activities: Main Streets/ Roads and Central Business District Sweeping Primary collection from communal/ collection points at the Ward- Units to the Rehabilitation Programme.

Operation of the Central Transfer Station

Secondary Transfer of Waste from the Central Transfer Station to the Landfill

Operation of “Taka n Pesa Centers”

Public Private Partnership Arrangements for ISWM Projects

4.4.1 Strategies identified during the study

According to Kisumu County, there is an act that governs households on how their waste should be managed. The act is County Solid Waste Management, Act of 2015. The Act was passed in 2015 by the county assembly of Kisumu and is currently working on the regulations for the proper execution of the law. The law guides on how to manage waste. Households are very critical partners because they generate much of the waste. Kisumu is not that much industrialized, so much wastes comes from market and households and households are the greatest generators of waste. The County government also plays an important role when it comes to common umbrella that unifies the garbage collectors[CITATION CoK21 \l 1033].

There is an umbrella of all the waste actors within Kisumu city known as KIWAN (Kisumu Waste Actors Network). All people who are doing waste as a business have an umbrella. Kisumu City management are working with the waste umbrella network on waste management issues. The other partner on waste issues is the UN Habitat, which is in the process of advancing some revolving fund of one million to KIWAN so the members can borrow from the Sacco, then they use it for their daily operations of the waste, including purchase of equipment, and whatever they need. At the ward level, there exist the devolved waste management committee, which comprises of the village elder, chief, assistant chief and the representative of the landlords [CITATION Cou21 \l 1033].

There is KISWAMP (Kisumu Integrated Solid Waste Management Plan), that is the strategy being used in the county in the environment department. The strategy advocates for the involvement of the community in waste management; the devolvement of waste management and also having the waste material recovery. Further, the strategy encourages the recycling of waste so that the public can benefit from the waste. The city has plans to establish material recovery centers in its 14 wards, currently 3 centers have been established in Obunga, Ahero and Maseno. The centers are managed by the communities in the respective wards; the city management will link them to the market for various wastes for example, plastics, organic waste. Possible products from the waste include bio manure. The city management also has plans for establishment of biodigesters for biogas in the wards as a strategy of managing solid waste for energy production and environmental conservation. This is informed by findings on the types of waste generated which shows that 75% of the waste is organic produced by households and the market.

The Kisumu County Integrated Development Plan (CIDP) is a super plan for Kisumu. It gives an overall framework for development and aims to co-ordinate the work of the county, sub-counties and other spheres of government in a coherent plan to improve the quality of life for all the people living in the county [CITATION Cou21 \l 1033].

In line with the strategies, the households' also set rules on how to manage waste. In Kombedu slums, the researcher viewed that 50% of the respondents had household rules that guided them on how to work collaboratively with care takers for proper management of waste. One of the respondent views was as follows:

> Caretakers sensitizing the households on cleanliness and advice parents to be watchful of their children especially the time when the pit has been dug deeper so that they may not end up falling inside the ditch. One of the caretakers in Obunga estate had this to say on waste management "Basically, I used to check like which waste can burn, which ones can still have value, for example if I have some metal in them, can I give this metal to someone to give me some money? If I have some which can injure somebody like the glasses, can I now keep these ones aside? And others which can be burnt like clothes I will still look at, is there cloth which I can use as a mopper? So finally, I decide on what to burn. Unfortunately, I was not checking how they were going to affect the air quality. And so, at times I burn plastics in them and by the end of the day it smells so badly (Kombedu 1).
>
> It is a rule that everyone to deposit their waste in the built pit. Every Saturday the waste is collected by the garbage collectors who transfer the waste to their green track using sacks. After which, the care taker cleans the built pit (Kanyamedha 1).

According to the research findings, around 80% of the interviewed households in Kanyamedha and Nanga area in Nyalenda pay for garbage collection as a way of managing waste. Two respondents said the following about payment:

> In terms of payment to the garbage collector, I don't know it is how much because we pay it together with the rent. It is only the landlord who can tell as he is the one who organizes and communicates with the garbage collectors (Kanyamedha 2).
> I could say if there could have been another best alternative of managing this waste, I think I could have been saving this money a lot because the last time I checked I used like Kes. 200 in a month, of which if I could find another best alternative of managing

> this waste, I could put that money to another best use other than giving those guys (Nanga 1).

During the study, the researcher observed dug pits in Kombedu slums. According to the response from the household respondents, the pits are used as areas for waste disposal by the households.

> The pits are buried and dug again for composition to take place where after the soil is used as manure for the farms established just around the pits where vegetables are grown to sustain the livelihood of the households (Kombedu 2).

For the households that engaged in waste collection, this was evident by the black waste papers placed outside of some households while some used sacks that are thereafter carried by the waste collectors. The researcher during the rounds in households observed constructed waste area in Kanyamedha. In line with response from the interviewed respondents, the construction area in the household locality is used by tenants to dispose waste and thereafter emptied by garbage collectors once in a week.

Households are viewed as critical partners when it comes to solid waste management since, they are the main waste producers. Vuka-Sasa and Netoya private waste collectors are Key Informants who were interviewed in relation to this study. Netoya operates in Nyalenda to airport area. Vuka Sasa operates from Nyalenda to Manyatta area. The waste collectors gave their views on how households are critical partners in SWM as follows:

According to waste collectors, households are a very critical partner in solid waste management because they are waste generators and they don’t know the proper disposal ways hence waste actors enhance the waste reduction strategy by encouraging households to practice waste reduction. There are households which are provided with garbage bags for waste disposal. This category of household pays a higher fee for waste disposal services and

mostly they are residents from Kanyamedha and Nanga (17 households). There are also households which do not require the garbage bags, they put them in one bucket, and therefore pay less for garbage collection services. There are households that need garbage collection twice a week, they feel that they have more waste so they feel if collected twice a week they feel more better. Garbage collection services are charged by the number of garbage picked per week; if once a household pays Kes. 50, twice means Kes 100 and Kes 25 per bag of garbage storage [CITATION Net21 \l 1033].

Households are the backbone of the garbage collection business; without them waste collectors cannot operate. That is why households are treated with care by being true to them, offering quality service to them so that they can allow waste collectors come the next time as the partnership has been created. There are some households that pay weekly for Kes 50, and others pay Kes 30 on weekly basis. The difference is that people who live in permanent structures or apartments in the locality where we operate have to pay 50 but we also have people who live in the slums we give them a lower fee of 30 bob, some will even negotiate they want 20. We provide receipts to households after they have done payment. Some people are prompt to payment because they need a clean area but at times you also get stubborn customers whom you go and they are not ready to pay at that moment but we deal with them like that and eventually they pay. If you do not want to pay for the services then we are not rendering the service to you. Most people do not have a place to dispose their waste that is why you find the estate littered with waste or have illegal dumpsites because they with throw it at the road side at night then early in the morning. Those are people who do not want to pay, they do those shady kinds of behavior of throwing garbage along the road[CITATION Vuk21 \l 1033].

4.4.2 Education awareness on Solid Waste Management

The main goal of awareness is to let people know that there are different proposals of handling waste. Effective waste management is a continuous process of public education, discussion, implementation and evaluation. In 2020, the government rolled out a Competency-Based Curriculum that focuses on enhancing the practical skills among learners to ensure they contribute positively to societal well-being. Thus, young people will be nurtured to develop habits that support best practices in the waste management. Through the curriculum, the education awareness on SWM will increase as the knowledge will expand through the teachers to the children who will share with their parents at home especially the mothers who are custodians of cleanliness and environmental issues at household level. The education and social officers can explain and promote their 3Rs programs using kid-friendly symbols, events, sports, cultural days, and cartoons. We will also encourage the private sector to work with us as partners to reform SWM through the various commercial and manufacturing associations.

People are inclined to look for further information after they are made aware of waste management problems. Program planners frequently employ a range of communication strategies. For instance, public support and involvement should increase if the education program is well-planned and carried out. School initiatives will, over time, indirectly help parents become aware of trash concerns in addition to teaching the next generation of citizens, as children commonly bring information home from school and talk to their parents about it [CITATION Hor18 \l 1033].

In line with education awareness, 23 respondents are knowledgeable and trained on how to manage solid waste while 29 respondents are not trained on how to manage solid waste but

use their common sense in managing waste to ensure development is achieved. Respondents' views were as follows;

> I am an environmental scientist where I have learnt much on waste. Hence, there is need for awareness creation on waste especially in this area. During rainy season, the drainage system clogs up leading to floods and foul smell. People also become sick like me because of the water (Nyalenda 1).
> Long time ago we used to have the 4K club where we were taught much on agriculture and environment. So, I am now doing it manually and adding some knowledge (Nyalenda 2).
> This is a type of education I received when I was back in my school life. In class. I was taught on how I could practice segregation (kombedu 3).
> I follow intersocial in social media and learn. Mostly from radio and TV stations (Kanyamedha 3).

The Key informants emphasized by saying the following:

> There are several avenues of doing that, and to get a wide spread audience, the best would be using local radio stations where we have structured programs, may be weekly programs or monthly programs just touching on waste and spreading the gospel. The second thing is using local institutions, once people have converted remember I told you that we have champions, we develop champions within so that they become your local ambassadors and they can spread it within the youth groups, within the elderly groups, and within households within those locations. Thirdly, is to have this sink in the minds of politicians, Kisumu Nyanza and the country as a whole, so much value political utterances. So, if they become part and parcel of political utterances, whenever politicians are campaigning, whenever they are sending any other message they have. If this one is also packaged and it becomes part of the message being sent, I think it will be absorbed better. Yea but if politicians spread it as waste is takataka, something valueless and all that, not so many people will pick it. It affects the public people. They are very important people. You might have very nice intentions, and very good ideas but if this is not bought, by the political class, be assured that it will fail [CITATION CoK21 \l 1033].
> There was workshop in Pand Pieri Catholic Centre in 2020. It was awareness creation and people were discussing on strategies on how people can support the waste management, and I learnt a number of things on how to do that. And of course, at personal level I have also been trying to do my own reading about SWM [CITATION fab21 \l 1033].
> Whenever we have our sites within town, we invite people who are willing to learn, we take them through what we do and how to do it. When we have exhibitions anywhere like in the show grounds, we have people around to give more information of what we do and how we do it. We even allow students to come and learn in our sites. Those who want to know what we are doing and how we are doing it, we allow them to come, we are always open to share the knowledge [CITATION Fle21 \l 1033]
> We do the trainings especially during the Naam Lolwe festival where we were training the community on uses of plastics, effects of burning like global warming, clogging

and take them through the whole training of recycling. As much as we are doing the sensitization and cleaning of the city, we are talking to people because they should not through plastics carelessly [CITATION pre211 \l 1033].

We offer civic education to people when we go to plots, we talk to them. We tell them the challenges that are there in the waste collection, how we can solve the challenges, the solution also. How we can operate so that both the clients that is the household and I can have easy operation [CITATION Vuk21 \l 1033].

Yes, I have received education in relation to waste management. We have our group, it is called Kisumu waste actors Network (KIWAN), we go for forums, seminars and we go for trainings as waste collectors in Kisumu [CITATION Net21 \l 1033].

