FACTORS INFLUENCING RECYCLING OF SOLID WASTE IN MACHAKOS COUNTY, KENYA

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DECLARATION

The research is my original work and has never been presented for any award in any other university.

……..Date……..

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L50/76167/2014

This research project has been submitted for examination with my approval as the assigned University Supervisor.

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DEDICATION

I dedicate this proposal to my family for their encouragement and support through prayers in these challenging times, because without their cooperation, understanding, support and encouragement, the completion of this research project could have not been possible.

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ABBREVIATION AND ACRONYMS

4Rs	-	Reduction, Re-use, Recycling and Recovery
CBO	-	Community Based Organisations
E-WASTE	-	Electronic Waste
EU	-	European Union
HDPE	-	High Density Polyethylene
LDPE	-	Low Density Polyethylene
NEMA	-	National Environmental Management Agency
NCC	-	National County Council
NGO	-	Non-Governmental Organisation
NIMBY	-	Not In My Backyard
PET	-	Polyethylene Tetra phthalate
PP	-	Polypropylene
PVC	-	Polyvinyl Chloride
SWM	-	Solid Waste Management
SPSS	-	Statistical Package for Social Science
UNEP	-	United Nations Environmental Programme

ABSTRACT

This study sought to establish factors influencing recycling of solid waste in urban areas within Machakos County. The aims of the study were; to ascertain how technical factors influence recycling of solid waste in Machakos County, to determine how financial factors can affect recycling of solid waste in the Machakos County, examine the influence of stakeholder involvement on solid waste recycling in Machakos County. The target population for this study was Machakos county's employees in the solid waste management department, NEMA officials, public health officials and MOH. The study employed a descriptive survey design and interview guide to key informants and the target population was 122 individuals drawn from different sub-counties in Machakos County. A stratified sampling technique was used. It comprised of all the respondents who were targeted. There was collection of primary data using questionnaires. Analysis of the data collected from the pilot study done was analyzed using SPSS 21 and Microsoft Excel. The study found that financial factors played a role influencing recycling of solid waste in Machakos County. Technical factors such as lack of professional personnel and equipment had an association to recycling solid waste. Stakeholder involvement such as informal sector, community based organizations, donors and NGO's have an influence on recycling of solid waste. The researcher examined the data and demonstrated the results in tables. The recommendations in this research centered on factors influencing recycling of solid waste in Machakos County, Kenya were, strict enforcement of by-laws and policy, more budget allocation and proper waste allocation systems which are as follows: The County government should allocate enough budgets for provision of SWM services within the county. The county should facilitate proper waste management activities so as to reduce, reuse and recycle solid waste in the county's environment. Additionally, the County should advocate for good recycling activities of the solid wastes to add value by converting the solid wastes to useful products. Besides, it should develop market for the solid waste materials by putting in place good policies for disposing the materials. The county should enforce regulations while at the same time promoting campaigns which will reduce disposal of solid waste in the county. It will be important to publicize training manuals, best practices and also provide useful technical and financial assistance which will encourage better solid waste recycling and reusing practices.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Solid waste recycling simply means the conversion of solid waste into a particular new something such as paper, plastic, metals such as iron and many others. Decayed and dead plants, vegetables and fruits also are recycled in order to protect the environment as found by Morris (2005). Lavee (2007) defines waste as any matter which is disposed after its major use, or in case it is worthless with no more useful use. They are usually recycled through composting. The difference between solid waste recycling and reusing is very apparent according to Clark and Foster (2009). Solid waste recycling usually involves turning waste materials to new things, while waste reusing is whereby waste materials are given a new use instead of disposing of (Morris, 2005).

There are various reasons for recycling solid waste. The first reason is to reduce trash in the landfills thus safeguarding the environment as explained by Clark and Foster (2009). This is viewed by many scholars as the main objective for recycling solid waste. The second reason for solid waste recycling is to minimize the amount of raw material and even energy used in producing new products such as paper, glass and many more (Moore, 2008). It is recommended by scientists that trash is recycled instead of disposing of it.

Finally, as per statistics from UNEP, solid waste recycling helps lower carbon products evident in the environment thus making the environment cleaner as claimed by Baird, (2004). Reduction of the amount of waste is very effective with the use of effective waste recycling methods. Moore (2008) posited that Waste management needs to be taken into consideration, taking into account the increasing volumes of waste materials especially in the developing countries which are economically growing. There are various types of solid waste recycling methods depending on the type of waste materials as it will be seen in

chapter two of this study. The major types of solid waste materials which are recycled include; paper, glass, plastic and scrap metal. Others include E-waste, medical waste, and bio-waste.

Various success stories on solid waste recycling have been evident. Consider an example, in the United States; more than 70% of the paper used in the nation in the year 2013 was made from recycling waste paper as explained by Guerrero et al (2013). This exceeded the production by the year 2012 which was 66% by 4%. This was not only good news for the paper industry in the country but also the environment in general. The paper industry attained a great number of recycling waste paper products thanks to the collective efforts of the American Paper Association and the American Forests organizations as found out by Moore (2008). These organizations embraced people, within the nation, to recycle papers at home, school and even work in their day to day activities as claimed by Decker et al (2000). The annual paper recycling went high and reached the 75% mark in the country making it a very true success story on waste recycling (Baird, 2004).

A considerable number of people are making income from waste recycling. Consider an example where Kitale residents have been in the forefront in making money from waste. Indeed, waste is wealth. The residents of the community usually collect solid waste which is mostly dumped on the roadside and take it to their processing sites where it is recycled. They recycle the waste matter to new products such as Sufurias, bangles, roofing tiles and many other products (Morris, J., 2005). Another success story is from the women in Kibera who make hand bags from polythene papers and ear rings from bottle tops among others. Kibera is known to be the leading informal settlement scheme in Africa. However, youths from this settlement have come up with good ways of converting solid waste to useful products. They make products such as table mats and even shopping bags from the solid waste discarded all over. (KEMA)

Nathanson (2015) found out that even solid waste management had also a convolved history. He noted that with the advancement of technology human beings were able to revolutionize how they managed solid waste material (SWM) since they understood its impact on the environment and even their general health.

Baird (2004) traced the roots of SWM in the very ancient times. According to him, the first instance where solid waste was recycled was back then in the 4th century. This was performed by the Greeks. They performed proper solid waste management by arraying the waste removal system so as to manage the increased amounts of solid waste attributed to the increasing population. In those days, Baird (2004) notes that trash was just collected and then dumped to pits which were situated outside the major towns in Greece. However, later the Greek people viewed the discarded waste matter to be a threat to both human and also the environmental health.

Metzger (2009) also has an history on SWM in Europe. He notes that the plagues that affected Europe by the 14th and 16th centuries were attributed to the unsanitary urbans centres due to the careless disposal of solid waste. Most governments in the European zone developed proper solid waste management techniques so as to fight the diseases which were emerging as a result of poor disposal of solid waste. However, Metzger (2009) notes that the efforts to see proper disposal of solid waste were majorly hindered by the fact there was many social and political problems in the Euro zone.

Nathanson (2015) notes that it was in the 18th century that SMW practices were taken heavily in majority of cities worldwide. He notes that due to the industrial revolution, many countries especially in Europe and America were having problems with the generation of many tonnes of solid wastes. Solid waste became a major problem and this marked an "Age of Sanitation" as claimed by Metzger (2009).

Majority of the communities started participating in proper solid waste management activities such as waste collection in order to secure the general health of the society. With the technological advances marked in 19th and 20th century SWM was revolutionised. There was development of more advanced ways of SWM such as creating incinerators and even development of garbage cans for disposing solid waste matter.

According to Hoornweg and Giannelli (2007), cities took more organized approaches for SWM. They employed new technology and put in place policies while at the same time enforced regulations in order to manage waste properly. For instance, the US formulated the Clean Air Act of 1970 as found out by Tangri (2003) to curb the increasing air pollution in the country. This act forced many incinerators which had no air pollution controls to be shut down. It is important to understand that the SWM industry has undergone tremendous transformation with the advancement of technology. Activities such as recycling and even composting have been introduced so as to fight the increasing solid waste concern as found out by Tangri (2003).

There are various material which can be recycled which include plastic papers, glass, scrap metal, paper and garbage from markets. These products can be recycled to create employment and at the same time protect the environment from harm (Morris, 2005). Manure can be got through composting of the garbage which in turn the stakeholders benefit from it.

There are different types of waste. Examples being municipal (can either be residential, institutional or commercial), agricultural and special waste such as sewerage sludge. These wastes can be recycled differently using different technical know-how (Moore,2008)

Literature recommends that good technical skills are crucial in having a good SWM system. From definition, technical skills comprise of the knowledge and abilities needed to accomplish specified duties by the personnel according to Zaman and Lehmann (2011).

poor roads and vehicles (Alcott, 2005), deficient infrastructure (Julia et al, 2009) and technology also affect SWM (Zaman & Lehmann, 2011).

Solid waste management often takes a big amount of the total recurrent municipal budget. Despite the high financial burden, the counties usually struggle in provision of proper SWM services. From stats of USAID, states in the developing countries spend around 20-50 % of their budget on managing their solid waste. This majorly affects the distribution of the remaining budget to serve the population on other needs. Oskamp (2005), notes that local authorities are analysing whether to allow the private sector to do the SWM services or not. The reason behind this is that the public sector have lagged behind and has been inefficient in SWM due to poor management and the high costs involving SWM practices (Zaman & Lehmann 2011). Increasingly public–private partnerships (PPP) have been viewed as the solution to improve municipal performance in SWM at lower costs (Prakash, 1998). But even with a new partnership approach the financial aspects of municipal solid waste management remain critical for ensuring sustainability of the system. This concerns budgeting, cost accounting, financial monitoring and evaluation aiming at recovering sufficient money to cover recurrent operational expenditures of the collection service as well as to stock up capital for new investments or large maintenance. These methods are too seldom employed and the municipality rarely knows the actual cost of providing the service (Alcott, 2005). While external capital may often be needed for major investments, the recurrent costs should by preference be covered by a combination of user fees, and local taxes. Also, cross-subsidization and/or financing from governmental sources may be needed to ensure equitable access to service (Alcott, 2005)

A stakeholder is an individual or an organisation with a stake or even an interest in something (for this case– solid waste recycling). There are persons and organisations involved in solid waste recycling: they include; informal sectors, community based

organisations, non-governmental organisations, local authorities, formal sector and international donor according to Prakash, (1998).

