

**DETERMINANTS OF EFFECTIVE SOLID WASTE  
MANAGEMENT IN BOMET TOWN,  
BOMET COUNTY, KENYA.**

**BY**

**KORIR DAVID KIPKEMOI**

**A research report submitted in partial fulfilment of the requirements  
for the award of degree of Master of Arts in project planning and  
management of the University of Nairobi.**

**2018**

## **DECLARATION**

This research report is my original work and has not been presented for examination in any other Institution.

Signature ..... Date .....

**Korir David Kipkemoi**

**L50/89905/2016**

This research report has been submitted for examination with my approval as the University Supervisor

Signature .....Date .....

**Dr. Moses Otieno**

Lecturer, School of Open and distance learning, University of Nairobi.

## **DEDICATION**

This research report is dedicated to my lovely wife Eunice Korir and our young daughter, Joy Cherono for encouragement and the much needed moral support in the process of putting together this report.

## **ACKNOWLEDGEMENT**

I wish to appreciate in a special way my supervisor Dr. Moses Otieno for his tireless encouragement, positive criticism and professional guidance in the process of developing this research report. His scholarly guidance, encouragement, constructive comments and invaluable suggestions have been a great source of inspiration to me in putting together this report.

My sincere appreciation goes to the University of Nairobi for the opportunity given to me to be part of the great institution during the course of my study. The staff from Kisii Open and distance learning centre led by Henry Kebabe were of great help to me all the way to the end of my course work.

My colleagues including Steve Kombich, Joseph Maiyo, and Sharon Chelangat among others were of great help in putting together this report in the form of generating useful ideas, advice and invaluable group discussions all the way.

Finally I thank my family; wife Eunice Korir, sons Edward, Raymond and Denis together with daughter Joy for their support and constant encouragement throughout this project. They have always supported me in the pursuit of my academic and indeed all my life goals. They have always stood by me through the good and the bad times. They were also with me for every step of the long and tedious journey of completing this project and I can never properly express how much their love and support has propelled my successes in life.

## TABLE OF CONTENTS

<b>Title</b>	<b>Page</b>
<b>DECLARATION</b> .....	ii
<b>DEDICATION</b> .....	iii
<b>ACKNOWLEDGEMENT</b> .....	iv
<b>REFERENCES</b> .....	viii
<b>APPENDICES</b> .....	viii
<b>LIST OF FIGURES</b> .....	ix
<b>LIST OF TABLES</b> .....	x
<b>LIST OF ABBREVIATIONS AND ACRONYMS</b> .....	xi
<b>ABSTRACT</b> .....	xiii
<b>CHAPTER ONE: INTRODUCTION</b>	
1.1 Background of the Study.....	1
1.2 Statement of the Problem.....	4
1.3 Purpose of the study.....	5
1.4 Objectives of the study.....	5
1.5 Research Questions.....	5
1.6 Null Hypothesis .....	6
1.7 Significance of the study.....	6
1.8 Limitation of the study .....	7
1.9 Delimitation of the study .....	7
1.10 Basic assumptions of the study .....	7
1.11 Definitions of significant terms .....	7
1.12 Organization of the study .....	8

## **CHAPTER TWO: LITERATURE REVIEW**

2.1 Introduction.....	10
2.2 Empirical review.....	10
2.2.1 Impact of solid waste management on human health and environment.....	11
2.2.2 Sustainable solid waste management and development .....	16
2.3 Determinants of solid waste management .....	18
2.3.1 Influence of financial resources on solid waste management .....	19
2.3.2 Influence of technical skills on solid waste management .....	20
2.3.3 Influence of community participation on solid waste management .....	21
2.3.4 Influence of institutional capacity on solid waste management .....	22
2.4 Theoretical framework.....	23
2.4.1 Systems theory.....	23
2.4.2 Theory of reasoned action.....	24
2.5 Conceptual framework .....	26
2.6 Research gaps.....	27
2.7 Summary of literature review.....	28

## **CHAPTER THREE: RESEARCH METHODOLOGY**

3.1 Introduction.....	29
3.2 Research Design.....	29
3.3 Target Population .....	30
3.3.1 Sample Size .....	30
3.4 Sampling Techniques .....	31
3.5 Research Instruments.....	31
3.5.1 Questionnaire.....	32
3.6 Validity and Reliability of research instruments.....	32
3.6.1 Validity of the instruments.....	32

3.6.2 Reliability of the instruments.....	33
3.7 Data collection process.....	33
3.8 Methods of data Analysis .....	34
3.9 Ethical Considerations.....	34
3.10 Operationalization of variables.....	35

#### **CHAPTER FOUR; DATA ANALYSIS AND INTERPRATATION**

4.1 Introduction .....	37
4.2 Response rate of respondents .....	37
4.3 Demographic information of respondents .....	37
4.3.1 Age bracket of respondents .....	38
4.3.2 Level of education of respondents .....	39
4.3.3 Occupation of respondents .....	39
4.3.4 Residency of respondents .....	40
4.4 Garbage collection .....	40
4.4.1 Frequency of garbage collection .....	40
4.4.2 Garbage pile up .....	41
4.4.3 Waste collection ability by County government .....	42
4.4.4 Service to Bomet town by County government .....	42
4.4.5 Respondent’s satisfaction on waste collection .....	43
4.5 Study variables .....	43
4.5.1 Technical factors and effective solid waste management .....	43
4.5.2 Financial factors and effective solid waste management .....	44
4.5.3 Institutional factors and effective solid waste management .....	46
4.5.4 Community participation and effective solid waste management .....	47

**CHAPTER FIVE; SUMMARY OF FINDINGS, CONCLUSIONS AND  
RECOMMENDATIONS**

5.1 Introduction .....	49
5.2 Summary of the findings .....	49
5.3 Discussion of findings of the study .....	49
5.4 Conclusions of the study .....	51
5.5 Recommendations of the study .....	51
5.6 Suggestions for further research .....	52
<b>REFERENCES</b> .....	53
<b>APPENDICES</b> .....	59
Appendix I; Letter of transmittal .....	59
Appendix II; Questionnaire.....	60
Appendix III; Time schedule.....	64
Appendix IV; Budget.....	65

## LIST OF FIGURES

	<b>Page</b>
Figure 2.1; Optimal waste management strategy .....	18
Figure 2.2; Theoretical framework.....	25
Figure 2.3; Conceptual framework.....	27

## LIST OF TABLES

	<b>Page</b>
Table 3.1; Study respondents.....	30
Table 3.2; Respondents response options .....	34
Table 3.3; Operational definition of variables.....	36
Table 4.1; Respondent's response rate .....	37
Table 4.2; Gender of respondents .....	38
Table 4.3; Age bracket of respondents .....	38
Table 4.4; Level of education of respondents .....	39
Table 4.5; Occupation of respondents .....	39
Table 4.6; Residency of respondents .....	40
Table 4.7; Frequency of waste collection .....	41
Table 4.8; Waste pile up .....	41
Table 4.9; Ability of County government to collect waste .....	42
Table 4.10; Service by the County government .....	42
Table 4.11; Waste collection satisfaction of respondents .....	43
Table 4.12; Technical factors and solid waste management.....	44
Table 4.13 Financial factors and solid waste management .....	45
Table 4.14; Institutional factors and solid waste management .....	46
Table 4.15; Community participation and solid waste management .....	47

## LIST OF ABBREVIATIONS AND ACRONYMS

<b>AD</b>	Anno Domino
<b>CBD</b>	Central Business District
<b>CBS</b>	Central Bureau of Statistics
<b>CO<sub>2</sub></b>	Carbon Dioxide
<b>CH<sub>4</sub></b>	Methane
<b>DN</b>	Daily Nation
<b>EEA</b>	European Economic Area
<b>ICT</b>	Information and Communication Technology
<b>IDO</b>	Industrial Diesel Oil
<b>IPA</b>	Innovations for Poverty Actions
<b>JICA</b>	Japanese International Cooperation Agency
<b>KCC</b>	Kampala County Council
<b>KCG</b>	Kisumu County Government
<b>KMA</b>	Kumasi Metropolitan Assembly
<b>KNBS</b>	Kenya National Bureau of Statistics
<b>SWM</b>	Solid Waste Management
<b>NEMA</b>	National Environmental Management Authority
<b>NIMBY</b>	Not In My Back Yard
<b>NGO</b>	Non-Governmental Organization
<b>PPP</b>	Public Private Partnership
<b>ROSA</b>	Resource-Oriented Sanitation
<b>SPSS</b>	Statistical Package for the Social Sciences
<b>SWM</b>	Solid Waste Management
<b>SWMS</b>	Solid Waste Management System
<b>TRA</b>	Theory of Reasoned Action

<b>TQM</b>	Total Quality Management
<b>UN</b>	United Nations
<b>UNDEA</b>	United Nations, Department of Economic and Social Affairs
<b>UNFPA</b>	United Nations Fund for Population Activities
<b>USAID</b>	United States Agency for International Development
<b>USEPA</b>	United States Environmental Protection Agency
<b>WHO</b>	World Health Organization

## ABSTRACT

The management and disposal of solid waste has become a challenge in Bomet town, Bomet County. This is evidenced by the persistent stockpiles of uncollected waste found on almost all back streets and other open spaces or illegal dumps all over the town. The purpose of this study was to establish determinants of effective management of solid waste in Bomet town. The study focused on technology, availability of financial resources, community participation and the policies on solid waste management by the County government of Bomet. The sample of the study consisted of 160 respondents; 140 of whom were randomly selected household heads from the core urban population of Bomet town while key informants were purposively selected as follows; 10 from Bomet County government's waste management office, 5 from National Environment Management Authority (NEMA) and 5 from public health office. Data collection was done through questionnaires and interviews respectively. Analysis of the data was done using descriptive statistics which included frequencies and percentages. Cross tabulations was done by use of Statistical Package for Social Sciences (SPSS) version 20 software and Coefficient of internal consistency of the questionnaire calculated using the Cronbach's alpha formula to show the relationship between various variables and test the significance of the solid waste management variables respectively. The study came up with recommendations as follows; the government should allocate enough finances for provision of SWM services within the urban area of Bomet town and increase the SWM's capacity to manage waste from residential and business areas, hire more employees for collection, sorting, composting and management. Educational activities such as the organisation of conferences, seminars and workshops, publication of training manuals, case studies and best practices, and provision of technical and financial assistance should be conducted. The study suggests further research on other social factors affecting the performance of Sustainable solid waste in Bomet town which may not have been identified in this study. Another suggestion is a study on the treatment of the solid waste at the final stages and its effects on human health.

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of the study

Urbanization has become a global phenomenon with its consequences being more pronounced mostly in developing countries. The main drivers of this trend are presumed to be high rate of population growth, declining opportunities in rural areas and shift from stagnant and low paying agricultural sector to more assumedly paying urban occupations. The resultant rise in rural-urban migration has led to the flourishing of slums and the growth of squatters and informal housing all around the rapidly expanding towns and cities of the developing world. Urbanization directly contributes to unplanned for and therefore uncontrolled solid waste generation. Unscientific waste handling causes health hazards and environmental degradation according to Napoleon, *et al* (2011). Throughout history, human development has been associated majorly to planning for the management of solid waste due to its effects on both the human health and environmental conservation. One of the first instances of waste management occurred in the 4th century A.D. with the ancient Greeks according to Nathanson (2015)

The plagues that affected Europe between the 14th and 16th centuries were often spread by vermin that thrived in the unsanitary urban conditions that were common during this time. It was in the 18th century that municipal collection of garbage begun in some of the world's major cities, but the methods were still fairly crude according to Banga (2011). In the latter part of the 19th century and into the 20th century, technological advances including the use of garbage cans and creation of incinerators and sanitary landfills began to be used; the latter replacing the practice of open dumping and becoming a common practice in the developed world according to Hoornweg & Giannelli, (2007).

With the passing of the Clean Air Act in the United States in 1970, many early incinerators without air pollution controls were shut down and replaced with modern waste -to-energy plants (Tangri, 2003). The modern waste management

industry in the developed world has come far, and with recycling and other advances it will continue to grow and change with the needs of the community. Presently, SWM conditions in the developing world are quite dire; more reminiscent of conditions found in past in the now developed world (Ojedokun, 2011)

In a study conducted in India, it was found that when citizens were exposed to open dumping and burning of waste they developed increased health problems due to the release of dangerous toxins such as dioxins, which are known to cause cancer and other health challenges according to U.S. Department of Health and Human Services, (2001). The majority of urban centres in India dispose their solid waste by depositing it in low-lying areas outside the city without following the principles of sanitary landfilling such as leachate collection and monitoring that make this disposal method unsustainable. In both rural and urban areas, open burning of household waste has become commonplace in areas where collection is limited or non-existent altogether, postulates Kama Vasisth (2011).