We partner with organizations where we as an organization we have been trained in civic education and civic engagement. We partner with uraia and we have been taking part in civic action within our community. There is a number of projects we have been influencing and following up for the completion. Then again, we have been taking part in policy development in different stages like sanitation policy we were there, waste management policy some of us were represented, and we are advocating the youth to take part in civic education and public participation. That is where we can get solution of our problem. We use door to door, passing the information, we have a performing group doing the entertainment and in turn educate the community using the performing art [CITATION Uni21 \l 1033]

The CIDP is a 5-year plan. Every governor after 5 years when their term is over, assuming that the next term a new governor comes in, he will use the plan. In the CIDP you include the achievements within the 5 years. Anything included in the CIDP can be budgeted for but sometimes you realize that a program will come but it is not in the budget so you won't get its money because when they are doing budget, they refer to the CIDP. Some of those strategies if they are included in the CIDP, even if a partner comes, they get a guiding document and the project can be funded. For example, the waste management project in schools from colleges to primary is being funded by Complex Urban System and Health (CUSH). This is a project by London University partnering with Maseno University to sensitize women groups and primary schools in slums within Kisumu on waste management and tree nursery. For the waste management activities, we have the (Complex Urban System and Health), CUSH program in slums within Kisumu that is Obunga, Manyatta and Nyalenda which is being done for the schools and women. You realize that most of our households' women deal with the waste. The waste mostly starts in the kitchen where women are mostly involved. As much as we say that the women are the high generators of waste, the people who benefit are mostly the men. We target the women and stakeholders. Stakeholders in this case, from Obunga we involve the waste collectors, even from Kondele but majorly is on schools and women in the slum areas.We also have the Sustainable Energy Access and Climate Action Project (SEACAP) under the climate change department which is funded by the expertise France whereby under the climate information systems, it informs the farmers on the rainy seasons [CITATION Cou212 \l 1033]

As authority NEMA has a department on environmental awareness. At the county level, there is one officer who is in charge of such awareness though there is no representative of the department at the ground. So, this awareness done with environmental clubs in schools, colleges. Awareness is also conducted in industries

> and regulated facilities like the hotels, the factories, and institutions of higher learning like Maseno university where they have the environment club. Because of few officers, when they request for meeting attendance, a representative goes and does a presentation on topical environmental issues especially with the CBOs, and the NGOs. Around Kisat area NEMA has actually done a lot because it is a wetland and the houses in Kombedu slums are doing pit latrines, so a lot of awareness has been done in that area for the conservation of river Kisat. At least now it is a bit clean. Awareness is a continuous process so we are heading to river Wigwa. For the primary schools, from class 4 to 8, it's handled as environmental club [CITATION Nat21 \l 1033]

4.4.3 Waste disposal methods

In line with various ways of disposing waste, for households which are in slum areas, most of them tend to burn their waste. The area leader of Nyalenda explained that in Nyalenda slums, about 90% of the households burn their waste. Recently, some of the households in Nyalenda started embracing the garbage collection criteria where they pay around Kes 20 to garbage collectors for their waste to be collected but it is hardly being practiced. Netoya waste collector explained that in Kombedu slums, due to the limited space, 40% of the respondents practice burning of waste while 60% practice the burying of waste as a way of waste disposal. The waste that does not burn up or decompose are visible in the neighborhood vicinities which when accumulates up leads to the formation of illegal dumpsites in the slums.

The household respondents who burn waste responded as follows;

> We have a dustbin the house where we collect dust and after a week we come and dispose in the pit. We mix the waste all together. In town I mostly see the county trucks that collect waste after a week and go and dispose in Mamboleo, but here in slums I have not seen any type of initiative for waste collection. The waste we normally burn after a week where we mix all the waste and use paraffin to burn them. Poor roads have made this place inaccessible for trucks to come and collect waste. Hence, we venture more in digging of pit where we dispose our waste and burn thereafter, we burry the remaining for decomposition so that the soil can gain fertility that can help boost vegetable growth. The government should think of an initiative of how they can help collect these waste as it is harmful to our health especially the children who play around the pit and also, the flies at the pit can come and settle on

> our food an in-turn lead to outbreak of diseases which will affect our health (kombedu 2).
>
> We have bins inside the house and outside the house in the yard. So, these bins when they are full, we dry the waste then we burn before it becomes a big pile. There are some waste that animals feed on like leaves on sukuma, sugarcane remains after chewing, remnant of ugali we give to chicken. The reason we started poultry is so that they can feed on remains of ugali (Nyalenda 2).
>
> Every household is responsible for sweeping in front of the house. For burning waste, we have routine of each household. We have routine for burning waste as instructed by landlord. We have a dug pit near the toilets where we dispose all the waste by mixing them all together including the pampers and waste in the pit to avoid spread of waste and burn. To avoid the toilet being full, it is good to dispose the pamper and pads in the waste pit and burn (Nyalenda 3).

The area elder of Nyalenda explains how the government initiative of Kazi mtaani has played a major role in proper disposal of waste especially in the slum areas. She clarifies by saying:

> I am the Village elder of Wasiko C in the government and the village is Kapuothe. We use the fishermen to remove waste from river Wigwa which they deposit on the shows of the river. When the NYS in conjunction with kazi mtaani were working, they used to collect all the waste on the shows of the river and the village that have dried up and they burn. We normally organize for barazas every Mondays at the chief's camp. Where we can discuss about diseases, insecurity, cleanliness, right now mostly we discuss about covid. We are sensitizing in the village on people to wear mask, wash hands and keep distance. We have one problem, someone might have bought mask last month but they are still wearing it until today, so they do not know what are the problems. For mask, today wear this tomorrow change and wear another one, so that you are safe. We have some which people are wearing and washing which is not good for or health. First of all, I have never even seen garbage collectors in this village. The county people are mostly concentrating in the town cleanliness but here in the village I have never seen them. As a village elder, I must go around the village. If I find someone who has thrown waste anyhow, I tell them to collect and burn. Most households have now followed that behavior so that we can enhance cleanliness in our village [CITATION Nya21 \l 1033].

In middle income areas like Kanyamedha, waste disposal method is well organized especially by the landlords who ensures that the waste collection fee is inclusive in the tenant's rent thereafter, they organize with garbage collectors of how the waste can be disposed. Around 10 respondents of households in Kanyamedha practice waste collection

while 2 respondents of the respondents especially who live in their own homes still practice burning. For Nyalenda and Nanga, 6 of the respondents are currently embracing the waste collection as safe method of waste disposal. The respondents elaborated as follows;

> With me I have 2 dustbins so I put them in the one in the house and then I transfer them probably after a day to the one which is outside so that the collectors who come once a week, whenever they come, they find mine out there and then turn to their carrier and then they go with them (Kanyamedha 2).
> The company that collects garbage is like an NGO and they collect at a fee of Ksh. 20. I cannot recall their name but they are local people who have been employed to do that but I know the pioneers were the NGO. It came as if it is an NGO self-help, to help people on how they can stay in slums and rural areas. The NGO was located in Dunga. They had a pickup for collecting waste, they issue polythene paper when it is full, they come and pick. I cannot tell exactly where they dispose the wastes after collecting but they do not throw in the lake they dispose where we used to decompose waste at Kachok dumpsite (Nanga 2).
> I dispose in the dustbin in my house. For the food remains I place in carrier bag and dry waste I place in the dustbin in the kitchen thereafter I dispose in the compound pit twice in a week. They used to give us carrier bags and we had a dug pit also for disposing. Afterwards, the landlord built the pit, and buried the dug pit. He started issuing the papers whereby everyone would have the paper in the house and remove and place in the pit on Sundays for the garbage collectors to carry. nowadays we are not issued with the carrier bags. I would prefer I myself to pay for the money and the issuing of carrier bags to continue as each tenant was responsible to collect all their household waste unlike now some waste like glass bottles are never collected by the garbage collectors (Kanyamedha 4).
> In this plot, it is a rule that everyone to deposit their waste in the pit, you cannot just leave waste anywhere in the compound, you dispose behind there where we have a built. The care taker cleans the built pit after the waste are collected on a weekly basis with the garbage collectors. The landlord is the one responsible of paying the garbage collectors and also the caretaker as the fee is inclusive in the rent (Kanyamedha 1).

The National Environmental Management Authority sets laws that guide on how waste can be managed are properly be disposed in the environment. The NEMA officer said the following;

> This is NEMA in Kisumu County. As you know, this waste management is a devolved function but as authority we still have the mandate to supervise and coordinate the activities in that waste management and also providing policy direction for the country. So, the forums are actually coordinated by the delegacies and sometimes public benefit organizations. That is, the civil society. So, our work is just to provide facilitation on the laws, the procedures, and the policies that govern waste management, and also remind the concerned authorities on what is expected of them to

> keep our county clean. We have 2 types of waste in this County, we have the solid waste and the liquid waste. We provide licensing, we approve the applications from the business people who have the recommended types of vehicles. We give them a license to transport, and dispose solid waste at the designated disposal site. And as you know, we only have one site, kachok, which I believe the plans are underway to relocate it but currently, is what we are using. So, we give information to the public that all waste must be sorted. And that the waste must be transported safely to a waste receptacle. These are bins either provided by the landlord or the county government to contain the waste. And then the bins should be regularly emptied into a truck which is enclosed so that the waste is transported safely without falling off from the truck to the disposal site. In the waste management strategy, the sites are supposed to be fenced off so that the scattering of the waste is prevented and it must also be gated to prevent unauthorized entry, and it must be protected by a security guard, and then record should be taken like how many tons of waste do we receive per day for example, in this City of Kisumu [CITATION Nat21 \l 1033].

4.4.4 Strategies put in place to help in recycling of waste

Reduce and reuse are components in the circular economy that work hand in hand with each other. All the interviewed organizations practice Reduce and reuse of generated waste. Around 70% of the interviewed households reuse some of the waste products for other purposes while they practice the reduce component by using magazines, boxes, tetra Pak and brown packaging bags. Reusing reduces waste production compared to using polythene bags for packaging. Some households especially in the peri urban and slum areas tend to reuse, bury or decompose waste as a way of reducing the amount of waste. Some of the respondents gave ideas on how they reuse and reduce waste generation in the following ways;

> Some of the waste is not good for human consumption but good to be used in the shamba. For us we have the responsibility of collecting and disposing the waste at desired place. For the once we burn it turns to ash which is also important to be used in the shamba. We have dug pit where we put the waste. We have compost pit where put waste for manure that is used in the farm and non-biodegradable waste we burn. Each and every paper has a use in this compound. For the magazines and boxes, we use it for lighting jiko, the nylon once we burn in the compost pit. The animal remains for cows and poultry we put in the compost pit for decomposition (Kanyamedha 5).

A household respondent in Kombedu explains how they venture more in digging of pit where they dispose our waste and burn thereafter. The remaining waste is buried for decomposition so that the soil can gain fertility that can help boost vegetable growth. The respondent proposes that the government should think of an initiative of how they can help collect waste as it is harmful to health especially the children who play around the pit and also, the flies at the pit can come and settle on food an in-turn lead to outbreak of diseases which will lead to health issues. The respondent also proposes that mixing the waste using sand and cow dung adds fertilizer to the land and is good for growing vegetables as he has planted grass where the cows feed on as their waste remains there to help decompose the area ready for the next plantation season. While the cows walk there, the land turns to uncultivated land hence becomes fertile for the next cultivation season (kombedu 4).

There is a machine that I am made to understand. Waste water can be recycled and be reused. However, for us here what we can do with the waste papers we can use them for planting, we use the water to irrigate our planted vegetables by sprinkling. We reuse paper bags before they become old and be waste, so we reduce waste by reusing. The rugged clothes we use for cleaning purposes (Nyalenda 4).

