

**FACTORS INFLUENCING EFFECTIVE SOLID WASTE
MANAGEMENT: THE CASE OF MUNICIPAL COUNCIL OF MOMBASA,
KENYA**

BY

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DECLARATION

This research project report is my original work and has not been presented for examination to any other institution.

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DEDICATION

I wish to dedicate this work to my parents Mr. & Mrs. Maloba; words cannot fully describe what I feel for you. All your sacrifices and efforts in making sure that we as a family live a healthy and satisfying life are the reasons why I have made it this far in education, Bravo dad and mum!!

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ABBREVIATIONS AND ACRONYMS

AFD:	Agence Francaise de Developpement
CBOs:	Community Based Organizations
DOE:	Department of Environment
EMCA:	Environment Management and Coordination Act
ESTs:	Environmentally Sound Technologies
GNP:	Gross National Product
ISWM:	Integrated Solid Waste Management
JICA:	Japan International Cooperation Agency
KNBS:	Kenya National Bureau of Statistics
LA:	Local Authorities
MCM:	Municipal Council of Mombasa
MOH:	Ministry of Health
MSWM:	Municipal Solid Waste Management
NCC:	Nairobi City Council
NEMA:	National Environment Management Authority
NGOs:	Non-Governmental Organizations
NIMBY:	Not In My Backyard
SWM:	Solid Waste Management
SWMS:	Solid Waste Management System

UN:	United Nations
UNEP:	United Nations Environment Programme
UNPD:	United Nations Populations Division
UN-HABITAT:	United Nations Human Settlements Programme
USEPA:	United Nations Environmental Protection Agency

ABSTRACT

The management of municipal solid waste has become a problem in Mombasa. This is easily identified by the persistent heaps of uncollected waste found on the street sides or ubiquitous illegal dumps. The purpose of the study was to determine the factors influencing effective solid waste management in Municipal Council of Mombasa. In order to improve the strategy for managing solid waste, a better understanding of both technological and managerial aspects is needed. While various reports, projects and policy documents on the subject of solid waste management are available, the factors affecting effective solid waste management tends to be overlooked. The study focused on technology, availability of financial resources, community participation and the policies affecting solid waste management by the Municipal Council of Mombasa. The sample of this study consisted of 140 respondents; 94 of whom were randomly selected household heads drawn from Kisauni, Mvita, Changamwe and Likoni divisions in Mombasa County and 16 were purposively selected key informants from the Municipal Council of Mombasa, National Environment Management Authority, Community Based Organizations, Private waste collection companies and key businesses within the city. The data was primarily collected through questionnaires and interviews respectively. Analysis of the data was done using descriptive statistics which included frequencies and percentages. Cross tabulations and chi square tests were also done to show the relationship between various variables and test the significance of the solid waste management variables respectively. The findings reveal that technology influences the effectiveness of solid waste management with the test statistic given as $X^2(2) = 48.833, p \leq 0.05$, indicating that there is a relationship between technology and effective solid waste management. The results show that there are variations in planning, development and operations in the choice of technology adopted by MCM with lack of formal recycling, recovery efforts and the collection rate being inadequate with only 61.7% of wastes being collected. Secondly the results show that the availability of financial resources influence effective solid waste management with the test statistic given as $X^2(2) = 38.759, p \leq 0.05$, indicating that there is a relative significant relationship between financial resources and effective solid waste management. The results reveal that there is an almost universal conviction that MCM should provide waste collection service without charging directly for it. Thirdly, the results reveal that community participation influences the effectiveness of solid waste management with the test statistic given as $X^2(2) = 13.408, p \leq 0.05$, indicating that there is a less significant relationship between community participation and effective solid waste management. The results show that 57.4% of the respondents were aware about the environmental problems associated with indiscriminate dumping but do not care whether their wastes are dumped illegally or taken to an approved disposal site, provided that it is taken out of their immediate neighbourhood.. Finally the results show that policies influence effective solid waste management, however there are shortfalls in the legislation which have led to limited human and financial capacity to enforce legislation and an uncoordinated enforcement by NEMA and the Council without clear defined roles and responsibilities. In conclusion there is an urgent need for the enhancement of community initiatives and partnerships by the MCM to increase awareness of the importance of solid waste management and its contribution to a healthy living environment. This study recommends the formulation of an efficient urban solid waste management with participation from the public, private and the community through an integrated solid waste management system.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Waste management is a global issue which calls for maximum attention. In most developed and developing countries with increasing population, prosperity and urbanization, it remains a major challenge for municipalities to collect, recycle, treat and dispose of increasing quantities of solid waste (UN-HABITAT, 2010). A cornerstone of sustainable development is the establishment of affordable, effective and truly sustainable waste management practices (Bogner, *et al*,2007).Solid waste management is one of the functions that have been devolved to local government in a number of developing countries (Dijk, 2006). Its proper handling of this task is often taken as an indicator of the successfulness of urban reform.

Municipal solid waste management (MSWM) is one of the critical environmental challenges of rapid urban development facing the developing countries including Kenya. Solid waste arising from human domestic, social and industrial activities is increasing in quantity and variety as a result of growing population, rising standards of living and development of Technology (Baabereyir, 2009). It was estimated that in 2006 the total amount of municipal solid waste (MSW) generated globally reached 2.02 billion tones, representing a 7% annual increase since 2003 (UNEP, 2009). It is further estimated that between 2007 and 2011, global generation of municipal waste will rise by 37.3%, equivalent to roughly 8% increase per year.

The need to manage this increasing waste in an environmentally effective, technologically feasible, economically affordable and socially acceptable manner is a problem faced by all nations of the world today. Waste management is also not glamorous; yet without it, every city would cease to exist (Zurbrugg, 2002). Hence all cities, the world over, have developed some way of dealing with the problem. The degree of success with which the developed and the developing countries, including Kenya, are coping with the problem is, however, very different. While the developed world has sought effective solutions through greater efforts to move up what is called the "solid waste hierarchy", the developing world countries are simply overwhelmed with the waste problem or can now barely grapple with the elementary stages of it. The solid waste hierarchy is an internationally accepted and recommended ranked priority of waste handling using the following ascending order of preference: open burning, dump,

landfill, incinerate, recycle, reuse, and prevent (Kreith, 1994). The first two (open burning, and dump) are least preferred and actually not recommended even though the methods are highly used by many developing countries.

In most developing countries, typically one to two thirds of the solid waste generated is not collected (Zerbock, 2003). As a result, the uncollected waste is dumped indiscriminately in the streets and in drains, contributing to flooding, breeding of insect and rodent vectors and the spread of diseases. The situation in Africa, particularly in the capital cities is severe. The public sector in many countries is unable to deliver services effectively, regulation of the private sector is limited and illegal dumping of domestic and industrial waste is a common practice. In general, solid waste management is given a very low priority in these countries. As a result, very limited funds are provided to the solid waste management sector by the governments, and the levels of services required for protection of public health and the environment are not attained. The problem is acute at the local government level where the local taxation system is inadequately developed and, therefore, the financial basis for public services, including solid waste management, is weak.

The service provided in a majority of developing country cities and towns can, at best, be described as unreliable, irregular and inefficient. In Nairobi, the capital city of Kenya of about 4 million people, only about 25 per cent of the estimated 1,500 tons of solid waste generated daily gets collected (UN-HABITAT, 2010). Yet, until the mid-1970s the Nairobi City Council (NCC) singly collected over 90 per cent of the waste.

1.2 Statement of the Problem

The problem of managing solid waste in the urban areas must be seen in the wider context of problems caused by rapid urbanization. Most municipal authorities in developing countries have failed to provide their expanding populations with adequate services for managing solid waste (Abduli et al, 2007). In Kenya and in its cities particularly Mombasa, urban solid waste management poses a serious environmental problem. The fast growing quantities of solid waste constitute an enormous challenge for Municipal Council of Mombasa (MCM). According to the Kenya National Bureau of Statistics, census carried out in 2009, the urbanized population consisted of 32.3% with more than 12.4Million Kenyans living in urban areas and Mombasa having 939,370 habitants (KNBS, 2009). As a result the city has subsequently experienced serious garbage collection problems over the years with the collection rate falling to 25% of the 110,000 tons produced (Senkoro, 2003). This is also due to the fact that most local

authorities in developing countries spends only 30% of their budget on refuse collection and disposal but can only account for between 30-50% of MSW (Hoornweg et al, 1999). The Municipal Council of Mombasa (MCM) is responsible for solid waste management under the Local Government Act Cap 265. However only 40% of the households have a regular waste collection service and only half the generated waste is collected (UN-HABITAT, 2010). Consequently, the lack of a responsive capacity by the MCM has led to the cropping up of illegal dumpsites at Makupa market, Kongowea market, VOK Transfer Station in Bombolulu, Mwembe Tayari market, Ganjoni site, Mackinon market and Bamburi along Kisauni-Bamburi road which have not only become an eyesore but also an health hazard. Additionally, as the amounts of solid waste increases, the cost of its removal increases too.

In view of this discrepancy and the poor quality of service provided in most areas in Mombasa, in terms of the quantity of solid waste collected and the environmental protection provided, there was need to determine the factors influencing solid waste management in Municipal Council of Mombasa in Mombasa County.

1.3 Purpose of the Study

The purpose of the study was to investigate the factors influencing effective solid waste management: the case of Municipal Council of Mombasa.

1.4 Objective of the Study

The overall objective of the study was to determine the factors influencing effective solid waste management in Municipal Council of Mombasa in Mombasa County.

The specific objectives of this study were:

1. To examine how technology influences solid waste management in Municipal Council of Mombasa
2. To assess how availability of financial resources influences solid waste management in Municipal Council of Mombasa.
3. To establish the extent to which community participation influences solid waste management in Municipal Council of Mombasa.
4. To establish how policies influence the management of solid waste in Municipal Council of Mombasa.

1.5 Research Questions

The research set out to answer the following research questions:

1. How does technology influence the effectiveness of solid waste management in Municipal Council of Mombasa?
2. How does the availability of financial resources influence effective solid waste management in Municipal Council of Mombasa?
3. To what extent does participation of the community influence effective solid waste management in Municipal Council of Mombasa?
4. How do policies influence the effectiveness of solid waste management in Municipal Council of Mombasa?

1.6 Research Hypothesis

The research tested the following research hypotheses:

1. H_0 : Technology does not influence the effectiveness of solid waste management in the Municipal Council of Mombasa.
 H_a : Technology has an influence on the effectiveness of solid waste management
2. H_0 : The availability of financial resources does not influence the ability of the Municipal Council of Mombasa to undertake effective solid waste management.
 H_a : The availability of financial resources influences the ability of the Municipal Council of Mombasa to undertake effective solid waste management
3. H_0 : The participation of community based organizations (CBOs) does not influence the effectiveness of solid waste management.
 H_a : The participation of community based organizations (CBOs) influences the effectiveness of solid waste management.

1.7 Significance of the Study

In order for MCM to improve its strategy for managing solid waste, a better understanding of both technological and managerial aspects is needed. While various reports, projects and policy documents on the subject of solid waste management are available, the factors influencing solid waste management tends to be overlooked. The community tend to be neglected, both in their role as waste handlers as well as in their role as stakeholders and potential contributors to solving the problem.

To make up for these shortcomings, this study will illustrate how technology, financial resources, policies and community participation in solid waste management are conceptualized in the literature and their potential contribution in solid waste management in Mombasa. By elaborating upon the factors influencing effective solid waste management in the context of MCM, this study adds to the scanty body of knowledge about sustainable solid waste management strategies in the city. The knowledge that will be generated in respect to technical and social dimensions can be used in the future by researchers and policy makers in their search for more effective and sustainable SWM policies both in Mombasa and Kenya and comparable situations elsewhere in the world.

1.8 Delimitations of the Study

This study highlights the factors influencing effective solid waste management. As a result the necessary remedies are recommended. The study draws lessons from best practices elsewhere and suggests ways of adopting them. Therefore it will help identify the challenges of solid waste management, so that remedies may be evolved. The study is confined only on solid waste disposal from households in the four divisions and does not cover sewerage. A total of six weeks was spent collecting data from the key respondents and the general respondents.

1.9 Basic Assumptions of the Study

An assumption is a supposition that a fact is true (Oso & Onen, 2008). The following factors: financial resources, solid waste management policies, technology, and community participation in solid waste management services are expected to influence the effective management of solid waste in the Municipal Council of Mombasa. The existing government policies that guide and influence solid waste management may not be controlled adequately due to the fact that the advent of the new constitution already in place and yet to be fully operationalized, some policies may have changed without notice. The basic assumption of this study therefore is that these laws and government policies on solid waste management remain the same throughout the course of this study. But it is hoped that they have a significant effect on the results of the study.

1.10 Definitions of Significant terms

Integrated Solid Waste Management- this refers to integrated systems that involve the use of a combination of techniques and programmes to manage the municipal waste stream.

Municipal Solid Waste Management- refers to solid wastes from houses, streets and public places, shops, offices, and hospitals, which are very often the responsibility of municipal or other governmental authorities, solid waste from industrial processes are generally not considered “municipal”.

Solid Waste Management- refers to the discipline associated with controlling the generation, storage, collection, transfer and transport, processing, and disposal of solid waste in a manner that is in accordance with the best principles of health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitude

Solid Waste Hierarchy- is an internationally accepted and recommended ranked priority of waste handling using the following ascending order of preference: open burning, dump, landfill, incinerate, recycle, reuse, and prevent (Tchobanoglous *et al.* 2002)

1.11 Organization of the study

This report is organized into five chapters. Chapter one is 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 the study, delimitations of the study, basic assumptions and the definition of significant terms as used in the study. Chapter two presents the literature review which looks at the factors influencing 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. 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 and data collection procedures. The chapter also includes the ethical considerations of the study, data analysis and presentation, and the operationalization of variables. Chapter four contains the response rate of the study, the demographic characteristics of the respondents and factors influencing effective solid waste management. Chapter five presents a summary of the findings discusses the findings, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a three-part review of the literature on solid waste management as a theoretical framework for the study. The first section discusses the general overview of solid waste management while the second part focuses on the solid waste problem in developing countries, discussing the nature and causes of the problem. The third section of the chapter is devoted to examining the factors influencing solid waste management and how they relate to the subject of solid waste management.

2.2 Overview of Solid Waste Management

The term solid waste has been defined differently by various authors. Solid waste is any material that arises from human and animal activities that are normally discarded as useless or unwanted (Tchobanoglous *et al* 1993). According to Zerbock (2003), solid waste includes non-hazardous industrial, commercial and domestic waste including:

1. Household organic trash
2. Street sweepings
3. Institutional garbage and
4. Construction wastes.

Operationally, it can therefore be said that, solid waste is any material which comes from domestic, commercial, and industrial sources arising from human activities which has no value to people who possess it and is discarded as useless.

While developed countries have largely overcome the problem of waste removal from human settlements, they still grapple with the difficulties and high costs of collection and struggle with the implementation of sustainable waste management strategies (Pacione, 2005). Solid waste management in the developing countries demonstrates daunting problems partly due to this negligence in international circles, but more as a result of the inability of the national and local responsible sectors to cope with the problem. The per capita waste generation rates are generally less than those in the developed nations but are equally increasing in amount and variety.

There is great city, national and regional variation. The daily average per capita rate for Africa is 0.50-0.87 kg (Hoomweg, 1999). In Asia it varies widely between less industrialized and industrialized regions, for example, from an average of 0.1-0.6 kg in

India (less industrialized) to 5.5 kg in Hong Kong (more industrialized) (Beureking *et al.* 1999). Latin America and the Caribbean have averages of 0.3-1.0 kg per capita per day (UNEP, 1996.) The composition is mostly organic biodegradable waste 70-90% (JICA, 1998).