Most of the cities in Ghana practice the open dump system of waste disposal, which is in a more or less uncontrolled manner. Since the system is not highly engineered, it poses numerous challenges to both public health and the environment. According to Asase (2011), the city of Kumasi is estimated to generate close 500 tons of solid waste daily according to the the 2006 projected population of 1,610,867 people.

According to Kruljac (2012), South Africa has taken huge culculated steps towards an improved, equitable and sustainable waste management system. With good legislation in place, clarity in functional roles and responsibilities, international lessons and commitments, and sufficient technical capacity together with human capital, the South African approach demonstrates the country's commitment towards an efficient world class system for waste management. This is what has enabled South Africa to remains in the forefront on environmental protection amongst developing countries and is committed to implementing a world class system that will improve waste management in the country.

In Uganda, the rapid and often unregulated growth of the urban areas has in many ways outpaced the ability of the urban authorities to provide adequate housing, sewers and collection of solid waste amongst other challenges. Although the environmental problems associated with garbage do not disappear with collection, uncollected garbage worsens many of the environmental hazards associated with urban settlement. Uncontrolled waste disposal by burning and dumping adds to atmospheric and hydrologic pollution loads, clogs waterways and increases the danger of flooding according to Okot-Okumu (2012).

Kenya has a growing human population and an increase in urbanization which has resulted in indiscriminate disposal of solid wastes at the river sides, road reserves and backstreets. The urban centres have attracted a large population of informal settlement dwellers as well as the middle class. Despite the existence of laws and policies guiding waste management, weak implementation and poor practices have led to towns and cities being overwhelmed by their own waste, consequently affecting public health and the environment as observed by Henry, Yongsheng & Jun, (2010).

A study done in Nairobi indicates that about 30-40% of the waste generated is not collected and less than 50% of the population is served (UN-Habitat, 2010). In Nakuru, it is estimated that 45% of the waste generated is collected and disposed of at Giotto Dumpsite, 18% is recovered and the rest accumulate in the environment (ROSA Project, 2007). As the urban population in Nairobi and elsewhere in East Africa grows, so does the solid waste management burden, a situation worsened by poor funding for urban sanitation departments and lack of enforcement of sanitation regulations. At least 100 million people in East Africa lack access to improved sanitation according to Lubaale, & Musyoki (2011). Without proper controls, solid waste is often dumped in abandoned quarries or similar sites, as is the case in Nairobi city, where waste is transported to Dandora dumping site, a former quarry. Waste management is proving a hard nut to crack for most County governments in Kenya, putting to question the devolved units' abilities to manage public health and the environment.

According to the fourth schedule of the Constitution, safe disposal of both solid and effluent waste management rests entirely with the County governments. This however, is not the case in many counties including Nairobi, Kisumu, Kisii, Kakamega and Bomet among many others, where heaps of garbage is common even in the central business districts.

It is estimated that Bomet Township will generate close to 45 tonnes of solid waste per day by the year 2020, the volume at 2006 being about 12 tons per day (NEMA, 2006). This seemingly small amount of Solid waste could be explained by the fact that most of the residential households within the town are rural - based, and are able to manage their waste in crude ways including burning without having to rely on the County government.

## **1.2 Statement of the problem**

Clean environment and healthy population are good signs of an efficient solid waste management system. An efficient solid waste management involves effective collection, storage, treatment and disposal of solid wastes. Proper solid wastes management increases environmental aesthetics and quality, productivity, economic development, healthy living and high quality of life. Studies by other researchers have shown that efficient solid waste management helps to avert far reaching health hazards and environmental protection.

Bomet County currently uses a temporary open dumping site for solid waste and an open pit for effluent waste management. Despite the present concerns from individuals and the County governments about solid waste management in Kenya, Bomet town is still faced with serious solid waste management problems (NEMA 2006). From observation, solid wastes are commonly found uncollected or simply piled in illegal dumps within the town centre. The Solid waste is neither collected in a reliable and safe manner nor transported and disposed of in an environmental friendly manner. The researcher observed that in Bomet town, wastes appear to be indiscriminately disposed of in places that are not designated dumpsites. Thus, wastes are seen littered along the streets, market places, roads and along the drainage channels.

Based on the above challenges, this study was undertaken to investigate the factors determining solid waste management in Bomet town with a view of coming up with recommendations towards improving the current SWM system.

### **1.3 The purpose of the study**

The purpose of the study was to establish the determinants of effective Solid Waste Management in Bomet town of Bomet County, Kenya.

### **1.4 Objectives of the study**

The study was guided by the following specific objectives;

1. To establish the extent to which financial resources determine solid waste management in Bomet town.
2. To assess how technical skills determine solid waste management in Bomet town.
3. To evaluate how community participation determine solid waste management in Bomet town.
4. To examine how institutional capacity determine solid waste management in Bomet town.

### **1.5 Research questions**

The study sought to answer the following research questions;

1. To what extent does financial resources determine solid waste management in Bomet Town?
2. What contribution does a technical skill have on solid waste management in Bomet Town?
3. How does community participation determine solid waste management in Bomet Town?

4. To what extent does institutional capacity determine solid waste management in Bomet Town?.

### **1.6 Null Hypothesis**

The solid waste management system in Bomet town, Bomet County Kenya is not Sustainable.

### **1.7 Significance of the study**

The current state of solid waste management in Bomet town is poor, hence the need for this study to understand the challenges and come up with strategies of improving the delivery of this all important service. While various reports, projects and policy documents on the subject of solid waste management are available, the factors determining solid waste management tend to have been overlooked. The community's role for example, both as waste handlers and stakeholders makes them potential contributors to solving the problem.

This study sought to illustrate how technology, financial resources, government policies and community participation in solid waste management are conceptualized and their potential contribution in improving solid waste management in Bomet town. By elaborating upon the factors determining solid waste management in the context of the County government of Bomet, it is hoped that this study will add to the body of knowledge about sustainable solid waste management strategies in the town. The findings of this study will also be of available to researchers and policy makers in their search for effective and sustainable SWM policies both in Bomet county as well as comparable situations in neighbouring counties.

It is also hoped that the study will assist the local community to understand the importance of actively participating and collaborating with the County government on not only solid waste management but also on issues directly or indirectly affecting their livelihoods in one way or the other.

### **1.8 Limitations of the study**

Certain conditions beyond the control of the researcher placed restrictions on the conclusion of the study and their application to other situation. The researcher for instance was not be able to control the attitude of the respondents as they responded to the questions. The respondents were at liberty and at times gave socially acceptable responses which affected the validity of the findings.

### **1.9 Delimitation of the study**

This study was confined to the factors determining effective solid waste management in Bomet town. The source of the solid waste is both the business premises and residential households within Bomet town. The study relied heavily on information given by the residents of Bomet town without taking into consideration the situation in other towns within Bomet County where the situation may be different with better or worse environmental conditions. Some of the respondents were not willing to volunteer information altogether for their own reasons and the time frame for the study was short, from January 2018 to July 2018.

### **1.10 Basic assumptions of the study**

An assumption is a supposition that a fact is true (Oso & Onen, 2009). The study was based on the assumptions that the sample drawn was representative of the target population in all its major characteristics, respondents were willing to give information honestly and objectively and that data collection instruments were valid and reliable in taking the desired measurements.

### **1.11 Definition of significant terms**

**Determinant** -- An element that identifies or determines the nature of something or that fixes or conditions an outcome.

**Management** -- The organization and coordination of the activities of a business in order to achieve defined objectives.

**Solid waste management** -- Controlling the generation, storage, collection, transportation, and final disposal of solid waste.

**Solid waste** -- A waste type consisting of everyday items that are discarded by the public.

**Financial resources** -- The money available to a business for spending in the form of cash, liquid securities and credit lines.

**Technical skills** -- The knowledge and abilities needed to accomplish mathematical, engineering, scientific or computer-related duties, as well as other specific tasks relating to technology.

**Community** -- A social entity made of people or families with similar interests or social network or relationship at local level.

**Community participation** -- A process by which a community mobilizes its resources, initiates and takes responsibility for its own development activities.

**Institutional capacity** -- Sets of rules, processes or practices that prescribe behavioural roles for actors, constrain activity, and shape expectations

**Disposal** -- All actions concerned with placing waste and residues in their final resting place.

## **1.12 Organization of the study**

This study is organized into five chapters. Chapter one covers the introduction to the study. It presents the background of the study, statement of the problem, purpose of the study, the objectives of the study, research questions, research hypothesis, and significance of the study, delimitations of the study, basic assumptions and the definition of significant terms as used in the study.

Chapter two brings out the literature review which looks at the factors determining solid waste management which include; technology in solid waste

management, financial resources for solid waste management, community participation in solid waste management and solid waste management policies by the County government of Bomet. This chapter also presents the conceptual framework of the study.

Chapter three outlines the study design, the target population, methods of data collection, validity and reliability of the research instruments. The chapter also brings out methods of data analysis, ethical considerations of the study and the operationalization of variables.

Chapter four deals with analysis of data, presentation and interpretation. Chapter five comprises the summary of the findings, discussion, conclusions, recommendations, and suggestions for further research.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter consists of the review of related literature from some of the cities and towns of the world on strategies adapted to address the problem of solid waste management. Further, an in-depth analysis of the strategies was undertaken to determine their effectiveness with an objective of coming up with the best practices that could be proposed for Bomet Town. This chapter also features both the theoretical and conceptual frameworks of the study.

#### 2.2 Empirical review.

Management is essential in every aspect of human life including solid waste. Agwu (2012) points out that waste began to be associated with management because of the need for plans and methods for its disposal, a procedure which requires specific and well-tailored policies. Management in the context of this study is the process of coordinating the efforts of members of management agencies, using available material and human resources for effective results.

The business of keeping our environment free from the contaminating effects of waste materials is generally termed waste management. Solid waste management is therefore the process of collection, storage, treatment and disposal of solid waste in such a way that they are harmless to humans, plants, animals, the ecology and the environment generally. The unhealthy disposal of solid waste is one of the greatest challenges facing developing countries today according to Kofoworola, (2007). Hoornweg, *et al* (2013) indicates that waste management involve the collection, transportation, treatment and disposal of waste including after care of disposal sites and defines waste management as purposeful, systematic control of the generation, storage, collection, transportation, separation, processing, recycling, recovery and disposal of solid waste in a sanitary, aesthetically acceptable and economical manner.

The priority of a waste management system is the provision of a cleansing service which helps to maintain the health and safety of citizens and their environment (Cooper, 2000). Hoornweg, *et al* (2013) regards the business of waste management as a professional practice which goes beyond the physical aspects of handling waste. It also involves coming up with policies, determining the environmental standards, fixing emission rates, enforcing regulations, monitoring air, water and soil quality and offering advice to governments, industry and land developers, planners and the general public. Waste management therefore, involves a wide range of stakeholders who perform various functions to help maintain a clean, safe and pleasant physical environment in human settlements in order to protect the health and well-being of the population and the environment. Effective solid waste management is, however, a growing challenge to all municipal and County governments especially in developing countries (Hilburn 2015).

An unprecedented phenomenon is being witnessed in the development of places of habitat; the balance of human settlement patterns having shifted from more people inhabiting rural areas to more people living in urban areas and cities of the world (UNFPA, 2011). Whenever waste is poorly managed it becomes a danger to health, a nuisance, and indeed a major social problem. In addition, solid waste management occupies a vital place in the economies of both developed and developing countries (Abagale, *et.al* 2012).

### **2.2.1 Impact of solid waste on human health and environment**

Uncontrolled burning of solid waste and improper incineration contributes significantly to urban air pollution. Greenhouse gases on the other hand are generated from the decomposition of organic wastes in landfills, and untreated leachates are known to pollute the surrounding soil and water bodies. Health and safety issues also arise from improper solid waste management. Insect and rodent vectors are attracted to the waste and can spread diseases such as cholera and dengue fever (Mensah, 2011). Using water polluted by solid waste for bathing, food preparation, irrigation and drinking can also expose individuals to disease organisms and other contaminants. The United States Public Health Service

identifies twenty two human diseases that are linked to improper solid waste management. According to Al-Khatib & Kontogianni *et al* (2015), waste workers and pickers in developing countries are seldom protected from direct contact and injury, and the disposal of hazardous and medical wastes with solid waste poses serious health threat to them. People know that poor sanitation affects their health, especially in developing and low income countries, but the same people are the most unwilling to pay for environmental improvements (Jha *et al* 2011).

Waste include food left-overs, leaves, old newspapers, used bottles, construction debris, and chemicals from factories, candy wrappers, disposable diapers, old cars, or radioactive materials among many others. According to Davidson (2011), people have always produced waste, but as industry and technology evolved and the human population grew, solid waste management has become increasingly complex.

Throughout history, there have been four basic methods of managing waste: dumping, burning , finding another use for it (reuse and recycle), and not creating the waste in the first place (waste prevention) according to Davidson (2011). The success in using these four methods however depends on the wastes being managed. Municipal solid waste is different from industrial, agricultural, or mining waste. Hazardous waste is a category that should be handled separately, although it is sometimes generated with the other waste types.