1.2 Statement of the Problem

For successful environmental protection there ought to be effective waste recycling program. All the countries (the developing or even the already developed) have had problems with environmental pollution and could not manage their waste properly. According to Lynn et al (2014), there are various challenges affecting a successful solid waste recycling especially in the cities. Some wastes have been noted to have immediate and long-term health implications and making the problem more important to study (Pearce et al, 2013).

Inaccessibility as a result of poor geography of most Urban centers, poor designed routes for solid waste collection, less and poor-functioning operational equipment, poor activities of burning garbage, the bad conditions of most of the dumpsites are the major technical problems facing most counties as found out by Lynn et al (2014). Insufficient funds as well as recovery service charging, willingness to pay and budget allocation are among the financial challenges. Stakeholders involved include, the informal sector, society based organizations, NGOs, local authorities, formal sector and even international donor community.

Machakos County does not have sufficient funding, lacks technical know-how and improper legislation, thus, influencing negatively on solid waste recycling. There is deep rooted corruption that makes it hard to follow the stipulated environmental laws by NEMA. Inadequate dumping garbage dumping sites have negative attitude from the community has made to unsatisfactory solid waste recycling according to Nathanson

(2015). The study therefore sought to establish factors influencing recycling of solid waste in Machakos County, Kenya.

1.3 Purpose of the Study

This study intends to establish factors influencing recycling of solid waste in Machakos County

1.4 Objectives of the Study

Specifically, this project intends to;

i. To establish the influence of technical factors on recycling of solid waste in Machakos County.
ii. To determine the influence of financial factors on recycling of solid waste in Machakos County.
iii. To ascertain the influence of stakeholder involvement on recycling of solid waste in Machakos county.

1.5 Research questions

The following research questions are to be studied in this project:

i. What is the influence of technical factors on recycling solid waste in the Machakos County, Kenya?
ii. To what extend does financial factors influence recycling of solid waste in Machakos County?
iii. What influence does stakeholder involvement have on recycling of solid waste in Machakos County?

1.6 Significance of the Study

The study provided effects of recycling solid waste on the effectiveness of waste management in the Machakos County, Kenya. It also gave guidelines to the policymakers of the county on how to come up with effective waste recycling methods. The study used various methods of collection of data such as questionnaire to collect information regarding recycling of solid waste methods. The study will be important to policy makers of Machakos County since it will help them understand technical factors involved in recycling of solid waste (Baird, 2004). The study had benefits to the stakeholders since it is inclined to improve lives. This study was be beneficial to the society, the country, the government at large and the global front since it will show how recycling of solid waste can help in effective waste management. The results of the project will add value to education, science, technology and the recent on-going researches on effective ways of waste management since it will give and explain more latest methods of recycling solid waste that have been used in the already in the most developed nations. Therefore, the findings from this study will be useful in addressing the factors influencing recycling of solid waste in Machakos County, Kenya.

1.7 Limitations of the Study

The researcher encountered the following barriers and challenges: the interviews used in the data collection although had many advantages, it was time consuming and costly and the researcher overcame these by setting time frames within which the interviews were conducted to save time and reduce costs.

1.8 Delimitation of the Study

The study was delimited to Machakos County, Kenya with a time frame of almost two months. The subject area of the study was recycling solid waste in Machakos County. The variables included in the study which affect recycling of solid waste were; technical

factors, financial factors and stakeholder involvement as the independent variables. Recycling of solid waste was the dependent variable in this study. Results showed how recycling of solid waste had been undertaken within the county.

1.9 Assumptions of the Study

The study was based on the following assumptions.

I. The respondents gave information regarding solid waste recycling to the best of their knowledge without external influence whatsoever.

II. The respondents gave the answers correctly and truthfully in the questionnaire forms.

III. The respondents spared their time for the solid waste recycling study to provide the required data.

1.10 Definition of Significant Terms

City

Is a large and usually densely populated urban area. In our case, we will be referring to Machakos City.

Environment

Is the natural, as a whole or in particular geographical area, the area in which something exists or lives?

Factors

Refer to a circumstance, fact, or even influence that contributes causally to a result.

Garbage

In reference to Machakos County is the amount of waste from various sources including households and market places.

Recycling

Refers to the act of processing used or abandoned materials already used in order to produce new products

Stakeholder

A stakeholder is an individual or an organisation with a stake or even interest in something (for this case – solid waste recycling).

Technology

Is practical application of the science discipline which deals with making, modification and knowledge of tools, machines, techniques to commerce or industry?

E-Waste

Refers to electronic waste, for example, cable, old television sets, and computers etc.

Waste

Refers to any materials unused or/and rejected as worthless or unwanted.

Waste management

Refers to the generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of solid wastes

1.11 Organization of the Study

The study has been organized into five chapters. The first chapter gives the background of the study, statement of the problem, the purpose of the study, research questions and

research hypothesis. It further goes on to describe the significance of the study, limitation and delimitations of the study, basic assumptions and finally definition of significant terms.

Chapter two will deal with review of literature based on the objectives of the study. A theoretical framework will be discussed in relation to the study. A conceptual framework will be used to show the variables of the study and their indicators. The chapter will be concluded with a summary of the literature review.

Chapter three will deal with research methodology which captures, the design, target population, sample size and sampling technique, research instruments, data collection procedure, data analysis technique, ethical considerations and operationalization of variables.

Chapter four provides data analysis and discussions while chapter 5 contains summary of study findings, conclusions and recommendations of the study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature of some of the counties in the world on recycling of solid waste. The literature focuses on the purpose of identifying major key determinants, challenges and suggesting possible solutions.

2.2 Recycling Solid Waste in Urban Areas

The issue of recycling solid waste in the already developed and the developing countries is different. Although the first world countries generate larger amounts of wastes, they have sufficient facilities and technologies to manage the waste they produce as posited by Baird, (2004). Developing countries especially in African and Asian continents are still finding it difficult to manage their waste accordingly (Gonget al, 2016). They have inadequate and poor disposal facilities of waste. In countries with rapid population, there is a need for government policies to be very clear on the issue of solid waste management. There is an urgent need of competent bureaucracies for good management of waste especially in the growing urban centres.

There is a need for services and programmes that will cater for management of hazardous chemical and biological waste as claimed by Zaman and Lehmann, (2011). Governments need to come up with policies which will embrace recycling of solid wastes. Recycling of solid waste in order to manage wastes in urban areas (Hamad et al, 2013). Since most of the urban areas are becoming slowly industrialised, there is a need for the government to develop disposal areas in order to dispose of waste safely (Zaman and Lehmann, 2011).

Some countries have used solid waste recycling as a way to create jobs so as to alleviate poverty. A good example is China. According to recent research by the International Solid

Waste Association China was making around $5 billion yearly from recycling waste materials. The country is the leading importer of waste matter for recycling. Europe is the main exporters with Germany leading in exportation of waste.

An initiative named *Trash to Cash* has been started in the urban cities of Norway. This initiative is aimed at recycling solid waste so as to generate income for the country and alleviate poverty in the country. According to Schackelford, (2006) some governments have come up with national policies which promote efficiency of using resources to minimise wastage due to waste. Consider an example of UK where by the administration governing London has developed a national policy pioneering efforts to minimise waste in order to improve the industrial competitiveness of the country.

Many countries have come up with movements which advocate for minimization of the amounts of solid waste matter to be dumped in the landfills. For instance, in Berlin, there have been introduction of composite sites. Organic fraction of garbage has been turned into useful and commercial products. Grosse, (2010) explains that with the incorporation of technology, it is very effective nowadays to convert waste materials to raw materials in order to produce new products.

2.3 Review of Related Literature

Pearce et al (2013) did a study to investigate relationship existing between waste management and waste recycling in the United States. In the study they adopted a cross-sectional survey research design. The results of the study were apparent that an effective solid waste recycling initiative was an effective way of waste management in the states. Similarly the environment which had an effective solid waste recycling initiative was superbly clean (Mulder et al, 2014). The study concluded that effective waste recycling processes were indeed the best way to manage waste for a clean environment. The study

relied on primary qualitative data to measure the effectiveness of waste management in the US (Baird, 2004). My research will use both primary and secondary data to measure factors that affect waste recycling in Machakos County.

Mulder et al, (2014) also did a study to examine how collection equipment affected solid waste recycling. According to them there are three basic types of collection equipment namely; human powered, animal powered and the engine powered. They tried to examine which was more effective in collection of solid waste. They observed that the human powered collection systems could mostly be used using hands and hand pushed carts. The motorized collection equipment (engine powered) was noted to be very effective in collection of tonnes of garbage (Baird, 2004). However according to their study the motorized collection equipment had a challenge of accessibility especially in the big cities where traffic jams and overcrowding was evident Tierney, (1996). They concluded that human powered collection system was mostly used in most cities due to its convenience compared to other collection systems (namely engine and animal powered).