The household respondent said that when it comes to plastic waste, they place them aside and give it to some mama who requests and comes collecting them during the weekends. For bottle of soda, they are used for storing water in the fridge and tins of ice cream for storing food remains in the fridge (Kanyamedha 6)

The key informants also gave their response on how they contribute to reusing and recycling of waste products as follows:

The rules that we give households when in it comes to waste management, the rules that are there, the few places that I go, that people take them seriously, the middle-class and upper class. Where I come from nobody, even the county I don't think if they are concerned because we tell them sometimes, we are seeing this and this and it is not happening right and they are taking no action. I think either their hands are tied or they cannot do anything about it. For the middle and upper we see even like burning waste, they do not practice. In Nyalenda, people burn anything even the one that does not need to be burnt. But places like Milimani, an upper income estate, when you walk around you see there are some adherences, people are trying to comply [CITATION Net21 \l 1033].

Some days ago, Mr. green organization came here and taught us on how we can recycle alcohol bottles to make beautiful glasses. We are thinking of getting the machine for cutting the glass then for drawing so that we do not throw the bottles away, we use them to get money by cutting the glass, decorate and sell [CITATION Vuk21 \l 1033].

The area leader says that NYS has really helped and made people realize the importance of practicing and maintain cleanliness. Even if a person has a bushy homestead, they used to call upon the youth in Kazi Mtaani who come and assist with the cleanliness in terms of slashing and burning the waste so as to reduce waste disposed illegally in the neighborhoods [CITATION Nya21 \l 1033].

4.4.5 Tools and technology for managing waste

For waste to be properly disposed, transported and effectively used in the circular economy, a number of tools and technology are used to ensure the activities are being conducted effectively. The tools are mostly used by garbage collectors and waste enterprises. Of the interviewed households, around 10 respondents use tools like jembe for kitchen gardening or have dug pits. Rake in most cases is used for collection of waste and also the gloves and dustpan. The household respondents said:

A respondent from Kanyamedha illustrates on how he uses a jembe for digging compost pit whereby a rake is used for assembling all the organic matter in the pit then turned after 3 months. Thereafter, it is used in the maize farm as manure.

Various types of tools and technology are highly used by the Key Informants who were interviewed during the study. They elaborated on the tools and technology as follows;

> Flexi biogas company specializes on making digesters for both human waste and biogas which helps in bio sanitation. In making of interlocking bricks as building from recycled plastics, the machine used for the process is known as makiga. Incinerator is for burning wastes that require high heat. The tools used at flexi include spanners, pliers, all plumbing and mechanical tools [CITATION Fle21 \l 1033].
>
> United Destiny Shapers Community Based Organization uses sacks for waste collection and as planting kits. The weighing scale is used for weighing the value of waste and food products from urban agriculture. The jembe and spade used for composting to turn it to make good compost [CITATION Uni21 \l 1033].
>
> Fablab Winam is a hub that majorly focuses on digital fabrication that involve use of machines which understand the computer language. A lot of things are designed using the computer, which are sent to the machines for final production. Other technologies involve IOT, Internet of Things which matches sensors to different things. This is one technology that the high-end technologies around the world are using. There can be a number of innovations around waste management. there is someone working in something called tibin which has sensors and can sense when the dustbin is full and then sends an alarm [CITATION fab21 \l 1033].

Basically, waste collectors are trying to come up with GPRS to digitalize operations, but in revenue collection there is aa challenge in documenting though there are plans to make it online. What I noticed is the unemployment rate and the kind of desperation the young people are in. So, those are the personal drives that make me engage the youth as most of boys down here lack guidance and someone tell them we can do this, and I have seen waste management we have a lot of work to do. Thus, there is need to mobilize the youth [CITATION Net21 \l 1033].

In CIDP, that is County Integrated Development Plan Unit. If you look at environment and natural resource section, we have talked strongly on how to build enterprises along SWM so that any waste that is generated is absorbed within the locality and within the city and is made resourceful. And is only through that, the Kisumu County will be able to minimize or eradicate the illegal dumping of waste and create income to people along those lines. So, it is one thing that is taken seriously, even at the moment material recovery stations are being established in the 7 sub-counties where the process has begun with 2 stations within the city where waste will be recovered and turned into resources. And the equipment to that effect that we have already bought, 4 shredders, 4 bailers [CITATION Cou21 \l 1033].

Precious plastics recycling company uses shredder machine that chops off big plastics into smaller pieces for easy melting, storage and transportation. Injection machine that makes smaller sized products because of the size of the hopper. The extrusion machine for melting the plastics in different shapes. The process is as follows; we receive the plastics when they are dirty and mixed up, we remove the wrappers around the bottles. We clean them and dry them up and put in the mix bag. We have the industrial codes in each bottle that guides how to sort and know the types of the plastics to place in their speculated bags in line with the codes because of different chemicals, physical and melting point. After sorting we go to the shredding machine where we label the baskets differently depending with the plastic code that is being shredded to avoid the mixing. This is because of different melting temperatures of different plastic codes. We can either to mix or not to mix the colors. From the shredder machine after producing the granules, we narrow to the extrusion machine. It now depends on the shape and design but we work on the mold that we have. Where we can make different types of products as you want as it comes out as a filament and you mold to your desired shape. After that we now have the injection where you can only make the product of the mold that we have. That is the limiting factor. Finally, we do the product finishing and ready for the market [CITATION pre211 \l 1033].

So, the sorting from the source in the kitchen ready to go to the receptacle even the sorting in the vehicle, the vehicle must have cubicles so that there is a cube for plastic, cube for kitchen waste, the biodegradables, and so on. And the same is also provided for when they are now disposing at the site. Again, we license the exhausters, and we give them the guidelines. The procedures of doing the exhausting up to the point at the ponds how they dis-sludge. Not many people who have adapted the use of exhausters or this orthodox way of pumping more so at night. Then in the morning you find it flowing, you can’t trace the pollutant but in few cases that have been reported to use we have managed to arrest and we have cases running in court for those pollution cases. For instances where the landlords and their caretakers they prefer to pump, against exhausting. The technology of biodigesters if adopted, it is working well. When rightfully installed, then it can help us in solving the problem. But again, there

is denial, lack of acceptance from most developers. People are still stack with either septic system a stock away pits in stable grounds or sewer line. Because most estates here are not sewed so, people are stuck with the septic. They fear that if the biodigester fails, what will they do with the waste. But it has worked in so many places and we need to bring awareness to the people so that it is accepted. It is economical in the long run so long as they don't dispose the pampers and the pads [CITATION Nat21 \l 1033].

Waste collection, transfer and transportation

A lot of tools and technology are involved when it comes to components of SWM used by waste collectors and waste enterprises. NEMA is the body responsible for giving license to waste collectors to ensure that wastes are properly collected and safely transported to the dumpsite. When it comes to ways of collecting and transporting waste, these were the response:

> Representative of Vuka Sasa in Nyalenda said that: "Waste collectors have the PPE's that our youth have during the garbage collection. We have the gumboot, gloves, overall and the cap. We use the spade when we have spillage in the pickup or canter, we use it to collect. We have partnered with an organization in Manyatta, they do plastic recycling. We are thinking of getting a place in our compound here where all the plastics will be placed here and then those people will be buying from us. It is also a source of revenue. They crush the plastics and mold kids' toys using machines. We use trucks and pickups. We are not using the carts but we are thinking in that line so that we can get easy movement in the interior places where we the vehicle cannot penetrate [CITATION Vuk21 \l 1033].
>
> To maintain a clean environment, NEMA officer said that the County government of Kisumu has provided waste receptacles in the markets and 3 bin color within town so as to enhance proper waste collection after which the county waste collectors transfer and empty the waste in Kachok dumpsite. It is so unfortunate that the 3-color bin is to enhance the practice of waste segregation yet during collection all the waste is mixed in one truck. Therefore, the county government should take the initiative of providing segregated trucks for waste collection to make is easier for separation at the dumpsite. When you find a container is full and it is overflowing, there is a failure, system is not complete, like the producer of the waste should ensure that the waste is safely transported to the receptacle. After reaching the receptacle then it is the responsibility of the municipality, the city now to move it to the disposal site at Kachok. The officer goes further saying that as NEMA they provide licensing, approve applications from the business people who have the recommended types of vehicles by giving them a license to transport, and dispose solid waste at the designated disposal site. And as you know, Kachok is the only dumpsite in Kisumu which I believe the plans are underway to relocate it but currently, is what is being used. So, we give information to the public

> that all waste must be sorted. And that the waste must be transported safely to a waste receptacle. These are bins either provided by the landlord or the county government to contain the waste. And then the bins should be regularly emptied into a truck which is enclosed so that the waste is transported safely without falling off from the truck until dumping site. In waste management strategy, the sites are supposed to be fenced off so that the scattering of the waste is prevented and it must also be gated to prevent unauthorized entry, and it must be protected by a security guard, and then record should be taken like how many tons of waste do we receive per day for example, in this City of Kisumu [CITATION Nat21 \l 1033].
>
> When it comes to SWM, founder of United Destiny Shapers says that people think that it is the role of the county government, to come clean and collect the waste. But they can't reach all the areas, now we are complementing. He explains on how they deal with waste at the ghetto then take to the transfer points where the county collects and take them to the Kachok dumpsite. This means that they are at the grassroot level whey they remove waste at grassroot and take them to transfer points next to the road and they take them. Also, the organization engages in adding value to the community by helping keep a clean environment within the slum. Since the big lorries cannot penetrate in the slums due to small roads which are inaccessible that it why private collectors offer services from grassroot to take waste to the transfer points next to the road. Kachok has not yet been relocated but not yet because of some issues of negotiating either to relocate it to Miwani or Kajulu [CITATION Uni21 \l 1033].

Netoya waste collector explained on how the county tries to clean the garbage along the road known as transfer points so that they can save their face. If they are serious about but, they should not let people put it down, they should put stations then they come and take like the one they have put at Dunga. The local authorities are people who should put policies, that is their work, they should enforce. Netoya waste collector goes further to explain on how they collect waste and the tools and equipment they use as follows:

> We do provide the gumboots but we don't have enough. We have gloves, spades, rakes for collecting the littered waste around the dustbins, which we don't miss in our truck. Basically, we train the boys we work with, the waste is packaged, from the bags they are put, we load them on the truck. When we get to the dumpsite, we use the spades to remove them. That is where the education should come in, the syringes and glasses should not be there, there should be some segregation done at household level, so the people handling waste we protect them. We have people who take for the pig food and you can also make the organic fertilizer from it. But whenever you put glasses in it, it becomes even hard. Even the county has a challenge because it is mixed. You know waste is money, but when they do that, even they take the wealth from it and endanger us. The waste cannot also be reused because it is mixed. That is why I said the education should come in and how are we going to educate the people because the other time the county told us about it. Like I told you I charge 25 bob per

> bag but when they want to separate the waste, they will need like 6 bags. When you are having one bin in your house, you will have to get like another 4, nobody is willing to take up that challenge. Even the county itself I don't think they are willing. I think they are the first people who should be doing this but they are not willing, you see they put everything together. Educate our people especially the kids. There are people who give the waste to the kids to take them to the roadside. There are also the garbage collectors who collect the garbage and they don't have the capability and the passion to take the garbage to the right place. They are paid money and the garbage does not reach the dumping site; they leave them along the road some dump them on the river. It is not documented but there is a small fee pay at the dumpsite which is measured in terms of tuktuk, pickup, cart, lorries. It ranges from 100-500 shillings. The loaders who load the waste, now your people cannot load the waste, there are the boys at the dumpsite are the ones who are given that privilege to offload the waste. When we go there, they also get what they need like the cartons, polythene, they get tissue aside, the whiskey bottles white one in color. I have to pay anytime they offload my truck for me but for the fee I pay once even if I make may trips to the dumpsite in a day [CITATION Net21 \l 1033].