Management faces many problems as waste management authorities have, in a majority of cases, experimented with almost every strategy and with high and modern waste management Technology acquired from the developed countries, with very little success. This failure has been linked to the acquisition and use of incorrect and ill-adapted technologies with heavy costs of maintenance, lack of expertise and inadequate funding and staff. According to Kironde (1999) some authors believe that even more pertinent are corruption and the autocratic 'command-and-control' approach to waste management issues (Kironde *et al.*, 1999). Non-inclusive management that excludes other stakeholders has also been a crucial issue. Management is concentrated on collection and transportation of which only 20-80% is collected using 20-50% of the city's operational budgets; yet servicing less than 50% of the city population or areas (Hardoy *et al.* 2001).

According to Johannessen, (1999) landfilling remains the most prominent technique with open dumps being the common practice. There are also many illegal dumps created in empty spaces, lakes and ponds, drains, canals, street corners, riversides, estuaries and coasts. Littering is a common phenomenon. These uncollected solid wastes deface the aesthetics of the city and bring about serious environmental and health hazards. According to Kironde, (1999) this phenomenon caused some African cities in the mid-1980s to be dubbed 'Garbage Cities' and 'Cities of Mess'. Hardoy *et al.* (2001) have provided statistics on the levels of waste collection in selected cities across the developing world (Table 2.1) which shows the collection rates of the cities

Table 2.1: Solid waste collection in selected cities in developing countries

City(Country)	Percentage of Solid Waste Collected	Year
Accra (Ghana)	10	1989
Addis Ababa (Ethiopia)	60	1998
Ahmedabad (India)	65	2000
Baroda (India)	05	1994
Kampala (Uganda)	10	1993
Kumasi(Ghana)	30	2000
Latin American cities	50-70	1999
Lusaka and other cities (Zambia)	10	1997
Mombasa (Kenya)	40	2000
Ouagadougou (Burkina Faso)	30	1995
Sao Paolo (Brazil)	70	1998

Source: Hardoy et al (1993) pages 59-60; Hardoy et al, (2001) pages 80-81

The above analysis has shown that even though cities in poor countries generally have low levels of solid waste collection and disposal, there seems to be great variations in the scale of the waste problem across regions and countries (Hardoy *et al.*, 2001). Regionally, Latin American cities appear to have better environmental management than African and Asian cities. This is reflected in the high waste collection (up to 70 percent in some cases) in Latin American cities compared with the very low levels of waste collection in African and Asian cities as shown in Table 2.1. What this means is that while all developing countries cities grapple with solid waste collection and disposal, some are doing relatively better than others. Regionally, Africa seems to have the worst situation with regard to urban solid waste management (Hardoy *et al.*, 2001). The Local Authority, which is the statutory authority to manage wastes in the city, is duty bound to play a leading role in addressing these critical issues including the organization, coordination and cooperation with the other actors.

These other waste stakeholders include the national government authorities, non-governmental organizations (NGOs), community based organizations (CBOs), formal and informal private sectors, scavenger and scavengers' cooperatives, households and individuals. These groups and individuals are usually termed informal until they are recognized and have been registered (Akoto, 2011). These groups are involved in waste collection and removal, recycling, composting and waste recovery for reuse. They are also involved in street sweeping, clearing drains and repairing, transforming and reusing discarded articles supplying waste collection equipment. All these groups and individuals do play an important role in municipal solid waste management.

In cities where they have been recognized and integrated, the waste management situation has greatly improved as in the cases of the many scavengers' cooperatives in Latin America and Asia (Hardoy *et al.* 2001). Nevertheless the situation of solid waste management in many towns and cities of the developing countries remains inadequate and inefficient. Schübeler (1996) describes the situation as highly unsatisfactory. This suggests that the conventional management system and the unorganized informal sector in place are not based on sustainable strategies and methods.

2.3 Review of Related Literature

Researchers have identified several factors that mitigate against solid waste management efforts. Linden *et al.* (1997) identified ten common constraints to be militating against solid waste management efforts in Asian countries.

These were:

1. Inappropriate technologies/processes
2. Enforcement inefficiencies/non-existent; illegal dumping
3. Lack of financing
4. Lack of training/human resource
5. Lack of political support
6. Lack of legislation
7. Policy conflict among levels of government/overlapping responsibilities
8. Rapid increase in waste generation/limited data
9. Lack of awareness among public, and
10. Limited land areas; land tenure issues

(Linden *et al.*, 1997).

These factors, according to the report, frustrated the waste management efforts of municipal authorities in Asia and made it difficult for them to keep their city

environments clean and safe for the populations. After studying the solid waste problem in Tanzania, Kironde (1999) has also attributed the abysmal performance of the waste sector to resource constraints including the scarcity of financial, physical, human and technical resources for the organization of waste management operations.

JICA,(1998) identified several causes of the waste problem including the lack of dumping sites, ignorance of the masses about the need for proper waste disposal, inefficient collection methods, poor government attitude towards waste management, poverty of the people, corruption among public officials and lack of trained personnel for waste management. Similarly, Mungai (1998) points out that the solid waste has become a problem in Nairobi, due to increasing urbanization without adequate disposal sites and transportation. These have posed serious constraints to the waste sector and dampened efforts towards solid waste management in the city. Many other writers have elaborated on how the factors cited above (plus others) interact to aggravate the solid waste problem in poor country cities.

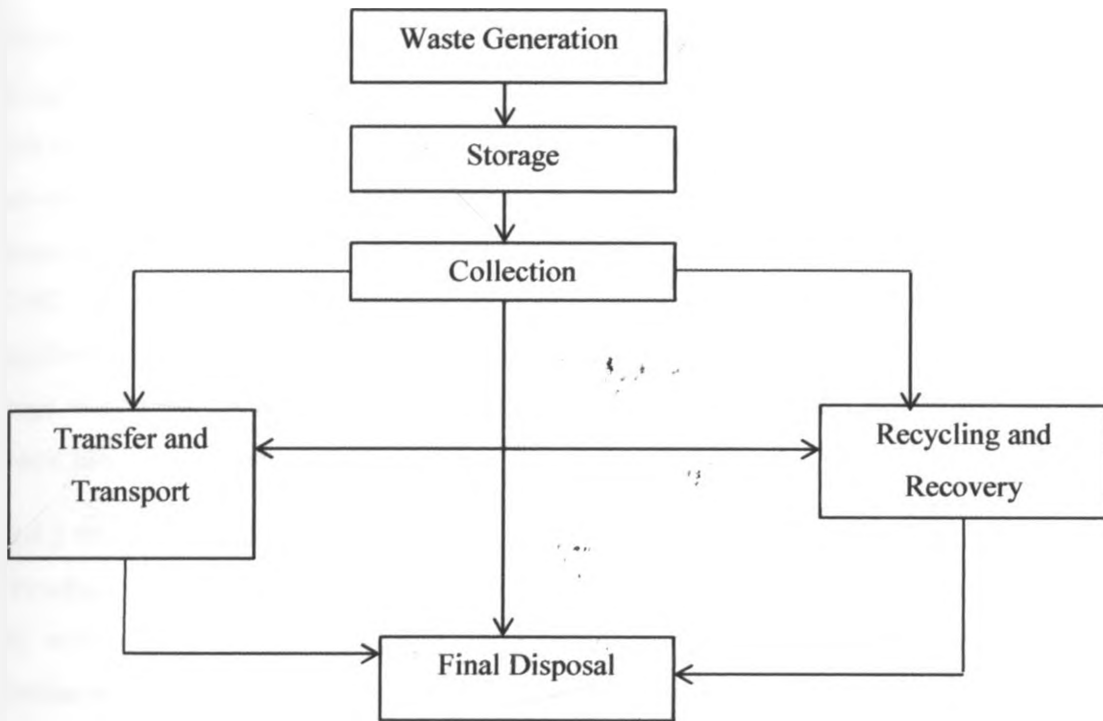
In summary the management of municipal solid waste (MSW) presents a major challenge for the municipal authorities in Kenya where rapid growth, social and cultural change, widespread poverty, inadequate and weak local governance and limited financial resources all contribute to increasing pollution and waste disposal problems (Zurbrugg *et al*, 1999).

2.4 Technology in Solid Waste Management

Given the large number of individual issues and specific problems in various municipal solid waste management systems, it would seem tempting to address individual issues as they arise and apply local fixes, so as to keep collection and disposal services operating continuously as efficiently as possible. Indeed, in the short term, this is likely to be a good approach. In considering the long term, however, it is apparent from the scope of problems and the external factors brought to bear upon municipalities that a broader, more integrated set of solutions will be necessary in order to adequately address municipal solid waste system (MSWM) in the future. Sound practice is a management system that embodies a reasonable balance of feasible, cost-effective, sustainable, environmentally beneficial, and socially sensitive solutions to SWM problems (UNEP, 1996). In other words, sound practices function together to achieve defined solid waste policy goals, while appropriately responding to the entire set of conditions that constrain the choices available in specific MSWM decisions (UNEP, 1996).

Therefore, if solid waste management is to be accomplished in an efficient and orderly manner, the fundamental aspects and relationships involved must be identified and understood clearly (Tchobanoglous *et al*, 1993). On the basis of this solid waste management incorporates the following: source separation, storage, collection, transportation and disposal of solid waste in an environmentally sustainable manner. These are some of the six key elements illustrated in Figure 2.1 below.

Figure 1: Key Elements of Solid Waste Management Systems



As shown in figure 1 above, the key elements in solid waste management include: waste generation, storage, collection, transfer and transport, recycling and recovery and final disposal. This means that when waste is generated it is first stored in either dustbins or skips. It is then collected and finally disposed of in landfill. Also, when waste is collected it can be transferred from small collection equipment like the tricycle to a bigger truck for final disposal. On the other hand, waste collected can be processed or recycled and recovered for materials to be reused. These elements are further elaborated below.

2.4.1 Types and Components of Solid Waste Generated

Solid waste consists of many different materials. Some can burn, some cannot. Some can be recycled, some cannot. Therefore, a detailed understanding of the composition of solid waste will indicate the management methods that will be used. Solid waste is composed of combustibles and non-combustible materials. The combustible materials include paper, plastics, yard debris, food waste, wood, textiles, disposable diapers, and other organics. Non-combustibles also include glass, metal, bones, leather and aluminum (Zerbock, 2003).

Waste generation encompasses those activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal (Hornweg et al, 1999). According to UNEP (2009), in 2006 the total amount of municipal solid waste (MSW) generated globally reached 2.02 billion tones, representing a 7 per cent annual increase since 2003. It is further estimated that between 2007 and 2011, global generation of municipal waste will rise by 37.3 per cent, equivalent to roughly 8 per cent increase per year (UNEP, 2009). The Programme also says that, as per WHO estimations, the total health-care waste per person per year in most low income countries, is anywhere from 0.5 kg to 3 kg.

2.4.2 Storage of Solid Waste

Tchobanoglous *et al* (2002) explain storage to mean where solid waste is stored before it is collected. It could be stored in a skip or dustbins and not thrown away indiscriminately. According to them, storage is of primary importance because of the aesthetic consideration. Appropriate storage containers are required to save the energy and labor and increase the speed of collection and reduce the crew size. It is important that the containers should be functional to the type of materials and the collection vehicles used. Containers should also be durable, easy to handle, economical as well as resistant to corrosion, weather conditions, and metals, glass tips etc. Usually these are made up of thick plastics. When mechanized collection system is used the containers are specially designed to fit the truck mounted loading mechanisms

2.4.3 Collection of Solid Waste

Collection is a key link in the MSWM system and it is usually undertaken by the municipality or contracted out to private companies. In either situation waste collection coverage is inadequate as it ranges from 20-80% with a mid-range of 40-50% (UNEP 1996). Collection accounts for a very high fraction of the total waste management budgets with Asia having as much as 80% (World Bank, 1999). With the inability of the official waste delivery teams to serve the whole city efficiently, waste generators further arrange with informal and informal private groups to collect their waste for a negotiated fee. For most of the areas house-to-house collection is rare. The official waste collectors are responsible for collecting waste disposed of in public moveable containers placed at strategic spots of the city (Kreith, 1994).

2.4.4 Transfer and Transportation of Solid Waste

According to Kreith (1994), transfer and transport involves two steps: (1) the transfer of wastes from the smaller collection vehicle to the larger transport equipment and (2) the subsequent transport of the wastes, usually over long distances to the final disposal site. Various types of transportation equipment are applied to carry waste. These range from locally adapted equipment such as human or animal drawn carts (wheel barrows, tricycles, push carts) to conventional open-back trucks, side and rear compactors and trailers. These conventional trucks are often acquired from foreign friendly cities, governments and international non-governmental organizations (NGOs).

2.4.5 Recycling and Recovery of Solid Waste

Recycling is the process of separating, collecting, processing, marketing and ultimately using a material that would have been discarded. It also helps in the source reduction and reduces the municipal and commercial costs involved in waste collection and disposal and helps in protecting the local environment. However a successful implementation of source reduction program requires the cooperation of stakeholders: businessmen, industrialists, consumers and state and local governments. The element of processing and recovery includes all the technology, equipment, and facilities used both to improve the efficiency of other functional elements and to recover usable materials, conversion products or energy from solid wastes (Tchobanoglous *et al*, 2002). In the recovery, separation operations have been devised to recover valuable resources from the mixed solid wastes delivered to transfer stations or solid waste processing plants (Tchobanoglous *et al*, 1993). Therefore recycling and recovery reduces reliance on

landfills and incinerators. It protects human health and the environment by removing the harmful substances from the waste stream. It also conserves natural resources by reducing the demand for raw materials. Recycling reduces the volume of the waste that has to be finally dumped, which means a reduction in pollution at the waste sites.

2.4.6 Final Disposal of Solid Waste

It is the ultimate fate of all solid wastes whether they are residential wastes collected and transported directly to landfill site. The dumping of solid waste in landfills is the probably the oldest and definitely the most prevalent form of ultimate garbage disposal. Many "landfills" are nothing more than open, sometimes controlled, dumps. The difference between landfills and dumps is the engineering, planning, and administration involved. Open dumps are characterized by the lack of engineering measures, no leachate management, no consideration of landfill gas management, and few, if any, operational measures such as registration of users, control of the number of "tipping fronts" or compaction of waste. In an examination of landfills throughout the developing world in 1997-1998, Johannessen (1999) found varying amounts of planning and engineering in MSW dumping; among the various regions visited, African nations (with the exception of South Africa) had the fewest engineered landfills, with most nations practicing open dumping for waste disposal.

2.5 Financial Resources for Solid Waste Management

Developing countries have solid waste management problems different than those found in fully industrialized countries; indeed, the very composition of their waste is different than that of 'developed' nations. Although low-income countries' solid waste generation rates average only 0.4 to 0.6 kg/person/day, as opposed to 0.7 to 1.8 kg/person/day in fully industrialized countries, Cointreau (1982) and others (Blight and Mbande 1996, Arlosoroff 1982) noted several common differences in the composition of solid waste in developing nations. In most developing countries local governments have the primary responsibility to provide solid waste management services. Local governments must rely on a variety of financial resources to fund the services. In most cases, different resources are used to finance capital investments than to finance operating and maintenance costs (Cointreau, 1982). Furthermore, a mixture of resources may be used for financing of the various components of a waste management system (i.e., collection, transfer, resource recovery, and final disposition).

General municipal revenue, raised by means of municipal taxes which are normally assessed on the size or value of the property being served, is the usual source of funds for the operation of solid waste management services (Cointreau, 1982). The central government generally finances MSWM and other municipal activities through taxes collected by the Treasury. Even municipal property taxes and direct taxes on household refuse collection flow to the coffers of the central government. These funds are then allocated across the different central government ministries and to the municipalities. MSWM is then funded by allocations from the responsible ministry for capital projects and special projects (such as public education) and by municipal allocations for operation and maintenance.