Freudenrich, (2014) investigated how stakeholders impacted waste management in the society. He used panel data and questionnaires to ask members of a community in Germany how they were participating in solid waste recycling. According to the members of the community, recycling was the major way they used to manage waste (Bonnie (2006). However some of the members had started a processing unit for waste recycling. Freudenrich, (2014) was able to understand that the government had also input stringent measures to curb disposing waste carelessly. Waste bins had been deposited all over in the area for people to dispose of waste carefully. From the study Freudenrich, (2014) concluded that community awareness was also important in managing waste for a clean environment (Schackelford, 2006) and that's what will be applied in my study.

Layton, (2009) conducted a study to examine the challenges that faced the efforts of waste recycling in Ethiopia particularly Addis Ababa. They analysed how waste was being managed through recycling in the city (Bonnie, 2006). From there study the noted that the rapid increasing population was the main challenge facing waste management since in turn resulted to increasing volumes of domestic wastes (Pratarelli, 2010).

This increased the need for more waste recycling. Layton, (2009) also found out that most of the recycling plants in the city where not functioning efficiently and thus waste was not recycled accordingly Bonnie,(2006). The study also found out that most of the trucks and equipment were so old and could not even transport waste efficiently to the recycling plants Baird, (2004). The study recommended that there is a need for the Ethiopian government to purchase new equipment for use in the waste recycling plants. It also recommended that new technology to be incorporated in the waste recycling process to improve efficiency (Schackelford, 2006).

Lavee,(2007) conducted a study to determine the practices of waste management in both developing and already developed countries. He analysed the processes which involved waste recycling i.e.; collection, processing, disposing and then recycling of waste. According to him, the processes which involved waste recycling where least efficient in the developing countries particularly in the African continent. The already developed countries where efficiently recycling there waste as also observed by Medina, (2000).

From stats per UNEP, United States was doing in recycling waste from paper. According to the stats 60% of the paper materials used all over US came from recycling waste paper. This is indeed a considerable percentage. However countries in the African countries depicted poor percentages in waste recycling. From the stats, only 5% of materials made

from recycled waste were being evident in the continent. This shows why African states should improve their existing waste recycling programmes (Medina, 2000).

Bonnie, (2006) did a study in order to analyse the impact of cost on solid waste recycling. The results of this study established that some various governments have not funded effectively programs for waste recycling especially in Africa. The cost of waste recycling initiatives is typically high. However, the cost is worth it thus shows the need for funding waste recycling initiatives. Bonnie, (2006) suggested that there was a need for funding of the waste recycling initiatives for efficient waste management program. Effective funding policies regarding the cost of waste recycling equipment must be formulated in order to ensure efficiency in waste management (Pratarelli, 2010).

Grosse, (2010) studied Greece to determine how the country was doing when it came to waste recycling. He checked the impact of technology to waste recycling systems. He measured efficiency when a waste recycling system was integrated with the new technology (Medina, 2000). He analysed the panel data using regression method. The study showed a positive relation existing between the efficiency of waste recycling systems with the new technology. Grosse, (2010) concluded that there is a need for policy makers to embrace the new technology in waste recycling initiatives (United States Geological Survey, 2006).

Zaman and Lehmann, (2011) conducted a study in a cement industry in Pakistan to ascertain how they the company was recycling its waste. He observed the waste products from the cement factory were; polythene paper, cement from cracks, sewerage water and polluted gas. He noted that the industry was taking part in waste recycling programs

The cement industry employed humans to collect the already used polythene bags which were then taken to processing unit. They were recycled in the unit and later used for

packaging cement (Medina, 2000). The industry also recycled the waste water by treating it accordingly and then reusing it for production purposes within the factory. He also observed that the industry tapped the polluted gases to use as raw materials for instance the carbon monoxide produced (Hagelüken, et al. 2010).

Alcott, (2005) studied the relationship existing between policy makers and efficiency of waste recycling. He sampled different 12 major cities in different countries. He observed how stringent the various policymakers where when formulating policies concerning waste recycling according to Hagelüken, et al. (2010).

He observed that countries such as UK, Germany and the US which had more stringent legislative measures on dumping waste had formulated effective systems for recycling the waste (Medina, 2000). He observed that many countries especially in the African continent were not strict on regulations concerning waste disposal as per statistics from United States Geological Survey, (2006). They also had not formulated efficient policies for waste recycling as posited by Alcott, (2005).

Solid waste recycling is an area widely revisited by academia in order to postulate waste management for a clean environment as observed by Hagelüken, et al. (2010). Recycling is very essential in ensuring environment is not polluted (Alcott, 2005). It is required since there is an increasing volume of wastes due to growth of our cities. The government ought to implement effective solid waste recycling programmes to curb the increasing volumes of solid waste from our day to day activities (Medina, 2000).

It is as a result of poor policies regarding waste management that most African cities are facing problems of solid waste (Alcott, 2005). There are various solid waste recycling collection systems i.e. human, animal, and engine powered as explained by Clark, (2011). Financing is required to ensure efficiency regarding solid waste recycling. Since there is an

increase in population in our cities due to urbanization there is a need for solid waste recycling to be efficient accordingly to cater for the increasing wastes especially from household's garbage. The new technology need to be incorporated in the new waste systems as demonstrated by Hagelüken, et al. (2010).

2.4 Theoretical Framework

There are various practices and treatments of solid waste disposal in order to recycle them. However, these solutions of waste management may not necessarily solve the problem of waste disposal evident in the Machakos County however they provide a great opportunity of utilising waste disposed. These parts will theoretically explain the process of solid waste recycling considering the type of waste material. Different countries use different methods of solid waste recycling (Tierney, 1996). They also use different collection systems of their waste for recycling. Because sometimes waste may from plastic, metal or even glasses may be collected together there is a need for separation before recycling (Pratarelli, 2010).

2.4.1. Theories of Solid Waste Recycling

The study applied Ajzen's theory of planned behaviour as a way of predicting voluntary use when it comes to solid waste recycling receptacles as demonstrated by Pimenteira, et al. (2015). Results show that attitude was the major behavioural intention when dealing with the waste management programme as found out by Huesemann, (2003). The theory recommends that solid waste recycling should be encouraged in order to manage waste properly. It encourages the use of green technology in order to safeguard the environment from pollution (Pimenteira, et al. 2015).

2.4.2 Principles of Recycling Solid Waste

The main principle of recycling solid waste hierarchy was applied in this study which emphasised the need of managing solid waste efficiently as possible as explained by Lavee (2007). The other principle used in recycling solid waste is the "Best practicable Financial Option" which provided the best disposal route in terms of stakeholder involvement and financial costs and the benefits which ought to be regarded (Lavee, 2007).

2.4.3 Generalization of Recycling Solid Waste

Recycling of solid matter is the major basis of SWM. The county government has to emphasis more on solid waste recycling initiatives and programs in order to form the basis of generalization on solid waste recycling for Machakos County as explained by Hussmann, (2003).

2.4.4 The Various Waste Materials and their Recycling methods

Glass mostly from beverage products is the most collected and recyclable glass product in many countries as explained by Carl, (2005). The glass is usually broken into smaller pieces in order to lower it volume. This enables easy transportation of the waste to the recycling plants (Schackelford, 2006). In the recycling plant it is then used to produce new glass products. Lately glass wool production is the new product which is most preferred glass product. This has been one of the best solutions for waste glass (Freudenrich, 2014).

Plastic packages are the main plastic source for food packaging. They are the major source of waste material in the county. LDPE, HDPE, PP and PET are the major plastic product materials (Freudenrich, 2014). Recovering is also done as a way of waste management for the plastic wastes. Plastic is recovered by simply being used in blast furnaces in order to produce energy (Layton, 2009). The plastic can also be employed in manufacturing PET products. Countries such as Belgium are able to recover and recycle their HD materials.

Other materials may be transported to the UK where it has advanced solid waste recycling system (Carl, 2005).

Scrap metals come as waste as a result of steel packaging and cans mostly from aluminium usually used in food production. Magnet is usually used to recover the steel which has Iron component. For other metals such as aluminium, eddy current separation is used in order to recycle them (Carl, 2005). Metal packaging usually is widely popular due to the space of storage. Customer's high demand also makes it very widely popular. Metal waste usually find its way to the dumpsite since it is difficult to separate and collect as noted by Hagelüken, et al. (2010).

Therefore many metal wastes are burned in the dumpsites. In the already developed countries mostly in the Euro zone cans especially from beverages are refundable (Layton, 2009). However, the case is totally different especially in the developing countries therefore these products often are found in the dumpsites found out by Schackelford, (2006).

Paper waste is in most recycled to make carton packages. The waste is usually sorted in order to separate it before it is transported to pulp mills. Shredding and pulping is done for the material in order to purifying it as posited by Carl, (2005). The recovered is then applied in production of new paper products. Cartons packages are separated i paper mills so as to recover the aluminium waste which is transported to aluminium production factory (Hagelüken, et al., 2010).

In the already developed countries especially in the Euro zone, Bio waste often works well compared to garbage from kitchen. The bio waste collected is usually used to generate quality compost and biogas as claimed by Freudenrich, (2014). The bio waste is often treated via the landfill after undergoing the processes of incineration and biological

treatments respectively. Incineration usually reduces the volume of the waste before it is taken to the landfill (Hagelüken, et al., 2010).

This helps the waste occupy less space for longer production when on the landfill. Incineration process uses the bio waste as the source of energy for generation of electricity. Bio treatments are also done on the bio waste. They usually refer to composting and then producing the biogas (Layton, 2009). Aerobic and anaerobic processes usually depend on the contents evident in the bio waste which often affects the efficiency of the general process (Tierney, 1996). In the US bio waste treatment is more efficient while using anaerobic digestion in order to produce biogas as demonstrated by Freudenrich, (2014).