Initially, humans did worry much about waste management and they simply left their garbage where it dropped at any particular time. As permanent communities developed however, people began to dispose of their waste in designated dumping areas. The use of such open dumps for garbage is still common in many parts of the world (Wilson *et,al* 2013). Open dumps have major disadvantages, especially in heavily populated areas as toxic chemicals can filter down and contaminate groundwater. The liquid that filters through a dump or landfill is what has come to be called leachate. Dumps are capable of generating methane, a highly flammable and explosive gas produced when organic wastes decompose under oxygen-poor conditions (Davidson, 2011).

The sanitary landfill is believed to have come into existence in England in the 1920s. In landfilling, garbage is compacted and covered at the end of every day with several inches of soil. According to Wilson *et al* (2013), landfilling technology began to be used in the United States in the 1940s and by the late 1950s, it became the dominant and therefore most accepted method of disposing municipal solid waste in the country. These early landfills had significant challenges with leachate leakage and methane emission, but have largely been resolved at facilities built since about the early 1970s. The best landfills are normally those lined with clay and thick plastic sheets allowing the leachates collected at the bottom to be drained through pipes and processed into methane gas. The gas is then safely piped out of many landfills (Wilson *et,al* 2013).The dumping of waste does not only take place on land, ocean dumping was once used as a waste disposal method by some United States coastal cities and is still practiced by some nations. Waste material from sewage treatment is reported to have been dumped at sea in huge quantities by New York City in 1992 although this is now illegal in the United States. Also called bio solids, sewage sludge is not generally considered solid waste, but it is sometimes composted with organic municipal solid waste (Wilson *et,al* 2013).

Burning has a long history in municipal solid waste management with some American cities known to have begun burning their garbage around the late 19<sup>th</sup> century in cremators (Guerrero, *et,al* 2013). These devices however became inefficient with time and cities went back to dumping and other methods. In the 1930s through 1940s, new types of more-efficient garbage burners known as incinerators came into use. The early models of these incinerators were rather dirty in terms of their emission of air pollutants and in the early 1950s , their use was gradually discouraged and were finally shut down. In the 1970s, resource recovery or waste-to-energy plants came into use according to Guerrero, *et,al* 2013. These newer incinerators are still in operation to date and in addition to burning garbage, they produce heat or electricity that can be used in nearby buildings or residences, or sold to any utility in need. Many countries embraced the new waste-to-energy plants as a result of the energy crisis in the early 1970s

but it became difficult to find locations to build these facilities around the mid-1980s, mainly because of public opposition arising from air-quality issues (Guerrero, et,al 2013) .

Industrial wastes that are not hazardous have traditionally been sent to landfills or incinerators but the rising cost of disposal has prompted many companies to seek alternative methods for handling these wastes, such as waste prevention and recycling (Grosse, 2010). It is to be noted that manufacturing plants at times reclaim certain waste materials by feeding them back into the production process.

Public attitudes will always in a way play a pivotal role in decisions about waste management with almost every proposed new landfill or waste-to-energy plant being opposed by people who live near the site. Public officials and planners refer to this reaction as NIMBY; Not In My Back Yard (Noto 2010). In the event that an opposing group becomes vocal enough, a city or County government is likely to loose interest in a proposed waste-disposal project. Recycling and waste prevention initiatives are known to enjoy strong public support.

Reducing waste at the source is the cheapest method of managing waste. Waste prevention may also reduce the amount of resources needed to manufacture or package a product. For example, most roll-on deodorants once came in a plastic bottle, which was inside a box. Around the year 1992, deodorant manufacturers redesigned the bottle so that it would sit well on shop shelves, thereby eliminating the need for the box as packaging. This is called source reduction and saves businesses money, while at the same time reducing waste (Grosse, 2010).

When the current recycling boom began in the late 1980s, markets for the recyclables were not sufficiently considered. This resulted in some recyclables collected in large quantities not being sold and some ending up in landfills. Presently, the development of recycling markets is indeed a high priority. To boost recycling markets, many local and state governments now require that their own agencies purchase and use products made from recycled materials. In the year 1993, an executive order requiring the federal government to use more recycled products as a major step forward for recycling was issued by President

Bill Clinton of the United States of America (Aderogba & Afelumo 2012).

Biological treatment, a technique for handling hazardous wastes, could be called a high-tech form of composting. Biological treatment, like composting, employs microbes to break down wastes through a series of metabolic reactions. Many toxic, carcinogenic, or undesirable substances in the environment can be rendered harmless through this method. Genetic engineering, a controversial branch of biology dealing with the modification of genetic codes, is closely linked with biological treatment, and could produce significant advances in this field (Memon 2010).

Waste management became an expensive proposition during the 1990s, more so on issues touching on disposal. As a result, waste managers started searching for innovations that would improve efficiency and reduce costs. Several new ideas in land-filling involved the reclamation of useful resources from wastes. For example, instead burning or releasing the methane gas that is generated within solid-waste landfills, some operators started collecting the gas and using it to produce power either for local consumption or to be sold as fuel (Aderogba, & Afelumo, 2012). At some landfills, the management has experimented with a new but untested concept known as landfill mining. This concept is all about digging up an existing landfill to recover any recyclable materials and sometimes to re-bury the garbage in a more efficient way. Landfill mining has faced criticism as a result of its cost and practicability but some operators strongly believe that it can save money under certain circumstances.

A 1994 United States Supreme Court ruling could increase the cost of incineration significantly (USEPA 2010). In its considered ruling, the court stated that ash produced by municipal solid waste incinerators contain high levels of toxic substances such as lead and cadmium and must therefore be treated as hazardous waste. All incinerator ash must therefore undergo testing to separate those going to a hazardous waste landfill from those to a standard landfill. Currently, many hospitals are using a much smaller type of a similar incinerator in the management of medical wastes such as blood, surgical waste, syringes and laboratory wastes. According to Aderogba & Afelumo, (2012) however, the

safety of these medical incinerators has become a major concern in some communities.

In a study conducted by the Environmental Protection Agency (EPA) released in 1994 found that medical waste incinerators were among the leading sources of dioxin emissions into the air. This study also discovered that dioxins formed as a result of burning certain chemical compounds, pose a high risk of causing cancer and other health hazards in humans according to USEPA 2010.

### **2.2.2 Sustainable Solid Waste Management and Development**

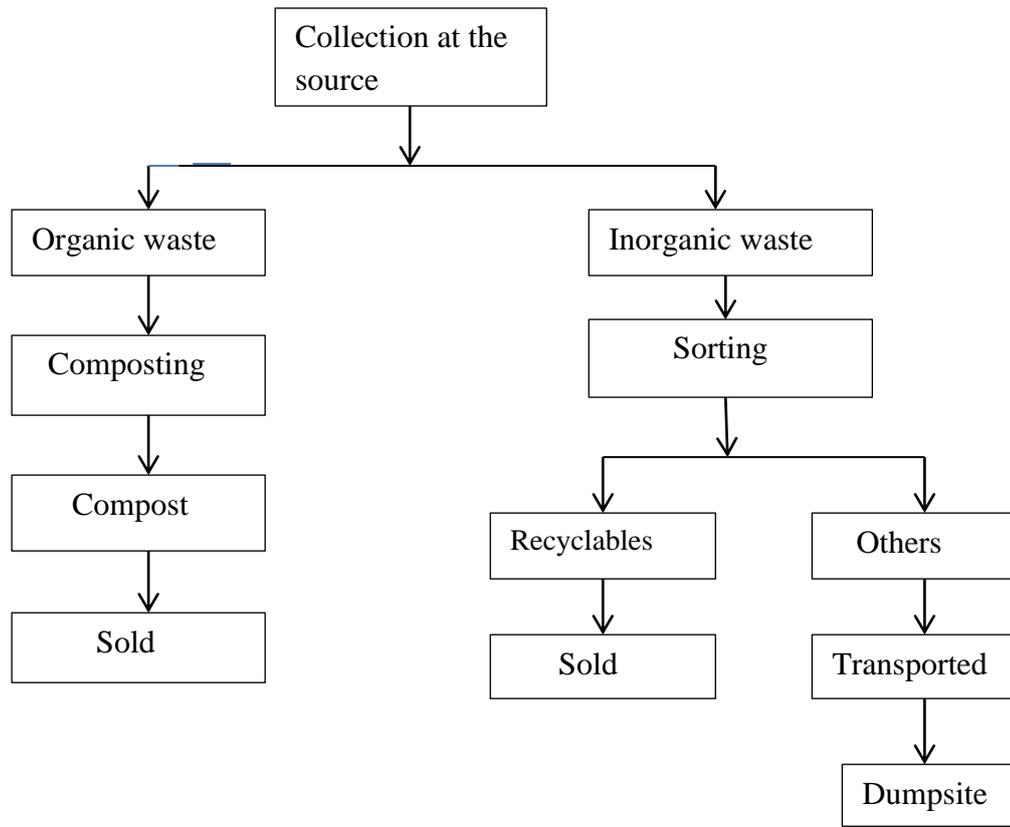
The world's urban population increased to more than 50 per cent of the world's total population in 2015 and is expected to rise further to approximately 70 per cent of the total by 2050. Most of this population growth will be concentrated in developing countries with the urban population in Africa being projected to treble from 470 million in 2015 to 1.2 billion in 2050, making Africa the continent with the highest urban population growth (UNDEA, 2014).

Globally, the World Bank estimates that the amount of MSW generated by urban areas is growing even faster than the rate of urbanization. By 2002, there were 2.9 billion urban residents who generated about 0.64 kg of MSW per person per day according to World Bank (2011). In 2012, there were about 3 billion urban residents each generating 1.2 kg per day, and with the urban population projected to reach about 4.3 billion by 2025 with each resident generating about 1.42 kg of MSW every day, the total MSW will reach 2.2 billion tons by then (World Bank, 2011). In many low-income countries, MSW disposal is a neglected area, and a major environmental health hazard. The cost of disposal of large quantities of waste is often beyond the financial capacities of cities and municipalities especially in developing Countries. Many low-income countries lack the facilities for safe disposal of MSW and the most common waste disposal practice in these countries is uncontrolled dumping. The waste sector was the third largest contributor to global emissions of non- carbon dioxide (CO<sub>2</sub>) greenhouse gases in 2005, accounting for 13 per cent of total emissions according to USEPA (2010). In the waste sector, the two largest sources of emissions are landfilling of solid

waste and wastewater, which together contributing 92-93 per cent of emissions throughout the 1990s to 2030 period. Methane (CH<sub>4</sub>) from landfills will account for an average of 58 per cent of waste emissions in the same period. Increases in waste generation and population drive the quantity of these global waste emissions continuously upwards (USEPA, 2010).

Nairobi, the capital city of Kenya, exemplifies the problems of a dysfunctional waste management system with the city producing about 2,400 tons of waste per day. While 93 per cent of Nairobi's waste is potentially reusable, only 5 per cent is actually recycled and composted. Moreover, only 33 per cent of waste produced is collected for disposal at Nairobi's only official dumpsite of Dandora according to JICA (2010). The official dumpsites, and even more so the illegal ones, are operated in an unplanned and highly unsanitary ways. As a result, poorly managed and improperly disposed of solid waste pollutes the air, water and soil, causing significant health and environmental problems (JICA, 2010). There are a number of factors that influence waste generation in many urban areas and cities such as technology, facilities for separation, management policies and enforcement, legislation, individual level of income, level of education, geographical location, political stability, gender roles and cultural practices (Abel, 2009). The quantity of solid waste generation also varies with socio-economic groups in which the middle class are most responsible (Sridhar, 2013). Waste management is also affected by other aspects or enabling factors that facilitate the performance of the system. They include technical, financial, institutional and community participation.

**Figure 2.1;** Optimal waste management strategy



**Source ;** Researcher (2018)

As shown in figure 2.2 above, the key elements in solid waste management include waste generation, storage, collection, separation, transfer and transport, recycling and recovery and the final disposal.

### **2.3 Determinants of Solid Waste Management**

Several factors are known to influence solid waste management in many municipalities and cities the world over. Necessary technology and technical skills, facilities for separation at the source, strength of effective solid waste management policy and enforcement, environmental education and awareness and income status of individuals among others, are some of the factors affecting solid waste scenario in cities and urban centres. Using the instruments of questionnaire and interviews, this study sought to evaluate the following determinants of solid waste management in Bomet town; technical, financial, institutional and public participation.

### **2.3.1 Influence of financial resources on solid waste management**

Municipalities have faced massive challenges in the management of solid waste due to financial factors. The huge expenditure needed to provide the service, the absence of financial support, limited technical resources, the unwillingness of the users to pay for the service and lack of proper use of economic instruments have hampered the delivery of proper waste management services. Sharholly, (2008) indicates that the involvement of the private sector is a factor that could improve the efficiency of the system.