Before one can examine individual problems in MSW management, it is important to understand the political and economic framework in which governments must frequently work in developing countries. Municipal authorities spend up to 50% of their revenues on waste-related issues. With increased urbanization, demand for services will undoubtedly increase. Municipal tax and fee revenues, however, are not likely to rise as quickly as the population. This is due to the fact that of the people moving to the city, the majorities are likely to be poor migrants from rural areas in search of employment, unable to contribute significantly to the revenues of the municipality. Although they may demand marginally less services due to their lower consumption, they are likely (at least at first) to congregate in the poorer, more densely settled areas, exacerbating the health and sanitation problems posed by these often unplanned communities.

Meeting the financial demands of MSW management will continue to be a problem in the cities of developing countries. In areas where residents are assessed fees for waste removal, the rate of collection can be quite poor (Schübeler, 1996). Further, fewer and fewer people will be willing to pay in the face of poor or declining service. Many municipalities may not even be aware of the degree to which revenues are collected, or the true costs of their entire MSW operations. The problems are compounded when revenues from MSW collection are simply rolled into the general treasury, as opposed to returning to waste-related operations. Many municipalities have turned to privatization as a potential solution; certainly the financial picture is cleared somewhat when the entire system is turned over to outside contractors. However, local governments will still be held to account if service declines.

Solid waste management services are generally a low-priority item in government budget allocations, thus the financial base for these activities is weak. This is particularly

true of local governments who are the real overseers of solid waste management programs. To make up for deficiencies in the budget allocations, municipalities have tended to switch from collective municipal garbage disposal to outsourcing contracted services. However, in developing countries, there is a wide disparity in the ability of residents to pay user fees for garbage collection, and as a result the municipal fiscal situation has often hardly improved. This poses a challenge for those involved in trying to establish sustainable waste management systems (Zerbock, 2003).

The development of responsible and responsive local government is thus dependent on local government having at least some degree of freedom with respect to local revenues, including the freedom to make mistakes and be held accountable for them (Cointreau 1982). This means that local government must have control over the rates of some significant revenue source if they are to be fiscally responsible and able to innovate as to the way they finance basic services.

Financial management is an enduring problem for local authorities of all sizes. Not only is this problem related to the failure to account for all the revenue received from the central government on the one hand and the rates payers on the other, but they are often unable to efficiently collect all revenues that are due to them (Zerbrock, 2003). Depending on the size of the local authority and the number of people to whom it renders services, a large proportion of the money generated by local authorities comes from the provision of water services, licensing fees and issuance of permits for developments of land (UN-HABITAT, 2010). Other opportunities for generating revenue such as the collection of rates on agricultural produce or from the fees from natural reserves and game parks are available to select local authorities because these are dependent on the resource endowments of the regions in which they are situated (United Nations Human Settlements Programme (UN-HABITAT, 2010).

Under this system, MSWM is just one of many ministerial and municipal responsibilities. Funding for MSWM reflects the priorities of the responsible ministry and of the municipal council. It does not accommodate the actual budget required for the MSWM program, projects, and operations

2.6 Community Participation in Solid Waste Management

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. Women and men, girls and boys are involved in different waste-related activities, partly because of cultural

traditions and conventions, partly because of practical interests, such as earning income and maintaining a healthy living environment and partly because of the wish to gain recognition as a worthy community member. 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 neighborhood. Other benefits include empowerment of residents for active participation in municipal affairs, noticeable decline in childhood diseases, increased use of toilets and public lavatories, and a drop in the number of children begging near dumpsites.

Community participation in urban waste disposal means involving key institutional actors in the process, such as district committees, nongovernmental organizations (NGOs), local authorities and market women associations. Others are traditional rulers, district heads, religious leaders, teachers, politicians and youths.

Syagga (1992) supports the involvement of the community sector as an effective way of increasing access of the poor to urban services, including waste management. Indeed Karanja (2005) led credence to this, when he observed 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. Zerbock (2003) further supports this; 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.

2.7 Solid Waste Management Policies

A major problem and development constraint in developing countries is the lack of overall plans for solid waste management at the local and national levels (Ogawa, 1995). Solid waste management in developing countries has received less attention from policy makers and academics than that paid to other urban environmental problems, such

as air pollution and wastewater treatment. Nevertheless, the improper handling and disposal of solid wastes constitutes a serious problem: it contributes to the high morbidity and mortality rates in many Third World cities.

The management of solid waste is dealt with under several laws, By-laws, regulations and Acts of parliament, as well as policy documents. In Kenya, there is no statute or national policy or organization established to regulate the management of solid waste. The policies, laws and organizations relevant to solid waste exist under different statutes including the Environmental Management and Co-ordination Act 1999, the Local Authorities Act Cap 265 and the Water Act and the Physical planning Act among others. In September 2006 however, the National Environmental Management Authority (NEMA) issued regulations on solid waste management to be observed by all parties handling all kinds of waste in Kenya.

Its noteworthy to say that before the enactment of the Environmental Management and Coordination Act (EMCA) 1999, Local Authorities (LAs) had monopoly over sanitation and SWM services in Kenya, largely under the Local Government Act (Cap 265) and Public Health Act (Cap 242). The former empowers LAs to establish and maintain SWM services while the latter requires them to provide the services. The Acts however neither set the standards for the service nor require waste reduction or recycling. In addition to this the Acts do not classify the waste into municipal, industrial and hazardous types or allocate responsibility over each type (UNEP, 2009).

Though municipal authorities have held the responsibility of managing solid waste from their inception over three centuries ago, the issue seldom got the attention it deserved. Elected representatives as well as the municipal authorities generally relegate the responsibility of managing municipal solid waste (MSW) to junior officials such as sanitary inspectors. Systems and practices continue to be outdated and inefficient (UN-HABITAT, 2010). No serious efforts are made to adapt latest methods and technologies of waste management, treatment and disposal.

Though a large portion of the municipal budget is allotted for solid waste management, most of it is spent on the wages of sanitation workers whose productivity is very low. There are no clear plans to enhance their efficiency or improve working conditions through the provision of modern equipment and protective gear. Unionization of the workers, politicization of labour unions and the consequent indiscipline among the workforce are all results of bad working conditions and inept handling of labour issues (UN-HABITAT, 2010).

It's commendable that considerable progress has been made with respect to the policy and legal/regulatory framework for SWM over the last few years. Thus, EMCA 1999 allocates considerable property rights as far as various aspects of environment management are concerned. However, comprehensive legislation which fills in the gap of important regulatory functions and is enforceable is required for sustainable development of SWM systems (Gombya et al, 2006).

2.8 Conceptual Framework

The conceptual framework was developed through explaining and ascertaining the relationships and interconnectivity of the objectives of the study. In this study, financial resources, technology, policies and community participation are the dependent variables. They are however moderated by politics and rapid population growth towards effective solid waste management. Indeed this is the nature of the relationship between the variables of this study.

Figure 2: Conceptual Framework

Independent Variable

Financial Resources in SWM

- Mode of solid waste management financing
- Sustainability of the mode of solid waste management financing

Technology

- Types and components of solid waste generation
- collection, transportation and disposal of solid waste
- Final disposal of waste

SWM Policies

- Regulatory and economic instruments for SWM.
- Shortfalls of the SWM policies

Community Participation

- Awareness of public to solid waste management policies
- Role of CBOs in SWM

Dependent Variable

SWM Effectiveness

- Integration of the solid waste management principles

Rapid Population Growth
Politics

Moderating Variable

2.10 Literature Gaps

The available evidence and literature of the factors influencing effective solid waste management is indeed substantive but not exhaustive. A body of knowledge exists on the various variables of research but these have not been wholly dealt with, in reference to solid waste management in Mombasa. Indeed this literature has not been extensively written and moved from grey literature into peer journals. While research and evaluation will help to clarify what constitutes the best practices in solid waste management, utilizing the existing knowledge of program experiences can help move towards developing a more substantive body of knowledge and eventually evidence of good program practice. The most important factor in the course of this review is the fact that financial resources play a major role in solid waste management. However the vertical imbalance causes severe financial problems for local government, exacerbated by the increasing reduction in central government transfers combined with the lack of assignment of new revenue sources and restricted autonomy to adjust the present sources.

Secondly, technology plays a crucial role in solid waste management however there exists a gap whereby there are solid waste management practices that emphasize collection, transportation and final disposal with variations in planning, development and operations in the choice of solid waste management systems used in developing countries with minimal recycling and reuse. Thirdly, community participation plays a crucial role in effective solid waste management however the role of community based organizations in collecting the solid wastes and their shortcomings in waste collection have not be effectively covered in the literature review. The consequence of this gap is that most of the stakeholders do not understand the role they are expected to play in the solid waste management sector.

Finally, solid waste management policies are essential for effective solid waste management, however there exists a policy gaps where the service delivery of most of the local government is influenced by the central government legislations which are beyond its control. Additionally most of the solid waste management policies especially in developing countries lack provisions to facilitate solid waste recovery and recycling enterprises in addition to lack of coordinated efforts in enforcement of the existing solid waste management policies. In conclusion this highlights the lack of integration and coordination of the solid waste management practices thereby leading to ineffective and unsustainable solid waste management practices. This appears to point to the fact that

there appears to be a gap in research and documentation of effective solid waste management with attention being paid to the significant variables of research in the study.

2.11 Summary of Literature

This chapter has reviewed the literature related to the various themes in the study. These include financial resources, technological aspects, policies influencing solid waste management and the community participation in solid waste management. As the second largest city in Kenya, Mombasa has a serious solid waste management problem. Urban settlements in the city are characterized with worsening waste disposal situations which the municipal authorities seem unable to deal with. A survey of literature on the factors influencing effective solid waste management in the city shows that no major research has been done on the subject and it is the need to investigate the problem that has motivated me to embark on this research.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter examines the research design, the location of the study, population, sample size, data collection methods and procedures, validity and reliability of research instruments, ethical considerations, data presentation and analysis techniques to be used and the operational definition of variables. It will describe in detail what will be done and how it will be done.

3.2 Research Design

This study was conducted through a descriptive survey research design. A descriptive survey is a present oriented methodology used to investigate populations by selecting samples to analyze and discover occurrences (Oso & Onen, 2009). It was used to provide numeric descriptions of some part of the population. It describes and explained events as they occurred. The design was purposively selected for this study because of the economy of the method, the ability to understand the selected population from a particular part of it.

3.3 Target Population

This study was carried out in Mombasa County. Mombasa is situated in the South-Eastern part of Coast Province. It is the smallest of the seven districts in Coast Province, covering an area of 229.6 Km². According to the 2009 population census; Mombasa has a total population of 939,370. Mombasa is divided into four divisions namely; Mvita, Kisauni, Chagamwe and Likoni. The approximate number of households in this whole area is 327,373 and a population density of 23,506.

3.4 Sample Size and Sampling Procedure

Sampling is the gathering and asking of a range of individuals the same questions related to their characteristics attributes, how they live or their opinions. It also involves the collection of relevant information (O Leary, 2004).

The formula for calculating the sample size is as follows:

$$n = \frac{X^2 NP (1-P)}{d^2 (N-1) + X^2 P (1-P)}$$

Whereby:

Z^2 is the z value (e.g., 2.71 for 90% confidence level, 3.84 for 95% confidence level, and 6.64 for 99% confidence level);

d is the margin of error (e.g., .07 = + or - 7%, .05 = + or - 5%, and .03 = + or - 3%); and

P is the estimated value for the proportion of a sample that will respond a given way to a survey question (e.g., .50 for 50%).

(Krejcie & Morgan, 1970)

$$\begin{aligned} n &= 3.84 * 939370 * 0.25 / 0.0049 (939369) + 3.84(0.25) \\ &= 901795.2 / 4603.873 \\ &= 196 \end{aligned}$$

Therefore the sample size was 196 people, but due to resources and time constraints, the researcher selected a sample size of 140, which is 71.4% of the sample size. This is shown in the table 3.4.1

Table 3.1 Study Respondents.

Respondents Category	Number in Each Category	Percentage
General Respondents (Household Heads)	120	85.7%
Key Informants	20	14.3%
Total Number of Respondents	140	100%

The sample of this study consisted of a total of 140 respondents; 120 of who were household heads form the larger Mombasa area and 20 key informants were purposively selected. This is the best selection for the study as this number is representative of the whole population in Mombasa.

This study employed cluster sampling technique to select the sample. This particular technique refers to the type of sampling where the population is divided into relative small groups (clusters) and parts of the clusters randomly selected as the sample. All members of the chosen clusters were then studied. This particular method gives all the members of the population an equal chance of selection for the study.

Table 3.2 Sampling of General Respondents

Grouping of General Respondents into Zones	Number of General Respondents per Zone
Zone 1(Kisauni Division)	30
Zone 2(Mvita Division)	30
Zone 3(Changamwe Division)	30
Zone 4(Likoni Division)	30
Total Number of Respondents	120

Table 3.3 Sampling of General Respondents in Zone 1.

Locations in Zone 1	Number of Respondents
Bamburi	5
Ganjoni	5
Kisauni	5
Kongowea	5
Majengo	5
Old town	5
	30

Table 3.4 Sampling of General Respondents in Zone 2

Locations in Zone 2	Number of Respondent
Majengo	10
Railway	10
Tononoka	10
	30

Table 3.5 Sampling of General Respondents in Zone 3

Locations in Zone 3	Number of Respondents
Changamwe	5
Kipevu	5
Mikindani	5
Miritini	5
Portreitz	5
Tudor	5
	30

Table 3.6 Sampling of General Respondents in Zone 4

Locations in Zone 4	Number of Respondents
Ganjoni	7
Likoni	9
Mtongwe	7
Shika Adabu	7
	30

The entire Mombasa area was divided into four zones namely zone 1, zone 2, zone 3 and zone 4 as shown in table 3.2. From each of these zones, the researcher used simple random sampling technique based on the households visited to select 30 respondents (household heads) in each zone so that the total number added up to 120 respondents. Tables 3.3, 3.4, 3.5 and 3.6 above show how the researcher sampled the respondents based on the different locations in the zones. The researcher favoured this particular sampling technique due to the fact that he was using zones rather than individual members because of the factual sampling frame could not be constructed. This is generally because the population under study is very large and scattered over a large geographical area. Another reason for the selection of this method is due to pragmatic reasons like resources and time to be spent in the course of the study.

Table 3.7 Sampling of Key Informants

Key Informants in the Study	Number to be Sampled
CBOs	4
MCM Officials	3
NEMA Officers	2
Local Private Waste Companies	4
Businesses and Institutions	7
Total Number of Key Informants	20

The researcher purposively selected the following individuals to be used as the key informants in his study; 4 CBOs, 3 MCM officials drawn from the department of environment, 2 NEMA officials, 7 businesses and companies and finally 4 local private waste collection companies that collect garbage in Mombasa. The major reason of selecting of these individuals was that of methodological reasons.

3.5 Data Collection Instruments

After carefully considering the research questions, the nature of the data needed for the analysis and the prevailing conditions on the research field, it became evident that the best way to collect adequate data for the research would be a combination of the methods of both quantitative and qualitative approaches. This is because some of the data required were qualitative in nature and could best be obtained through interviews while others were quantitative and thus, could be elicited by means of questionnaires.

Furthermore, aspects of the data were physically observable and could be gathered through direct field inspection or observation. In view of this, the researcher became convinced of the usefulness of combining different methods from both qualitative and quantitative approaches in an attempt to gather the data needed for this investigation. The study, therefore, employed interviews, semi-structured questionnaires, field observation and documentary analysis, drawing upon the strengths of these different methods to improve the quality or validity of the data.

3.6 Data Collection Procedure

Aware of the challenges involved in interviews the researcher made adequate preparations to maximize the chances for successful interviews. This was accomplished by writing to key stakeholders (namely the MCM, NEMA, key businesses and private

waste companies) to inform them of my study and to request interviews with them (Appendix 1). Copies of the interview schedules were attached to the letters of transmittal to let the potential interviewees know the issues to be covered in the interviews.