In hazardous, incineration and combustion is usually used as ways conforming to environmental standards for breaking down hazardous waste in order to reduce its volume. A landfill is usually built for burying hazardous waste after being treated. Certain treatments are necessary before the waste is disposed of in the land as explained by Hagelüken;et al. (2010).Liquid hazard waste is often disposed in underground injection wells. These injection wells prevent under spillage to the water sources as claimed by Schackelford, (2006).

E-waste commonly referred to the electronic waste is often regarded hazardous. However this type of waste can be recovered and reused as for the other waste materials. Various consumers can purchase the E-waste since it is a raw material for production of other valuable goods as claimed by McDonald (2010). Cadmium with a symbol Cd is mostly used for making electronic products mostly rechargeable batteries and switches (Pratarelli, 2010).

Cadmium is widely considered as a very toxic metal for human beings as explained by Freudenrich, (2014) and as per stats of United States Geological Survey (2006). However,

McDonald (2010) demonstrated how cadmium can be bio accumulated for safety of the environment (2010). For instance mobile phones are made using different by products mainly copper, cadmium and silver. This by products can be recycled to make other more useful products as found out by Vigso and Dorte (2004).

Medical waste is waste from medicinal products. It is usually subdivided into three categories namely; general solid waste, special waste and the hazardous waste (Pratarelli, 2010). Special waste is usually contaminated at high levels and thus requires the process of incineration for purification and reduction of volumes as demonstrated by Tierney (1996). General waste can be recovered easily. Recycling is also done for this general waste. Hazardous medical waste is usually sent to the recovery plant for recovery (McDonald, 2010).

2.5 Conceptual Framework

The study discussed the concept of recycling solid waste. Recycling solid waste can be referred to as the process which involves the conversion of solid waste material into new products. From the study we can say that recycling solid waste usually prevents waste of potentially useful materials (Foster and Clark, 2011). Recycling solid waste also reduces the use of new raw materials and also minimises energy usage thus lowering pollution. Greenhouse gas emissions are also lowered. Recycling solid waste is a very vital component in SWM. This is key in the waste hierarchy of "Reduce, Re-use and Recycle" (Vigso and Dorte, 2004). Some of the independent variables that were identified in this study include: technical factors, financial factors, and stakeholder involvement. The dependent variable, which is recycling of solid waste was tested in the study.

Conceptual Framework

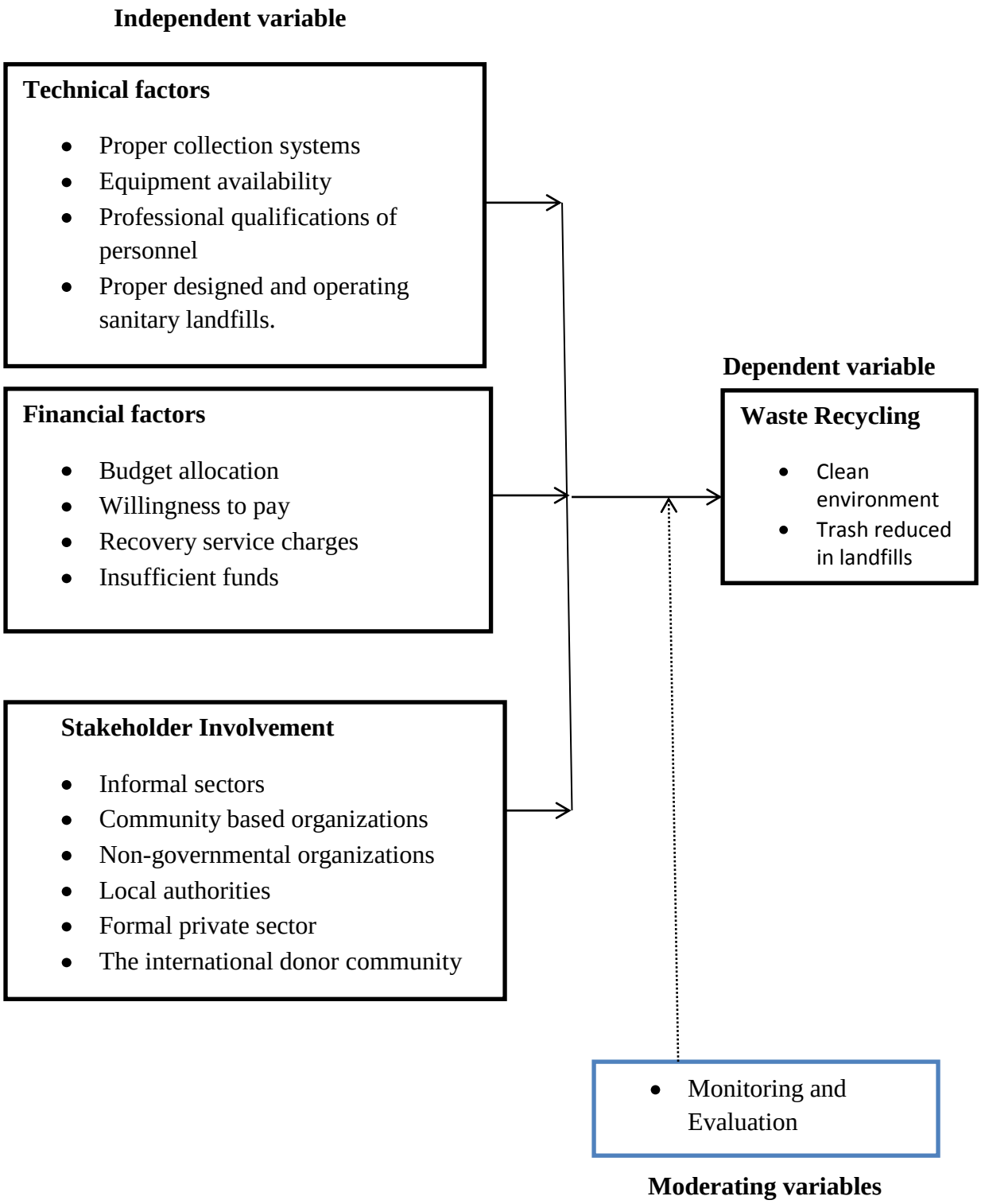

Fig. 1: Conceptual Framework

(Source: Author)

2.5.1Technical Factors

Technical factors are the knowledge and capabilities to perform specialized tasks. There are various technical factors that can be implemented in recycling of solid waste as claimed by Foster and Clark, B. (2011). In order to collect waste to be recycled, waste bins, garbage bags and containers are usually used. Trucks, trains or even ships are used for transporting the waste to the required processing units for recycling. The waste processing technologies vary (Vigso and Dorte, 2004).

From literature it is evident that poor technical skills impact negatively the technical factors influencing SWM. There has been many deaths of unqualified personnel as a result their poor technical skills in SWM systems as found out by Odegi (1994). Alcott (2005) claims that county authorities fail to employ qualified personnel in the numerous dockets of SWM like planning and operational dockets. According to Odegi (1994) developing countries have less personnel with the right technical know-how of performing SWM planning and operational activities. Most of the officers hired in order to help in solid waste recycling activities have no any training regarding technical know-how in any institution. It is important for the county governments to understand that adequate trained personnel are key in ensuring the sustainability and efficiency of solid waste recycling activities. Loss of funding is another problem which has been attributed to collapse of majority of the solid waste recycling initiatives.

Also, Alcott (2005) did a study in developing countries to ascertain how availability of qualified personnel impacted recycling of solid wastes. From his study he concluded that most projects regarding solid waste recycling failed due to unqualified personnel and also inadequate funding. This makes it difficult to undertake solid waste recycling projects in many of the parts in these countries.

Namilyango college in Kampala Uganda conducted a study to know what caused failure of most of the projects regarding solid waste recycling. They did research in Kampala (the capital city) and other major Ugandan cities. They concluded that most initiatives for recycling solid waste failed as a result of unqualified manpower and also insufficient funding. Kironde (2011) realized that human labor in Dar es Salaam in Tanzania was much inadequate. There are less personnel in the SWM which has been the reason for failure of many of the solid waste recycling activities in the city. Additionally, Kironde (2011) notes that most of the employees in the SWM are paid poorly and also have poor conditions. This has discouraged many qualified employees from joining the SWM sector. Even with the current unemployment levels in the country most people are shunning from joining the SWM sector due to low pay as found out by Onibokun (2009).

2.5.2 Financial Factors

Counties have failed to manage solid waste because of financial constraints. The high expenditure as a result of solid waste recycling services is a financial burden to most counties in Kenya. Brunner (1999) notes that less financial assistance, unpaying users and even less human resource has made it difficult to undertake solid waste recycling. Brunner (1999) recommends opting to involve the private sector in order to facilitate efficiency when it comes to solid waste recycling. SWM often takes a big amount of the total recurrent municipal budget.

Despite the high financial burden, the counties are struggling to give SWM services to the public as found out by Zaman & Lehmann (2011). Stats from USAID show that developing countries are struggling to spend around 20-50 % on activities related to solid waste recycling considering their budget is not sufficient. Most governments from these developing countries are on the view that it would be better to allow the private sector in provision of SWM considering the high cost of SWM services. Increasingly public–private

partnerships (PPP) have emerged as the best solution to improve SWM service performance at lower costs (Prakash, 1998). But even with a new partnership approach the financial aspects of municipal solid waste management remain critical for ensuring sustainability of the system. This concerns budgeting, cost accounting, financial monitoring and evaluation aiming at recovering sufficient money to cover recurrent operational expenditures of the collection service as well as to stock up capital for new investments or large maintenance. These methods are too seldom employed and the municipality rarely knows the actual cost of providing the service (Alcott, 2005). While external capital may often be needed for major investments, the recurrent costs should by preference be covered by a combination of user fees, and local taxes. However, cross-subsidization and financing from governmental sources may be needed to ensure equitable access to service (Alcott, 2005)

2.5.3 Stakeholder Involvement

A stakeholder is an individual or an organisation with a stake or even interest (for this case – solid waste recycling). There are persons and organisations involved in solid waste recycling: they include; informal sectors, community based organisations, non-governmental organisations, local authorities, formal sector and international donor according to Prakash, (1998).