Solid waste management often takes a big amount of the total recurrent County Government or municipal budget and despite the high financial burden, the local authorities often struggle to provide adequate and reliable services. According to USAID it is common for municipalities in developing countries to spend up to 50 per cent of their available budget on solid waste management, which often can only stretch to serve less than 50 per cent of the population (Memon, 2010). Public sector inefficiencies and continuously increasing cost has led local authorities to analyse if this service can better be provided by the private sector (El Fadel & Massoud 2012). Increasingly public private partnership arrangements (PPPs) have emerged as an alternative to improving municipal solid waste service performance at lower costs (Zhu, 2007). But even with the new partnership approach the financial aspects of municipal solid waste management remains 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 municipalities rarely know the actual cost of providing the service (Wilson, 2012). 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, but some degree of cross-subsidization and/or financing out of governmental sources may be needed to ensure equitable access to service (Wilson, 2013).

### **2.3.2 Influence of technical skills on solid waste management**

According to Mrayyan & Hamdi, (2010) technical determinants of solid waste management systems are related to lack of necessary skills and training among personnel within municipalities and government authorities, poor roads and poorly maintained collection vehicles, deficient infrastructure, insufficient technologies and reliable data. Onibokun (2009) on the other hand is of the opinion that most municipal authorities are unable to attract suitably qualified personnel to carry out aspects of waste management such as planning, operations and monitoring. Ogawa (2012) corroborates this observation when he posits that developing countries characteristically lack the technical expertise required for solid waste management planning and operation and this is usually the case at both national and local levels. He further argues that many officers in charge of solid waste management have little or no technical background training in engineering or management. Without sufficiently trained personnel, solid waste management projects can neither be effective nor sustainable to any extent. Ogawa, (2012) observes that in many cases, solid waste management programmes initiated by external consultants have collapsed in the hands of local management due to the lack of expertise and failure to allocate enough funds. Mrayyan & Hamdi, (2010) also observe that local governments in developing countries generally lack the required capacity and technical expertise to accomplish effective and sustainable waste management programmes. Several studies in Africa and elsewhere in the developing countries confirm the scarcity of qualified waste management personnel and how this results in failure to undertake effective and sustainable waste management in the cities (Ogawa, 2012).

The lack of qualified waste management personnel has been blamed on the lack of training and poor conditions of service in the sector. Generally, employees in the waste sector are poorly paid and have very poor conditions of service which makes many people shun jobs in the sector, including casual labourers (Kironde, 2011). Thus, besides the difficulty of attracting professional waste management staff, it is also difficult to attract labourers to the waste sector in spite of the high levels of unemployment in poor country cities (Onibokun, 2009 & Kironde, 2011).

### **2.3.3 Influence of community participation on solid waste management**

Community participation in SWM is the key to a sustainable and integrated project. The aim is to get as many local actors as possible to participate and actively contribute to the project. Most important is the creation of a feeling of ownership for the project among the population whose waste is being managed and whose local environment is being improved by the project

According to Muthoni, (2014), community participation is taken as a crucial aspect of solid waste management. Community participation in solid waste management is always required because solid waste management is a continuous maintenance system, for example to store the garbage in a specific bag or bin, to bring it to an agreed point, to separate it into dry and wet waste among many other activities. Community participation in this sector might be more important than in any other urban service.

Community-based urban waste management involves neighbourhood communities, households, community based organizations and small, informal enterprises engaged in collection and disposal, re-use and recycling of waste materials (Muthoni 2014). Such waste activities range from managing the resources within the household or family to the more formal municipal activities of collection. They include disposal, re-use and recycling, as well comprising community decision making and management and the ways in which individuals, communities and governments arrange and negotiate the diverse interests of the public and private sectors (Kreith, 1994).

Recent research on urban solid waste management in developing countries shows that community participation in waste management yields several benefits, including health and social benefits such as proper disposal of waste in special bins outside the homes, reduction in the quantity of refuse dumped in rivers, on streets or burned and reduction of odour generated from uncontrolled dumping of refuse in the neighbourhood (Njoroge *et al* 2014).

Community participation in urban waste disposal means involving key institutional actors in the process, such as district committees, non-governmental

organizations (NGOs), local authorities and business associations. Others are opinion leaders, district heads, religious leaders, teachers, politicians and the youth (Njoroge *et al* 2014).

Muthoni, (2014) supports the involvement of the community sector as an effective way of increasing access of the poor to urban services, including waste management. Indeed Njoroge *et al* (2014), lends credence to this sentiment when he observes that in Nairobi, organizations in the community sector such as charitable organizations, ethnic associations, professional support NGOs, welfare societies, village committees, self-help groups, and security committees are already providing many of these services. Lubaale & Musyoki (2011) further support this scenario when he points out that any potential change to the waste disposal framework must take into account the urban poor, many of whom dependent on waste scavenging for their entire subsistence.

#### **2.3.4 Influence of institutional capacity on solid waste management**

Inefficient institutional arrangements adversely affect urban planning in poor countries generally and environmental service delivery in particular (UN-Habitat, 2014). It is characteristic of developing countries to have several agencies involved in the delivery of solid waste and other municipal services. Ogawa, (2012) observes that there are often no clear roles or functions of the various agencies involved in urban environmental management. In the case of externally supported solid waste management projects, it is common for different agencies within the same country or city to act as counterparts of external support agencies for different waste management projects without any collaboration of efforts (Ogawa, 2012). Institutional inefficiencies of this nature can lead to duplication of functions, gaps in service delivery and waste of already scarce resources, or even the collapse of solid waste management programmes altogether (UN-Habitat, 2013). Zurbrugg, (2009) notes the deficient management capacities of institutions involved in urban environmental management in poor country cities.

Institutional systems provide a framework for better social order in a community as well as public policy formulation and implementation process. They are also

requisite for legitimizing policies, social values and actors embodied in resource development and utilization, economic programmes, governance practices and promoting specific cultural heritage (UNEP, 2013).

Management deficiencies are often observed in the municipalities and cities in most developing Countries. Researchers who have investigated the institutional factors that affect solid waste management systems have come to the conclusion that local waste management authorities lack organizational capacities and professional knowledge. Besides they conclude that the information available is very scanty to be of any use from the public domain (Chung & Lo, 2008). The extremely limited information is not complete or is scattered around various agencies concerned, making it extremely difficult to gain an insight into the complex problem of municipal solid waste management (Seng, 2010). Researchers have also documented how an adequate legal framework contributes positively to the development of the integrated waste management system according to Asase (2011). The absence of satisfactory policies and weak regulations are detrimental to the success of solid waste management systems (Seng, 2010).

## **2.4 Theoretical framework**

Theories are the underlying principles upon which a phenomenon is based. Halvorson (2012) defines theory as a formal set of ideas that is intended to explain why something happens or exists. It is the principle on which a particular subject is based. A theoretical framework provides the basis upon which a study is built. This study will be anchored on two management theories: the systems theory and the theory of reasoned action.

### **2.4.1 Systems theory.**

Systems theory refers to the interdisciplinary study of systems in general, with the goal of discovering patterns and making clear principles that can be recognizable and applicable to all types of systems at all nesting levels in all research fields.

Systems theory, postulated by L. von Bertalanffy in the 1930s deals with interdependence of sub-systems or components that make up a whole system. The

tenets of systems theory are integration of parts of a system in problem solving and that problem of a system cannot be solved as well if it is considered in isolation from components that make up the system. This theory applies to the study since solid waste management is a system comprising of various interrelated components of waste storage, waste collection, transportation, transfer stations, management methods and management options among others.

These components cannot be carried out in isolation due to their interrelatedness. Solid waste collection for example may not be well carried out in the absence of collection equipment and transportation vehicles. The various components of solid waste management are interdependent on each other for effective SWM system. The SWM workers in the different sub-systems and the beneficiaries of their services also cannot work in isolation. Their interdependence will help ensure effective and efficient solid waste management system.

#### **2.4.2 Theory of reasoned action.**

The theory of reasoned action (TRA) was proposed by Ajzen and Fishbein in 1975 and reviewed in 1980 (Ajzen & Fishbein 1980). The theory assumes that human behaviour is grounded in rational thought, and the model uses the principle of compatibility which predicts that attitudes reflect behaviour only to the extent that the two refer to the same valued outcome or state of being. The theory stipulates that the intention of acting has a direct effect on behaviour, and that it can be predicted by attitudes. These attitudes on the other hand are shaped by subjective norms and beliefs, and situational factors influence these variables' relative importance. TRA accounts for times when people have good intentions, but translating intentions into behaviour is thwarted due to lack in confidence or the feeling of lack of control over the behaviour according to Boudreau G. (2010).

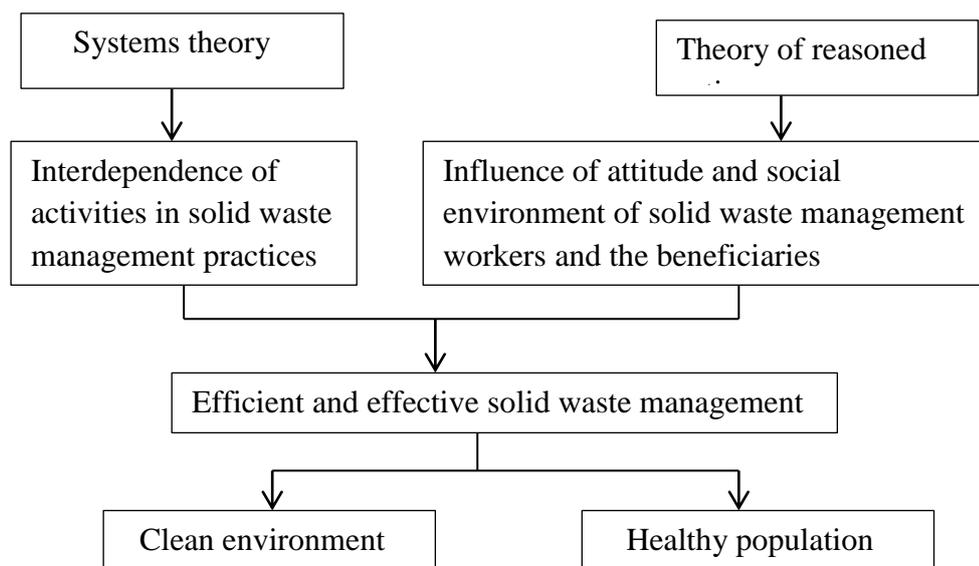
The theory of reasoned action is important to the extent that it provides a foundation for understanding why people may not act in favour of the environment, despite having good intentions either due to their lack of confidence or for the reason that they feel they lack control above the behaviour.

The model gives further explanations as to how good intentions for the environment are not enough in themselves to propel an action. Subjective norms

in this context denote an individual's beliefs about whether their society's members, family, friends and co-workers believe that the individual should or should not participate in a specific behaviour. The social environment has been proven to mediate the consequence of environmental attitude on environmental behaviours (Stern, Dietz, Abel, et al 1999).

TRA applies to this study in that solid waste management is influenced by the solid waste workers' attitude and social environment. The solid waste workers' attitude towards solid waste is guided by their belief and evaluation of the effects of solid waste management on health and environment. If they believe that poor solid waste management will adversely affect health and environment, they will be motivated to be committed to good solid waste management practices.