The questionnaire for the household survey was developed to cover the objectives of the study and answer the research questions of the study. The questionnaire was, therefore, seen as an appropriate tool which allowed for the collection of standardized information across participating households with regard to the variables of interest. The survey questionnaire is semi-structured, containing both open-ended and closed-ended questions. The closed-ended questions required the respondent to make choices from alternative responses while the open ended questions provided spaces for them to give their own answers to questions. The respondents were given two weeks to complete the questionnaires after which the researcher collected them

3.7 Validity and Reliability of Research Instruments

Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials while validity is the accuracy and meaningfulness of inferences, which are based on the research results (O. Mugenda & A. Mugenda, 2003). The reliability and validity address issues about the quality of the data and appropriateness of the methods used in carrying a research project. A number of measures were taken to ensure reliability and validity of the study. First of all, the themes on which the interview questions were developed were drawn from the objectives stated in the study. After developing the interview guide, it was given to two research students (who were also using interviews in their own research) to review and comment on its structure and contents. After this, the interview guide was given to my supervisor to provide useful advice for improvement.

Secondly, to achieve reliability and validity of the questionnaire, the instrument was designed with great care, matching the questions with the objectives stated in the study. The initial draft was reviewed after which I presented it (together with the proposal for the study) to two other research students who were also using questionnaires in their studies to review it. Next, I employed the 'expert validation' method (Mensah, 2006) by presenting it to my supervisor. The questionnaire was also tested by four households heads from a different county in a pilot study. The responses generated were critically

examined in relation to the objectives set for the study and were compared with each other to check common understanding of items in the questionnaire.

3.8 Data Analysis and Presentation

Both quantitative and qualitative data was gathered for the study using questionnaires, interviews, field observation and documentary sources. After collecting the data from both the household and businesses and institutions questionnaire survey it was coded and fed into SPSS v20 for analysis in order to generate a descriptive picture of the data gathered on such themes as waste generation and handling practices, services available to for waste disposal and their respective satisfaction with the quality of service. This also covered questions items relating to the funding of waste disposal and environmental concerns of waste disposal in the city. Simple percentages, frequencies and cross tabulations were used to analyze the quantitative data obtained from the questionnaire administration.

The qualitative data from interviews which was conducted to the key respondents was analyzed manually by making summaries of their views and supporting those with relevant quotations that were captured with those views, supported with data from documentary sources and my own field observations of the waste situations in the city. The analysis was organized under themes derived from the data and the research questions that guided the entire investigation.”

3.9 Ethical Considerations

A number of ethical issues were addressed in the course of the research including informed consent, access and acceptance, and confidentiality and anonymity. In the conduct of this research, the principle of informed consent was given the required attention by explaining the purpose of the study to participants and making them aware that participation was optional and they could choose to answer or not answer any questions in the course of the interview. Another ethical issue that was addressed in the conduct of this study was access and acceptance which are closely related to the issue of informed consent. Access and acceptance involve obtaining permission to carry out research in a community, institution or organization (Bell, 1991).

In the conduct of this study, access to all premises such as institutions, organizations, businesses, communities and homes were duly negotiated. Prior to the conduct of the interviews, letters were written to all institutions and organizations identified to

participate in the study, informing them of the impending study and seeking their consent to visit their premises for the interview discussions. In all cases, approval and consent was obtained before the researcher conducted the interviews. Confidentiality and anonymity issues were also addressed in the study. In recognition of the ethical requirement that information obtained from, or about, a participant during research should be treated confidentially, none of the information provided by interviewees will be disclosed to other people. To achieve anonymity of the data to be gathered from respondents in the household survey personal data such as names and addresses of householders who answered the questionnaires was left out in the design of the instruments.

3.10: Operational Definition of Variables

Variables are 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. Table 3.8 below shows the operational definition of variables for the study which gives a summary of the variables, indicators, measurement, and scale and also data collection methods used.

Table 3.8: Operational Definition of Variables

Variable	Indicators	Measurement	Scale	Data Collection Method
Independent variable: Financial Resources	<ul style="list-style-type: none"> • Mode of solid waste management financing • Sustainability of the mode of financing 	Existing financial situation of the Municipal Council of Mombasa. Sources of finance for municipal solid waste management	Nominal	Key Informant interviews and Questionnaires
Independent variable: Technology	<ul style="list-style-type: none"> • Types and components of solid waste generation • Collection, transportation and disposal of solid waste • Final disposal and recycling of solid waste 	Planning and development involved in selecting appropriate technologies for solid waste management Operations involved in solid waste management	Nominal	Questionnaires and Key informants interviews
Independent variable: Solid Waste Management Policies	<ul style="list-style-type: none"> • Regulatory and economic instruments for solid waste management. • Sustainability of the policies in terms of enforcement 	Shortfalls in Solid Waste Management Legislation.	Nominal	Key Informant interviews.

Independent variable:
Community Participation in Solid Waste Management

- Awareness of the public to solid waste management principles
- Attitude of the community to solid waste management

The public awareness and attitude towards solid waste management

Nominal

Questionnaires and Key informants interviews

Dependent variable: Solid waste management

- Integration of effective solid waste management practices

Establishing the factors influencing effective solid waste management

Ordinal

Questionnaires and Key informants interviews

CHAPTER FOUR:

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter analyses the data collected from the solid waste management study conducted in the city of Mombasa through questionnaire survey, interviews and field observations. Data was collected on the following issues:

1. Technology in Solid Waste Management
2. Sources of Finance for Solid Waste Management
3. Community Participation on Solid Waste Management
4. Effect of Policies on Solid Waste Management

4.2 Response Rate

The response profile of the sample population used for this study is described by the frequency table 4.1 below. Out of 140 respondents identified for the survey there was response of 110 respondents. This represented a response rate of 78.6% which is an accepted figure for a social science research study. Out of the 20 key informants identified for the interviews by the respondents only 16 responded and accepted to be interviewed. This represented 80% of the sample. Secondly of the questionnaires returned by the households, 94 were considered complete and usable and thus represented 78% of the response rate.

Table 4.1 Response Rate of the Study Respondents

Respondent Category	Number in each category	Response Rate	Percentage
Household Respondents	120	94	78%
Key Informants	20	16	80%
Total Number of respondents	140	110	78.6%

4.3 Demographic Characteristics of the Respondents

Table 4.2 below indicates the education demographics of the respondents. It is divided into three categories representing primary schooling, secondary schooling and finally tertiary education with a university degree or college diploma. The education demographics indicate that a majority of the respondents, 51%, have either a university degree or college diploma, 44.7% have a secondary school certificate and 4.3% having a primary schooling education level. Therefore 95.7% of the household respondents have a secondary schooling education level or higher hence placing the calibre of their opinions at an educated level. This large proportion of the respondents with tertiary education contributes significantly to the validity of the results.

Table 4.2 Education among the Household Respondents in the Study.

Education	Frequency	Percentage
Primary (KCPE)	4	4.3
Secondary (KCSE)	42	44.7
Tertiary (Degree/Diploma)	48	51.0
Total	94	100.0

4.4 Technology in Solid Waste Management

One of the main reasons for difficulties and disappointments in the field of solid waste collection is the failure to take account of the important differences between geographical regions, between nations, between cities and even within cities. Below are the variations that influence the collection systems in terms of planning and development and operations involved in solid waste management in the city of Mombasa.

4.4.1 Hypothesis Testing on the Significance of Technology in Effective Solid Waste Management

H_0 = Technology does not influence the effectiveness of solid waste management

H_a = Technology has an influence on the effectiveness of solid waste management

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The researcher sampled ninety four respondents to answer the research question how does technology influences the effectiveness of solid waste management in MCM? Table 4.3a below shows the cross tabulation of technology and solid waste management effectiveness, from the results the researcher was able to deduce that 87.5 % and 5.4% of the respondents believe that appropriate technology (solid waste management systems) leads to satisfactory and very satisfactory solid waste management effectiveness respectively, whereas only 7.1 % respondents believed that appropriate technology leads to poor solid waste management effectiveness. Secondly, 76.3 % of the respondents believed that inappropriate technology (solid waste management systems) leads to poor solid waste management effectiveness whereas only 23.7 % of the respondents believed that inappropriate technology leads to satisfactory solid waste management effectiveness.

The data from table 4.3a above was analyzed using a chi square goodness of fit test in order to test the significance and the output is presented in table 4.3b. The results showed that the null hypothesis stating that technology does not influence the effectiveness of solid waste management was rejected and the alternative hypothesis stating that technology influence the effectiveness of solid waste management was accepted. The summary of the test statistic of the output in table 4.3 b is given as $X^2 (2) = 48.833, p \leq 0.05$, indicating that there is a relationship between technology and effective solid waste management.

Table 4.3a Technology and SWM Effectiveness Cross tabulation

			SWM Effectiveness			Total
			Poor	Satisfactory	Very Satisfactory	
Solid Waste Management Systems (Technology)	No	Count	29	9	0	38
		% within Solid Waste Management Systems	76.3%	23.7%	0.0%	100.0%
	Yes	Count	4	49	3	56
		% within Solid Waste Management Systems	7.1%	87.5%	5.4%	100.0%
	Total	Count	33	58	3	94
		% within Solid Waste Management Systems	35.1%	61.7%	3.2%	100.0%

Table 4.3b Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	47.833 ^a	2	.000
N of Valid Cases	94		

4.4.2 Types and Components of Solid Waste Generated

The knowledge on the types and the components of solid waste generated will inform the management to use the appropriate methods to effectively deal with the various components in solid waste. Methods such as source separation, recycling, compositing can be used depending on the component of waste in the waste stream.

The Municipal Council of Mombasa (MCM) estimates the garbage generation in the city to be approximately between 700-850 tonnes a day. According to the Municipal Council of Mombasa (MCM) and Agence Francaise De Developpement (AFD) in a study conducted in 2009 on Waste Characterization for Solid Waste Management Project in Mombasa, the commonest types of waste generated in the area were organic waste, plastics and waste paper. These components are shown in the table 4.1 below.

Table 4.4 Major Components of Waste Generated

Component	Percentage by Weight
Organic Waste	51.7
Waste Paper	9.5
Plastics and Rubber	31.0
Wood	3.2
Textile	6.0
Total	100

Source: Municipal Council of Mombasa (MCM) and Agence Francaise De Developpement (AFD): Waste Characterization Study. (2009)

Table 4.4 above shows that, organic waste constituted about 51.7 per cent of all the components, of waste generated followed by plastics and rubber which constituted of 31 per cent and the least generated was wood with 3.2 per cent of the waste generated in the city. The household survey conducted also further shows that the common household wastes consists of organic waste which is mainly food wastes, vegetables and fruits followed by plastics and waste papers. This therefore means that organic kitchen wastes contribute up to two thirds of the waste stream. This further explains why a lot of organic wastes and polythene papers were seen in the dumpsites visited in Kibarani, Shonda and Mwakirunge dumpsites and also the illegal dumpsites in VOK, Mwembe Tayari market and Mackinon market.

4.4.3 Methods of Disposal of Solid Waste in Households

According to the Deputy Director in the Department of Environment the MCM seeks to acquire three hundred (300) litter bins to enhance refuse collection within the Central Business District (CBD) to reduce litter along major roads in the city especially for pedestrian use. Furthermore, the MCM has a storage bin standardization policy, that has been outlined in the MCM Environmental Management Bylaws, 2008 in section 53 that specifies the size and pattern of dustbins to be used both in businesses and households respectively.

The disposal of household solid waste is one of the functional elements in the management of waste. Table 4.5 illustrates the storage bins used for primary waste storage by household respondents in Mombasa. From the table the researcher was able to deduce that most of the households preferred disposing their refuse in disposal polythene bags (48.9%), followed by open container bins (33%) and finally the closed container bins (18.1%). Table 4.6 below additionally gives an illustration of the types of primary waste storage receptacles preferred by the respondents in different divisions within the city.

Table 4.5: Description of the Type of Storage Receptacles used by the Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Closed Container	17	17.9	18.1
	Open Container	31	32.6	51.1
	Polythene Bag	46	48.4	100.0
Total	94	100.0		

Table 4.6 Cross tabulation of the Type of Storage Preferred by Respondents in different Divisions within the City

		Type of Waste Storage Receptacles			Total
		Closed Container	Open Container	Polythene Bag	
Division	Kisauni	10	8	9	27
	Mvita	3	9		
	Changamwe	3	13	7	23
	Likoni	2	7	21	30
Total	17	31	46	94	

4.4.4 Collection, Transportation and Disposal of Solid Waste

Generally, waste collection service does not reach the entire population of the city. According to the Chief Superintendent in the Department of Environment for the Municipal Council of Mombasa the total urban population that is covered by the Municipal Council of Mombasa (MCM) in terms of garbage collection is 8.39% of the total population living in Mombasa. Additionally MCM only covers Mombasa Island only with coverage of up to 98% cumulative total.

Solid waste management includes the hauling and final disposing at landfills. Table 4.6 displays the methods of solid waste collection and disposal preferred by respondents within the four

divisions in the city. As shown in the tables 4.7 below there are four modes of solid waste disposal in the city. These are home collection (door-to-door), burning/illegal dumping (no collection), waste dump (communal dumpsite) and communal containers (skips). These modes of solid waste disposal fall under either primary waste collection or secondary waste collection. The solid waste collected is then finally disposed of in landfills (open dumps) located in Kibarani, Mwakirunge and Shonda all in different locations within Mombasa county.

Table 4.7 Cross tabulation of the Method of Solid Waste Disposal Preferred by Respondents within the Four divisions in the City.

Division	Disposal Methods				Total
	Burning & illegal Dumping	Home/Roadside Collection	Waste Container/Skips	Waste Dump	
Kisauni	9	12	2	4	27
Mvita	2	6	5	1	14
Changamwe	8	1	4	10	23
Likoni	19	8	2	1	30
Total	38	27	13	16	94

Primary Waste Collection

From the survey, 28.7% of the respondents indicated that, waste was collected directly from their homes either through home collection or roadside collection as indicated in table 4.6 above. This main mode of collection was carried out in Kisauni division (Zone 1) mostly in the high class and Middle class residential areas. This observation was corroborated by the Project Manager of Keen Kleeners Waste Company who cited that most of their residential customers come from the middle class and high class residents in the Kisauni division. The respondents who paid for the home collection service paid between Ksh.200 to Ksh.1, 000 per month depending on the service provider. According to the some of the household respondents these charges especially those charge by private waste collection companies were exorbitant and this accounted for the lack of patronage in some divisions in the city as show in table 4.6 where burning and illegal dumping is

the norm. However a majority of the household respondents preferred the door to door service because of its convenience and the frequency of service going up to three times a week especially if the waste collection service is provided by CBOs.

Secondary Waste Collection

Table 4.6 shows that incineration; illegal dumping and use of skips (communal containers) were the other methods of disposal preferred by the respondents respectively. Incineration and illegal dumping is the main mode of disposal with 40.4% of the respondents indicating that they collected their own wastes and dispose them by either burning or disposing them by throwing in the bushes or roadside. This indicated that the environmental awareness of most the respondents who preferred burning and illegal dumping to be low and this further contributed to their unwillingness to pay for a solid waste collection service. This analysis is well postulated in the table 4.8 below that show the cross tabulation of environmental awareness and choice of solid waste disposal method preferred by the respondents.

Table 4.8 Cross tabulation of Environmental Awareness and Choice of Disposal Method Preferred by Respondents.