Informal sector: there is a need to development the working conditions especially for those involved in collecting solid waste. Additionally, the market for selling solid waste should be improved. However, there is a high chance that introducing machinery in the informal sector will formalize the sector thus alienating the individuals who depend on the informal sector for their livelihoods. Odegi (1994) noted that waste collection was very organized amongst the pickers. From studies by UNCHS (1993), it is clear that the informal sector

has created many employment opportunities for the unemployed people in Asian countries like India.

Community based organisations: the CBO's have good opportunities to give SWM services. CBO's stakeholders have a massive effect on SWM. They determine whether the activities of discarding solid waste is creating any concern regarding the community health. Also, the members of the society not involved in the community based activities of solid waste recycling should also take part in recycling solid waste in the community's environment.

Non-governmental organisations: the NGO stakeholders work together with other stakeholders such as CBO's. NGOs play a crucial role since they give technical training regarding solid waste recycling to the other major stakeholders such as CBO. Besides, they give financial aid and mobilise the society on the need to support solid waste recycling. the best example showing the role of NGO is in Nairobi. The NGO has educated many CBO's in the capital city on how to make money from solid waste. According to Ondiege and Syagga (1990), the NGOs in Kenya have mobilised and motivated CBO groups especially from Kibera (an informal settlement in Nairobi) to make useful products from the solid waste materials. They have started an initiative known as "Garbage is Money" campaign. The main challenge facing this stakeholder (NGO) is lack of adequate finances and human resources. Besides, the NGOs have failed to give the community organizations adequate skills in marketing the products from recycling the solid waste. There is a need for the NGOs to train the community organizations marketing skills so that they may intensify selling of products from solid waste.

Local authorities: the major role of the local authorities is to enforce the laws governing solid waste disposal in the cities. The local authorities also participate in provision of

SWM services in the cities. However, the local authorities lack political will which is its major challenge in undertaking its role.

Formal Private Sector: the private sector has limited role in solid waste recycling in many cities. This stakeholder gives good solid waste recycling services to majority of the income businesses which earn more. The formal private sector offers expensive SWM services which may be expensive to majority of the people in the cities. The major challenge facing this stakeholder is the inability of some residents to pay for its services. Additionally the formal private sector faces challenge of accessibility to most of the areas especially in the rural areas.

The international donor community: the donor community is also involved in solid waste recycling. Donor agencies give funds to the NGOs as found out by Prakash (1998). The donor community also funds the CBOs thus making it participate in solid waste recycling activities in the community. Also, the international community gives help to the local authorities. They donate equipment which is essential for recycling solid waste as found out by Odegi (1994). It is important for the international community to support the development of networks which will facilitate recycling of solid waste materials. This network should also constitute the planners, NGOs, the formal private sector and also the CBOs so that they could share innovations to ensure effective methods of recycling solid waste as recommended by Ondiege and Syagga (1990).

Local authorities: The primary role of the NCC should be that of advisor to the other actors in solid waste recycling. This would entail reducing the NCC's role as a service provider to a minimum. The NCC should only be involved in the provision of services when it is not possible for the private or community sector to do so. The NCC cleansing sector

recognizes that this should be its role, but faces substantial barriers in its lack of political will on the part of city members of county assembly (Odegi 1994)

Formal private sector: The private sector does not have an important, although limited role to play in solid waste recycling in developing cities. The private sector is an effective provider of solid waste recycling services to upper income businesses and residential areas. However there is no by- law enforcing who can afford it to make use of these services. The NCC might consider implementing such a by-law enforcing those who can afford it to make use of these services.

NGO's should also initiate mass media and other types of educational campaigns to increase awareness about the hazards of unmanaged solid waste, even in upper income areas. Within informal settlements, the private sector cannot provide solid waste recycling because of the inability of the residents to pay for those services and the poor accessibility to those areas. Therefore, there is still a need for local authorities to work with CBO'S to improve services in those areas (Odegi 1994)

The international donor community: Many donor agencies already have extensive funding programs for NGO's in developing countries.(Prakash 1998). This is an effective method of funding local solid waste recycling initiatives since the NGO's and CBO's are often closer to the people than government, including local authorities. At the same time, the international community must provide assistance to local authorities' structure and equipment will not be sustainable in the long term because local authorities lack maintenance capacity (Odegi 1994). Finally, international organisations, with the full participation of NGO's and local authorities should support the creation of regional network which promotes solid waste recycling and reuse. The relationship between city planners, private sector, NGO's, CBO's and recycling industries would be useful in

sharing innovations and best practises in solid waste recycling. Such a network should also result in a powerful lobby (Ondiege and Syagga, 1990)

2.6 Knowledge Gaps

Knowledge gaps have been evident in this study regarding recycling of solid waste since most of the study done provides a hypothetical review without a solid scientific evidence. The national and regional scenes have been reluctant in studying solid waste recycling and most of the study is derived from the international front. Knowledge gaps have been evident and there is a need for the local scholars to do more research in the regional and local level in order to zero in those gaps.

The existing literature on solid waste recycling should be affirmed by more research and tests. The effects of technical factors on solid waste recycling should be studied be affirmed by more research on the topic. Innovations should be done in the local front in order to improve their solid waste recycling initiatives for effective waste management initiatives.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter delves into the design of the study. The chapter outlines the intended design of the study, the target population of the study as well as the process of identifying the sample that participated in the study as the respondents. Further, the chapter describes the intended study data collection procedures as well as the instruments used to collect the data. It will also provide strategy to be used in the data collection and analysis in order to answer the research questions. Finally, the chapter winds up by describing the data analysis methods and procedures.

3.2Research Design

A research design can be defined as an arrangement of collecting and also analysing data in a way which can combine relevance of the research and the economy involved in the procedures. It is simply the conceptual structure in which the research is done as found out by Orodho (2009). In the study, both qualitative and quantitative data were collected. The study used a descriptive research design which involved collection of data so as to answer the status of the study subject.

Descriptive design was adopted because it ascertains and even describes how the going is. Descriptive analysis explains the attitudes, values and even characteristics. This method was employed since it is effective in collection of descriptive data as claimed by Mugenda and Mugenda (2003). Besides, it analyses the current practices and also needs of the sample chosen. It was effective as it enabled the researcher to gather information when it comes to the opinion, perception, attitude and even the views of the respondent.

3.3 Target Population

The research was done in Machakos County having four major players in solid waste recycling that was, 4 employees from NEMA, 62 employees from Machakos County SWM department, 40 employees from Ministry of Public Health and Sanitation and 16 employees from Ministry of Housing(MOH) who formed the target population(Machakos County, Ministry of Housing and Ministry of Sanitation 2015).

3.4 Sample Size and Sampling Procedure

The sampling procedure was guided by the general rule in most social science research which suggested that the use of the largest sample will facilitate generalization (Nachmias, 1996). Stratified random sampling was used to categorise the four players into public health Machakos County Solid Waste Management department, NEMA and MOH. A census study was carried out in all the four players, that was, all the respondents from NEMA, 62 employees from Machakos County SWM department, 40 employees from Ministry of Public Health and Sanitation and 16 employees from the Ministry of Housing.

3.5 Methods of Data Collection

The research instrument used in conducting this research was the questionnaires and interview schedules. The questionnaire as a tool was used because it is familiar to most people (Nachmias, 1996). Almost all the respondents had an experience when it came to completion of the questionnaires which had been forwarded via the mail. Mugenda and Mugenda (2003) claim that the use of questionnaire is convenient especially when it is used for a large population of respondents. Questionnaires promote easy and also quick way of deriving data in a short time span.

The structure and unstructured were employed in order to get the response from the sample chosen. The questions which were structured ensured uniformity and were easy to

processes as also found out by Nachmias. The structured questionnaires incorporated as list of the alternatives which allowed the respondents to choose the suitable answer which described the current situation well. The respondents were expected to tick their choice. The researcher gave the respondents the questionnaires so as to avoid confusion as a result of 'drop and pick' methodology.

Mugenda and Mugenda (2003) also recommend the use of questionnaires since they are easy to analyse the data. Additionally, there are various statistical analysis soft wares such as SPSS which can be employed to process them efficiently. Questionnaires are termed objective since the responses can be collected via standardised ways.

3.6 Pilot Study

In order to ascertain whether we are studying the correct concept a pilot study was carried out before the actual administration of the study. Filing of the questionnaire was done on 5 respondents in the neighbourhood counties specifically Makueni and Kitui to see whether the questionnaires are reasonable and valid. Analysis of the 5 filed questionnaires was done with the help of an expert in order to validate the questions of the subject. The expert also examine whether or not the questions will be easy to be understood by the respondent.

3.7 Validity

Valid refers to the degree of accuracy and meaningfulness of influence based on research results. Content validity refers to the degree of to which the content of the item reflects the content domain of interest. It's the content about what we say the test is about? (Miller, 2003). Cresswell (2003) suggest the validity of the instrument is asking the right question framed from the ambiguous way and based on the study objectives. Validity of the data was done using content related validity. This was done by presenting the instrument to the supervisor to evaluate the applicability appropriateness of the content. Clarity and

adequacy of construction of the instrument in suggestions made and modified appropriately. This measures the degree to which data collected using particular instrument represents a specific domain of indicators or content of a particular concept (Mugenda and Mugenda, 2003). The indicators of variables were clearly defined and scrutinize and instruments developed to match them.