4.4.6 Impact of SWM on health, social environment and Development of Kisumu City

The County Government of Kisumu is actively implementing waste management and health related activities in slums through the Complex Urban System and Health (CUSH) program. The program is meant to increase the number of active participants in matters of waste management waste management activities that have an effect on people's health are as follows;

> Cleanliness has helped prevent diseases and stomach ache in my house. I ensure the compound is clean so that my children cannot pick waste and put hands in their mouth which leads to diseases. I also ensure that flies do not go to my house by spraying the house, especially the kitchen and keeping it clean as most of the time flies carry diseases. I have never gone to the lake to fetch water because we have water in our households. The village people in Dunga are the most who fetch in the lake (Nyalenda 3).
>
> In terms of SWM Kisumu County has tried. There are cleaners who do the cleaning to keep the County clean. The household respondent says that Healthwise, he has not yet suffered any disease in this locality but environmentally, the area around Kachok dumpsite sometimes stings because of the waste that has been thrown anyhow because of the poor management of waste. There is no fresh air and I think that is dangerous to my health (kombedu 4).

The Key Informants responded as follows:

When plastics are burnt, people end up inhaling the toxic gases which are not good for our health as in the long time it might lead to cancer but it depends on how often you inhale and type of plastic being burnt. Clogging of sewage with plastics bringing to malaria. Through melting using the right temperature helps prevent people from inhaling the smell and also, we add value by recycling to make new products. While melting, we are not also being affected that much with the smell as it is minimal but may be the gases when we set high temperature than expected. That is why we make use of the carbon mask so that we do not inhale the gases. That one happens when we are starting up. If you walk around, you won't see plastics as everyone knows is their goal to go and sell. As we started, we first encouraged the community to bring the plastics. If someone is able to bring 1 kg of plastics, we buy them at 10-15 shillings. This makes people be aware of the recycling company and makes people who are idle in the community to be engaged. The surrounding people they also hardly burn plastics as they know there is somewhere they can take and in turn earn some income [CITATION pre211 \l 1033].

Fablab Winam representative said that as an organization they have created an attitude among the young people to know that waste can be reused, can be repackaged, the users can be altered and make something very important. And so, there is a shift in people in how they are handling the waste. The activities done by the organization encourage generation of income for young people who participate in them and their work with health and waste management issues are also improving skills and reducing the pollution of the environment. Fablab activities might not have direct effect on people's health except but they have products which are helping in health situation for example, the printing materials which help in health situations, like foot operating washing machine, elbow operated tap which is 3D printed, and face shield. Fablab work with other health facilities in repair of some health equipment which can easily be fixed using the technology we have [CITATION fab21 \l 1033].

Currently the county government is trying to bring a number of initiatives to deal with this waste, that is why they are even relocating the waste dumping point from Kachok to somewhere else coz they want to keep the place clean. There are dustbins distributed all over so that there is proper collection. There are waste collectors in Kisumu who are collecting these wastes, some are private collectors and the county themselves has environment department which has unit for collecting waste. So, I think in Kisumu currently, it is not that badly of. The only thing remaining is how to make good use of these waste collected properly so that there is none going to the dumpsite. And as per our organization that is where we are heading to, we want to render landfills obsolete. The investors coming in, organizations and companies are coming up. If you look around there are hotels being built, which means the environment is clean enough to accommodate these hotels. Within the city and sub-counties around there is proper management of waste, attracting organizations which can manage the waste and generate some income from it. So generally, there is improvement in development in terms of investors coming in, the locals also getting something to do because when you are told to take waste somewhere and get something out of it, you will generally develop because you are getting something. Which means there is some wages attached to the waste they are collecting. There is a lot of impact like Cholera has reduced due to proper maintenance of fecal matter. The sewar lines are properly made so that there are no spillages. Also, there is clean

environment around. So, these diseases associated with filthy environment has reduced. It is attracting investors to come around. So, by that the locals can get something and from there they can maintain their health status by providing food and other amenities [CITATION Fle21 \l 1033].

As a village elder, she takes the responsibility of going around the village and if she finds someone who has thrown waste anyhow, she takes the responsibility of telling them to collect and burn. Most households have now followed that behavior so that cleanliness can be enhanced in the village. Environment being clean has changed the face of Kisumu town and its streets. This has really changed the appearance of Kisumu especially recently when the president was coming for Madaraka day in Kisumu. cleanliness is really helping the health of the locals because you see the way that place is bushy, once they slash there won't be mosquitoes. People should also keep their homesteads so that we can avoid the flies from having breeding areas so that we can avoid having diseases like cholera and typhoid which mostly affects the locals especially during floods. River Wigwa is really affecting us as it is the most breeding point of mosquitoes. The way Ministry of health gave us mosquito nets, it was of much help to us [CITATION Nya21 \l 1033].

4.4.7 Developments achieved through the implementation of SWM strategies

Solid Waste Management has brought about development in Kisumu City in various ways. The respondents gave their views as follows:

Since the creation of botanical garden after the clearing of part of Kachok dumpsite, VIC hotel is one of the most functional hotels currently. The mall now is also actively functional (Kanyamedha 6).

Flower vase made of recycled papers is a development at household level. You may end up using them unknowingly because whatever we buy you buy purporting to be new but the way it is made, you may not know exactly. Also, the Mbuta fish company produces fillets for feeds, oil and skin used for making other products. Some people take the mgongo wazi, fry and sell to people (Nyalenda 5).

In terms of development, Fablab Winam representatives talked of a company which has been created which can help in processing of waste into fuel and other benefits like manure a

group of people who are called flip flop who built boat using the waste plastics. In Fablab Winam office, they run trainings with children using plastics on how they can pick plastics and recycle them by mixing with electronics to build their own toys. Basically, though this is a negative development, currently there are youth working in the so called ’kazi mtaani’ and what they are doing is removing the waste on the sewerage lines and water lines [CITATION fab21 \l 1033].

Just for what I have seen is the government has done nothing but from the private enterprises they have seen shredding machine, the moldings at Dunga hill camp. I have not seen the government doing anything. The government has the machines but is very slow when it comes to implementation. The flipflop boat was a showcase product from Lamu. They were trying to send a message that we can do something for our lake from the pollution that comes out from our lake, also trying to keep the lake clean [CITATION Net21 \l 1033].

Networking, has made the UDS organization to work closely with the public health, county, and it us made us make exchange visits in other areas. The other day, the organization team was invited for a visit in Naivasha with an organization called salivation also doing waste management on sludge management adding value on it. So, it has been a very good platform to go and learn a lot from that. Also, the flipflop boat was a showcase product from Lamu and it was launched in Kisumu during the Naam Lolwe festival in 2021. They were trying to send a message that we can do something for our lake from the pollution that comes out from our lake, also trying to keep the lake clean [CITATION Uni21 \l 1033].

Circular economy is what every country and every region is geared towards. It ensures that your output from one process becomes an input to the next level of production. Therefore, at

the end of it we will have zero waste. We can encourage it as a country by some leverage on taxation. Anything which is produced from something being considered a by-product, let us say the charcoal briquette. You know there are people who do manufacture of furniture in large scale and they produce it a lot but after that they can't use it. But if there is a factory that uses it to make briquettes it will compress. When it comes to taxation, they should be given some exemption because taxation is oppressing people, it is not easy. So, that is a point of improving circular economy in this country. Also, talking with industrialized. Whatever you are producing, like for example the sugar processing industries, they produce molasses which is hotcake but they also produce bagasse. This bagasse can be used to make the briquettes, to enrich the soil, they should contact another person who also needs it. Bagasse has high moisture system, so if you find a way of drying it out in your system, it comes out dried so that it is just packaged and the next company takes it to go and make briquettes with it, that one can also help [CITATION Nat21 \l 1033].

Developments are there, those who never had a job, got a job. The vehicles which were not there we bought for collection and disposal of waste. We have bins everywhere in town here where users, people who are in town are supposed to dispose waste. And you cannot through any paper along the streets, there are places where you are supposed to drop it, and they are put in a very strategic place, you need not to walk a long distance with waste in your hand. So, all that is creation of better sanitation [CITATION Cou21 \l 1033].

The on-set of new government in Kisumu has made the city clean. Every morning you will find the town being cleaned and the clogged sewer lines being opened. They do away with bushy areas. In CIDP, that is County Integrated Development Plan Unit. In environment and natural resource section, it talks strongly on how to build enterprises along SWM so that any

waste that is generated is absorbed within the locality and within the city and is made resourceful. And is only through that, it can help in minimizing or eradicate the illegal dumping of waste and will create income to people in Kisumu along those lines. So, it is one thing that is taken seriously, even at the moment establishment of material recovery stations in the 7 sub-counties is ongoing. This has started with 2 within the city where waste will be recovered and turned into resources. And the equipment to that effect that we have already bought, 4 shredders, 4 bailers [CITATION Cou212 \l 1033].

Plate 4.1: Shredding machine

Plate 4.2: Bailing machine

4.5 Role of stakeholders in SWM

Leaders play a critical role in solid waste management when it comes to policy making. In terms of ensuring that the policies are well implemented into programs and projects, organizations and the government help in the process. In this study, the stakeholders who were interviewed under the government are: NEMA, Ministry of Environment in Kisumu County and City of Kisumu. The business enterprise that actively practice SWM and were involved in this study involve; Fab lab Winam, Flexi biogas company, Vuka sasa waste collectors, Netoya waste collectors, Dunga Innovation hub/precious plastics/ Streamline plastics. United Destiny Shapers was the only Community Based Organization that was interviewed.

4.5.1 United Destiny Shapers Community Based Organization

UDS CBO operates in Nyalenda informal Settlement located in Kisumu City. It was founded and registered in 2017. UDS CBO is an initiative of Passionate youths and community members, who have skills on human rights, community development, social environment, integrated agriculture, water/hygiene, national resource management and HIV/ AIDS. The organization was formed in order to empower the marginalized, vulnerable groups/ individuals and households through network and linkages with Government and other like-minded organizations. UDS CBO through its sanitation programme, it led to the formation of Vuka Sasa Youth Group, a leading in sanitation and garbage collection in Nyalenda. UDS provide a nobble opportunity to members who uses this platform as an income generating activity. Majority of youths involved have been transformed from drug

addict and criminal acts to responsible community members. Sanitation level of the shared facilities and general environment has so far improved a great deal. UDS also actively engages in urban agriculture through organic farming by using compost manure made from biodegradable waste. UDS works in collaboration with Kibuye Waste Management CBO that produces certified organic fertilizer by use of organic waste from Kibuye market. The fertilizer is used in demo UDS demo farms within Nyalenda to produce indigenous vegetables that are sold to the locals at subsidized fee. This project promotes food security within Kisumu County and good health as they are highly nutritious.

As a way of utilizing minimized space in Nyalenda slums, UDS encourages households to reuse plastics as planting kits whereby approximately 15% of households interviewed in Nyalenda are actively practicing the urban agriculture by use of plastics as planting kits. This promotes urban agriculture hence healthy nutritious food by reducing money spent on purchase of food stuff. It is as seen in plate 4.3 below:

Plate 4.3: Waste plastics being used as planting kits in practicing urban agriculture

4.5.2 FabLab Winam Organization

FabLab Winam was established in 2018 and is located in Kisumu, Kenya and operate within the Lake Basin Region. It is an open-access laboratory for creative fabricators, artists, scientists, Engineers, educators, students, amateurs, and professionals of all ages the goal is

to distribute manufacturing, research, and education. FabLab Winam is part of a network of over 1700 labs from over 100 countries across the world. It has a customized set of tools and machines that enable users to make and easily replicate designs made by other members of the network. FabLab Winam upholds a culture of collaboration, creativity and localization.