		Disposal Method				Total
		Burning and illegal Dumping	Home/Roadside Collection	Waste Container/Skips	Waste Dump	
Environmental Awareness	No	37	2	0	1	40
	Yes	1	25	13	15	54
Total		38	27	13	16	94

Vehicles and Equipment used in Solid Waste Management

Interviews conducted to the principal engineer in the mechanical section in the Municipal Council of Mombasa revealed that there is no policy to standardize the vehicles and equipment used in solid waste collection in the city. However, it was noted that the purchase of the vehicles depends on various factors that come into play but mostly informed by cost, durability and

efficiency of the vehicles and equipment. Table 4.9 shows the number of vehicles owned by MCM. The council has a total of thirty four (34) vehicles used for solid waste management in the city with only twenty (20) in good conditions and operational. The remaining fourteen are either in fair or bad condition thereby not operational as shown in the table below the number and conditions of vehicles used for garbage collection by MCM is below average.

In terms of age nine (9) vehicles are more than 10 years old and fourteen (14) vehicles are between 5 and 10 years old and in operation. This is further aggravated by the lack of a policy on stock maintenance since purchases are only done on a need basis. Although, MCM owns a workshop to maintain and repair its vehicles and equipment it appears run down due to the frequent breakdowns of collection vehicles and unavailability of spare parts thereby rendering some of the vehicles and equipment unserviceable. Interviews conducted with the stores clerk in the stock maintenance section in the environment department in the MCM indicates the number of equipment used for primary collection within the city is not adequate due to ever increasing waste being collected in the city. All these factors lead to excessively high downtimes often influenced by slow rates of repair and the resulting delays in returning vehicles to service.

Table 4.9. Solid Waste Management Vehicles Owned by the Municipal Council of Mombasa

Vehicle Type	No.	No. of vehicle by condition			No. of vehicle by age			
		Good	Fair	Bad	>10	5-10	2-5	>2
Compactor vehicles	3	1	1	1		2	1	
Tipping truck with sliding cover(Side Loader)	6	4	1	1	2	3	1	
Open truck with tipping mechanism(Tipper)	13	8	2	3	3	2	8	
Water tanker	1	1				1		
Tilt frame or hoist truck handling big metal bin (Skippers)	6	3	2	1	4	2		
Bulldozers	2	1	1			2		
Shovel loader	2	1	1			2		
Bobcat	1	1						1
Total	34	20	8	6	9	14	11	

Source: Municipal Council of Mombasa, 2012

4.4.5 Regularity of Waste Collection in Solid Waste Management

The frequency and convenience of the waste collection service that is expected by the population cannot be ignored when planning collection systems. Regular collection is an important exercise in solid waste management. In the survey the researcher was able to deduce that only 61.7% of the respondents received waste collection service in comparison with 38.3 % who did not receive any waste collection services either from MCM or any other waste collection agency hence leading to them either dumping in bushes or burning them. Table 4.10 below illustrates generally, the relationship between the number of times waste is collected per week and the

waste collection service provider. 28.1% of the respondents indicated that their wastes were collected on a daily basis and 17% of the respondents indicated that the wastes were collected twice a week with the lowest incidence being weekly and thrice a week incidences in which 8.5% and 7.5% of the respondents reported to respectively. The areas indicative of daily and thrice per week collection service were the areas primarily served by private waste collection companies like Keen Kleeners. These areas were primarily out Mombasa Island like Nyali and Tudor areas which had the highest rates of home collection (door-to-door) service. Interviews conducted to MCM staff indicated that they offer the garbage collection service daily however on the ground this was not the case since a survey on most of the areas within the city showed that the communal containers were filled with uncollected waste leaving most of the residents throwing their wastes outside the container and thereby leading to littering and breeding of diseases such as typhoid, cholera and diarrhea which are sanitation related diseases.

Table 4.10 Cross tabulation of the Frequency of Service and Waste Collection System

Frequency of Service		Waste Collection System			Total
		Home/Roadside Collection	Communal Container	Waste Dump	
Daily	Count	11	5	11	27
	% within Frequency of Service	40.7%	18.5%	40.7%	28.1%
Twice Weekly	Count	5	6	5	16
	% within Frequency of Service	31.2%	37.5%	31.2%	17%
Thrice Weekly	Count	5	0	2	7
	% within Frequency of Service	71.4%	0.0%	28.6%	7.5%
Weekly	Count	6	1	1	8
	% within Frequency of Service	75.0%	12.5%	12.5%	8.5%
Total	Count	27	12	19	58
	% within Frequency of Service	46.6%	20.7%	32.8%	61.7%

4.4.5 Final Disposal of Solid Waste

The final disposal sites of solid waste in Mombasa are open dumping sites located at Kibarani, about 7 kilometres away the city centre; Mwakirunge, located about 17km from the city center and Shonda, located about 8kilometres from the city centre. Visits to the sites showed that they were in bad shape especially the Kibarani dumpsite. Although open dumping is by far the most common disposal method in most countries, open dumping causes many problems. Interviews conducted to the Cleaning Superintendent 1 in charge of all the garbage dumping sites in the city revealed that wastes are unloaded wherever the driver of the collection truck finds a convenient space and sometimes access to parts of the site may be blocked by piles of waste, accumulation of water or rough terrain. He added that usually there are many smoldering small fires which

may be started by waste pickers for various reasons or by municipal workers in an attempt to discourage fly breeding and reduce the volume of the waste.

However some of the fires may also start as the result of natural processes, scraps of glass focusing the sun rays, or depositing of burning loads. Approximately 75% of wastes from the city are disposed through open dumping at the disposal sites. MCM still dumps its wastes at the Kibarani dumpsite whereas other private waste collection companies and CBOs dump either at Mwakirunge or Shonda open dumpsites. Table 4.11 below shows a breakdown of the characteristics of the disposal sites present in the city.

Table 4.11 Disposal Sites present in Mombasa City and their characteristics

Items	Disposal Site		
	Site 1	Site 2	Site 3
Name of site	Kibarani	Mwakirunge	Shonda
Total area (ha)	-	-	-
Year when disposal started	1960s	2006	
Estimated life span Expired remaining (year)		12 years	-
Amount of waste deposited daily (tons/day)	750	-	100
Distance from collection area to site (km)	7	17	8
Disposal Method	Open dumping	Open dumping	Open dumping
Existence of animals on site	Yes	Yes	Yes
Existence of waste pickers or scavengers on site	Yes	Yes	Yes
Existence of open burning on site	Yes	Yes	Yes

Source: Municipal Council of Mombasa, 2012

The MCM, its contractors and private waste collection companies openly dispose all their solid wastes at the dumping sites posing serious environmental issues. There is no sanitary landfilling and of concern is that the cleansing officer even revealed that he did not know anything about sanitary landfilling. In sanitary landfilling, waste is supposed to be spread in thin layers, compacted and covered with fresh layer of soil each day to minimize pest, aesthetic, disease, air and water pollution problems. Since none of these environmental considerations had been incorporated into the siting, operation and planning process of this dumping sites, the site's conditions were observed to be rather pathetic and unsatisfactory as can be outlined here;

- a) The waste was not covered with any layer of soil since there was no bull-dozer to compact and cover the waste with a fresh layer of soil and the only present vehicle was a shovel loader.
- b) There was no litter and dust control. The site was generally untidy and dusty.
- c) Human settlement was very close to the dumping site.
- d) Due to lack of proper screening, papers and plastics were blown away by wind from the dumping sites towards the residential quarters with the possibility of spreading diseases and other environmental hazards especially in the Shonda and Kibarani dumpsites.
- e) The dumps were also a health menace to the surrounding residential areas because they are a source of objectionable smoke and odour.
- f) The sites security was quite unsatisfactory as reported by the MCM employees and private waste collection companies employees interviewed.
- g) There were dogs inhabiting the dumping sites which could attack and injure someone.
- h) The road to the dumping site at Mwakirunge is not tarmacked and accessibility is a problem for the vehicles transporting waste. Access was particularly difficult during the rainy season. There were no special arrangements for bad-weather conditions.
- i) There were no pest control measures. Hence the dumping sites served as a breeding ground for flies, mosquitoes; and other types of insects. There was no application of insecticides because of MCM's financial constraints.
- j) There was ground water pollution at the disposal sites in cases where it rained due to leachate generation.

- k) There was an average of three municipal council employees at each of the disposal sites and this was not adequate number of staff to ensure security, record-keeping on waste deliveries and other duties.

In conclusion, it should be observed that no environmental and socio-economic aspects were taken into consideration in the siting, operation and planning of the MCM disposal sites.

4.5 Financial Resources for Solid Waste Management

The general municipal revenue is raised by means central government grants and municipal taxes normally on single business permits and property tax. The municipal taxes are normally assessed on the size or value of the property being served, is the usual source of funds for operation of solid waste management services in the city.

4.5.1 Hypothesis Testing on Significance of Financial Resources in Effective Solid Waste Management.

H₀: The availability of financial resources does not influence the ability of MCM to undertake effective solid waste management

H_a: The availability of financial resources influences the ability of MCM to undertake effective solid waste management

The researcher sampled ninety four respondents to answer the research question how the availability of financial resources influences the effectiveness of solid waste management in MCM. Table 4.12a below shows the cross tabulation of financial resources and solid waste management effectiveness, from the results the researcher was able to deduce that 84.5 % and 5.3% of the respondents believe that availability of financial resources leads to satisfactory and very satisfactory solid waste management effectiveness respectively, whereas only 10.5 % respondents believed that availability of financial resources leads to poor solid waste management effectiveness. Secondly, 73 % of the respondents believed that lack of financial resources leads to poor solid waste management effectiveness whereas only 27 % of the respondents believed that lack of financial resources leads to satisfactory solid waste management effectiveness.

The data from table 4.12a above was analyzed using a chi square goodness of fit test in order to test the significance and the output is presented in table 4.12b. The results showed that the null hypothesis stating that availability of financial resources does not influence the effectiveness of solid waste management was rejected and the alternative hypothesis stating that availability of financial resources influence the effectiveness of solid waste management was accepted. The summary of the test statistic of the output in table 4.3 b is given as $X^2 (2) = 38.759, p \leq 0.05$, indicating that there is a relative significant relationship between financial resources and effective solid waste management.

Table 4.12a Financial Resources and SWM Effectiveness Cross tabulation

		SWM Effectiveness			Total
		Poor	Satisfactory	Very Satisfactory	
Financial Resources	Count	27	10	0	37
	No % within Financial Resources	73.0%	27.0%	0.0%	100.0%
	Count	6	48	3	57
	Yes % within Financial Resources	10.5%	84.2%	5.3%	100.0%
Total	Count	33	58	3	94
	% within Financial Resources	35.1%	61.7%	3.2%	100.0%

Table 4.12b Chi-square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	38.759 ^a	2	.000
N of Valid Cases	94		

4.5.2 Sources of Finance for Municipal Solid Waste Management

According to the Deputy Director in the DoE at MCM, the municipal tax collection systems are inadequately and poorly administered in the council with most of the expenditure directed towards the payment of salaries and remunerations (personnel costs). This fact was substantiated

by the comparison of the MCM budget summaries of the financial year 2012/2013 and that of 2010/2011 as shown in the Table 4.13 below. The table shows an increase of over 4% in personnel costs up from Kes.1, 263,704,296 to Kes.1, 319,804,905. The table below also shows that during the current financial year 2012/2013 the MCM has registered a deficit of Kes.444, 517,888 regardless of collecting more revenue than the previous financial year of 2010/2011 which is attributed towards poor administration and seen as a justification for the insufficient funds that are available to provide adequate services to the residents.

A survey by the researcher by means of questionnaires showed that informal or squatter urban communities, because of their informal status, pay no municipal taxes. Subsequent interviews with officials in the department of environment within MCM reveal that this fact has often been used as the principal argument against providing these communities with municipal services. The officials' site that the issuance of land title deeds or, at least, a declaration of intention to provide titles is necessary before municipal revenues can be derived from these communities. Furthermore, it is often assumed that squatter communities like the ones living in slum dwellings in most parts of Mombasa are unable or unwilling to pay for urban services let alone solid waste management collection fees. Table 4.13 below summarizes the revenue and expenditure of Municipal Council of Mombasa during the financial years of 2010/2011 and 2011/2012

Table 4.13: Existing Financial Situation of the Municipal Council of Mombasa

	Approved Estimates (Last FY-2011)	Approved Estimates (Current FY-2012)	Percentage Change
REVENUES			
LATF	1,007,374,313	1,275,086,016	27
RMLF	139,675,360	294,995,170	111
CILOR	31,240,540	31,240,540	0
<i>Sub-total</i>	<i>1,178,290,213</i>	<i>1,601,321,726</i>	<i>36</i>
<u>Local own Revenue</u>			
Single business	315,293,595	326,664,074	4
Market and slaughter house fees	101,423,699	89,934,304	-11
Property rates and plot rent	466,475,679	651,898,447	40
Bus parks/vehicle parking	23,614,567	86,678,100	267
House rent and stall rent	83,527,901	75,973,220	-9
Cess revenue	-	67,799,697	-
Other fees (public health & technical)	52,530,568	133,831,814	155
Other fees (education fees, advertisement)	287,083,340	167,727,104	-42
<i>Sub-total</i>	<i>1,329,949,349</i>	<i>1,600,506,760</i>	<i>20</i>
TOTAL REVENUES	2,508,239,562	3,201,828,428	28
EXPENDITURES			
Civic expenditures	60,906,718	59,800,155	-2
Personnel costs	1,263,704,296	1,319,804,905	4
Operations costs	508,912,482	655,882,135	29
Maintenance costs	321,721,833	580,265,332	80
<i>Sub-total recurrent</i>	<i>2,155,245,329</i>	<i>2,615,752,527</i>	<i>21</i>

Capital projects	331,087,583	596,593,847	80
Long term loan repayment	-	430,000,000	
TOTAL EXPENDITURES	2,486,332,912	3,642,346,374	46
DEFICIT/SURPLUS	21,906,650	(440,517,888)	-211

Source: Budget summary report of MCM for financial years 2010/2011 and 2012/201

Based on the data presented in table 4.13 obtained from the MCM the researcher was able to postulate that the scarcity of financial resources in the MCM is hindering the effectiveness of the solid waste management in the city. According to officials in MCM the financial problems are exacerbated due to the deficit of Kes.440, 517,888 in the budget summary for the current financial year .The researcher was also able to determine that there is any association between effective solid waste management and availability of financial resources from data collected from the household respondents in regards to payment of solid waste management services.

4.6 Community Participation in Solid Waste Management

As one starts to appreciate the MCM, s limitations in the provision of SWM services, the need for privatization to solve the problem becomes increasingly important. Privatization here does not imply wholesale transfer of services from the MCM to the community, but rather the gradual taking over by CBOs, as a result of the failure of MCM to provide the necessary level of performance.

4.6.1 Hypothesis Testing on the Significance of CBOs in Effective Solid Waste Management

H₀: The participation of community based organizations (CBOs) does not influence the effectiveness of solid waste management

H_a: The participation of community based organizations (CBOs) influences the effectiveness of solid waste management

The researcher sampled ninety four respondents to answer the research question to what extent does community participation influence the effectiveness of solid waste management in MCM.

Table 4.14a below shows the cross tabulation of community participation and solid waste management effectiveness, from the results the researcher was able to deduce that 76.3 % and

7.9 % of the respondents believe that community participation leads to satisfactory and very satisfactory solid waste management effectiveness respectively, whereas only 15.8 % of respondents believed that community participation leads to poor solid waste management effectiveness. Secondly, 48.2 % of the respondents believed that lack of community participation leads to poor solid waste management effectiveness whereas 51.8 % of the respondents believed that lack of community leads to satisfactory solid waste management effectiveness.

The data from table 4.14a above was analyzed using a chi square goodness of fit test in order to test the significance and the output is presented in table 4.14b. The results showed that the null hypothesis stating that community participation does not influence the effectiveness of solid waste management was rejected and the alternative hypothesis stating that community participation influences the effectiveness of solid waste management was accepted. The summary of the test statistic of the output in table 4.3 b is given as $X^2 (2) = 13.408, p \leq 0.05$, indicating that there is a less significant relationship between community participation and effective solid waste management.