3.8 Reliability of the Study

Reliability of research tool is realised if it yields consistent information or data after repeat measurements are taken under the same conditions. The tools were pretested (Pilot testing) with the respondents from Kitui and Makueni County and the data obtained will not be included in the final analysis. The main purpose of pre-testing the research instrument is to identify any weakness and improve them. The pre-test was likely to give an indication of the time required to complete the tool. This respondents were retested a second time two weeks later and the consistency between the two sets of the will be computed using Cronbach's alpha coefficient which yielded an alpha of 0.8. Therefore, the instruments were found reliable since the alpha value obtained was to greater than or equal to 0.7 (Nunally, 1998)

3.9 Methods of Data Analysis

Primary data collected from this study was analysed using descriptive statistics including cross tabulation and frequency table. Cross tabulation was used to understand two different survey items and how they relate. Inferential statistics involving Pearson correlation coeffient and regression analysis will be used to establish associations between the determinants of solid waste recycling. Data will be analysed by feeding in a statistical package for social science (SPSS) and the output frequency tables and cross tabulation generated.

3.10 Operational Definition of Variables

The section shows operational definition of variables as shown in Table 1

Table 1

Research Objectives	Data collection instruments	Source of Data	Measuring scales	Data analysis techniques
To establish the influence of technical factors on solid waste recycling in Machakos County	Questionnaires and interview schedules	NEMA Ministry of Public Health and Sanitation Machakos County SWM department MOH	Nominal, ordinal and interval	Descriptive statistics like frequencies, and mean, Pearson correlation and regression analysis
To determine the influence of finances on solid waste recycling in Machakos County	Questionnaires and interview schedules	NEMA Ministry of Public Health and Sanitation Machakos County SWM department MOH	Nominal, ordinal and interval	Descriptive statistics like frequencies, and mean, Pearson correlation and regression analysis
To determine the influence of stakeholder	Questionnaires and interview schedules	NEMA Ministry of Public Health	Nominal, ordinal and interval	Descriptive statistics like frequencies, and

involvement in solid waste recycling in Machakos County		and Sanitation Machakos County SWM department MOH		mean, Pearson correlation and regression analysis

3.11 Ethical Issues

This study followed the proper research guidelines and procedures. The sources of the information employed in this study are acknowledged well as expected. Besides, on administering the questionnaires, consent was first sought then the questionnaires were issued. Also, the respondents were informed of their rights before the questionnaires had been given. They were guaranteed of full confidentiality and their identity was protected. Personal information of the respondents was only employed in the study. Besides, the respondents' names were not revealed. The respondents were informed on the potential limitations which could have arose. Adequate procedures were in place ensuring that the confidentiality of the participants was intact. The participants will be given the results of this study.

CHAPTER FOUR
DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents the results obtained from the study analyzed as per the three objectives of the study. The study had the following objectives: to establish the influence of technical factors on recycling of solid waste in Machakos County, to determine the influence of financial factors on recycling of solid waste in Machakos County, to determine the influence of stakeholder involvement on recycling of solid waste in Machakos county. The questionnaire return rate was 100% since all the 122 questionnaires were filled and returned.

4.2 Social demographic characteristics of the respondents

It refers to a group defined by its sociological and demographic characteristics. Demographic characteristics refer to age, sex, working experience and education level. Sociological characteristics are objective traits in this case technical factors, financial factors and stakeholders.

4.2.1 Age

The study looked to determine the age of the respondents from the Ministry of public health and sanitation, MOH, National Environmental Management Authority and the Machakos County SWM department. This was to help determine the age distribution for the respondents. These responses are shown in table 2. Results showed that most respondents were in age brackets of 21-50 years 86% and those above 50 years had 14%. From the stats it is evident that most of the participating respondents were aged 21-50 years. This meant that majority of respondents were of mature age and understood the factors influencing recycling of solid waste.

Table 2: Age distribution of respondents in Machakos County, Kenya

Age Distribution in years	Frequency	%
21-30 years	50	24.6
31-40 years	41	35.2
41-50 years	32	26.2
Above 50 years	17	14.0
Total	122	100.0

4.2.2 Gender

The study looked to determine the gender distribution among the participating respondents in NEMA, Machakos County SWM department, Ministry of Public Health and Sanitation and the MOH. The participants were requested to indicate their gender and the obtained results were shown in Table 3.

Table 3: Gender of respondents in Machakos County, Kenya

Gender	Frequency	%
Male	77	63.1
Female	45	36.9
Total	**122**	**100**

From the results in table 3, majority of the respondents were male 63.1% while the 36.9 were female. This is an indication that we had more male participating in recycling of solid waste.

4.2.3 Working experience

The study sought to find out the working experience of the respondents, how many years they were involved in recycling solid waste. The results are shown in Table 4.

Table 4: working experience of respondents in Machakos County, Kenya

Years	Frequency	%
Less than 5 years	43	35.2
5-10 years	20	16.4
10-15 years	26	21.3
15-20 years	17	14.0
More than 20 years	16	13.1
Total	122	100

The results revealed that 35.2% have been working for less than 5years, 16.4% have worked for 5-10 years and 13.1% for more than 20 years. This indicates that most respondents had enough experience knowledge and skills in recycling of solid waste in Machakos County. The results also show that the competence and skill increases with increase in years of performing the Job.

One of the interviews said that: '*working experience improves as the employee acquire numerous job knowledge which will enable him or her to perform tasks at considerably high levels'*

4.2.4 Educational level

The study looked to find out the formal education levels participants. This was to determine whether education levels of respondents had an influence on recycling of solid

waste in Machakos County. Participants were requested to indicate their level of education and the results were shown in table 5.

Table 5: Educational level of respondents in Machakos County, Kenya

Education Level	Frequency	%
Others	31	25.4
Diploma	46	37.7
Bachelor's Degree	26	21.3
Masters	17	14.0
PHD	2	1.6
Total	**122**	**100**

The findings on the level of education of the respondents pointed out that 25.4% of the respondents had certificates, 37.7% had a diploma educational level. 21.3% had degree education level, 14% had Master's Degree while 16% of respondents had a PhD education levels. This showed that majority of the respondents in Machakos County 63.1% have attained certificate and diplomas. The results show that 2(1.6%) PHD, 17(14.1%) Masters, 26(21.3%) Bachelors, 46(37.7%) Diploma, 31(25.4%) Certificates have had an education. This means the respondent's understood and responded to the questionnaires administered to them.

4.3 Technical factors

This section focuses on analysis of how technical factors like proper collection systems, proper qualifications of personnel, proper designed and operating sanitary land-fills and equipment availability influence effective solid waste recycling in Machakos County.

Table 6: Technical factors and recycling of Solid Waste

Variable	SA	A	U	D	SD
County is not efficient in waste generation, storage, collection and disposal of solid waste	30(24.6%)	45(36.9%)	11(9%)	25(20.5%)	11(9%)
County has enough equipment and personnel involved in solid waste recycling	9(7.4%)	25(20.5%)	9(2.4%)	57(46.7%)	22(18%)
County has weak solid waste collection, transportation and handling infrastructure	36(29.5%)	40(32.8%)	10(8.2%)	28(23%)	8(6.6%)
There is a number of active players involved in collection, transportation and disposal of solid wastes	15(12.3%)	33(27%)	7(5.7%)	36(29.5%)	31(25.4%)
There is very high solid waste generation within the county which cannot be handled by available equipment and vehicles	30(40.2%)	43(35.2%)	7(5.7%)	38(31.1%)	4(3.3%)
Personnel in solid waste management have adequate qualifications an skills	7(5.7%)	12(18%)	8(6.6%)	44(24.6%)	41(33.6%)
Waste workers have poor working conditions	41(33.6%)	57(46.7%)	6(4.9%)	16(13.1%)	2(1.6%)

N=122

Key: SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree

The results point out that the County is not efficient in solid waste storage, collection and safe disposal of waste; strongly agree (24.6%), agree (36.9%), undecided (9%), County did not have enough equipment and personnel involved in solid waste management; strongly agree (7.4%) agree (20.5%), disagree (46.7%), disagree (18%); County had weak solid waste collection, transportation and handling infrastructure; strongly agree, (29.5%), agree (32.8%), undecided (8.2%), disagree (23%)and strongly disagree (6.6%) there was a number of active players involved in waste collection, transportation and disposal. Strongly agree (12.3%), agree (27%), undecided (5.7%), disagree (31.1%) and strongly disagree (3.3%); personnel involved in waste management do not adequate qualification skills. Strongly agree (5.7%), agree (18%), undecided (6.6%), disagree (24.6%), strongly disagree (33.6%). Results also showed that workers had poor working conditions, strongly agree (33.6%), agree (46.7%), undecided (4.9%), disagree (13.1%) and strongly disagree (1.6%)

Table 7: Technical factors and recycling of solid waste

Effective Solid Waste recycling

Technical Factors	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Strongly Disagree	6	1	3	11	30	51
Disagree	9	1	2	5	10	27
Undecided	0	3	2	0	4	9
Agree	3	2	1	5	14	25
Strongly Agree	2	2	1	4	1	10
Total	20(16.3%)	9(7.4%)	9(7.4%)	25(20.5%)	59(48.3%)	122(100%)

The result from table 7 was to show whether technical factors played a role in effective solid waste recycling. The results illustrated that 68.8% of respondents agreed that financial factors influence effective solid waste recycling, 23.7% disagreed while 7.4% of respondents were undecided

4.4 Financial factors

This section focuses on how financial factors like budget, capacity to pay for services and sufficient allocation of funds influence recycling of solid waste in Machakos County.