FabLab Winam is an organization that reuses electronic waste by getting them from people who sell valuable parts. Hence, FabLab Winam wealth lies in people and community that is why they invest in empowering community with knowledge on how to reuse electronic useful parts to come up with new products like robots and toys as shown in plate 4.4 below;

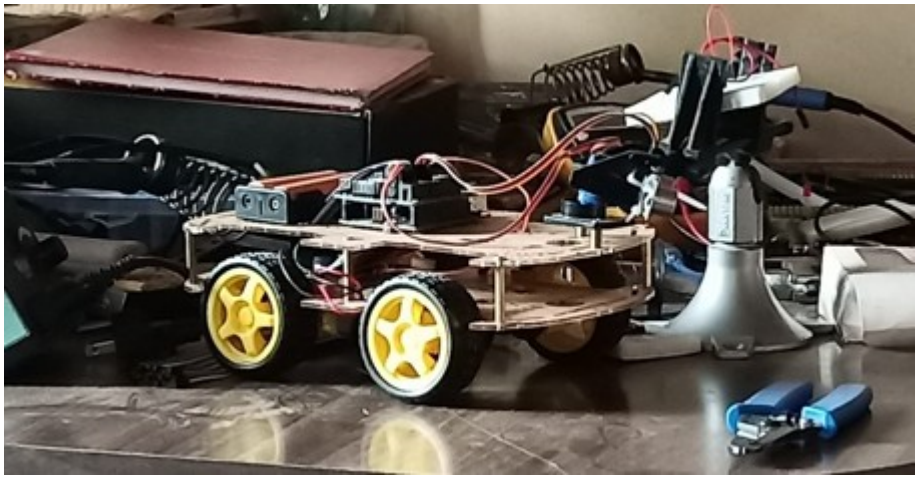

Plate 4.4: Sample toys from reusing and recycling electronic waste

4.5.3 Flexi Biogas Company Limited

Flexi biogas is located on the show of Lake Victoria at Dunga Beach. It is formally known as Biogas International Limited or BIL, a limited liability company that was founded in Kenya in the year 2011 and its main office is in Karen, Nairobi. The company deals with production of biogas by use of cow dung for introduction of gas production, water hyacinth

from the lake, and food remains. The company has brought about development at Dunga beach by supplying the fish vendors with biogas which they use to fry fish and the service is paid on post-paid manner. This has helped in reducing the cost used in buying firewood for cooking which in turn emits soot which is dangerous to environment and people's health. The fish remains after eating are there after recycled by the company to help in the production of biogas hence, in turn recycling the fish waste to production of biogas a by-product. The biogas production method is being exemplified by most households and organizations within Nyalenda where they use cow dung as the source product of gas production at their household level. Flexi biogas also uses the water hyacinth in biogas production hence help in the cleanup of the lake to make it easier for the navigation of the boats and also, the aquatic species to get adequate oxygen. Through the use of biogas, this reduces the amount of cost used for cooking fuel at household level as the cost is directed to other use.

Plate 4.5: Biogas being used a cooking fuel

The organization also deals with the creation of bio-san exemplified toilets (plate 4.6) that are being used in the slums of Nyalenda. The toilet is made by use of a number of drums instead of digging toilet holes. Through the drums, anaerobic process takes place through

which the waste is converted into water and can be directed to the farm as it is rich in fertilizer. The toilet demo is located at United Destiny Shapers Organization where the community are trained on its use and advantages where is exemplified in the whole of Nyalenda slums, there will be reduced cases of toilet overflow as in this case the waste is immediately converted into fertilizer.

Plate 4.6: System of Bio-San toilet

4.5.4 Dunga Hill Camp Innovation Hub

Dunga Hill Camp is a resort located on a hill on the way to Dunga Beach and is located on the shores of Lake Victoria. It was founded in December 2013. The innovation hub in Dunga Hill Camp was founded by Plastiki Rafiki who donated machines for recycling hard plastics to make new plastic products. This was during the Flipflopi Naam Lolwe festival of innovation and artivism that was held at Dunga Hill Camp in 2021. During the festival, the Mbuta Sculpture made of waste was launched at Dunga beach round about to showcase the development from plastics. The sculpture was made in collaboration between Kisumu

County, Naam Lolwe festival artists and the flipflopi project. It symbolizes the ecosystem and call to action against plastic pollution on Lake Victoria.

Plate 4.7: Mbut Lolwe Sculpture

The camp is majorly known for embracing using of recycled products. For example, the walls of the building in the camp are made of recycled plastics while the glass cups used in the camp are recycled wine glass bottles. The landscaping at the resort is also done by use of tyres used as staircases. Recycled metal is molded to various artifacts like giraffe sculpture for purpose of beautification. The innovation hub is a section within Dunga Hill Camp and it deals with the recycling of hard plastics like the jerrican type of plastics to make new products like toys, bowl, pegs and cups.

The Innovation hub works in collaboration with precious plastics and streamline plastics in collection of plastics. Precious Plastics and Dunga Innovation Hub recycle hard plastics jerrican by categorizing them into different classes before shredding them into small sizes

ready for melting into different shapes of products. The new products involve plates, bowl, cups and toys.

Streamline Recycling Company is a private company that promotes the collection of light plastics like drinking plastic bottles which they buy from people. The plastics are shredded for easier packaging and thereafter exported to India for the production of polyester material. Streamline recycling company was started in 2019 in Kisumu with a purpose of recycling light plastics which it collects from the Western region. The company promotes collection of plastics by school children by rewarding them with an exercise book to every kilogram of plastics collected. The company mainly engages in segregating plastics in terms of colors and material type, thereafter shreds them for easier packaging and export to India where they are recycled to polyester material used in making clothes. The reselling of second-hand clothes through the mitumba business helps in the economic development of the County's income.

Plate 4.8: Streamline recycling company

The collaborative effort of the 3 plastic recycling companies has brought about development in Kisumu whereby the community are using recycled plastic products which are locally produced and are also durable. The companies have also provided job opportunities to the

locals and a venture to learn especially to students involved in environmental clubs and courses. In turn, the County Government of Kisumu generates revenue through the taxes paid from these companies. This explains how in turn solid waste management is impacting on development of Kisumu city.

4.5.5 Respondents' views on role of stakeholders on SWM

According to the both the Key Informants and household respondent (30) views, the stakeholders in terms of organizations and leadership that are actively involved in solid waste management in Kisumu are as follows:

> The role of NEMA is to ensure that the environment is kept clean. Ministry of environment works hand in hand with NEMA. The landlord should also remind the tenants of cleanliness and proper disposal using stickers for reminder. The county to use the landlords and local authority to pass information on waste management to the community in ground (Kanyamedha 4).
>
> KIWASCO, they are the ones managing the waste of human products and waste of water. SHOFCO educate the communities on how they could practice the 3R's of products. WISE organization in Dunga (Nyalenda 1).
>
> There is a plastic recycling place in Manyatta, known as precious plastics and then flip flop team in Dunga hill camp which has an innovation hub for recycling plastics and they also have a building which has walls made from recycled plastics. Then of course us as Fablab Winam, Kick Kenya (The Kisumu Innovation Kenya) is based in Kibuye which uses the waste of iron sheet and wires to make greeting cards [CITATION fab21 \l 1033].
>
> The County have a structure made up of sub-county administrators, ward administrators, and village administrators whom the county works with. Village administrator basically seat within the village level, ward administrator at the ward level then sub-county at the sub-county level. The county also works with the central government who are the local administrators like the chief and assistant chief. County government of Kisumu has devolved waste management at the ward level where there is ward waste management committee which comprises of the village elder, chief, assistant chief then our structure who work together with the representative of the landlords. When it comes to payment, that one now it depends as the private waste collectors work independently by going to the landlords to make agreement of waste collect collection. Also, as an authority, county has the sections that collects waste but not everywhere like in the slum areas but collection is done in urban areas. This is why the county decided to give private people opportunity and the authority to collect from their locality since they are within the locality. They are

the people with the groups, the youth groups, the women groups that are operating within those areas. So, they talk with the landlords, they collect from the tenant then they take to the final destination the dumping site. So, it is the agreement between the landlords and the private waste collectors you know we cannot be involved as a city [CITATION Cou21 \l 1033].

Waste collectors are willing and are looking for partners but not able to get one to work with. There is partnership with Dunga hill camp which is still not a big partnership but trying to do best for mother nature and the lake by organizing cleanups around the lake, river wigwa and plastics collected are recycled [CITATION Net21 \l 1033].

Households are the major partners because they are the ones producing the waste, a lot of waste at the household level. Without them we cannot get this waste, so they are very important. Waste collectors like ghasia poa, blue stars and also, county government, ministry of health through the PHO (Public Health Officers) and Community Health Volunteers (CHV), do conduct cleanup activities by identifying hotspot waste areas within the community. During commemoration days, when the government is involved like world environmental day, UDS partners with the government [CITATION Uni21 \l 1033]

CHVs mostly walk door to door in this households and sensitize on the cleanliness of the environment, food, and it is their role to confirm the cleanliness of each and every household. The CHVs are trained by the Ministry of Health at District hospital and are involved in sanitation, environment, taking care of pregnant mothers and children under 5 checking their nutrition using MUAC. In terms of sanitation, when there is an outbreak of disease, they alert people starting from above, is starts from MOH, to CHVs and now the information gets disseminated to the community so that people are now aware about the break out of a certain type of disease. For the CHVs, they pick it from that point and start creating awareness and sensitizing the community [CITATION Nya21 \l 1033].

Interaction involves various stakeholders in waste management especially on awareness during inspection of facilities. Interaction then comes when people make applications for licensing, where NEMA verifies the application and issues them with a license and interaction also happens when monitoring the license condition [CITATION Nat21 \l 1033].

4.6 Influence of public participation in Solid Waste Management and its impact on development of Kisumu City

The public involves community members especially households actively participate in solid waste management as they are the major waste generators. The public play roles of waste collection, finance, sorting, transportation and recycling. The impact of the public in solid waste management is realized in Circular economy which involves reuse, reduce and

recycle, basically the 3Rs. This is the process through which waste actors decrease waste volume to be disposed in dumpsites. The County Government of Kisumu is involved in ensuring that circular economy is practiced through the KIWAMP first and second strategies which are; Waste reduction at source, and Waste recycling and composting. These strategies promote public participation in waste related activities like through the reduction of plastic waste, Jua Kali sector, Taka ni Mali centers and composting contribute to development in Kisumu City. In line with the study, the garbage collectors also encourage the practice of circular economy by reducing the amount of waste generated through replacing plastic bags with use of sacks to collect waste at household level after which they segregate the collected waste to get products that can be reused and recycled. For example, the hard plastics they take to Dunga innovation hub for recycling while light plastics are taken to streamline plastics. The scrape metals are taken to Kibuye scrape yard after which they are taken to Kibos metallics for recycling.