Table 4.14a Community Participation and SWM Effectiveness Cross tabulation

			SWM Effectiveness			Total
			Poor	Satisfactory	Very Satisfactory	
Community Participation	No	Count	27	29	0	56
		% within Community Participation	48.2%	51.8%	0.0%	100.0%
	Yes	Count	6	29	3	38
		% within Community Participation	15.8%	76.3%	7.9%	100.0%
Total	Count	33	58	3	94	
	% within Community Participation	35.1%	61.7%	3.2%	100.0%	

Table 4.14b Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.408 ^a	1	.001
N of Valid Cases	94		

4.6.2 Community Based Organization's Solid Waste Management Service Arrangements

In Mombasa city there are many community based organizations but the researcher was only able to identify only four (4) active in SWM activities. The five active CBOs that were operational during the survey period included: Usafi Community Organization, Mwembe Tayari Youth Group, Kongowea Market Youth Group and Kisauni Youth and Self Help Group. Some of these CBOs supplied dust bins to only clients who agreed to pay a negotiated fee which ranged between Ksh 300-500 per month. The CBOs utilized the door-to-door collection systems and used wheel barrows in transportation of wastes from their clients to the transfer stations, skips or open spaces. None of sampled CBOs transferred waste directly to the dumping sites due to their low capacity. These CBOs surveyed provide employment to some youths and women; for example, usafi community organization has 10 permanent and 2 casual employees. Most CBOs were faced with technical problems like, lack of finance for expansion of services and limited occupational protective facilities dust coats, gloves, gum boots and nose masks. Generally, CBOs provided better services than the MCM because they are directly answerable to their clients. According to most of the CBOs interviewed there needs to proper partnership between CBOs and MCM in order to increase the efficiency of solid waste management services in the city.

4.6.3 Public Awareness and Attitudes towards Effective Solid Waste Management

Interviews conducted to DOE officials in MCM and results from questionnaires submitted to households and some businesses and institutions within the city of Mombasa shows that there is no formal public engagement forum in regards to the participation of the community in solid waste management apart from payment of garbage collection whereby most of the respondents paid for solid waste management service either provided by MCM, community based organizations or private waste collection companies.

According to the Chief commercial officer at Keen Kleeners-a private waste collection company- there needs to be more stakeholder involvement in solid waste management in the city with regular public barazas being held to sensitize the public about environmental awareness. The official further indicates that the problem is with the MCM because they do not show any concern with the regard to the destination of the wastes, as evident by the mushrooming of many illegal dumping sites in the city, and normally give solid waste management in general a low priority.

In terms of environmental awareness, the study indicated that 57.4% of the respondents are aware about the environmental problems associated indiscriminate dumping but due to their attitudes towards littering and economic constraints the households are do not care whether their wastes are dumped illegally or taken to an approved disposal site, provided that it is taken out of their immediate neighbourhood. This is often referred to as the -NIMBY- factor (Not In My Backyard). This is further illustrated in table 4.15 below which gives a breakdown of the environmental awareness within different divisions in the city.

Table 4.15: Cross tabulation of Environmental Awareness in different Divisions within the City

Division		Environmental Awareness		Total
		Not Aware	Aware	
Kisauni	Count	11	16	27
	% within Division	40.7%	59.3%	100.0%
Mvita	Count	2	12	14
	% within Division	14.3%	85.7%	100.0%
Changamwe	Count	9	14	23
	% within Division	39.1%	60.9%	100.0%
Likoni	Count	18	12	30
	% within Division	60.0%	40.0%	100.0%
Total	Count	40	54	94
	% within Division	42.6%	57.4%	100.0%

The survey conducted indicated that 40.4% of the respondents allocated waste collection services to community based organizations (CBOs) within their communities. This is further observed in Table 4.16 below. This is followed closely by 38.3% of the respondents who incinerate or choose to dispose their wastes indiscriminately by throwing in the bush or roadside and/or in the drain since they have no waste collection service

Table 4.16: Shows the Divisions in the City and the Waste Collection Services Preferred

Division		Service Provider				Total
		No Collection	Private Waste Company	CBO	MCM	
Kisauni	Count	8	12	5	2	27
	% within Division	29.6%	44.4%	18.5%	7.4%	100.0%
Mvita	Count	3	2	6	3	14
	% within Division	21.4%	14.3%	42.9%	21.4%	100.0%
Changamwe	Count	7	0	16	0	23
	% within Division	30.4%	0.0%	69.6%	0.0%	100.0%
Likoni	Count	18	0	11	1	30
	% within Division	60.0%	0.0%	36.7%	3.3%	100.0%
Total	Count	36	14	38	6	94
	% within Division	38.3%	14.9%	40.4%	6.4%	100.0%

44.4% of the respondents in Zone 1(Kisauni) preferred private waste collection service providers to collect their wastes. Table 4.16 further shows that in Zone 2(Mvita) and Zone 3(Changamwe) preferred the CBOs over all the other garbage collection service providers with 42.9% and 69.6% respectively due convenience and frequency of the service providers and the sense of ownership towards programs being run by the community. However in Zone 4(Likoni), 62.1% of the respondents normally dispose of their wastes either by dumping on the roadside, in drains or burning themselves within their own compounds.

4.7 Solid Waste Management Policies

According to the Deputy Director in DoE at MCM, SWM is a complex matter. Although the technical aspects are of prime importance, there are also a number of non-technical questions that have to be addressed to give a complete picture of the issue. The indiscriminate dumping within certain areas in the city possesses environmental risks. The Enforcement officer in the department of compliance in NEMA in an interview pointed out the role of legislation is to provide a framework for organizational decisions.

Both officials from NEMA and MCM indicated that Environmental regulations need to be designed and created to protect the health and integrity of the delicate Mombasa ecosystem and the human populations and must also be enforced in order to prevent the need for costly remediation measures in the future.

These policies-Environmental Management and Coordination Act (EMCA), 1999; Local Authorities Act (Cap 265), Public health act and the MCM Environmental Management bylaws, 2008- include the government's adoption of a spatial planning in the management of solid waste, and allocation of a substantial amount of finances for solid waste management and a strict enforcement of sanitation laws by agencies.

4.7.1 Shortfalls in Solid Waste Management Legislation

As would be expected of any legislation, there are several shortfalls in the Kenyan legislation on SWM. This study does not intend to give a detailed analysis of the current solid waste legislation but to pin-point the major shortfalls that need attention by environmental policy makers. Drawing on interviews with key informants from MCM and the compliance department in NEMA together with field visits to the three dumping sites within Mombasa city and document review the researcher was able to point out the following policy gaps in the Local Authorities Act, EMCA, 1999, public health act and MCM environmental management bylaws, 2008.

Most of the shortfalls in the Local Government Act 1984 are administrative or political in nature and influence the SWM less indirectly than directly. Restructuring of the Local Government Act of 1963 in 1984, gave the Minister for Local Government immense powers in the control of local authorities in Kenya. The current Act therefore denies local authorities autonomy in decision-making and management of their affairs. MCM should have the liberty to choose waste management programs, limit waste disposal, impose generation and disposal levies, or do

whatever it is that best fits their needs and/or abilities. Currently, the council does not have this freedom. The 1984 Act also makes it difficult for the MCM to hire and fire its own employees. These kinds of limitations for the MCM have led to institutionalization of bad practices of SWM in the council. Such legal shortfalls have also led to understaffing problems in most of the Municipality's Departments with incompetent and unskilled staff thereby influencing service delivery.

It is essential to increase the revenue base of the Council. However, under Section 148 of the Local Government Act, the local authorities and thus MCM have no powers to effect any fees or charges or make any expenditure on any service without the approval of the Ministry of Local Authorities. All financial estimates/budgets must be approved by the Minister of Local Government before expenditure takes place. Under such loopholes in revenue collection, there are more beneficiaries than contributors in the provision of basic services. The MCM therefore lacks regulation for collection, storage, transportation and disposal of solid waste. There are no by-laws to facilitate solid waste recycling enterprises in the town. The MCM, as a local authority, is under obligation under the provisions of the Public Health Act to take all lawful, necessary and reasonably, practicable measures for the maintenance of its areas at all times in clean sanitary conditions, and for the prevention of the occurrence thereof, or for the remedying or causing to be remedied, any nuisance or condition liable to be injurious or dangerous to health, and to take proceedings at law against any person causing or responsible for the continuance of such nuisance or condition (Republic of Kenya, Public Health Act).

Section 118 gives a list of what shall be deemed to be nuisance for purposes of the Act. Among these are two situations that are within the scope of this study. The first is any garbage receptacle, dustbin, dung pit, refuse-pit, ash-pit or manure heap so foul or in such a state so situated or constructed as in the opinion of the MOH be offensive or to injurious or dangerous to health. The second is any accumulation or deposit of refuse, offal, manure or other matter whatsoever which is offensive or which is injurious or dangerous to health.

In both of these situations, the MOH must serve a notice on the author of the nuisance or, in his absence, on the occupier or owner of the premises on which the nuisance arises, requiring him to remove it within such time as specified in the notice, and to execute such work as may be necessary to prevent a recurrence of the nuisance. Where the author of the nuisance cannot be

found and it is clear that the nuisance does not arise or continue by the act or default or sufferance of the occupier or owner of the premises, then the MOH must remove the same and do what is necessary to prevent the recurrence thereof.

In the two situations described above, the author of the nuisance is the MCM due to its failure to carry out the duty of cleaning the town. Where the Council cannot remove its own nuisance, the residents are left to help themselves because they cannot be able to take the MCM to court. Apparently, the Public Health Act superficially treats all wastes equally without due weight on the toxicity and the consequent pollution and health hazards on the individual waste category. This is simply due to lack of environmental health standards as pertains to waste management in Kenya. This has led to a situation where there is no waste segregation at source in the MCM. The Act gives power to the MCM or any other local authority to make by-laws in respect to all such matters as are necessary or desirable for the maintenance of the health, safety and well-being of the inhabitants of its area or any part thereof. The provision is repeated in the Local Government Act, Section 201. The irony with such provision is that, the same author of the nuisance is expected to make by-laws against themselves.

CHAPTER FIVE:

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In the Municipal Council of Mombasa (MCM) illegal dumping, irregular waste collections, lack of well-defined legislation and inadequate resources both in terms of Technology and finances are the key problems identified in solid waste management. Therefore the main objective of the study was to establish the underlying factors influencing effective solid waste management and suggest possible measures to tackle the problem. Below are the Summary findings of the study.

5.2 Summary of Findings

This study was carried out to find out the factors influencing effective solid waste management and through the analyses, the results revealed firstly in order to research question how technology does influences the effectiveness of solid waste management in MCM. The results deduced that 87.5 % and 5.4% of the respondents believe that appropriate technology (solid waste management systems) leads to satisfactory and very satisfactory solid waste management effectiveness respectively, whereas only 7.1 % respondents believed that appropriate technology leads to poor solid waste management effectiveness. 76.3 % of the respondents believed that inappropriate technology (solid waste management systems) leads to poor solid waste management effectiveness whereas only 23.7 % of the respondents believed that inappropriate technology leads to satisfactory solid waste management effectiveness. The data was analyzed using a chi square goodness of fit test and the results showed that the null hypothesis stating that technology does not influence the effectiveness of solid waste management was rejected and the alternative hypothesis stating that technology influence the effectiveness of solid waste management was accepted. The test statistic given as $X^2 (2) = 48.833$, $p \leq 0.05$, indicating that there is a relationship between technology and effective solid waste management. The results showed that there are variations in planning, development and operations in the choice of technology adopted by MCM with lack of formal recycling, recovery efforts and the collection rate being inadequate with only 61.7% of wastes being collected.

Secondly, in order to answer the research question how does the availability of financial resources influence the effectiveness of solid waste management in MCM. The results deduced that 84.5 % and 5.3% of the respondents believe that availability of financial resources leads to satisfactory and very satisfactory solid waste management effectiveness respectively, whereas only 10.5 % respondents believed that availability of financial resources leads to poor solid waste management effectiveness. 73 % of the respondents believed that lack of financial resources leads to poor solid waste management effectiveness whereas only 27 % of the respondents believed that lack of financial resources leads to satisfactory solid waste management effectiveness. The data was analyzed using a chi square goodness of fit. The results showed that the null hypothesis stating that availability of financial resources does not influence the effectiveness of solid waste management was rejected and the alternative hypothesis stating that availability of financial resources influence the effectiveness of solid waste management was accepted. The test statistic given as $X^2 (2) = 38.759$, $p \leq 0.05$, indicating that there is a relative significant relationship between financial resources and effective solid waste management. The results reveal that there is an almost universal conviction that MCM should provide waste collection service without charging directly for it.

Thirdly, the research question to what extent does community participation influence the effectiveness of solid waste management in MCM. The results deduced that 76.3 % and 7.9 % of the respondents believe that community participation leads to satisfactory and very satisfactory solid waste management effectiveness respectively, whereas only 15.8 % of respondents believed that community participation leads to poor solid waste management effectiveness. 48.2 % of the respondents believed that lack of community participation leads to poor solid waste management effectiveness whereas 51.8 % of the respondents believed that lack of community leads to satisfactory solid waste management effectiveness. The data was analyzed using a chi square goodness of fit test. The results showed that the null hypothesis stating that community participation does not influence the effectiveness of solid waste management was rejected and the alternative hypothesis stating that community participation influences the effectiveness of solid waste management was accepted. The test statistic given as $X^2 (2) = 13.408$, $p \leq 0.05$, indicating that there is a less significant relationship between community participation and effective solid waste management. The results show that 57.4% of the respondents were aware

about the environmental problems associated with indiscriminate dumping but do not care whether their wastes are dumped illegally or taken to an approved disposal site, provided that it is taken out of their immediate neighbourhood.

Finally, in order to answer the research question how do policies influence the effectiveness of solid waste management in MCM. The results show that there are four policies that govern solid waste management both at local and national level. These include the Environmental Management and Coordination Act (EMCA), 1999; Local authorities act (cap 265); Public health act and finally the MCM Environmental Management Act, 2008. However, MCM's service delivery is influenced by the Central Government legislations beyond its control. This situation denies MCM the liberty to choose its SWM programs. A good example is the 1984 Local Government Act which makes it difficult for the MCM to hire and fire its own employees. Similarly, there are no by-laws to facilitate solid waste recovery enterprises in the town. These limitations for the MCM have led to understaffing problems with incompetent and unskilled staff thereby influencing service delivery. Under such conditions, non-compliance has been common due to lack of awareness and 'I don't care' attitude. The situation is poor due to limited human and financial capacity to enforce legislation and an uncoordinated enforcement by NEMA and the Council without clear defined roles and responsibilities.

5.3 Discussions

In this study most of the objectives agree with the literature review but there were minor deviations from the expected results. Firstly when looking at the influence of technology in effective solid waste management. The researcher notes that the lack of recent data on waste characterization especially in terms of composition was one of the major factors influencing planning and development of an effective solid waste management system since the MCM only characterized wastes in terms of quantities (kg/m^3) thereby discouraging formal recycling efforts. However independent studies by Afd revealed that organic wastes, plastics and waste papers are the main components of the waste stream in the city. This was corroborated by results from the household survey that indicated 78.7% of the waste generated by respondents was organic waste followed by waste paper (13.8%) and plastics (7.4%). This observation concurs with Hoornweg, et al 1999 who cited that the average city's municipal waste stream in developing countries is over

50% organic materials. The descriptive survey also indicated that 47.9% of the respondents preferred using polythene bags as the main primary storage receptacle which is classified as an unstandardized waste receptacle and is a major contributor of littering within the city. This view concurs with that of Afd, 2008 who indicate that polythene bags constitute 31.9% of the waste stream in Mombasa.