Table 8: Financial Factors and recycling of Solid Waste

Recycling of Solid Waste

Financial Factors	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**	**Total**
Strongly Disagree	11	1	2	5	8	27
Disagree	6	1	3	11	30	51
Undecided	0	3	2	0	4	9
Agree	3	2	1	5	14	25
Strongly Agree	2	2	1	4	1	10
Total	**22(18%)**	**9(7.4%)**	**9(7.4%)**	**25(20.5%)**	**57(46.7%)**	**122(100%)**

Table 9: Financial factors and recycling of solid waste

Variable	SA	A	U	D	SD
There is enough budget allocation for provision of SWM services in the county	17(13.9%)	28(23%)	12(9.8%)	41(33.6%)	24(19.7%)
County has capacity to pay for those involved in collection of waste	10(8.2%)	28(23%)	7(5.7%)	45(36.9%)	32(26.2%)
Limited funds are allocated for SWM by County Government	24(19.7%)	39(32%)	12(9.8%)	40(32.8%)	7(5.7%)
There is sufficient funds allocated for promoting waste reduction, recycling and recovery	10(8.2%)	20(20.5%)	9(7.4%)	51(41.8%)	27(22.1%)

The results showed that there is enough budget allocation for provision of SWM services in the County Strongly Agree (13.9%), Agree (23%), Undecided (9.8%), Disagree (33.6%), Strongly Disagree (19.7%); County has capacity to pay for those involved in collection of waste Strongly Agree (8.2%), Agree (23%), Undecided (5.7%), Disagree (36.9%), Strongly Disagree (26.2%); Limited funds are allocated for waste management by County Government Strongly Agree (19.7%), Agree (32%), Undecided (9.8%), Disagree (32.8%), Strongly Disagree (5.7%); There is sufficient funds allocated for waste reduction, recycling and recovery Strongly Agree (8.2%), Agree (20.5%), Undecided (7.4%), Disagree (41.8%), Strongly Disagree (22.1%)

The result from table 9 was to show whether finances have an influence on recycling solid waste. The results illustrated that 67.2% of respondents agreed that financial factors influence recycling of solid waste, 25.4% disagreed while 7.4% of respondents were (Kim & Kamata, 2011) revealed that one principal reasons for not recycling solid waste in developing countries in financial constraints. Recycling solid waste has low priority especially in the developing countries. Only in the capital cities and other major cities are activities of solid waste recycling are done in these countries due to the limited funding which only funds the cities leaving other parts.

4.5 Stakeholder involvement and recycling of solid waste

This section focuses on stakeholders involvement factors like authority and environmental rules and organization capacity that influence effective solid waste recycle in Machakos County. Organization capacity influence effective solid waste recycle in Machakos County.

Table 10: Stakeholder involvement and Recycling of solid waste

Variable	SA	A	U	D	SD
County lacks public awareness on solid waste recycling	37(30.3%)	46(37.7%)	14(11.5%)	17(39%)	8(6.6%)
There is lack of information about local initiatives concerning solid waste recycling	31(25.4%)	56(49.5%)	14(11.5%)	18(14.8%)	3(2.5%)
The County council lacks a policy on waste reduction at the source and on involving community groups	32(26.2%)	54(44.3%)	10(8.2%)	19(15.6%)	7(5.7%)
County lacks clear authority and sanitation rules	33(27%)	44(36.1%)	10(8.2%)	24(19.7%)	11(9%)

N=122

Key: SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree

The results on the influence of stakeholders involvement in effective solid waste recycling in table 10 points out that county lacked public awareness on Solid waste recycling: strongly agree (30.3%) agree (37.7), undecided (11.5%), agree (13.9%) and strongly agree (6.6%); there was lack of information about local initiatives concerning solid waste recycling; strongly agree (25.4%), agree (45.9%), undecided (11.5%), disagree (14.8%) and strongly disagree (2.5%), the county lacked public policy on waste reduction at the source. Involvement of community groups result showed, strongly agree (26.2%), agree (44.3%), undecided (8.2%), disagree (19.7%), and strongly disagree (9%). The findings

from the interview schedule indicated that the county was inadequate in creation of awareness to the community on recycling.

Table 11: Stakeholders involvement and Effective Solid Waste Recycle

Institutional Factors	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**	**Total**
Strongly Disagree	9	1	2	5	8	27
Disagree	6	1	3	11	30	51
Undecided	0	3	2	0	4	9
Agree	3	2	1	5	14	25
Strongly Agree	2	2	1	4	1	10
Total	**20(24.4%)**	**8(9.8%)**	**11(13.4%)**	**26(31.7%)**	**57(46.7%)**	**122(100%)**

Table 11 shows that 78.4% of respondents agree that failure of stakeholders involvement have hindered effective solid waste management, 13.4% are undecided and 34.2% disagree that the stakeholders involvement actually play a role in solid waste recycling.

These results are in agreement with (Freudenrich, 2014) that carried out a research on stakeholder involvement that is in agreement with the results of this study that the stakeholders influence solid waste recycling

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSIONS AND CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of study findings, conclusions drawn, recommendations based on the conclusions and suggestions for further research.

5.2 Summary of the Findings

The study had the following objectives: to examine how financial factors influence effective recycling of solid waste in Machakos County; to establish the extent to which technical factors influence effective Solid Waste Recycling in Machakos County; to determine how stakeholder involvement influence recycling of solid waste in Machakos County.

Most of the respondents were in the age bracket of 21-50 years. This meant that majority of the respondents were mature middle age people and understood the determinants of effective Solid Waste Recycling in Machakos County. This age group has a high proportion that is actively engaged in effective Solid Waste Recycling in Machakos County. Stats showed that more males did effective Solid Waste Recycling in Machakos County than females. The results illustrated that 35.2% of the respondents have worked for less than 5 years, 16.4% had been working for a period of 5-10 years.

According to the working experience, 21.3% had been working for 10- 66 15 years, 14% for 15-20 years and 13.1% for more than 20 years. The results further showed 25.4% of respondents had certificates. 37.7% had diploma education level. 21.3% had degree education level. 14% had masters' degrees .1.6% of respondents had PhD education level.

There was a further prove that education levels of the respondents played a vital role on proper Solid Waste Recycling in Machakos County The study findings on the influence of economic factors on effective Solid Waste Recycling in Machakos County disclosed that financial factors with reference to charges, budget allocation, county capacity to pay for those who participate in collection of litter and sufficiency of funds for promotion of waste reduction, recycling and recovery led to inefficient effective Solid Waste Recycling in Machakos County.

Technical factors like proper collection systems, professional qualifications of personnel, proper designed, operating sanitary land-fills and equipment availability were not efficient in addressing effective Solid Waste Recycling in Machakos County. There were low levels of technical factors and these had marginal associations on the effectiveness of Solid Waste Recycling in Machakos County.

Results on the stakeholders' involvement revealed the county's was doing poor when it came to public awareness on the need of recycling solid waste. Also, the main stakeholders in SWM failed to formulate policies regarding waste reduction. Additionally, the stakeholders did not work together in addressing the issue of solid waste. The failure of the local authorities to constitute clear rules regarding sanitation reduced the effectiveness of the solid waste recycling activities.

5.3 Discussions

Age

The age group 31-40 carried the highest proportion of the population that is actively engaged in recycling of solid waste in Machakos County. These findings were consistent with the research carried out by Mulder et al (2014) who realized that old workers were more reliable and also had more skills compared to the other workers since they had more

experience. Additionally, Mulder et al (2014) also found out that older workers were more flexible and could easily accept new assignments. They also require less training to adjust to new duties. However, age could not be used alone to predict the individual performance in the study. Variations were noted.

Gender

Statistics showed that many males compared to females were involved in recycling solid waste in Machakos County than females. Prakash (1998) had noted that women in most developing countries have a low social and economic status and thus there participation in recycling solid waste in Machakos County was hampered. The sentiments by Ondiege and Syagga (1990) contradicted this findings by illustrating that women performed important roles and there role in fulfilling agricultural production and even development was considerable. For this reason, it is not possible to assume their role and relevance in the society.

Working Experience

Competence can be properly defined as the state of one being able to perform a specific task quite well. Odegi (1994) claims that people often acquire competence via training education and also experience. However, he considers the characteristic of an individual which may lead to effective performance on the specific task. The study findings were supported by Baird (2004) regarding job performance and experience. The findings showed that work experience affected the task performance in numerous ways. From the assumption made that task performance reflected on the proficiency when undertaking the specified duty, it is evident that job performance increases with the experience one attains with time due to obtaining more knowledge regarding the task undertaken (Grosse, 2010).

Education level

Through the data collected, it was a further proves that educational level of the respondents played a vital role on recycling of solid waste.

Technical factors

The findings on technical factors agreed with the findings of Huesemann and Huesemann, (2011) who established that the county is not efficient in waste generation,storage,collection and safe disposal of waste. The county did not have enough equipment and personnel involved in recycling of solid waste. There was a number of active players participating in solid waste collection, transportation and also disposal. Stats showed that the personnel involved in waste recycling do not have adequate qualification skills. The result also showed that the workers had poor working conditions.

Financial factors

The study finding disclosed that financial factors in terms recovery service charge, budget allocation and even their willingness to pay influence recycling of solid matter were inadequate to promote recycling of solid waste in Machakos County. In their research Kim and Kamata (2011) revealed that one principle reason for ineffective recycling of solid waste systems in majority of the developing countries especially in Africa and Asia is financial constraints. Recycling of solid waste matter is usually not given priority in those countries. Priority is given to solid waste recycling in the main cities due to the limited funding for the activities of solid waste recycling.

Stakeholder involvement

Results on stakeholder involvement on recycling of waste pointed out that the lives of people in informal sector can be improved through recycling of waste. Odegi 1994

confirms this in a study he carried out on economics of garbage collection and found out that stakeholders have an influence on recycling of solid waste. Community members were not active I community based organizations and NGO's offered little and/or no training and education to people regarding recycling of solid waste.