4.6.1 How the study respondents' practice circular economy

The interviewed household respondents also elaborated on instances where they practice circular economy at household level. Mostly, reusing and reducing is higly practised in all households. Recycling is practised through composting and manure making at household level (12 households) who Their illustrations were as follow;

> Mixing the waste, sand and cow dung adds fertilizer to the land and is good for growing vegetables. The other area I have planted grass where the cows feed on as their waste remains there to help decompose the area ready for the next plantation season. While the cows walk there, the land turns to uncultivated land hence becomes fertile for the next cultivation season. There are cow feeds which end up growing that we grind and give the cows to feed on. Using your knowledge, you will determine which type of waste plastic to reuse which thereafter helps in organization of products in the household and also helps maintain a clean environment. When the reused

> products are worked out, you burn. There is a dug pit where waste is put. In the compost pit, waste for manure is put and is used in the farm and non-biodegradable waste are burnt. Each and every paper has a use in this compound. For the magazines and boxes, they are for lighting jiko, the nylon are burnt in the compost pit. The animal remains for cows and poultry are put in the compost pit for decomposition (Kanyamedha 5).
>
> The glass soda bottle is used for buying salad, for storying drinking water. Filled up books are reused for lighting up the jiko. Organic waste like the vegetable remains are given to the chicken as feed. For the bottles if many, its given to people selling liquid soap or home-made yoghurt. For used magazine, they are given to the butcher people for wrapping. Reduction in waste production reducing pollution through waste (Nyalenda 6).
>
> Like reusing, let's say like these plastic bags. I could use it once, afterwards I normally decide to reuse it instead of disposing it. Then on recycling, I could talk about the bottles. Like the soda bottles. After finishing drinking my soda, I normally store water in them, I even carry water with them when I am going out and for buying in salad. For the magazine, I use for packaging the omena that I sell to my customers (kombedu 5).

The Key Infromants, in line with circular economy, they responded as follows:

> The waste recyclers at precious plastics and Dunga innovation hub expounded on circular economy as follows: they have 5Rs, recycle, reuse, reduce, recover and refuse but mostly practice recycling. Reducing is also involved, when doing the trainings, people are encouraged to reduce plastic usage and instead use alternatives like water bottles. Also, reuse the broken jerricans to plant vegetables, tyres for art work and flowers and for foot path in flooded areas or bring to the point of recycling at Dunga innovation hub [CITATION pre211 \l 1033].

Netoya garbage collectors who operate from Nyalenda to airport explain how they practice circular economy through their garbage collection activities:

> SWM definitely changing a lot, before I used not to practice reuse, reduce, repair but right now I have learnt a lot and I have known what wealth we have in waste if handled correctly we can make a living out of it, I have seen a lot and I have also gained. Personally, it has improved my life, my income has changes since I started handling waste. So, it is something that is positive so I encourage the youth and everybody. That is why I try to work with the youth around me, the ones who are in alcohol, the ones soling around I try to tell them there is something in waste. I have a lot of products made from waste like the toys, flower vase, there is one my son really likes, even at the organization Dunga hill camp where I take my plastics and try to make toys out if that. My fence is also made of the recycled parts from the vehicle doors which are reused for fencing purposes. In the recent time not like in the past, people are starting to see the importance of waste management, the land also is diminishing for illegal dumping. The population is increasing, the volume of waste is

increasing so they are starting to see the importance of garbage collection, they cannot hide from it any more. Urbanization has led to the increase of population and the penetration of lower- middle class. The standard of life has also increased and it goes hand in hand with the increase of waste. The 3R's motivated the startup of my organization. After collection recyclable parts are taken to dealers. This work involves a lot of logistics like transportation of waste. In transportation purposes, old school trucks that people left are the ones which are used. I started with the small truck, which was also a recycled product and which is being reused to make transportation easier. The collected glasses are taken to Pembe tatu, the junction on your way to Kibuye in Kaloleni. For cartons, they are taken to Kamongo, the mother at Lutheran [CITATION Net21 \l 1033].

United Destiny Shapers highly encourages and practice organic farming through composting by use on food waste and remains at household level especially within Nyalenda slums. The organization representative says that: To reduce, we encourage sorting at the source. When it is a household after cooking using the cooking oil plastic, can you sort it. After eating the vegetables, the banana pills, it can be sorted for composting. The polythene to be put in the right place, it can be reused to plant crops. UDS has been using containers to plant crops in it. Then to recycle, plastics are transferred to Nairobi for adding value through recycling. So, they go chop it and make another plastic from it through recycling [CITATION Uni21 \l 1033].

To add on, Vuka Sasa garbage collectors who operate mostly within Nyalenda expound on how circular economy is exemplified in waste collection jobs as follows: Circular economy means that do not put anything into waste. For example, if you use something you do not have to throw it but reuse and recycle again. Vuka Sasa are aware and planning of not just throwing plastics. Like the food waste instead of throwing, it is used for composting (plate 4.9) and for biogas production so that it can help in making manure and clean gas production for cooking. Those manure is used in the farm. Currently, the reduction of waste is not in place controlling the households on the amount of waste that they produce is not easy. That will also mean that if they are not producing waste, there is no job. The government is also campaigning for the recycling of waste [CITATION Vuk21 \l 1033].

Plate 4.9: Composting

> According to City of Kisumu representative, circular economy is currently being implemented in the city as follows:
> The county is constructing material recovery centers in these wards and doing intensive education awareness creation by training different women and youth groups in terms of management of wastes in these areas. Local administrators are also being involved for the enforcement of solid waste laws and regulations to ensure that they are adhered to [CITATION CoK21 \l 1033].

An officer from NEMA also explains how circular economy is documented as is being practiced in Kisumu:

> As a country, there is national solid waste management strategy that has been cascaded down to the 47 counties. The main objective of this strategy is to have zero waste, it is towards having zero waste in the country. The adoption of this strategy has been well. This strategy emphasizes on reusing, recycling and also reducing (the circular economy). First it starts with the responsibility of a waste generator. The person who is generating the waste has got the responsibility that it is sorted and safely delivered to a receptacle then from the receptacle now the responsibility comes to the municipality to remove it safely and regularly and transport it while closed to the disposal site which should be gated, fenced, must have a security guard, it must also have a weigh bridge that can weigh the quantity of waste as the tipper or the lorry passes. And then, it should be motorable, you know there is this tendency like the tippers just come and they tip off near the gate, so some access roads should be created so that when tippers come, they can proceed up to the last end and then they tip-off. So, it should be done that way until the disposal site is declared full by the responsible authorities. For Kachok it is not like that but they should follow the guideline as they are aware of it and it is something that is purely devolved and they were sensitized, all the heads of the sections in charge of waste management in all the 47 counties. But there should be some varies, it is not standard. Most counties, municipalities and towns are still moving towards full compliance with the strategy. Because in some points it needs resources to implement and they are doing it step by step, there is some progress. For the transfer points in Nyalenda where waste is thrown down, and county garbage collectors come and pick, no waste should be thrown down, there must be either a litter bin, the bins that you find along the streets, or a waste receptacle, the ones that are built halfway and then there is some roofing provided that can accommodate up to around 4-5 pickers full of waste, those are receptacles. In Kisumu, mostly they are found in the markets, they are green in color, some are containers as they are not constructed. But they are not disposal sites. They should regularly be emptied. When you find a container is full and it is overflowing, there is a failure, system is not complete, like the producer of the waste takes the responsibility of the waste to make sure that it is safely transported to the receptacle, after reaching the receptacle then it is the responsibility of the municipality, the city now to move it to the disposal site at Kachok [CITATION Nat21 \l 1033].

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter entails a summary of study findings, conclusions and recommendations. They are presented in the order of study objectives. Areas recommended for further study are also presented.

5.2 Solid Waste Management strategies

The study established the following:

As a result of households being major waste generators in the estates, the policy of SWM in Kisumu County on how waste can properly be handled and disposed starting from the waste generation point which is at household level. According to the literature review, under the SWM strategies in Kisumu, the strategy of Planning for a Sustainable Solid Waste Management System focuses on the planning of sustainable storage, collection, transportation and disposal systems which are essential elements of solid waste management. Through these elements the landlords, area leader, waste collectors and households tend to come up with guidelines which ensure that they implement this strategy as expected.

As a way of coming up with awareness programs, Kisumu County has a program known as (Complex Urban System and Health) CUSH where households in slum areas within Kisumu that is Obunga, Manyatta and Nyalenda are involved in the creation of awareness and sensitization on solid waste management. The CUSH program is illustrated in the Kisumu CIDP report. CUSH Project and SEACAP project emphasize on Environmental Planning which involves Environmental education plan, Environmental awareness and Waste Inventory and Periodical Assessment. For the assessment, it is done by the County environment officers. NEMA is involved in Environmental Impact assessment, policy and giving recommendation to the sites. The assessment is done by environmental experts in NEMA and also partnering with other inspectors from the county government. This statement is supported by the Kisumu County Director of Environment.

5.2.1 Developments achieved through the implementation of SWM strategies

The rehabilitation of Kachok dumpsite through startup of the relocation to Kasese in Chiga and proper management of the dumped waste has led to a number of developments like the reduction of heaps of waste and now leading to the creation of botanical garden through the 'tich tire'slogan. The rehabilitation has also led to the open up of businesses like the Vic hotel and now the space accommodates the market sellers from Kibuye Market. The Moi stadium is also currently under renovation so that it can continue attracting people to attend matches at the stadium. This statement is supported by Kisumu City Director of Environment.

At household level, for beautification purposes, people are reusing papers to make attractive flowers through which they sell and earn a living. Most households are now investing in using recycled products like flower vase, water hyacinth made furniture as a way of advocating for proper waste management. Some people also make a living from selling assorted waste like the plastics, valuable parts of destroyed electronics and selling compost manure made from biodegradable waste. The public health officers and Community Health Volunteers play an important role when it comes to sensitizing the community to practice cleanliness so as to promote healthy living. The practice of compost manure in the slums is promoting the practice of organic farming through which people get healthy food which promotes good nutrition and healthy living. The organizations are also coming in handy to train the community on how to reuse the plastics to practice urban agriculture especially in the slums where they can utilize the small space at home by designing hanging gardens at the door steps as supported by UDS organization.

5.3 Role of stakeholders in SWM

The stakeholders in relation to this study involves NEMA, the ministry of environment, waste business enterprise, waste collectors and the local authorities. The NEMA are in charge of policy and law formulation when it comes to waste management. In the ministry of environment in Kisumu, through the guidelines of the formulated policies, they try to implement the policies using various programs at grassroot level. At the city level, the ministry of environment has village elders from each ward whom they work in collaboration to ensure that information regarding waste management reaches the people in the community. For example, if there is an outbreak of disease like Cholera, the village elders pass the information to the community health volunteers in the community and that is how the whole information is spread.

Kisumu County having an umbrella of the KIWAN where most of the waste actors are covered, this has led to garbage collection activities extending also to the slums of Kombedu and Nyalenda. Through the KIWAN umbrella, the county also uses the umbrella to create awareness on SWM to the waste actors. The waste enterprises and organizations also come in handy in organizing community cleanup activities where they organize forums for awareness creation on SWM. In such forums, the county links up with the CHVs in the slum areas and environment champions to be in the frontline to sensitize the community on proper waste management.

Organizations and parastatals through the PPP strategy are coming in handy in the development of Kisumu City through beautification of round abouts and also, offering programs through which some of the plans in KISWAMP have been achieved.

Development through urban agriculture has contributed to food security and nutrition especially to the residents staying in Nyalenda, the largest slums in Kisumu City. This is through the collaboration of the County and organizations like UDS organization.