**Figure 2.2;** Theoretical framework



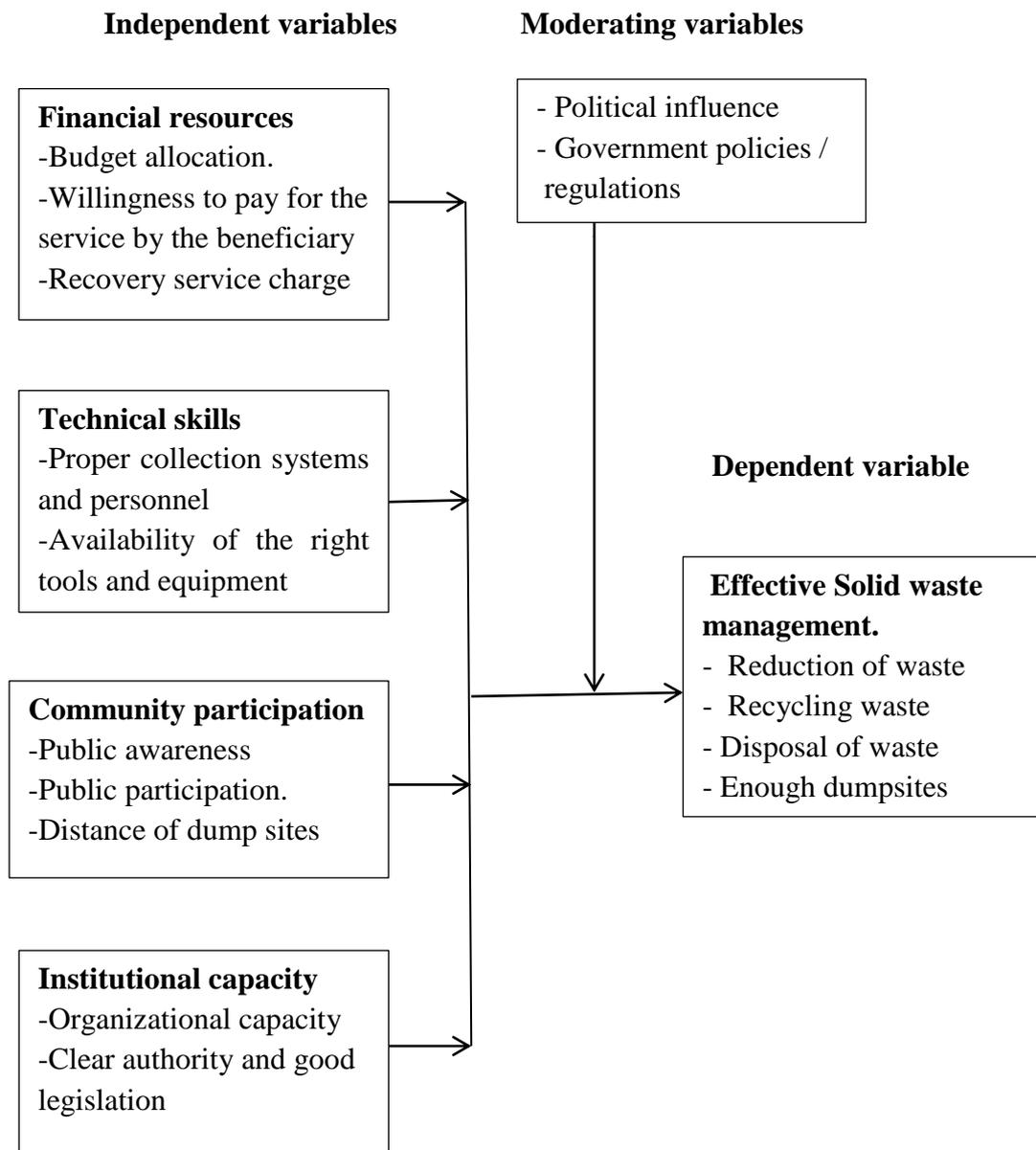
**Source;** Researcher (2018)

The above model shows the interaction of the two theories in management of solid waste. The systems theory captures the interdependence of solid waste management workers on management of solid waste. On the other hand, the theory of reasoned action highlights the attitude and social environment of solid waste management workers on management of solid waste.

## **2.5 Conceptual Framework**

There are a number of factors that influence waste generation in many urban areas and cities such as technology, facilities for separation, management policies and enforcement, legislation, individual level of income, level of education, geographical location, political stability, gender roles and cultural practices (Abel, 2009). The quantity of solid waste generation also varies with socio-economic groups in which the middle class are most responsible (Sridhar, 2013). Waste management is also affected by other aspects or enabling factors that facilitate the performance of the system; Technical, Financial, Institutional and community participation.

**Figure 2.3;** Conceptual framework



**Source;** Researcher (2018)

## 2.6 Research gaps

Although several researchers have carried out a number of studies on the causes of poor solid waste management and have provided a number of solutions to waste management in different parts of Kenya and the world at large, it is worth noting that almost all these studies have been carried out in big towns and cities

including Nairobi, Kisumu, Eldoret and Mombasa, leaving out the small emerging towns among them, Bomet. This study therefore sought to validate whether influencing factors of waste management and their solutions elsewhere are applicable to Bomet town.

## **2.7 Summary of literature review**

This chapter reviewed the literature related to the various themes in the study including financial resources, technological aspects, policies influencing solid waste management and the community participation as major stakeholders in solid waste management. As the largest town in Bomet County, Bomet town is struggling with solid waste management challenges. Urban settlements in the town are characterized with worsening waste disposal situations which the County government is seemingly struggling with. A survey of literature on the factors influencing solid waste management in the town showed that no major research has been done on the subject and this has motivated the researcher to embark on the research.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

This chapter discusses the methods and techniques that were employed to solve the research problem. It describes the research design, target population, sampling, data collection and analysis techniques that were used in the study. It also describes validity and reliability control techniques as well as ethical issues in the study.

#### 3.2 Research design

According to Trochim (2005), a research design provides the glue that holds the research project together. A design is used to structure the research, to show how all of the major parts of the research project work together in addressing the central research questions.

This research was a descriptive survey of randomly selected household heads and purposively selected key informants from the Bomet county waste management department, NEMA, and public health office using well-structured questionnaire for the purpose of primary data collection on the level of awareness, knowledge and practices of solid waste management in Bomet town.

This type of design was used for this study since the researcher wish was to obtain the information describing the existing status of a phenomenon and where possible draw valid general conclusions from the facts discovered on determinants of solid waste management within the core urban area of Bomet town. The questionnaire was validated using test-re-test technique while a pilot survey was conducted using 20 randomly selected respondents who were not part of the study sample. Coefficient of internal consistency of the questionnaire was calculated using the Cronbach's alpha formula as shown;

Cronbach's alpha model based on K components (K-items or test-lets);

$$X = Y_1 + Y_2 + Y_3 + Y_4 + Y_5 + \dots + Y_k$$

Formula for Cronbach's alpha;

$$\alpha = \frac{Kc}{v + (K - 1)c}$$

K = No. of components (items)

v = Average variance of each component

c = Average of all co-variances between the components across the component sample of persons.

### 3.3 Target Population and Sample size

According to Kothari (2004), an accessible population of interest from where a study sample is to be drawn and upon which the results are generalized is identified. In this study a homogeneous target population covering the urban area of Bomet town was used. The KNBS (2010) Bomet core urban population of 7035 was used as the total population in the study and the target population taken to be all the household heads. The researcher assumed that every household had five members making the household heads to be 1407 in total (7035 divided by 5)

#### 3.3.1 Sample Size

The sample size is a subset of the total population that is used to give the general views of the target population. The said sample size must be representative of the population in which the researcher would like to generalize the research findings. The sample of this study consisted of a total of 160 respondents; 140 of whom were household heads from the core urban area of Bomet town and 20 key informants purposively selected. This was taken to be the best and representative selection for the study of the total population

**Table 3.1;** Study respondents

<b>Stratum</b>	<b>Sample size</b>	<b>Percentage</b>
Households heads	140	87.5 %
Key informants	20	12.5 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

### **3.4 Sampling Techniques**

Sampling is defined as the process of selecting a subset of cases in order to draw conclusions about the entire set (Amin 2005). Sampling is important because administering a questionnaire to a large group of people is tiresome and expensive, thus studying a few of its members saves time and other resources.

In order to get a proportional representation of the targeted respondents, the study used a combination of random and purposive sampling techniques. According to Orodho (2009) 10% to 20% sample of the population is representative enough to be used as a sample. For this study 10% of the total population was selected as a sample with 140 household heads participating in the study. Purposive Sampling allows the researcher to use experts with the required information with respect to the objectives of the study at hand (Mugenda & Mugenda, 2003). In this respect, purposive sampling was applied to get participants from the county government's waste management staff, the local National Environmental Management Authority and public health department.

### **3.5 Research instruments**

This study employed interview guide and questionnaire as research instruments. The questionnaire was used to collect data from household heads. According to Best and Kahn (2006), a questionnaire is the most appropriate instrument because it enhances collection of data from a wide population. The questionnaire was in two sections; the demographic data and questions arising from the study objectives.

Interview guide was one of the instruments used in this study to gain more insight on factors determining solid waste management. According to Kombo and Tromp (2006), interviews provide in-depth information about the cases of interest to the researcher. They also allow the researcher to gain a detailed understanding of the topic under study and are useful for studying sensitive topics. The instrument is therefore suitable for the study because of the in-depth information it will be able to provide.

Before administration of the instruments a pilot study was carried out using 20 respondents who are not part of the study sample. This process was repeated after two weeks and the data of the first and the second tests were analysed.

### **3.5.1. Questionnaire**

Questionnaires are data collection instruments which are administered to the respondents so that they may respond to the questions asked. The questions were formulated according to the objectives of the study so that the respondents could give their opinion on the different variables being tested in the study. The questionnaire for the general respondents was divided into two sections: section one consisting of structured questions all of which were about the respondents bio data and section two consisting of both structured and unstructured questions all of which sought information on the perception of the respondents on solid waste management in Bomet Town .

Questionnaire was chosen because it is simple to administer and the respondents are able to answer the questions within their own time. The Questionnaire was administered by researcher.

### **3.6. Validity and Reliability of the Research Instruments**

The researcher tested the validity and reliability of the research instruments that were used during the data collection process in order to enhance the findings and recommendations of the research process.

#### **3.6.1 Validity of the instruments**

Validity of research can be explained as the extent to which requirements of scientific research method have been followed during the process of generating research findings. Oliver (2010) considers validity to be a compulsory requirement for all types of studies. The items in the instruments were tested for content validity and face validity.

Content validity (Logical or rational validity) is how well an instrument measures a theoretical construct using a formal, statistics-based approach, usually

with experts in the field. The said experts judge and evaluate whether the questions effectively capture the topic under investigation. For this study, the researcher sought the expert knowledge from the supervisor and lecturers to assess the instrument on the structure and content. Their feedback and recommendations were incorporated to improve the validity.

### **3.6.2 Reliability of the instruments**

Reliability in research, like validity, is a way of assessing the quality of the measurement procedure used to collect data in a study. In order for the results from a study to be considered valid, the measurement procedure must first be reliable. Reliability therefore is the degree to which an assessment tool produces stable and consistent results. The reliability of instruments in this study was controlled by the use of test-retest method where the researcher administered the same instruments to a smaller sample of respondents twice between two weeks.

### **3.6.3 Piloting**

Before the research tools were finally administered to participants, pre-testing was carried out to ensure that the questions were relevant, clearly understood and made sense. The pre-testing aimed at determining the validity and reliability of the research tools including the wording, structure and sequence of the questions. Piloting also ensured that any deficiencies or challenges were detected early and corrected before the actual data collection.

## **3.7 Data Collection procedure**

The researcher obtained a letter of introduction from the University of Nairobi which was then used to apply for a research permit from the National Council of Science and Technology and Innovation (NACOSTI) before proceeding to the study area for appointment with the household heads and the key informants for data collection. A covering letter requesting the respondents to participate in the study was attached to the questionnaire. All the respondents were informed beforehand about the purpose of the study. The researcher administered the questionnaire to the respondents to collect primary data. The 140 randomly

selected households were visited and the questionnaire administered to the respondents. The same was done to the 20 purposively selected key informants. The researcher also observed the conditions of the storage receptacles and the County government’s waste trucks to ascertain if they were used in the proper way.

### 3.8 Methods of Data Analysis

Data analysis is the vehicle used to generate and validate interpretations, formulate inferences, and draw conclusions ( Scherman 2007)

The Statistical Package for Social Sciences (SPSS-Version 20.0) was used to aid in analysing the data from the field to produce descriptive statistics and identify the importance of different factors determining effective solid waste management. Statistically weighted means were then used in answering the research questions. The response options in the instrument was also weighted as shown.

**Table 3.2;** Respondent response options

Strongly Agree (SA)	Agree (A)	Undecided (U)	Disagree (D)	Strongly Disagree (SD)
------------------------	--------------	------------------	-----------------	---------------------------

### 3.9 Ethical Considerations

Ethical considerations refer to an accumulation of values and principles that address questions of what is good or bad in human affairs.

To minimize potential, social and psychological stress on the respondents during data collection, the researcher ensured that interviews were conducted in a suitable, comfortable and private environment according to participants’ preferences. The researcher also listened and observed without displaying any judgmental attitude towards the informants or the information received. The researcher also capitalized on the meaning and process of informed consent, and the importance of protecting the privacy of participants and confidentiality of the information obtained from the participants.

The participants were provided with all the information about the study before obtaining their consent and adequately informed about the purpose of the study and methods to be used; their right not to participate in the study and measures to ensure confidentiality of information provided. Participants in the qualitative interviews were identified by code names and interviewed in private settings.

To protect the respondents' identities data was reported as a block instead of highlighting individual cases. Furthermore, the confidentiality and the privacy of the individuals and institutions given utmost consideration; no information was ever passed to third parties in any way.

### **3.10 Operationalization of Variables**

When designing a research study, Operationalization is the process by which the researcher sets out to measure something that is not directly measurable. For example, employee engagement cannot be measured directly, but there are certain things that engaged employees do or don't do that indicate their level of engagement. This could include working overtime when needed, volunteering to take on extra tasks, or not taking unscheduled leave. These activities, which are measurable, can be used to operationalize the concept of employee engagement.