5.4 Conclusions

The study had the following conclusions:

i) Financial factors like recovery service charges, budget allocation, and county capacity to pay for those involved in collection of litter and sufficiency of funds for promotion of waste reduction, recycling and recovery had low levels and this led to influence of Solid Waste Recycling in Machakos County.

ii) Technical factors like proper collection systems, professional qualifications of personnel, proper designed and operating sanitary land-fills and equipment availability were not efficient in addressing effective Solid Waste Recycling in Machakos County. Technical factors had marginal associations on the effectiveness of effective Solid Waste Recycling.

iii) Stakeholders-involvement like informal sectors, community based organisations, NGO's local authourities, formal private sector and the international donor community influences Solid Waste Recycling.

5.5 Recommendations

The following recommendations were made based on the findings and the conclusions of this study:

The County government should allocate enough budgets for provision of SWM services within municipality which should be reviewed periodically to ascertain if the monies are put to correct use and to ensure recycling of solid waste is done. The county ought to

emphasis on developing proper ways of ensuring solid waste is either reused, recycled or composted.

The county government has a duty as facilitator of initiatives regarding solid waste recycling to support the businesses and also the communities. It should fund, train, provide required technical assistance and even monitor the programs for solid waste recycling in the county.

For solid waste to be recycled there has to be proper collection systems, professional qualifications of personnel, proper designed and operating sanitary land-fills and equipment availability in order to minimize pollution to the environment and the occurrence of related health hazards. MSW is essential since it is a raw material which can be used to give adequate energy and also produce fertilizer. To improve the capability of MSW in recycling solid waste, there is a need to employ more personnel who will streamline the processes of collecting and sorting the solid waste.

The county administration ought to emphasis of good solid waste recycling practices. Besides, they should develop market for both the solid wastes and products from solid waste materials. They are able to do this when they formulate good policies and also provide economic incentives. They should also enforce regulations pertaining solid waste recycling practices in the county.

They should also start campaigns which will be advocating for solid waste recycling in the county. Rewarding and recognition for the best performing individuals in waste recycling would also be helpful since it will promote the public's awareness regarding recycling of solid waste materials. Additionally, it will encourage other individuals in the society to employ the same approaches to recycle solid waste.

5.6 Suggestions for Further Research

The following suggestions were made for further research:

A similar study should be conducted in other counties within the Republic of Kenya to ascertain if same results can be achieved.

A study should be carried out on the influence of Government policies on factors influencing Recycling of solid waste.

A study should be conducted to establish the influence of other stakeholders like NGOs and CBO's on factors influencing Recycling of Solid Waste

A study should be conducted to establish the influence of public's awareness of initiatives on Solid Waste Recycling.

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APPENDICES

APPENDIX I: INTRODUCTORY LETTER

To Whom It May Concern,

Dear Sir/Madam,

This is to kindly inform you that I am a student at the University of Nairobi pursuing a Master's Degree in Project Planning and Management and as part of course requirements, we are expected to carry out a research project work of which we are researching on "Factors influencing waste recycling in urban areas. A case study of Machakos County.

The purpose of this letter is to request you to assist me by responding to the questionnaire and returning them to me. You are further assured that any information given will be used for the purpose of the study only and will be treated with the confidentiality required.

I shall be glad to share a copy of the final report with you (please indicate your mailing address in the questionnaire).

I look forward to your assistance and co-operation.

Yours faithfully,

Eboso Susan Midika

APPENDIX II: QUESTIONNAIRE

SECTION ONE:

Dear Respondent,

I am a graduate student at the University of Nairobi pursuing a Masters in Project Planning and Management and currently conducting a survey on how technological factors influence waste recycling in Machakos County. Kindly take your valuable time to fill out this questionnaire. All the information provided will be treated with the strictest confidence, and will be used for the purpose of this study only. The results will be produced in the form of aggregated data.

SECTION ONE: DEMOGRAPHIC INFORMATION

1. Gender?

a. Male ❑

b. Female ❑

2. Age?

a. Below 20 years ❑

b. 21-30 years ❑

c. 31-40 years ❑

d. 41-50 years ❑

e. Above50 ❑

3. For how long did you/have you work in Machakos County?

a) Less than 5 ❑

b) 5-10 years ❑

c) 10-15 years ❑

d) 15-20 years ❑

e) 20 and above years ❑

4. What is your highest level of education?

a) Diploma ❑ d. Bachelor's degree ❑

b) Masters ❑ e. PHD ❑

c) Others (specify)

……..…….

5. Ever heard of solid waste recycling in Machakos County?

Yes❑ No❑

6. Does solid waste recycling have any effect on the socio economic aspect of your society?.....
.....
.....

7. How much do you spent on disposal of solid waste in your home per month?

a) >Ksh 100❑ c) Ksh 500>Ksh1000❑

b) Ksh100>Ksh500❑ d)>Ksh1000❑

8. Do you think the industries in the county are disposing solid waste appropriately?

Yes❑ No❑

SECTION TWO: TECHNICAL FACTORS ON RECYCLING SOLID WASTE

Does Technical factors influence waste recycling in Machakos County?

□ YES □ NO

Indicate the extent to which the following Technological Aspect influence Machakos County in a scale of 1-5 where: 1 = strongly agree, 2 = Agree, 3 = undecided or Neutral, 4 = Disagree and 5 = strongly disagree respectively.

No.	Questions	Strongly Agree	Agree	Undecided or Neutral	Disagree	Strongly Disagree
		1	2	3	4	5
1	Is Machakos County efficient in waste generation storage, collection and disposal of waste					
2	Does Machakos county have enough equipment and personnel involved in solid waste recycling?					
3	Does the Machakos have a weak collection, transport and handling infrustructure					
4	Does Machakos County have a number of active players involved in collection, transportation and disposal of wastes					
5	There is a high waste generation within the county which cannot be					

	handled by available equipment and vehicles?					
6	Personnel in solid waste management have adequate qualification skills					
7	Solid waste workers have poor working conditions					
8	Does the county have proper designed and operating sanitary land fills					

SECTION THREE: FINANCIAL FACTOR ON WASTE RECYCLING IN MACHAKOS COUNTY.

Does Financial factors influence waste recycling in Machakos County?

 YES NO

Indicate the extent to which the following financial factors influence waste recycling in Machakos County in a scale of 1-5 where: 1 = strongly agree, 2 = Agree, 3 = undecided or Neutral, 4 = Disagree and 5 = strongly disagree respectively.

No.	Questions	Strongly Agree	Agree	Undecided or Neutral	Disagree	Strongly Disagree
		1	2	3	4	5
1	That the county has sufficient financial resources to fund waste recycling initiatives in Machakos County, Kenya					
2	That the income of the society can be enough for them to manage waste recycling in Machakos County, Kenya					

3	There is enough budget allocation for the provision of solid waste recycling in Machakos County					
4	That the cost of maintaining waste recycling projects cannot affect the economy of the county in Machakos County, Kenya					
5	That the County have the capacity to pay those involved solid waste recycling					

SECTION FOUR: STAKEHOLDER INVOLVEMENT ON WASTE RECYCLING N MACHAKOS COUNTY, KENYA

Does Stakeholder involvement influence waste recycling in Machakos County?

□ YES □ NO

Indicate the extent to which the following stakeholder involvement influence waste recycling in Machakos County in a scale of 1-5 where: 1 = strongly agree, 2 = Agree, 3 = undecided or Neutral, 4 = Disagree and 5 = strongly disagree respectively.

No.	Questions	Strongly Agree	Agree	Undecided or Neutral	Disagree	Strongly Disagree
		1	2	3	4	5
1	That the lives of people in informal sectors are improved because of solid waste recycling in Machakos County, Kenya					

2	That the community members are active in community based organizations in relation to solid waste recycling Machakos County, Kenya					
3	That within the informal settlement, the private sector provide waste recycling because of the ability to pay for those services in Machakos county					
4	That the NGO's offer education and mobilizing of broad based support for community based solid waste recycling					
5	That the NGO's have been effective in providing groups with marketing skills they need to generate a profit through composting					
6	That many donor agencies have extensive funding programs to NGO's in Machakoos county to deal with solid waste recycling					

SECTION FIVE: MEASURE OF THE DEPENDENT VARIABLE

Indicate the extent to which the following statements influence waste recycling in Machakos County.

No.	Questions	Strongly Agree	Agree	Undecided or Neutral	Disagree	Strongly Disagree
		1	2	3	4	5
1	Technical factors influence waste recycling in Machakos County					
2	Financial factors influence waste recycling in Machakos County					
3	Stake holder involvement influence waste recycling in Machakos County					

THANK YOU FOR TAKING YOUR TIME TO PARTICIPATE IN THIS SURVEY

APPENDIX III: INTERVIEW GUIDE

1. Do you think technical factors influence recycling of solid waste in Machakos County?
2. Do you think financial factors influence recycling of solid waste in Machakos County?
3. Do you think stakeholder involvement influence recycling of solid waste in Machakos County?

APPENDIX IV: WORK PLAN

Period / Item	December 2015	January 2016	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016
Problem Identification								
Literature Review								
Proposal Writing								
Handing over proposal								
Development of Research instruments								
Data Collection								
Data Analysis								
Report Writing								
Handing over report for assessment								

APPENDIX V: BUDGET

PARTICULARS	**COST**	
ITEM	**Shs**	**Cts**
Writing materials	6,000	00
Travel expenses	20,000	00
Fuel/ electricity	10,000	00
Typesetting data/ instrument	10,000	00
Typesetting report	6,000	00
Proof reading	4,000	00
Printing	7,000	00
Re-typesetting	10,000	00
Final document	5,000	00
Researchers upkeep	40,000	00
Refreshments	20,000	00
Miscellaneous	10,000	00
Total	**148,000**	**00**