The organizations also come in handy in cleanup activities organized by the county government where the Dunga innovation hub takes the initiative of training the community members on how to segregate the plastics and recycle to new products. Fablab Winam in turn uses the plastics to train children on how to develop robotic products by using waste plastics and electronics.

5.4 Influence of public participation on solid waste management and its impact on development of Kisumu City

The recycling and reuse process explains how waste of one system becomes food for another. This clearly elaborates the cradle-to-cradle theory. Hence, with the right products, services and systems, the communities and entire city can create an interdependent and synergistic relationship with the surrounding ecosystem. Through the three principles, manufacturers can demonstrate efforts to improve their products for development to be realized. ‘This theory is designed to stop the cycle of use-waste-pollute, which suggests that certain products could be reused endlessly to make similar products (cradle to cradle), rather than recycled into lower grade products until the last stop is a landfill (cradle to grave). This

means that products can be used, recycled, and used again without losing any material quality in cradle-to-cradle cycles. Therefore, it could be the good way of reducing the waste from the raw materials of the products instead of using more and more virgin materials.' Hence, when faced with problems of municipal solid waste, this theory can bring us the possibility for the breakthrough. All in all, "cradle to cradle" plays an important role to develop and improve quality of items, increase value and spur innovation.

The practice of Circular economy in SWM has in turn brought development in Kisumu as most recycling companies are currently located within Kibos road. For example, we have the collection center of scrape centers in Kibuye which thereafter are taken to the steel company in Kibos. Streamline company is also located in Kibos where light plastics like the drinking bottles are recycled buy being shredded to small particles and in turn used to make polyester cloth materials. The streamline company is now working with community organizations to offer awareness on the locals on the importance of collecting the plastic bottles and in turn earn a living from it. It is through this awareness platform that children's education is also being promoted through the practice of SWM as a child gives a sack of plastic bottles and earn a book in turn hence keeping the environment clean.

5.5 Conclusions

In conclusion, it has been found that the capability of institutions and infrastructure for waste management, as well as trash creation, collection, and disposal, are the essential issues for solid waste management. Also, practice of circular economy in Solid Waste Management

brings about more development compared to linear economy which is based on exploitation of resources.

5.5.1 Solid Waste Management strategies and their effect on development of Kisumu City

Traditionally, waste management practices such as composting has been viewed as a practice for rural communities. With heightened rural-urban migration, many dwellers within the city still hold this perception. Shifting the perception requires time and capacity development. Besides, people's lifestyle continues to foster a challenge to managing waste. For instance, non-conventional waste management practices such as waste-burning, roadside dumping pose a critical challenge to achieving SWM goals, especially in low-income neighbourhoods. The majority of the people within low-income neighbourhoods have no income to pay for waste collection. Therefore, it is necessary to educate and inform people on the best way to handle waste and earn income from waste management to meet other livelihoods needs. Also, the awareness of the advantages one would receive and the attitude of a person towards solid waste management are two important factors that influence one's willingness to support and engage in any activity. The implementation of household-based management programs that involve them in proper waste storage, collection, segregation, and recycling activities is a potential strategy to improve SWM systems.

5.5.2 Role of stakeholders in SWM

The unemployment rate in Kenya, particularly in Kisumu, still stands high. Many youths who are currently unemployed lack clear guidance on which ventures will help them earn a

living. Thus, it is necessary for the County government to work in collaboration with formalized groups in different aspects of solid waste management to advance their mainstream activity thus influence development. The inefficiency of County government in waste management has paved the way for private companies to invest in waste management through the strategy of Public Private Partnerships (PPP) approach which undertakes various financing reforms at the county levels. However, most of these companies are less willing to serve low-income neighbourhoods due to low-profit turnover. This has made local waste workers and households in low-income areas to start engaging in urban agriculture, composting and plastic collection as a way of earning a living. However, they face the challenge of limited knowledge and skills that makes them not to advance in the activities making it necessary to effectively train and demonstrate how to manage waste at household level and also train the waste workers.

5.5.3 Influence of public participation on solid waste management and its impact on development of Kisumu City

The realization of development in solid waste management depends on public participation. A circular economy has advantages that are operational as well as strategic, on both a micro and macroeconomic level, according to the Ellen MacArthur Foundation (2015). Production costs should be reduced, and there should be less reliance on natural resources, if waste is eliminated from the waste management system by redesigning the products and recycling and reusing the materials to the greatest extent possible. A circular economy serves as the foundation for the growth of new concepts and innovation, and it is also expected to increase local employment, solving Kisumu's major unemployment problem. The benefits of

participation include increased participant knowledge, opinion, and comprehension of the key issues that concern them. Participants have the ability to establish goals and targets that are implementable, meaningful, and accepted locally. Strategies developed by technocrats and bureaucrats that take a top-down approach to addressing community concerns lack the political credibility that comes from household participation. The awareness of the advantages one would receive and the attitude of a person towards solid waste management are two important factors that influence one's willingness to support and engage in any activity.

5.6 Recommendations

Recommendations arising are as follows:

5.6.1 Solid Waste Management strategies and their effect on development of Kisumu City

For instance, awareness and sensitization to be done by the county government of Kisumu through media and activities by actively involving the households in the process. For example, households and waste actors can actively be involved through holding trainings, local community holding frequent sensitization baraza and organizing town hall meetings.

The County government should make it necessary, mandatory and legal waste segregation at source with penalty for not practicing waste segregation. Also, the County government should make it mandatory for landlords to have a specific disposal site for rental houses.

More strict rules and enforcement penalties should be made by the County government especially for the bio-degradable materials.

5.6.2 Role of stakeholders in SWM

The National and County government of Kisumu should emphasize on polluter-pay principle so that manufacturers and producers to take the responsibility of managing their product waste right from production, selling and use. This should mostly be exemplified to single use products like pampers so that manufacturers who also play an important role as waste stakeholders can learn the importance of managing waste.

The County should work with, incorporate, recognize and encourage private and individual enterprises.

Lake Victoria overlaps in East African Community countries that is Kenya, Uganda and Tanzania. This means these countries are affected by the same issue of waste in the lake. Therefore, there is need intensive cleanup between countries that are occupied by Lake Victoria.

5.6.3 Influence of public participation on solid waste management and its impact on development of Kisumu City

This study recommends Public-Private Partnership to be more in undertakings to enhance local ownership of the neighborhood projects or programs. This can be advanced by developing a Memorandum of Understanding to make the partnership between the government and local community stronger.

In budgeting, the National government through the ministry of environment should allocate more resources to Solid Waste Management.

Landfills like Kachok dumpsite tend to be a source of income to landfill communities. Landfills can be turned into activity by advancing them to material recovery centers. This can be done through Public-Private Partnerships to assist in funding the project which can be locally owned by community members.

5.7 Areas suggested for further studies

In line with study findings, the research more focus was on Reduce, Reuse and Recycle. Subsequent studies should focus on Refuse, Repair and Recover as forms of circular economy. Refuse involves to stop production or not allowing production of products harmful to the environment. For example, in the study, the respondents refuse the production of pampers due to its non-biodegradable nature and being toxic to the environment. Repair involves taking steps to minimize the waste being produced in the first place as a way of extending material and product life span. Recover aims at exploring the high-value recycling possibilities and develop new, scalable, closed loop solutions, through a series of practical implementation projects.

More studies to focus on attitude and behavior change amongst city residents especially on handling the waste that they generate at household level.

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HOUSEHOLD RESPONDENTS

(Kanyamedha 1) Household interview. (R. Ofwete, Interviewer)

(Kanyamedha 2) Household interview. (R. Ofwete, Interviewer)

(Kanyamedha 3) Household interview. (R. Ofwete, Interviewer)

(Kanyamedha 4) Household interview. (R. Ofwete, Interviewer)

(Kanyamedha 5) Household interview. (R. Ofwete, Interviewer)

(Kanyamedha 6) Household interview. (R. Ofwete, Interviewer)

(Kombedu 1) Household interview. (R. Ofwete, Interviewer)

(Kombedu 2) Household interview. (R. Ofwete, Interviewer)

(Kombedu 3) Household interview. (R. Ofwete, Interviewer)

(Kombedu 4) Household interview. (R. Ofwete, Interviewer)

(Kombedu 5) Household interview. (R. Ofwete, Interviewer)

(Nanga 1) Household interview. (R. Ofwete, Interviewer)

(Nanga 2) Household interview. (R. Ofwete, Interviewer)

(Nyalenda 1) Household interview. (R. Ofwete, Interviewer)

(Nyalenda 2) Household interview. (R. Ofwete, Interviewer)

(Nyalenda 3) Household interview. (R. Ofwete, Interviewer)

(Nyalenda 4) Household interview. (R. Ofwete, Interviewer)

(Nyalenda 5) Household interview. (R. Ofwete, Interviewer)

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KEY INFORMANT RESPONDENTS

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KI- Area Leader, N. (2021, June). Key Informant Interview. (R. Ofwete, Interviewer)

KI-City Director, E. (2021, June 24, Thursday). Key Informant Interview. (R. Ofwete, Interviewer)

KI-County Director, E. (2021, June 24, Thursday). Ministry of Environment. (R. Ofwete, Interviewer)

KI-County environment department, (2021, September). Key Informant Interview. (R. Ofwete, Interviewer)

KI-Fablab, W. (2021, June). waste enterprise interview. (R. Ofwete, Interviewer)

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KI-NEMA Officer, N. E. (2021, September). Key Informant Interview. (R. Ofwete, Interviewer)

KI-Netoya, c. (2021, June). Waste collector interview. (R. Ofwete, Interviewer)

KI-Recyclers, p. (2021, June). Waste enterprise interview. (R. Ofwete, Interviewer)

KI-UDS, U. D. (2021, June). Waste enterprise interview. (R. Ofwete, Interviewer)

KI-Vuka Sasa, c. (2021, June). Waste collector interview. (R. Ofwete, Interviewer)

APPENDICES

Appendix I: NACOSTI Research permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 473365

Date of Issue: 11/June/2021

RESEARCH LICENSE

This is to Certify that Miss.. Rebecca Achieng Ofwete of Moi University, has been licensed to conduct research in Kisumu on the topic: Influence of Solid Waste Management on Development of Kisumu City-Kenya for the period ending : 11/June/2022.

License No: NACOSTI/P/21/11103

473365

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix II: Introduction letter

Ofwete Rebecca Achieng'
P.O Box, 9402-00300,
Nairobi, Kenya.
TEL: 0706128331
achiengrebecca5@gmail.com

March 23, 2021.
To the respondent,
Dear Sir/Madam
REF: Request for participation in research study

I am a student from Moi University pursuing Master of Arts in Sociology.

I am conducting a survey to determine the influence of solid waste management on development of Kisumu City Kenya.

Your participation in the study will highly be appreciated and the information given will strictly be kept confidential and majorly be used in this study for academic purposes.

Please the attached copy of interview guide for the study that will be administered by the researcher. I look forward to your participation in the study.

Thank you.

Yours Sincerely,

Rebecca A. Ofwete.

MS/SOC/4371/20.

Appendix II: Consent form

CONSENT TO PARTIPATE IN A RESEARCH STUDY

Title: Informed consent for participation in a research study entitled "Influence of Solid Waste Management on development of Kisumu City-Kenya".

Researcher: Ofwete Rebecca Achieng' Title: Student Researcher

Introduction of participation: You are requested to voluntarily participate in the research topic 'Influence of solid waste management on development of Kisumu-City Kenya. Being a resident of Kisumu City and an active participant in solid waste management made you to be selected as a participant in this study. You are requested to carefully go through the consent form, understand and ask questions before consenting to participate in the study.