A variable is anything that might impact the outcome of a study. Therefore an operational definition describes exactly what the variables are and how they are measured within the context of this study.

The operationalization of variables was formulated to give the study a framework on how the variables were going to be researched.

Table 3.3 below shows the operational definition of variables for the study which gives a summary of the variables, indicators, measurement and the scales to be used.

**Table 3.3:** Operational definition of variables

<b>Objectives</b>	<b>Variables</b>	<b>Indicators</b>	<b>Measures</b>	<b>Scale</b>
Factors influencing solid waste management	Solid waste management	Clean environment	Good waste management system	Nominal
To establish the extent to which technical skills influence solid waste management in Bomet Town	Technical skills and expertise, together with right tools and equipment	Use of trained staff and correct equipment	Well paid and motivated staff	Nominal
To determine how funding influences solid waste management in Bomet Town	Funding	Allocation of funds	Enough funds allocated	Nominal
To examine how institutional capacity influences solid waste management in Bomet Town	County Government's support	Motivated staff and regular collection of waste	Staff paid on time and given security	Ordinal
To evaluate the extent to which community participation influences solid waste management in Bomet Town	Stakeholder involvement.	Community concern and input in waste management	Stakeholder involvement in decision making	Nominal

## CHAPTER FOUR

### DATA ANALYSIS AND INTERPRETATIONS

#### 4.1 Introduction

This chapter discusses the interpretation and presentation of the findings. It presents analysis of the data on the determinants of effective solid waste management in the core urban area of Bomet town. The chapter also provides the major findings and results of the study.

#### 4.2 Response Rate

The study targeted a sample size of 160 respondents from which 133 successfully filled in and returned the questionnaires making a total response rate of 83%. This response rate was excellent, representative and conforms to Mugenda and Mugenda's (1999) stipulation that a response rate of 50% is adequate for analysis and reporting while a rate of 60% is good and a response rate of 70% and over is excellent.

**Table 4. 1:** Respondent's response rate

	<b>Frequency</b>	<b>Percentage</b>
Responded	133	83%
Nonresponse	27	17%
<b>Targeted</b>	<b>160</b>	<b>100.0</b>

The above respondents included 10 county waste management staff, 5 NEMA officers and 5 public health officers.

#### 4.3 Demographic Information

The study sought to find information on various aspects of the respondent's background including the respondent's age, gender, highest level of academic qualification and occupation. This information was to be used in testing the appropriateness of the respondents in answering the questions regarding determinants of solid waste management in Bomet town.

**Table 4.2;** Gender of respondents

<b>Respondents</b>	<b>Frequency</b>	<b>Percentage</b>
Male	114	71 %
Female	46	29 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

The findings as shown in table 4.2 show that majority of the respondents in the study were male (71 %) while the rest were female (29 %). This depicts that majority of the household heads in the core urban population of Bomet town were male.

### **4.3.1 Age Bracket of respondents**

The question sought to establish the age bracket of the respondents and the findings were as shown in Table 4.3

**Table 4.3 ;** Age bracket of respondents

<b>Age bracket</b>	<b>Frequency</b>	<b>Percentage</b>
(20—29)	25	16 %
(30—39)	69	43 %
(40—49)	36	23 %
(50—59)	20	12 %
(60 and Above)	10	6 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

According to the findings as shown in Table 4.3, majority of the respondents were in age bracket (30-39) years accounting for 43%, (40-49) years representing 23 % , (20-29) years accounting for 16 % , 50-59 years representing 12 % while above 60 years accounted for 6 % of the respondents. This shows that majority of household heads are middle aged people expected to have an idea on solid waste disposal and its relevance to environmental conservation.

### 4.3.2 Level of Education of respondents

The researcher sought to know the level of education of the respondents and the findings were as shown in the Table 4.4

**Table 4.4;** Level of education of respondents.

<b>Level of education</b>	<b>Frequency</b>	<b>Percentage</b>
University level	7	4 %
Tertiary college	32	20 %
Secondary school	95	60 %
Primary school	26	16 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

From the study findings, majority of the respondents (60 %) had attained secondary level of education, 20% had tertiary level of education, 16% had attained primary level of education while the remaining 4% had university level of education. These statistics are a clearly indication that the core urban population of Bomet town had attained basic level education to understand the need for effective solid waste management.

### 4.3.3 Occupation of respondents

The question sought to know the occupations of the respondents and the findings were as shown in Table 4.5

**Table 4.5:** Occupation of respondents

<b>Occupation</b>	<b>Frequency</b>	<b>Percentage</b>
Unemployed	37	23 %
Civil servant	84	54 %
Privately employed	25	16 %
Business person	14	9 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

According to the findings in Table 4.5, 54% of the respondents were civil servants, 16% were privately employed people, 23% were unemployed while the rest 9% were business persons. These findings show that majority of the household heads involved in this study had a sustainable income.

#### 4.3.4 Residency of respondents

The study sought to find out whether the study respondents were residents of Bomet town.

**Table 4.6;** Residency of respondents.

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
Yes	150	94 %
No	10	6 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

From Table 4.6, majority of the respondents (94 %) were residents of Bomet town, save for a few (6%) assumed to be some of the purposively selected public servants. The respondents would therefore give valid and reliable information about solid waste management in Bomet town.

#### 4.4 Waste collection.

All the respondents indicated that there are no private or community based organizations involved in solid waste collection in Bomet town; meaning that solid waste is solely collected by the Bomet county government.

##### 4.4.1 Frequency of waste collection

The researcher sought to establish from the respondents the frequency of garbage collection in their respective areas and the findings were as illustrated in Table 4.7

**Table 4.7 ;** Frequency of waste collection

<b>Waste collection</b>	<b>Frequency</b>	<b>Percentage</b>
Daily	16	10 %
2 to 3 times a week	35	22 %
Once a week	99	62 %
Once in two weeks	10	6%
Once a month	0	0 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

From the research findings shown in table 4.7, majority of respondents, 62% indicated that the garbage collection in their areas was done once a week, 22% said they had their garbage collected 2 to 3 times in a week, 10% indicated that they had their garbage was collected daily and 6 % indicated garbage collection done once in two weeks in their premises.

Based on the findings, there is need for the county government to be consistent in garbage collection, through better mobilization of resources available as well as involving the residents.

#### **4.4.2 Waste Pile up.**

The researcher enquired from the respondents on whether there was waste pile up within their premises and the findings were as shown in table 4.8.

**Table 4.8;** Waste pile up in respondent's area.

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
Yes	104	65 %
No	56	35 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

From the study findings, majority of the respondents (65%) indicated that there was waste pile up within their premises while 35% had their areas being free of garbage pile up. These findings reveal that waste collection was not up to the residents' expectations.

#### 4.4.3 Waste collection ability by the county government.

The question asked whether Bomet county government was able to cope with waste collection in Bomet town and the findings were as illustrated in Table 4.9.

**Table 4.9;** Ability of County government to collect waste.

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
Yes	59	37 %
No	80	50 %
Not sure	21	13%
<b>Total</b>	<b>160</b>	<b>100 %</b>

From the findings in Table 4.9, half of the respondents (50%) were of the opinion that the County government was unable to cope with the volumes of garbage in Bomet town, while 37% were of a contrary opinion. 13% of the study respondents were non-committal.

#### 4.4.4 Service to Bomet town by the County government.

The researcher asked whether the whole of Bomet town was well served by the County government in terms of waste collection and the findings were as shown in table 4.10.

**Table 4.10;** Service to Bomet town by the County government

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
Yes	68	42 %
No	75	47 %
Not sure	17	11%
<b>Total</b>	<b>160</b>	<b>100 %</b>

From findings in table 4.10, 42% of the respondents were of the opinion that Bomet town was well served in terms of waste collection by the County government, 47% were of a contrary opinion while the remaining 11% were not sure either way.

#### 4.4.5 Respondent's satisfaction on waste collection.

Researcher enquired whether the respondents were satisfied with waste collection in Bomet town and the findings were as illustrated in table 4.11.

**Table 4.11 ;** Waste collection satisfaction of respondents

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
Yes	48	30 %
No	88	55 %
Not sure	24	15 %
<b>Total</b>	<b>160</b>	<b>100 %</b>

According to the findings, over half of the respondents (55 %) indicated that waste collection was not satisfactory, 30% were of the opinion that garbage collection was satisfactory while 15% were not sure whether the garbage collection was satisfactory or not. These findings reveal that Bomet county government needs to improve their waste collection systems by providing more trucks for garbage collection and increasing trained human resource.

#### 4.5 Study variables

The study was based on four variables; determinants of technical factors, financial factors, institutional factors and public participation on effective solid waste management in the core urban area of Bomet town.

##### 4.5.1 Technical Factors and Solid Waste Management.

This section focuses on the analysis of how technical factors such as efficient collection systems, the right equipment and qualified personnel, working conditions of workers and the volume of waste generated influence effective solid waste management in Bomet town.

**Table 4.12;** Technical factors and solid waste management

<b>Variable</b>	<b>SA</b>	<b>A</b>	<b>U</b>	<b>D</b>	<b>SD</b>
The County Government is not efficient in solid waste management	40 (25.3%)	59 (38.7%)	14 (7.4%)	32 (22.5%)	15 (6.1%)
The County lacks enough equipment and personnel for solid waste management.	30 (19.0%)	75 (46.6%)	7 (4.5%)	35 (21.7%)	13 (8.2%)
Personnel in solid waste management lack adequate qualifications and skills.	44 (27.2%)	47 (29.7%)	9 (5.5%)	41 (25.4%)	19 (12.2%)
Solid waste management workers have poor working conditions.	56 (35.1%)	48 (30.2%)	9 (5.3%)	42 (26.1%)	5 (3.3%)

**Key;** SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree.

The results on table 4.12 show that the County is inefficient in waste storage, collection and safe disposal; strongly agree (25.3%), agree (38.7%), undecided (7.4%), disagree 22.5%, strongly disagree 6.1%, County does not have enough equipment and personnel for solid waste management; strongly agree (19.0%) agree (46.6%), undecided 4.5%, disagree (21.7%), disagree (8.2%); Personnel in waste management do not have adequate qualifications and skills; strongly agree (27.2%), agree (29.7%), undecided (5.5%), disagree (25.4%), strongly disagree (12.2%). Results also showed that workers had poor working conditions, strongly agree (35.1%), agree (30.2%), undecided (5.3%), disagree (26.1%) and strongly disagree (3.3%)

#### **4.5.2 Financial factors and solid waste management.**

In this section focus is on the analysis of how financial factors including budgetary allocation, ability to employ private collectors and promotion of the

reduce, recycle and recovery model determine effective solid waste management in Bomet town.

**Table 4.13;** Financial factors and solid waste management

<b>Variables</b>	<b>SA</b>	<b>A</b>	<b>U</b>	<b>D</b>	<b>SD</b>
The County does not allocate enough budget for budget for solid waste management services in Bomet town.	39 (24.3%)	44 (27.8%)	21 (12.8%)	31 (19.6%)	25 (15.5%)
The County is unable to employ private waste collectors.	42 (26.4%)	59 (36.7%)	9 (5.6%)	37 (23.0%)	13 (8.3%)
The County allocates limited funds for solid waste management	35 (21.9%)	52 (32.5%)	15 (9.4%)	33 (20.6%)	25 (15.6%)
The County allocates insufficient funds for promoting waste reduction, recycling and recovery.	67 (42.1%)	36 (22.3%)	10 (6.1%)	34 (21.6%)	13 (22.3%)

**Key;** SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree.

The results on table 4.13 show that the county does not allocate enough budget for the provision of SWM services in the County; Strongly Agree (24.3%), Agree (27.8%), Undecided (12.8%), Disagree (19.6%), Strongly Disagree (15.5%); County has no capacity to employ private waste collectors; Strongly Agree (26.4%), Agree (36.7%), Undecided (5.6%), Disagree (23.0%), Strongly Disagree (8.3%); Limited funds are allocated for waste management by County Government; Strongly Agree (21.9%), Agree (32.5%), Undecided (9.4%), Disagree (20.6%), Strongly Disagree (15.6%); insufficient funds are allocated for waste reduction, recycling and recovery; Strongly Agree (42.1%), Agree (22.3%),

Undecided (6.1%), Disagree (21.6%), Strongly Disagree (7.9%)

### 4.5.3 Institutional factors and solid waste management

This is where analysis is done on how institutional factors such as public awareness policy, availability of local initiatives, policy on waste reduction at the source and sanitation rules determine effective solid waste management.