In terms of the predominant waste collection systems in the city are door-to-door(home collection), communal collection and waste dumps(no collection) with a majority of household respondents preferring home collection (46.6%) followed by waste dumps (38.9%) and communal containers or skips (20.7%). This further indicates that the collection is inadequate with only 61.7% of wastes being collected. This view concurs with Hardoy et al 1993 who cited that only 40% of waste is collected in Mombasa. The same view is shared by UNEP, 1996 who state that the waste generation exceeds collection and is well above the ability of municipal authorities to handle. They further state that waste collection is inadequate as it ranges from 20-80% with a midrange of 40-50%. Additionally, in terms of operations there is no policy for standardization of solid waste vehicles and equipment used by MCM and this one of the main reasons for frequent breakdowns and delays in service delivery. The survey established that MCM has 34 vehicles for garbage collection but only 20 were in good condition regardless of the fact that it owns its own workshop to maintain and repair the vehicles. Thus researcher noted that there was irregular and or lack of routine collection of waste by MCM with the services offered either daily or twice a week or even at times on a weekly basis and intermittently. This view is shared by UNHABITAT, 2010 who indicate that in the absence of a regular waste collection service, waste is dumped in open spaces, on access roads and along water courses.

In regard to final disposal the researcher was able to establish that there are three commissioned dumping sites in the city and approximately 75% of wastes from the city are disposed through open dumping at the disposal sites. There is no sanitary landfill in any of the disposal sites and no environmental considerations had been incorporated into the siting, operation and planning process of these dumping sites, the site's conditions were observed to be rather pathetic and unsatisfactory. Additionally there are no measures or efforts put in place by the local authority to encourage the adoption of the 3R (Reduce, Reuse, and Recycle). This view were similar to those

of Johannessen 1999 who found varying amounts of planning and engineering in MSW dumping among various African nations, with most nations practicing open dumping for waste disposal.

Secondly, when looking at the influence of financial resources in effective solid waste management. The results reveal that there is an almost universal conviction that MCM should provide waste collection service without charging directly for it. This view was evident in respondents from zone 4(Likoni division) where 60% of the respondents opted for no collection due to being levied waste collection fees. This observation concurred with that of Schubeler, 1996 who indicated that areas where residents are assessed fees for waste removal, the rate of collection can be quite poor. However other communities within the city are accustomed to making their own arrangements for waste collection and paying for the service directly. Zerbock, 2003 corresponds with the views of the researcher in that there is a wide disparity in the ability of residents to pay user fees for garbage collection, and as a result the municipal fiscal situation often hardly improved.

According to the Deputy Director in the Department of Environment (DoE) at MCM the major sources of finance for the MCM include single business permits, market dues, parking fees, rates, service charge, water charges, rents from the Council's properties, fees and other charges. There are external sources from the central government.e.g. LATF, roads maintenance levy fund, and any other donation that can arise. There was no major source that goes direct to SWM since all the money went to the same pool. This view was in contrast with Cointreau 1982 who indicates that different resources are used finance capital investments than to finance operating and maintenance costs. The interviews further indicated that meeting the financial demands of SWM was a major problem in MCM .The council was not able to estimate the true costs of their entire SWM operations. This was because SWM expenditures were simply rolled into the conservancy section. This attributed is replicated across various developing countries as indicated by Schübeler 1996 who stated that many municipalities may not even be aware of the degree to which revenues are collected, or the true costs of their entire MSW operations .He further stated that the problems are compounded when revenues from MSW collection are simply rolled into the general treasury as opposed to returning to waste related operations. Similarly, the researcher

observed that all the capital expenditures of the Municipal council were lumped up into the engineering department.

Even though SWM services are supposed to be self-financing, the available information indicates that no finance-collection system is available leading to insufficient funds to provide environmentally acceptable service to the town's residents which corresponds to Cointreau 1991 who states that municipal authorities spend up to 50% of their revenues on waste related issues. This can be attributed to lack of a policy on integrated solid waste management where recycling and composting can be established to not only create employment but also generating income for the cleansing section. The researcher therefore concluded that one of the greatest constraints to SWM is the inadequate financing process.

Thirdly, in terms of the influence of community participation in effective solid waste management. The researcher observed that areas serviced by the CBOs were those that MCM did not operate but client's preferred CBOs because they provided quality services than the MCM. For instance, CBOs collected wastes daily compared to the MCM which sometimes failed almost for a full week. MCM's refuse collection fleet mostly concentrated in the island and left most areas uncovered. CBO's have been able to penetrate into various residential areas (both middle income and low income areas). Therefore CBO's have enhanced the public's sense of responsibility towards environmental cleanliness in general. There are inter-linkages between MCM and CBOs. Wastes collected at the transfer station were transported to the dumpsite by the municipal council; this showed that MCM did appreciate the positive role played by the CBOs. The observations are similarly shared by various authors including Syagga 1992 who supports the involvement of the community sector as an effective way of increasing access of the poor to urban services, including waste management. Zurbrugg, 2000 further notes that community-based organizations can be effective in addressing the garbage problem in developing countries.

Fourthly, in terms of the influence of solid waste management policies in effective solid waste management. There are four policies that govern solid waste management both at local and national level. These include the Environmental Management and Coordination Act (EMCA) 1999; Local authorities act (cap 265); Public health act and finally the MCM Environment Management Act, 2008. This is in contrast to Ogawa 1995 who points out that the major problem

and development constraint in developing countries is lack of overall plans for SWM at local and national levels. As would be expected of any legislation there are several shortfall in the both the local and national legislation on SWM. MCM's service delivery is influenced by the Central Government legislations beyond its control e.g. the Local Government Act, the Public Health Act, NEMA regulations. This situation denies MCM the liberty to choose its SWM programs. A good example is the 1984 Local Government Act which makes it difficult for the MCM to hire and fire its own employees. Similarly, there are no by-laws to facilitate solid waste recovery enterprises in the town. This view is similar to observation made by UNEP, 1996 that the Acts neither set the standards for the service nor require waste reduction or recycling.

These limitations for the MCM have led to understaffing problems with incompetent and unskilled staff thereby influencing service delivery. Under such conditions, non-compliance has been common due to lack of awareness and 'I don't care' attitude. The situation is poor due to limited human and financial capacity to enforce legislation and an uncoordinated enforcement by NEMA and the Council without clear defined roles and responsibilities. This view is similar to UNHABITAT, 2010 which observed that unionization of the workers, politicization of labour unions and the consequent indiscipline among the workforce are all results of bad working conditions and inept handling of labour issues.

5.4 Conclusion

The findings show that technology influences the effectiveness of solid waste management with a test statistic given as $X^2(2) = 48.833$, $p \leq 0.05$, indicating that there is a relationship between technology and effective solid waste management. The results show that there are variations in planning, development and operations in the choice of technology adopted by MCM with lack of formal recycling, recovery efforts and the collection rate being inadequate with only 61.7% of wastes being collected. Secondly the results show that the availability of financial resources influence effective solid waste management with the test statistic given as $X^2(2) = 38.759$, $p \leq 0.05$, indicating that there is a relative significant relationship between financial resources and effective solid waste management. The results reveal that there is an almost universal conviction that MCM should provide waste collection service without charging directly for it. Thirdly, the results show that community participation influences the effectiveness of solid waste

management with the test statistic given as $X^2(2) = 13.408$, $p \leq 0.05$, indicating that there is a less significant relationship between community participation and effective solid waste management. The results show that 57.4% of the respondents were aware about the environmental problems associated with indiscriminate dumping but do not care whether their wastes are dumped illegally or taken to an approved disposal site, provided that it is taken out of their immediate neighbourhood. Finally the results show that policies influence effective solid waste management, however there are shortfalls in the legislation which have led to limited human and financial capacity to enforce legislation and an uncoordinated enforcement by NEMA and the Council without clear defined roles and responsibilities. In conclusion there is an urgent need for the enhancement of community initiatives and partnerships by the MCM to increase awareness of the importance of solid waste management and its contribution to a healthy living environment.

5.5 Recommendations

Based on the findings of the study, the following measures are recommended for efficient and effective management of solid waste in MCM. These include:

1. The MCM should be able to incorporate the improvement in the solid waste management systems (technology) outlined below as follows:

- a) Storage

The waste storage pits should be deep enough to avoid spillage of waste. The council should also provide enough storage material and frequent collection of waste. Standard litter bins should be provided at strategic points not only in the CBD area but also in the estates. The bins should also be compatible with planned recycling systems.

- b) Collection

MCM should ensure frequent and timely collection and proper disposal of waste. In some cases landlords and caretakers should also help in the collection and disposal. Transfer stations and skips should be provided in slum areas especially where accessibility is possible to avoid illegal dumping.

c) Disposal

Burning of waste should be discouraged. Since the Kibarani dumpsite is already expired, there is urgent need of identifying a new site for waste disposal. Health considerations should be taken into account in disposal strategies. Additionally new transfer stations should be identified since the siting of the existing ones possess environmental risks and have become eyesores within the city.

d) Recycling and Re-use

Waste management practices in the city have largely concentrated on how to collect and dump waste in the dumping site. Now, however, there should be a greater emphasis on techniques and approaches that avoid or minimize the need for waste disposal in the dumping site through diversion and recovery. Recycling and reuse will divert a significant quantity of materials from ultimate disposal. This will require:

- i. Establishment of drop off points for recyclable materials
 - ii. Training and deployment of personnel on waste segregation at source
 - iii. Provide containers designed for waste separation
2. The MCM should be able consolidate its revenue and expenditure from solid waste management so that it can be able to estimate the true costs of their entire SWM operations and hence become self-financed and be able have sufficient funds to provide environmentally acceptable level of service to the city's residents
 3. The community should adopt a self-help approach to solve the problem. Much can be achieved when the various communities mobilize themselves and organize periodic clean up exercises and by contributing financially to support the exercise, the residents can also act as watch dogs and make sure that they themselves adhere to proper waste disposal practices. Women should be made to play an important role as it has been realized that women do a greater part of solid waste handling and disposal in the community.
 4. Stricter enforcement of bylaws should be ensured by the MCM where administrative penalties for minor violations should be taken with urgency

It is hoped that these recommendations, when considered for action by the government, the Municipal Council of Mombasa, and the people themselves would help address the solid waste management problems and its related issues in Mombasa.

REFERENCES

- Abduli, M. A., Nabi Bidhendi, Gh. R., Nasrabadi, T. and Hoveidi, H., (2007). *Municipal Solid Waste Management in south coastline of the Caspian Sea*. J. Environ. Health, **70** (5), 34-37.
- Akoto Lillian. (2011). *Socio-economic factors influencing effective community participation in solid waste management: a case of Mishomoroni slums, Mombasa district*. Unpublished M.A thesis, University of Nairobi.
- Anthony Baabereyir. (2009). *Urban Environmental Problems in Ghana: A Case Study of Social and Environmental Injustice in Solid Waste Management in Accra and Sekondi-Takoradi*. PhD Thesis, University of Nottingham.
- Arlosoroff, Saul 1982. "WB/UNDP Integrated resource recovery project: Recycling of wastes in developing countries." In: *Appropriate Waste Management for Developing Countries*, edited by Kriton Curi. New York: Plenum Press, 1985
- Bartone, C. (2001). *Urban Environmental Priorities*. World Bank, Environment Department, Washington, D.C.
- Blight, G.E. and Mbande, C.M. 1996. *Some problems of waste management in developing countries*. Journal of Solid Waste Technology and Management 23, no. 1, February 1996. pp 19-27.
- Bogner, J., M. Abdelrafie Ahmed, C. Diaz, A. Faaij, Q. Gao, S. Hashimoto, K. Mareckova, R. Pipatti, T. Zhang. *Waste Management, In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Bryman, A. 2004. *Social Research Methods (2nd Edition)*. Oxford, Oxford University Press

Beukering, P., Sehker, M., Gerlagh, R and Kumar, V., 1999. *Analyzing Urban Solid Waste in Developing Countries: a Perspective on Bangalore, India*. Working Paper 24, CREED, India

Cointreau, S. (1982). *Environmental Management of Urban Solid waste in Developing Countries: A Project Guide*. Urban Development Technical Paper Number 5, World Bank, Washington DC.

Cointreau, S. (2001). *Declaration of Principles for Sustainable and Integrated Solid Waste Management*. Accessed at: <http://web.worldbank.org>. 17/06/07.

Dijk, M. P. Van (2006). *Managing cities in developing countries: Theory and practice of urban management*. Cheltenham: Edward Elgar.

Goombya.S.W & Mukunya.F (2006).*Solid Waste Management in Kawempe Division,Uganda:Issues and challenges and emerging options*. PhD Thesis, Makerere University.

Hardoy, J. E. et al, (2001). *Environmental Problems in an Urbanizing World*. London and Stirling: VA. Earthscan

Hornweg, D., Thomas, L. and Otten, L. (1999). *Composting and Its Applicability in Developing Countries*. Urban Waste Management Working Paper Series 8. Washington, DC: World Bank.

JICA (1998).An overview of solid waste management in Kenya, Republic of Kenya, *The study on solid waste management in Nairobi city in the Republic of Kenya: Final Report Vol .2*.

- Johannessen, L.M. and G. Boyer, 1999: *Observations of solid waste landfills in developing countries: Africa, Asia, and Latin America*. Report by Urban Development Division, Waste Management Anchor Team, World Bank, Washington, D.C.
- Karanja, A. (2005). *Solid Waste Management in Nairobi: Actors, Institutional Arrangements and Contributions to Sustainable Development*. PhD Thesis, Institute of Social Studies, The Hague, Netherlands. Available: <http://www.shaker.nl>.
- Kenya National Bureau of Statistics, (2009). *GDP Per Capita (constant 1982 prices) 1996 - 2008*. [Online]. Available from: <http://www.knbs.or.ke/>. [Accessed 10 January 2010].
- Kironde, J.M.L., (1999). Dar es Salaam, Tanzania. *Onibokun, A.G. (Ed). Managing the Monster. Urban Waste and Governance in Africa*. Pp. 101-172. Ottawa, IDRC.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*, 607-610.
- Kreith, F. (1994). *Handbook on Solid Waste Management*. New York: McGraw-Hill.
- Lettsome, C. (1998). The environmental impact of incineration on island nations. *Solid waste management: critical issues for developing countries*, edited by Elizabeth Thomas-Hope, 159-167. Kingston: Canoe Press.
- Linden, O. (Sida), Gomez E.D. (CMC) and Ngoilie, M.A.K. 1997 (Eds). *Common Constraints to Waste Management Programs on the East Asian Seas Region: Top Ten Constraints*. GEF/UNDP/IMO Regional Programme 1997. National profiles for Brunei, Darussalam, Cambodia, China, Indonesia, Japan, Malaysia, Philippines, Singapore, Thailand and Vietnam. Accessed at: <http://www.pemsea.org/pdfdocuments/regional-profiles-from-tropical-coasts-back-cover/tc-obc-vol5-6-no2-1.pdf>. 21/05/07

- Mugenda, A. and Mugenda, O. (2003). *Research Methods: Quantitative and Qualitative Approaches*. Africa Centre for Technology Studies (ACTS), Nairobi, Kenya. 258 pp
- Mensah, F.O. (2006). *Learner Support for University Distance Education in Ghana: A Study of Students' and Providers' Perceptions*. Unpublished PhD Thesis. School of Education, University of Nottingham.
- Mungai, G. (1998). *Solid waste management: critical issues for developing countries*, edited by Elizabeth Thomas-Hope, 159-167. Kingston: Canoe Press.
- Muniafu, M. and Otiato, E. (2010). *Solid Waste Management in Nairobi, Kenya: A case for emerging economies*. Available online at <http://www.jsd-africa.com>
- Municipal Council of Mombasa, (2008). *Environmental Management By-laws*, Nairobi, Government Printer.
- O'Leary, C. 2004. *The Role of Digital Technology in the Language Classroom*. *Language World Conference*. England: University of Oxford.
- O'Leary, C. 2005. Collaborative Learner Development in a University-Wide Language Programme. Paper presented at *The AILA's 14th World Congress of Applied Linguistics*. USA: Madison (Wisconsin). 24-29 July.
- Oso, W. Y and Onen, D. (2008). *A General Guide to Writing Research Proposal and Report. A Handbook for Beginning Researchers, Second Edition*. Makerere University Printer, Kampala.
- Pacione, M. (2005). *Urban Geography. A Global Perspective*. 2nd. Edition. London and New York. Routledge, Taylor & Francis Group

Rotich K., Zhao Y. and Dong J. (2005). *Municipal Solid Waste Management Challenges in Developing Countries – Kenyan case study*. Available online at [www. sciencedirect.com](http://www.sciencedirect.com) (March. 04, 2009)

Schübeler, P. (1996), *Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries*. SKAT, St. Gallen, Schweiz.