Purpose of the study: The main purpose is to investigate in to investigate influence of solid waste management on development of Kisumu City.

Length of participation: A participant is only allowed to participate in the study once and the entire interview will last for not more than half an hour.

Study procedures: The researcher must explain the meaning of the study and give chance to ask questions before participating in the study. You must carefully read, understand and interpret the consent information the append signature. You will remain with a copy of signed consent form.

Risks or side effects of participating in the study: This study is expected to result in no harm to the study subjects and will not contain questions on personal issues that would inflict harm on the respondents.

Benefits of participating in the study: The benefits may not be directly however, the data given will be helpful in understanding the topic under study.

Voluntary Participation: This means that participation in the study is through an individual's wish or willingness and no coercion is involved. Participant may ask questions related to the study at any time and may choose to respond or not respond to questions or may also stop participating in the interview at any time without incurring any consequences.

Confidentiality: The data from this research study will be recorded and strictly be kept confidential. Despite the data only known by the study team, identity of the participants will be kept anonymous. It will not be possible to keep key informants anonymous because their status is part of why they are selected as key informants. However, their answers will only be known to researchers and will be kept confidential.

Contact information of the researcher: you have the right to ask questions in line with the research topic before, during and after the research. If you would like clarification or to ask further questions after the study, please feel free to contact the researcher, Rebecca Achieng' Ofwete (Researcher) on phone +254 706 128 331 or email achiengrebecca5@gmail.com.

Statement of consent: I have read and understood the consent information or they have been read to me. I have also received answered to my asked questions. I do acknowledge that I am 18 years of age or older. Therefore, I consent to participate in this research and by signing the consent form, none of my legal rights have been waived.

Name of participant/interviewee: _____

Signature/thumbprint/mark: _____ **Date:**_____

Researcher's name: _____

Signature/thumbprint/mark: _____**Date:**_____

Name of witness (if interviewee is illiterate): _____

Signature/thumbprint/mark: _____ **Date:** _____

Appendix IV: Key Informants Interview guide

1. Representative from Ministry of Environment

The role of stakeholders in SWM

1. Please describe your position in Ministry of Environment and your role in SWM.

2. Please describe how you interact with other environmental stakeholders in Kisumu.

3. Please describe the role of the local authorities in SWM.

4. Please describe the place of households in SWM in Kisumu City.

SWM strategies and its effect on development.

5. Please elaborate SWM strategies in Kisumu and how they contribute to development in Kisumu-City.

6. Please explain the current impact of SWM on development of Kisumu.

7. Please elaborate how you offer civic education and how it impacts on waste segregation.

Circular economy towards SWM.

8. Please explain how your Ministry consider the practice of circular economy for effective waste management?

9. What developments have been achieved by practicing circular economy in SWM in Kisumu-City?

Challenges in waste segregation and SWM

10. Please elaborate on the public's attitude towards waste segregation and SWM?

11. Please elaborate on the challenges the Ministry faces in implementing the practice of waste segregation and SWM.

12. Please describe the improvements you would like to see in the current state of SWM in Kisumu.

2) **Waste Business Enterprise**

SWM strategies and its effect on development.

1. Please describe your position in this organization and your role in SWM.
2. Please elaborate what motivated the startup of your organization.
3. Please explain the current impact of SWM on development of Kisumu.
4. Please elaborate how practicing SWM has influenced your behavior and attitude towards handling of Solid Waste.
5. Please describe how your organization contributes to the implementation and practice of SWM strategies in Kisumu.
6. Please describe how households are critical partners in SWM.
7. Please elaborate how you offer civic education and how it impacts on waste segregation.
8. Please describe the developments your organization has gained through the set SWM strategies in Kisumu City.
9. Please explain how your organization has impacted on developments in Kisumu through SWM.

Circular economy towards SWM.

10. Please explain how you practice the 3R concept of circular economy.
11. Please elaborate how the strategy of waste reduction impacts to your organization.

12. Please explain the tools and technology you use in managing waste to produce valuable products.
13. How and what types of educational awareness programs do you conduct at household level for realization of importance of circular economy?
14. Please describe developments your organization has achieved by practicing circular economy.

The role of stakeholders in SWM

15. Please explain institutions or groups that you collaborate with in SWM and their roles.
16. Please explain how you collaborate with County Government of Kisumu to help maintain a clean environment.
17. In what ways do you think that existing solid waste management can be improved by local authorities?

Challenges in waste segregation and SWM

18. Please elaborate on public's attitude towards waste segregation and SWM?
19. Please describe challenges your organization faces in practicing and enhancing waste segregation and SWM practice.
20. How can local authorities participate in improvement of current SWM strategies in Kisumu?

3) Garbage Collector

SWM strategies and its effect on development.

1. Please describe your position in this organization and your role in SWM.

2. How does your operational structure promote the implementation of SWM strategies?

3. Please explain the current impact of SWM on development of Kisumu.

4. Please elaborate how practicing SWM has influenced your behavior and attitude towards handling of Solid Waste.
5. lease describe how households are critical partners in SWM.
6. Please explain the tools and technology you use in managing waste.
7. Please explain how you collect waste from households
    a) Which estates do you serve in Kisumu Central?
    b) How many households do you serve per day?
    c) Please explain your collection schedule in terms of time and duration.
    d) Which means do you use for transporting waste?
8. Please describe how households pay for collection services and time frequency.
9. Please describe developments that have been achieved through SWM strategies.
10. Please explain if you have ever received any civic education in line with solid waste management and how it impacts on your practice of waste segregation.

The role of stakeholders in SWM

11. Please explain institutions or groups that you collaborate with in SWM and their roles.
12. Please explain how you collaborate with County Government of Kisumu to help maintain a clean environment.
13. How can Kisumu County government improve in the implementation of SWM strategies?

Circular economy towards SWM.

14. Please explain how you practice the 3R concepts of circular economy
15. Please elaborate on developments that have achieved through the practice of circular economy.

16. How and what types of educational awareness programs do you conduct at household level for realization of importance of circular economy?

Challenges in waste segregation and SWM.

17. Please elaborate the public's attitude towards waste segregation and SWM

18. Please describe the challenges your area faces in SWM to protect environment.

19. Please describe the improvements you would like to see in the current state of SWM in Kisumu.

20. Please explain developments in Kisumu City that have been affected by challenges in waste segregation and SWM.

21. Please describe the improvements you would like to see in the current state of SWM in Kisumu City.

22. Please explain developments in Kisumu City that have been affected by challenges in waste segregation and SWM.

4) Area Elder/Leader: Nyumba Kumi Representative

SWM strategies and its effect on development.

1. Please describe your position in Kisumu Central and your role in SWM.

2. Please explain the current impact of SWM on development of Kisumu.

3. Please describe how households are critical partners in SWM.

a) How and what institutions are involved in SWM?

4. Please describe how you offer civic education on solid waste management to the locals.

5. Please describe how SWM strategies in Kisumu are implemented.

a) What are the challenges experienced during the implementation?

b) Please describe developments achieved through the implementation of the strategies.

Circular economy towards SWM.

6. Please describe how Kisumu Central considers circular economy for effective waste management.

7. Please describe the operational structures through which Kisumu Central implements SWM strategies.

8. Please describe how you interact with recycling groups/ institutions in your area.

9. How and what types of educational awareness programs do you conduct at household level for realization of importance of circular economy?

10. Please elaborate on developments that have achieved in your area of operation through the practice of circular economy.

Challenges in waste segregation and SWM

11. Please elaborate the public's attitude towards waste segregation and SWM?

a) Whose responsibility is it to manage waste?

12. Please describe the challenges your area faces in SWM and waste segregation.

13. Please describe the improvements you would like to see in the current state of SWM in Kisumu.

14. Please explain developments in Kisumu City that have been affected by challenges in waste segregation and SWM.

Appendix V: Open Ended Household questionnaire

Household demographic data

1. Where specifically are you located within Kisumu Central?
2. Please elaborate on your household size (how many members in the household).
3. Please elaborate on the type of waste generated from your household.
4. Please elaborate how practicing SWM has influenced your behavior and attitude towards handling Solid Waste.

SWM and its effect on development

5. Please describe how you understand SWM in Kisumu City.
6. Please describe how you dispose and manage household solid waste. (Compost, dustbin)
    a) Please elaborate on how you segregate your waste.
7. Please explain if you have ever received any civic education in line with solid waste management.

8. Please describe the developments you are aware of that have been brought about through Solid waste management in Kisumu City.

Circular economy towards SWM

9. Please describe how you practice the concept of circular economy (3R's) at household level to manage solid waste.

a) Please describe the developments you have realized by practicing the concept of circular economy at household level.

b) What products do you use in your household that were made from recycling of household wastes?

10. Please elaborate how Kisumu County offers educational awareness programs to households for realization on the importance of the circular economy.

11. Which organizations within Kisumu Central are you aware of that reuse and recycle household wastes?

The role of stakeholders in SWM

12. Please elaborate on institutions or groups involved in SWM in Kisumu City.

13. Please describe the role of local authorities on SWM.

a) What is the role of landlords or care takers towards SWM?

b) How can the existing solid waste management be improved by local authorities?

14. Please explain the role of County Government of Kisumu on SWM.

a) What is your view towards Kazi Mtaani?

Challenges in waste segregation and SWM

15. Please describe challenges faced in management of household solid waste?

a) How do you tackle these challenges?

16. What challenges does the County government of Kisumu face in regards to SWM?

a) How have these challenges had an effect on development within the City of Kisumu?

17. What is your suggestion in regard to improvement on waste management sector?

Appendix VI: Observation list

SWM strategies and its effect on development.

1. The presence of the following types of waste should be observed:
   a) Kitchen and garden waste
   b) Household sweeping waste
   c) Papers, boxes and magazines
   d) Rugged clothes
   e) Glass
   f) Metals
   g) Plastics
2. What are the commonly used containers for collecting waste?
   a) Metallic bin
   b) Plastic bin
   c) Nylon bag

d) Sack

e) Others (please specify)

3. Observe where is the waste bin is placed within the household

a) Within the kitchen

b) Yard of the house

c) Others (please specify)

4. What is the means of transporting collected waste?

a) Use of lorry

b) pickup

c) Cart

5. Please describe waste disposal methods used by the public within Kisumu CBD.

a) Thrown in nearby drains/street

b) Use of litter bin for mixed waste

c) Three-color Waste separation bins

Circular economy towards SWM.

6. How is the generated waste at source stored?

a) Mixed in one container

b) Separated in different containers

7. If waste is separated, are there containers for waste separation?

a) Yes

b) No

8. If yes, how is the separated waste managed?

a) Re-used at household level

b) Sold to recyclers

c) Mixed with other waste

d) Recycled

e) Composted

f) Others (please specify)

9. If sold, at what time and to whom do you sell the waste to?

10. If recycled

a) What waste do you recycle?

b) Where do you recycle them from?

c) What is the end-product of recycling process?

11. If composted, through which methods?

a) Compost pit

b) Open air composting

c) Closed container

d) Others (please specify)

Challenges in waste segregation and SWM.

12. What challenges are experienced in storage, collection, transfer and disposal of waste?

a) Is waste from household stored inside the house?

i. Yes

ii. No

b) If stored inside the house, how is it stored?

i. In bags

ii. In buckets

iii. In bins

iv. Others (specify)

c) If the waste is not stored, how is it managed?

i. Burnt

ii. Buried

iii. Thrown in drains and streets

iv. Collected by waste collectors

v. Others (please specify)