**Table 4.14;** Institutional factors and solid waste management

Variable	SA	A	U	D	SD
The County Government lacks Public awareness policy on solid waste management	47 (29.3%)	56 (35.1%)	15 (9.5%)	30 (18.8%)	12 (7.3%)
There is lack of information about available local initiatives concerning solid waste management.	39 (24.1%)	74 (46.3%)	17 (10.5%)	21 (13.8%)	9 (5.3%)
The County Government lacks policy on waste reduction at the source and on involving local community groups.	42 (26.2%)	71 (44.3%)	13 (8.1%)	25 (15.6%)	9 (5.8%)
The County Government lacks clear authority and clear sanitation rules.	44 (27.2%)	58 (36.0%)	13 (8.4%)	31 (19.3%)	14 (9.1%)

**Key;** SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree.

The results on the influence of institutions factors in effective solid waste management in table 4.15 show that the county lacks public awareness on Solid waste management: strongly agree (29.3%) agree (35.1%), undecided (9.5%), agree (18.8%) and strongly agree (7.3%); there was lack of information about

local initiatives concerning solid waste management; strongly agree (24.1%), agree (46.3%), undecided (10.5%), disagree (13.8%) and strongly disagree (5.3%), the county government does not have clear authority and sanitation rules, strongly agree (27.2%), agree (36.0%), undecided (8.4%), disagree (19.3%), and strongly disagree (9.1%).

#### 4.5.4 Community participation and solid waste management

Analysis of how stakeholder involvement at all levels determine effective solid waste management.

**Table 4.15;** Community participation and solid waste management

<b>Variable</b>	<b>SA</b>	<b>A</b>	<b>U</b>	<b>D</b>	<b>SD</b>
Stakeholders are not involved at all stages of solid waste management programs.	55 (34.4%)	37 (23.1%)	9 (5.6%)	32 (20.0%)	27 (16.9%)
Stakeholder involvement has no influence on the success of solid waste management.	29 (18.1%)	22 (13.8%)	15 (9.4%)	49 (30.6%)	45 (28.1%)
Stakeholders do not understand the details of SWM by the management by the county Government.	47 (29.4%)	51 (32.0%)	10 (6.1%)	32 (20.0%)	20 (12.5%)
Successful solid waste Management doesn't depend on the level of stakeholder involvement.	18 (11.3%)	33 (20.6%)	12 (7.5%)	53 (33.1%)	44 (27.5%)

**Key;** SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree

The results on the influence of stakeholder participation on solid waste management on table 4.15 show that the County does not involve the local community in addressing solid waste management problems; strongly agree (34.4%), agree (23.4%), undecided (5.6%), disagree (20.0%) and strongly disagree (16.9%) ; stakeholder involvement has a strong influence on solid waste management; strongly agree that there is no influence (18.1%), agree that there is no influence (13.8%), undecided (9.4%), disagree with no influence (30.6%), strongly disagree with no influence (28.1%); the stakeholders do not understand the details of solid waste management by the County government, strongly agree (29.4%), agree (32.0%), undecided (6.1%), disagree (20.0%),strongly disagree(12.5%). On the influence of successful solid waste management on the level of stakeholder involvement, the results showed that there exists a strong influence; strongly agree that there's no influence (11.3%), agree that there's no influence (20.6%), undecided (7.5%) disagree with no influence (33.1%) strongly disagree with no influence (27.5%).

## **CHAPTER FIVE**

### **SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter is organized into the following sub-headings: summary of the study, conclusions of the study, recommendations of the study and finally suggestions for further studies in line with the research questions.

#### **5.2 Summary of the findings**

The study sought to investigate the determinants of solid waste management in the core urban area of Bomet town with a view of suggesting measures to improve the management of solid waste in the study area. In this sub section the researcher outlines summary of the findings based on the objectives of the study.

Majority of the respondents in the study were in the age bracket of 30-39 years, showing that many of them were mature middle aged individuals who understood the importance of effective solid waste management in the urban area of Bomet town. More males than females participated in the study indicating that majority of the household heads are males in Bomet town. The results illustrates that 54% of the respondents were public servants, 23% were unemployed, 16% were privately employed while 9% were business owners. On the level of education, the results showed that 60% of the respondents had attained secondary school certificates, 20% had gone through tertiary colleges, 16% were of primary school level of education while 7% were university graduates.

#### **5.3 Discussion of findings of the study**

From the background information both genders are represented as heads of households and therefore equally take part in decision making. To address any issues regarding solid waste management both genders should therefore be involved at all levels. All age groups above 20 years were heads of households. To communicate to the local community all the age groups should be considered.

The literacy level of the community is quite high with 60 % of the population having secondary school education. This means the understanding level would be good for interventions to be taken. Also to address community concerns about solid waste management its inclusion in secondary school curriculum could be effective.

The study findings on the influence of financial factors on effective solid waste management in Bomet town disclosed that finances in reference to budget allocation on solid waste management services, ability to employ private waste collectors and the promotion of reduce, reuse and recycle model play a critical role. Institutional factor including public awareness policy, information about local initiatives on solid waste management, policy on waste reduction at the source and clear authority together with clear sanitation rules were investigated. From the findings, there was indication that Bomet County government has to invest on the above technical factors for efficient and effective solid waste management in Bomet town.

There is generally poor awareness on the benefits of solid waste management in Bomet town. The County government should consider initiating the process of building community capacity to enable the stake holders identify their own priorities, resources, needs, and solutions in such a way as to promote representative participation, good governance, accountability, and peaceful change. The majority of respondents expressed importance of contributing towards solid waste collection as well the importance of solid waste management.

Results from the technical factors revealed that the county is not efficient in solid waste management, does not have enough equipment and skilled personnel. The solid waste workers are working under poor conditions. On community participation, the findings indicate that the public involvement at all stages of solid waste management is low although it influences the success of the same according to the research findings. The public according to the findings do not also understand the details of solid waste management by the County government of Bomet.

#### **5.4 Conclusions of the study**

Effective solid waste management requires the effort of Bomet county government, the business community, local politicians, religious organizations, civil servants, the rich, the poor and a host of other tangible and intangible groups/ associations in the core urban area of Bomet town. All these stake holders must be brought together by a well thought out County government policy and legislation to work together towards solving the current challenge of the urban solid waste problem

The financial factors including service recovery charge, budget allocation and the county's capacity to pay well all those involved in waste collection together with sufficient funds for promoting waste reduction, recycling and recovery was found to be low resulting in inefficient and ineffective solid waste management in Bomet town.

Technical factors including proper collection systems, professional qualification of personnel, properly designed and operation of land-fills and availability of the right equipment was equally inefficient in addressing effective solid waste management in the study. Financial factors had significant association with effective solid waste management. Institutional factors such as county's lack of public awareness on solid waste management, the lack of policy for waste reduction at the source and involvement of community groups, lack of clear authority and clear sanitation rules equally influenced effective solid waste management in the study findings.

#### **5.5 Recommendations of the study**

The following recommendations were made in conclusion of the study; The County government should allocate enough money for provision of solid waste management services within the county which should be reviewed periodically to ensure that the funds are put to proper use in terms of efficient and effective waste management. The county government should also ensure better waste management through waste reduction at the source, reuse and recycling where possible. For waste management to be effective there should be proper waste

collection systems. Professional qualification of personnel, properly designed and operating sanitary land-fills and equipment availability so as to reduce environmental pollution and prevent health hazards. The research found out that there is no strict enforcement of the county by-laws by public health officers such that open pits and drainages are common. This research recommends that existing by laws should be strictly enforced in all areas of the county and new ones formulated to cope with changing times, for example formulation of county solid waste management policy.

The locals should be encouraged to be actively involved in decision making to strengthen the procedures and increase ownership of solid waste management process. The sanitation facilities on the other hand should be designed with the involvement of the locals to ensure that they are convenient and sufficient.

#### **5.6 Suggestions for further research**

The study was limited to determinants of effective solid waste management in Bomet town. Further research can be done on other social factors determining the performance of sustainable solid waste management in Bomet town which may not have been identified in this study. Recommended also are studies on the treatment of the solid waste at the final stages and how it affects the local population within Bomet town.

## REFERENCES

- Abagale, K. F., Mensah, A., and Osei, A. R. (2012), “*Urban solid waste sorting in a growing city of Ghana*”, International Journal of Environment and Sustainability, Vol.1, No. 4, Pp 18-25, available online at [www.sciencetarget.com](http://www.sciencetarget.com), accessed on 3rd January, 2013.
- Abel, O. A. (2009). *An Analysis of Solid Waste Generation in a Traditional African City: The Example of Ogbomoso, Nigeria*. Environment and Urbanization, SAGE Journals, 19 (2): 527- 537.
- Aderogba, K. A., & Afelumo, B. A. (2012). *Waste dumps and their manangement in Lagos Metropolis*. (M. Institute, Red.) International Journal of Learning & Development, 2(1), 2164-4063.
- Agwu, M. O. (2012), “*Issues and challenges of solid waste management practices in Port-Harcourt, Nigeria – a behavioural perspective*”, American Journal of social and management of sciences, online: [www.scihub.org](http://www.scihub.org), accessed on 3rd January, 2013.
- Ajzen I, Fishbein M, (1980). *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice-Hall
- Al-Khatib, I. A., Kontogianni, S., Abu Nabaa, H., Alshami, N., and Al-Sari’, M. I.,(2015). *Public perception of hazardousness caused by current trends of municipal solid waste management*. Waste Management, 36323- 330.
- Amin, M. E. (2005). *Social Science research* . Kampala; Uganda: Makerere University Printers.
- Asase, M.A.D., (2011). *Solid waste separation at source: A case study of the Kumasi Metropolitan Area*, a thesis submitted to the Chemical Engineering Department, Kwame Nkrumah University of Science and Technology, Kumasi, in partial fulfilment of the requirements for the Degree of Doctor of Philosophy, Faculty of Chemical and Materials Engineering, College of Engineering.
- Banga, Margaret. (2011). *Household Knowledge, Attitudes and Practices in Solid Waste Segregation and Recycling: The Case of Urban Kampala*. Zambia Social Science Journal, 2(1), 27-39.
- Best John.W, & Kahn, James.V. (2006). *Research in Education*. Boston: Pearson/Allyn and Bacon.
- Boudreau G. (2010). *Behavioural change in environmental education*.

- Chung, S., Lo, C., (2008). *Local waste management constraints and waste administrators in China*. *Journal of Waste Management* 28, 272–281
- Coopers & Lybrand (2000): *Cost-Benefit Analysis of the Different Municipal Waste Management Systems; Objectives and Instruments for the Year 2000*. Luxembourg
- Davidson Gary (2011). "Waste Management Practices: Literature Review" (PDF). Dalhousie University - Office of Sustainability.
- El-Fadel M. and Massoud M.(2012), *Comparative assessment of methodologies for methane emissions estimation from MSW landfills*, Seventh International Waste Management and Landfill Symposium, Cagliari, IV, pp. 63-70, Italy, October 4-8
- Grosse, F. (2010). "Is recycling 'part of the solution'? The role of recycling in an expanding society and a world of finite resources".
- Guerrero, L.A., Maas, G., Hogland, W., (2013). *Solid waste management challenges for cities in developing countries*. *Waste Manage.* 33 (1), 220–232
- Halvorson, Hans (2012). "What Scientific Theories Could Not Be" (PDF). *Philosophy of Science*. The University of Chicago Press. 79 (2): 183–206. doi:10.1086/664745. Retrieved 14 February 2013.
- Hamidi, Esmael (2010) "Fundamental Issues in L2 Classroom Assessment Practices," *Academic Leadership: The Online Journal*: Vol. 8 : Iss. 2 , Article 21. Available at: <https://scholars.fhsu.edu/alj/vol8/iss2/21>
- Henry, R. K., Yongsheng, Z., & Jun, D. (2010). *Municipal solid waste management challenges in developing countries- Kenya case study*. <http://www.ncbi.nlm.nih.gov/pubmed/16006111>.
- Hilburn, A. M. (2015). *Participatory risk mapping of garbage -related issues in a rural Mexican municipality*. *Geographical Review*, 105(1), 41-60
- Hoorweg, D., and Giannelli, N., (2007). *Managing municipal solid waste in Latin America and the Caribbean: Integrating the private sector, harnessing incentives*. Retrieved February 10, 2015.
- Hoorweg, D and Bhada-Tata P, (2013). *What a Waste: A Global Review of Solid Waste Management*, Urban Development Series, Knowledge Papers, No. 15. 2012, the World Bank, Washington DC. Accessed at: <http://go.worldbank.org/BCQEP0TMO015/2/2013>

- JICA, 2010. *Preparatory Survey for Integrated Solid Waste management in Nairobi City in the Republic of Kenya*, Final Report
- Jha A.K, Singh G.P, Gupta P.K (2011). *Sustainable municipal solid waste management in low income group of cities: a review*. Tropical Ecology, 52 (1) (2011), pp. 123–131
- Kama Vasisth (2011), *Waste Management*, Maxford books, New Delhi. pp. 4-7
- Kironde, J.M.L., (2011), Onibokun, A.G. (Ed). *Managing the Monster*. Urban Waste and Governance in Africa. Pp. 101-172. Ottawa, IDRC.
- Kothari, C.R., (2004). *Research methodology*. Methods and techniques. (2nd ed). New Delhi: New Age International Publishers.
- Kombo, K. D., & Tromp, L. A. (2006). *Proposal thesis writing*. Makuyu : Don Bosco Printers
- Kreith, F. (1994). *Handbook on Solid Waste Management*. New York: McGraw-Hill.
- Kruljac, S. (2012). *Public-private partnerships in solid waste management: Sustainable development strategies for Brazil*. Bulletin of Latin American Research, 31(2), 222-236
- Kufoworola O.F (2007). *Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria*. Waste management v. 27, pp.1139-1143.
- Lubaale, G. & Musyoki, S. (2011). *Pro Poor Urban Sanitation and Hygiene: Turning Challenges to Opportunities*. Presented at the East Africa Practitioners Workshop, LAICO Umubano Hotel, Kigali, Rwanda.
- Memon M.A (2010). *Integrated solid waste management based on the 3R approach*. Journal of Material Cycles and Waste Management, 12 (1) (2010), pp. 30–40
- Mensah, A. E. (2011), “*Management of solid waste in Kumasi central market*”, Bachelor Degree Thesis, KNUST, available on line on <http://www.scribd.com/doc/62400500/Management-of-Solid-Waste-in-Ghana-Case-Study-Kumasi-Central-Market>, accessed on 5th January, 2013.
- Mrayyan, B., and Hamdi, M. R.(2010). *Management approaches to integrated solid waste in industrialized zones in Jordan: A case of Zarqa City*. Waste Management, 26(2), 195-205

- Muthoni, Paul (2014). *Stakeholder's involvement in municipal solid waste management: a case study for Nairobi City County - Kenya*. Master's thesis, University of Jyväskylä, Finland. Available from <https://jyx.jyu.fi/dspace/handle/123456789/44288>.
- Mugenda, M. O., & Mugenda, G. A. (2003). *Research methods*. Nairobi; Kenya: African Centre for Technology Studies (ACTS).
- Napoleon, S., Momodu, K., O. D., & Joan E. D., (2011). *Mitigating the Impact of Solid Wastes in Urban Centres in Nigeria*. Kamla-Raj.
- Nathanson, J. (2015). *Solid-waste management*. Retrieved February 10, 2015 . <http://www.britannica.com/EBchecked/topic/553362/solid-waste-management>
- NEMA/PR/5/2/11848, (2006), *Compliance with Waste management regulations*. Proposed Construction of Bomet Sewerage System in Bomet Township, Bomet County.
- Njoroge, B. N. K., M. Kimani and D. Ndunge (2014). *Review of Municipal Solid Waste Management: A Case Study of Nairobi, Kenya*. Research Inventory: International Journal of Engineering and Science, vol. 4, No. 2.
- Noto, F., (2010). *Overcoming NIMBY Opposition*. <http://www.gcastrategies.com/booksandarticles/383/overcoming-nimby-opposition/> (retrieved 28.11.12).
- Ogawa H. (2012), *Sustainable Solid Waste Management in Developing Countries*, 7th ISWA International Congress and Exhibition, World Health Organization, Kuala Lumpur, Malaysia. 2000. Accessed at: <http://www.soc.titech.ac.jp/uem/waste/swm-fogawal.htm> 26/9/2012.
- Ojedokun, O. (2011). *Attitude towards littering as a mediator of the relationship between personality attributes and responsible environmental behaviour*. *Waste Management*, 31(12), 2601-2611
- Okot-Okumu, J., (2012). *Solid waste management in African cities – East Africa, Waste Management – An Integrated Vision*, ISBN: 978-953-51-0795-8, <http://dx.doi.org/10.5772/50241>.<<http://www.intechopen.com/books/waste-management-an-integrated-vision/solid-waste-management-in-african-cities-east-africa>>
- Oliver, V, (2010), *301 Smart Answers to Tough Business Etiquette Questions*. Skyhorse Publishing, New York USA

- Onibokun A.G. (2009). *Chapter 6: Synthesis and Recommendations in Managing the Monster: Urban Waste and Governance in Africa*, Ottawa International Development Research Centre.
- Orodho, J. A. (2009). *Elements of Education and Social Science Research Methods*. Maseno, Kenya: Kanezja publishers.
- Oso, W. Y., & Onen, D. (2009). *A General guide to writing research proposal and report*. Nairobi; Kenya: The Jomo Kenyata Foundation .
- ROSA Project (2007): *Baseline study on water and sanitation for Nakuru Town, Kenya*
- Scherman, V. (2007). *The validity of value-added measures in secondary schools*. Pretoria: University of Pretoria.
- Seng, B., Kaneko H., Hirayama K., Katayama-Hirayama K., (2010). *Municipal solid waste management in Phnom Penh, capital city of Cambodia*. Waste Management & Research 29, 491–500.
- Sharholly, M., Ahmad, K., Mahmood, G., Trivedi, R.C., (2008). *Municipal solid waste management in Indian cities*. A review; Journal of Waste Management 28,459–467
- Stern PC, Dietz T, Abel T, et al (1999). *A Value-Belief-Norm*. Theory of Support for Social Movements: The Case of Environmentalism. Human Ecology Review 6 (1999): 81-97.
- Sridhar K. S., Kumar S. (2013). *India's urban environmental challenges: Land use, solid waste and sanitation*, Yojana: Journal of the Ministry of Information and Broadcasting, 57, 30-34. Google Scholar
- Tangri, N. (2003). *Waste incineration: A dying technology* (pp. 1-101). Essential Action for GAIA Global Anti-Incinerator Alliance
- Trochim, W. and Kane, M (2005). *Concept mapping: An introduction to structured conceptualization in health care*. International Journal for Quality in Health Care, 17, 3, June 2005, 187-191.
- United Nations, Department of Economic and Social Affairs, Population Division (UNDEA) (2014). *World Urbanization Prospects*. Available from [esa.un.org/unpd/wup](http://esa.un.org/unpd/wup).
- UNEP, (2013). *Municipal solid waste comparative analysis study in Jubah, South Sudan*, United Nations Environmental Programme. Retrieved 28th January, 2015 at <<http://unep.org/SouthSudan/>>.

- UNFPA, (2011). *State of World Population 2011*: United Nations Population Fund. United Nations Environment Programme. United Nations Population Division (2015). *World population prospect*, UN department of economics and Social Affairs, UN Secretariat.
- UN-HABITAT, (2010). *Solid Waste Management in the World Cities: Water and Sanitation in the World Cities*. London: Gutenberg Press.
- USEPA (2010). *Municipal Solid Waste in the United States: 2009 Facts and Figures*. EPA- 530-R-010-012. Washington, DC: US Environmental Protection Agency, Office of Solid Waste. Available at: <http://www.epa.gov/osw/nonhaz/municipal/pubs/msw2009rpt.pdf>
- U.S. Department of Health and Human Services (2001). *Hazardous Substances Data Bank (HSDB, online database)* .National Library of Medicine Bethesda, MD.
- Wilson, C.D., Velis, C.A., Rodic, L., 2013. *Integrated sustainable waste management in developing countries*. Waste Resour. Manage. 166 (WR2)
- World Bank. (2011). *Municipal solid waste management in small towns*. An economic analysis conducted in Yunnan, China.
- Zhu, Da, (2007). *Improving municipal solid waste management in India: A source book for policy makers and practitioners*. Herndon: World Bank Publication.
- Zurbruegg, C., (2009). *Solid Waste Management in Developing Countries: A Sourcebook for Policy Makers and Practitioners*: EAWAG/SANDEC.

## APPENDIX I

### LETTER OF TRANSMITTAL OF DATA COLLECTION INSTRUMENTS

David K. Korir  
P.O BOX 309—20400

Bomet

Dear Respondent

#### **RE: REQUEST TO PROVIDE RESEARCH INFORMATION**

I am a Master's student at the School of Open and Distance Learning of the University of Nairobi currently conducting a research study on determinants of effective Solid waste management in Bomet Town.

You have been selected as one of the respondents to assist in providing the requisite data and information for this undertaking. I am requesting you to kindly spare a few minutes and answer the questions below. The information obtained will be used purely for academic purposes, and will be treated with utmost confidentiality. Your identity will be anonymous and your name shall not be recorded.

Kindly respond to all the questions honestly and truthfully.

Yours faithfully,

Korir David Kipkemoi

**APPENDIX II**  
**QUESTIONNAIRE**

This questionnaire is meant to gather information regarding the determinants of effective solid waste management in Bomet Town and you have been randomly selected to participate in the study. Any information given will be treated with confidentiality and will be used for academic purposes only.

Kindly respond by ticking in the boxes provided or by writing a brief statement in the spaces provided. Thank you.

**A). SOCIO DEMOGRAPHIC INFORMATION**

- 1) What is your Sex ? a) Male  b) Female
- 2) What is your age in years ? a) 20-29  b) 30-39  c) 40-49   
d) 50-59  e) Above 60
- 3) What is your level of Education ? a) None  b) Primary   
c) Secondary  d) College/University
- 4) What is the nature of your occupation?  
a) Unemployed  b) Civil servant  c) Privately employed   
d) Business person

**B). PRACTICES OF SOLID WASTE MANAGEMENT.**

5. Who collects garbage in your area? .....
6. What is the frequency of garbage collection in your area?  
a) Daily  b) (2-3) times per week  c) once a week   
d) once in two weeks  e) Once a month
7. Is there garbage pile up in your area? Yes  No
8. Is the collector able to cope with the volume of garbage in your area?  
Yes  No
9. Is your area clean/well served by the garbage collector?  
Yes  No

10. Are you satisfied with the garbage collection service in your area?

Yes [ ] No [ ] Not sure [ ]

**C). MANAGEMENT OF SOLID WASTE**

**i) Influence of availability of technical skills and equipment on solid waste management in Bomet Town, Bomet County.**

**Key;** SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree

	SA	A	U	D	SD
The County Government is not efficient in solid waste management					
County has enough equipment and personnel involved in solid waste management.					
There are a number of active players involved in solid waste management.					
Personnel in solid waste management have adequate qualifications and skills.					
Solid waste management workers have poor working conditions.					
There is very high solid waste generation thereby straining both personnel and equipment.					

Give your own opinion on the influence of availability of technical skills on effective solid waste management in Bomet Town.

.....

.....

.....

.....

**ii) Influence of funding on solid waste management in Bomet Town.**

**Key; SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree**

	SA	A	U	D	SD
There is enough budget allocation for provision of solid waste management services in the county.					
The County has the capacity to pay those involved in the collection of waste					
Limited funds are allocated by the County Government for solid waste management					
There are sufficient funds allocated for promoting waste reduction, recycling and recovery.					

Give your own opinion on the influence of availability of funds on effective solid waste management in Bomet Town

.....

.....

.....

.....

**iii) Influence of the institutional capacity on solid waste management in Bomet Town.**

**Key; SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree**

	SA	A	U	D	SD
The County Government lacks public awareness policy on solid waste management					
There is lack of information about available local initiatives concerning solid waste management.					
The County Government lacks policy on waste reduction at the source and on involving local community groups.					
The County Government lacks clear authority and clear sanitation rules.					

Give your own opinion on the influence of the County Government’s institutional capacity on effective solid waste management in Bomet Town.

.....

.....

.....

.....

**iv) Influence of Community participation on solid waste management in Bomet Town.**

**Key; SA, Strongly Agree; A, Agree; U, Undecided; D, Disagree; SD, Strongly Disagree**

	SA	A	U	D	SD
Stakeholders are always involved at all stages of planning and implementation of solid waste management programs.					
Stakeholder involvement has no influence on the success of solid waste management.					
Stakeholders understand the details of solid waste management as communicated by the County Government.					
Successful solid waste management depends largely on the level of stakeholder involvement.					

Give your own opinion on the influence of community participation on effective solid waste management in Bomet Town.

.....

.....

.....

.....

**APPENDIX III**  
**TIME SCHEDULE**

<b>No.</b>	<b>Activity</b>	<b>Time (Months)</b>	<b>Period</b>
A	Proposal writing and defence	2	March/ April 2018
B	Piloting	1/2	April/May 2018
C	Data collection	1	May/June 2018
D	Data analysis	1/2	May/June 2018
E	Typing, editing and final defence	1	June/July 2018

## APPENDIX IV

### BUDGET

<b>Item</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit cost (Ksh)</b>	<b>Total cost (Ksh)</b>
Printing paper	Ream	5	600.00	3,000.00
Internet	----	----	2000.00	2,000.00
Pens	Pack	1	400.00	400.00
Data collection/analysis				25,000
Type setting	-----	-----	2000.00	2000.00
Photocopying	-----	250	5.00	1,250.00
Binding	-----	5	60.00	300.00
<b>TOTAL</b>	-----	----	-----	37,950.00