Senkoro, H. (2003). *Solid Waste Management in Africa: A WHO / AFRO Perspective*. Paper 1, presented in Dar Es Salaam at the CWG Workshop, March 2003. Available: <http://www.skat.ch/sf-web/activities/ws/cwg/pdf/cwg-01.Pdf>[Accessed 25th July 2004]

Syagga, P. (1992). *Problems of Solid Waste Management in Urban Residential Areas in Kenya. In The Proceedings of African Research Network for Urban Management (ARNUM) Workshop: Urban Management in Kenya*, Joyce Malombe (Ed.). University of Nairobi.

Tchobanoglous, G., Theisen, H. and Vigil, S. A. 1993. *Integrated Solid Waste Management*. New York, McGraw Hill

Tchobanoglous, G., Kreith, F., 2002. *Handbook of Solid Waste Management*, 2nd edition, McGraw-Hill Handbooks.

UN-HABITAT & UN-OCHA, 2009. *Report on Planning Meeting convened jointly by UN-HABITAT & UN-OCHA: Strengthening Co-ordination Response on Urban Vulnerability in Kenya*. Nairobi, Kenya.

UN-HABITAT, (2010). *Solid Waste Management in the World Cities: Water and Sanitation in the World Cities*. London: Gutenberg Press.

UN-HABITAT, (2010). *Collection of Municipal Solid Waste in Developing Countries*. London: Gutenberg Press.

UNEP (2009), *Developing Integrated Solid Waste Management Plan - Training Manuals Vol.1-4*

UNEP. (1996). *International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management*. UNEP Technical Publication 6, Nov. 1996. Thomas-Hope.

US EPA, 1999: *National source reduction characterization report for municipal solid waste in the United States*. EPA 530R-99-034, Office of Solid Waste and Emergency Response, Washington, D.C.

US EPA, 2003: *International analysis of methane and nitrous oxide abatement opportunities*. Report to Energy Modeling Forum, Working Group 21. U.S. Environmental Protection Agency June, 2003. <<http://www.epa.gov/methane/intlanalyses.html>>.

US EPA, 2005: *Municipal solid waste generation, recycling and disposal in the United States: facts and figures for 2003*. Washington, D.C., USA, <<http://www.epa.gov/garbage/pubs/msw03rpt.pdf>> accessed 25/06/07

World Bank Water and Sanitation Program and India Ministry of Urban Development. (1993). *"Community-Based Solid Waste Management: Project Preparation Panaji Case Study."* World Bank, Washington, DC.

Zerbock, O. (2003). *Urban Solid Waste Management, Waste Reduction in Developing Countries*. Available http://www.cee.mtu.edu/peacecorps/documents-july03.wastereduction_and_incineration_FINAL.pdf. [Accessed 25th July 2004]

Zurbrugg, C. (2003), *Solid Waste Management in Developing Countries: Solid waste management includes all activities that seek to minimize the health, environmental and aesthetic impacts of solid wastes*, Eawag/Sandec

Zurbrugg, Christian, and Rehan Ahmed. (1999). "*Enhancing Community Motivation and Participation in Solid Waste Management.*" Sandec News 4 (January): 2-6.

APPENDICES

Appendix 1: A Letter of Transmittal

University of Nairobi,
School of Continuing and Distance Education,
Department of Extra Mural Studies,
P.O Box 88732-80100,
Mombasa, Kenya.
5th May 2012

Dear Sir/Madam,

TO WHOM IT MAY CONCERN

I **Nelson Isaac Maloba** Registration No: **L50/78010/2009** a student pursuing a **MASTERS OF ARTS DEGREE IN PROJECT PLANNING AND MANAGEMENT** at the School of Continuing and Distance Education in the University of Nairobi.

As part of the course I am required to go to the field for data collection and prepare a research project report. I am collecting data related to my research topic: **FACTORS INFLUENCING EFFECTIVE SOLID WASTE MANAGEMENT: A CASE OF MOMBASA MUNICIPAL COUNCIL, KENYA.**

This information I am gathering is purely for academic purposes and will be treated with utmost confidentiality. Thank you for your cooperation.

Yours Sincerely,

NELSON ISAAC MALOBA

L50/78010/2009

Appendix 2: Informed Consent Form

I have been briefed on the study on *Factors Influencing Effective Solid Waste Management: The Case of Municipal Council of Mombasa, Kenya*. I understand that the research is for academic purposes only. The findings and recommendations of the research may however be used to add to the scanty body of knowledge with regard to solid waste management in Mombasa. I have also been assured of the confidentiality of the information that I give and the need for honest responses. I therefore give consent for my voluntary participation.

Organization

Department

Position

Name.....

Telephone contacts

Sign

Appendix 3: Respondents Questionnaire

Hi, my name is Nelson Isaac Maloba, a Masters of Arts student in Project Planning and Management. I am conducting a research on Factors Influencing Effective Solid Waste Management: A Case of Municipal Council of Mombasa.

Confidentiality and Consent: You have been randomly selected to participate in the study. Consequently, with your consent, you will respond to this questionnaire. I would like to assure you that the information you share with us will be treated with high confidentiality. Furthermore I wish to assure you that your name will never be used in connection with any of the information you fill. You do not have to answer any question that you do not want to answer and you may stop filling the questionnaire at any point and time you want.

1.0 Introduction

This questionnaire is designed to facilitate the assessment of the current situation of solid waste management service in an urban area. The information collected by this questionnaire can be used to evaluate the factors influencing solid waste management in the county. To enable an accurate assessment, it is important that all information requested in the questionnaire should be provided as completely and accurately as possible.

Questionnaire Identification Information

Respondent Code.....

Date of Interview.....

Appendix 4: Questionnaire for Household Survey

Dear resident,

I am carrying out an academic study to assess the solid waste situation in this city. The purpose of this questionnaire is to find out about your household waste disposal needs, the waste disposal services you receive, and how you perceive the solid waste situation in this city. The ultimate goal of the study is to find ways of improving solid waste management in the city. As a resident of this city your views and ideas are considered very important for the success of this academic study and it would be very much appreciated if you could spend a little time to answer this questionnaire.

Thank you for your assistance.

Tick and/or give a brief explanation where appropriate

A: General Information

- I. Name of division: Kisauni [] Changamwe [] Likoni [] Mvita []
- II. How long have you lived in this neighborhood? Years Months.....
- III. How many people live in your house?

B: Household waste generation and disposal practices

- 1 Please indicate the items commonly found in your household waste and how often you generate them below.

Common household waste items (e.g. food waste, paper, plastic)

How often do you generate this? (e.g. daily, weekly, occasionally)

- 2 How do you store your waste before disposal?

- a) In a closed container []
- b) In an open container []
- c) In a polythene bag or sack []
- d) Other [] Please indicate:.....

- 3 In the table below, please indicate with a tick (✓) the type of waste collection service available to your household.

Waste collection service	(✓)	Question to proceed to
Home collection		
Roadside collection		
Truck visit		
Communal container		(Proceed to Q. 6)
Waste dump		(Proceed to Q. 10)
Other (Please indicate)		(Proceed to Q. 14)

- 4 In the table below, please indicate the name of your service provider and frequency of the service.

Service provider(e.g. municipal council, private garbage collection company,etc)	Frequency of service(e.g. once or twice per week,etc)

- 5 Is your service provider able to keep to the agreed schedule for waste collection?

a) Yes []

b) No [] what do you do with your waste then?.....

.....

.....

******(Proceed to Q.15)******

- 6 Is the waste container close to your home or other homes in the neighbourhood?
- a) Yes [] how close?(e.g. distance in meters)
 - b) No []
- 7 Is the waste container emptied regularly?
- a) Yes [] how regularly is it emptied?.....
 - b) No [] Do you know why?
Yes [] state reason:.....
No []
- 8 How will you describe the sanitation situation around the waste container?
- a) Very satisfactory []
 - b) Satisfactory []
 - c) Poor []
 - d) Very poor []
- 9 Is the waste dump close to your home or other homes?
- a) Yes [] how close is it to the nearest homes?.....(e.g. distance in meters)
 - b) No []
- 10 Is the waste dump maintained (e.g. is the waste regularly removed or burned)
- a) Yes [] who maintains it?
 - b) No []
- 11 How will you describe the sanitation situation at the waste dump?
- a) Very satisfactory
 - b) Satisfactory
 - c) Poor
 - d) Very poor

Proceed to Q.15

- 12 Please indicate how you dispose of your waste
- a) Burning []
 - b) In the bush/ roadside/ drain [] specify:.....
 - c) Burying []
 - d) Other method [] specify:.....

13 Why do you dispose of your waste by this method?

- a) I have no waste collection service []
- b) I cannot afford service fee []
- c) Other reason (please indicate) []

14 Do you know of any environmental problems associated with your method of waste disposal?

- a) Yes [] what are they?.....
- b) No []

15 Do you find your waste disposal arrangement convenient?

- a) Yes []
- b) No []. Why is it not convenient?.....

16 How will you describe the general waste situation in your neighbourhood?

- a) Very satisfactory []
- b) Satisfactory []
- c) Poor []
- d) Very poor []

17 Do you pay for your waste disposal service?

- a) Yes. []
- b) No. [] Are you willing to pay for your waste disposal service?

Yes [] why? (Go to Q.21)

No [] why? (Go to Q. 21)

18 In the table below, please indicate how you pay for your waste collection service

How often do you pay?	How much do you pay?	Who do you pay to?	Is it affordable?

*****Proceed to Q.23*****

19 Are willing to pay for waste disposal services?

- a) Yes []
- b) No []

20 How much are you willing to pay each month for the following types of service?

Weekly home collection	Weekly roadside collection	Regular block or communal container service
Ksh:	Ksh:	Ksh:

21 Do you think all households/businesses in this city should pay for waste disposal?

- a) Yes [] why do you think so?.....
- b) No [] Why do you think so?.....

22 How will you describe the quality of waste disposal service you receive?

- a) Very satisfactory []
- b) Satisfactory []
- c) Poor []
- d) Very poor []

23 Do you and your neighbours ever discuss the waste situation in this neighbourhood?

- a) Yes [] what have you?
- b) No [] why don't you?

24 In you were to compare with other communities or suburbs in this city, would you say your community receives a fair share of resources for waste disposal?

- a) Yes []
- b) No []. Why?.....

25 How would you rank environmental sanitation in your community in relation to others in the city?

- a) One of the cleanest neighbourhood's []

Appendix 5: Interview Guide for Municipal Council of Mombasa (MCM) Officials

Name of Department:.....

Designation of officer granting interview.....

1. Technology in Solid Waste Management.

Planning and Development

1.1 Physical characteristics of solid waste

(1) Has there been a recent study of the waste situation in this city?

- Yes [] when was this done?Who did it
- No [] why?.....

(2) If data on waste characteristics are available, please complete the following table:

Component	% By Weight
Paper	
Plastic and rubber	
Organic or vegetables	
Glass and ceramic	
Ferrous metal	
Aluminum	
Wood	
Textile	
Garden waste	
Others	
Total	

1.2 Storage

(1) Does the Department have a storage bin standardization policy? If so, please briefly outline the policy.

(2) Type of storage bin used (please tick appropriate space)

Type of Containers		Residential Premise				Commercial Premise			
		A	F	S	N	A	F	S	N
Individual Containers	Metal bin								
	Plastic bin								
	Plastic bag								
	Oil drum								
	Others								
Communal Containers	Metal bin								
	Plastic bin								
	Oil drum								
	Concrete bin								
	Roll-on roll-off								
Others									

A= Almost exclusively used

F= frequently used

S= Sometimes used

N= Never used

1.3 Collection

(1) Collection service coverage for domestic premises for the year 2011-2012.

	% of Total Population	Frequency of Collection
Urban Population		

(2) Collection service coverage for commercial/trade premises for the year 2011-2012.

	% of Premises	Frequency of Collection
Collected by MCM		
Collected by the MCM's contractor		
No collection service (done by owner)		

(3) Amount of waste collected (by both the MCM and Contractors) last year i.e. 2011

Solid Waste Type	Estimated Recycling Rate (%)	Amount Collected			
		MCM		Contractor	
		Measured	Estimated	Measured	Estimated
Domestic, institutional, commercial and trade waste					

1.4 Disposal

Items	Disposal Site		
	Site 1	Site 2	Site 3
Name of site			
Total area (ha)			
Year when disposal started			
Estimated life span remaining (year)			
Amount of waste deposited daily (tonne/day)			
Distance from collection area to the site (km)			
Disposal method (See notes below)			
Existence of animals on site	Yes / No	Yes / No	Yes / No
Existence of waste pickers or scavengers on site	Yes / No	Yes / No	Yes / No
Existence of open burning on site	Yes / No	Yes / No	Yes / No

Note: For disposal method, please specify as follow:

O = Open dumping

C = Controlled tipping (with occasional soil cover)

S = Sanitary landfill (with daily cover)

D = Dumping into water body (river/sea etc.)

Operations

1.1 Vehicles and equipment

(1) General information

a) Is there any policy to standardize the vehicles and equipment used by MCM? If so, please outline how this policy is being implemented.

b) Does the Department have its own workshop to maintain and repair its vehicles and equipment? If so, how does the workshop purchase spare parts? What is the average time taken for the purchase? What is the policy on stock maintenance?

(2) Equipment for primary collection (i.e. collection of solid waste from households to communal bin or depot for subsequent collection by collection vehicles)

Equipment Type	Number	Average capacity (cu.m)
Wheel barrows (1 wheel)		
Push carts (2-4 wheels)		
Others		

(3) Vehicles

Note: all vehicles owned both by the MCM and Contractors are to be counted with those of the contractors given in parenthesis.

Vehicle type	No.	Av. Cap. cu.m	No. of vehicle by condition (See note)			No. of vehicle by age (year)			
			G	F	B	> 10	5-10	2-5	<2
Compactor vehicles									
Tipping truck with									
Open truck with tipping									

Open truck without tipping									
Water tanker									
Open truck with									
Tilt-frame or hoist truck handling big									
Nightsoil tanker									
Vacuum truck									
Tractor									
Vehicle for									
Others									

Note: G = Good condition, F = Fair condition, B = Bad condition

- (4) Machinery used in landfill, including machinery owned by both the MCM and contractors

Machinery type	No.	No. of machinery by			No. of machinery by age			
		G	F	B	>10	5-10	2-5	<2
Bulldozers								
Bucket loaders								
Backhoes								
Compactors								
Tractors								
Others								

Note: G = Good condition, F = Fair condition, B = Bad condition

- (5) Typical purchase price of equipment in recent years

Equipment type	Purchase price	Year purchase made
Compactor vehicle		
Tipping truck with sliding		
Open truck with tipping		
Open truck without tipping		
Tilt-frame or hoist truck		
Bulldozer		
Landfill compactor		
Tractor		

- (6) Problems encountered in solid waste management service. Please tick appropriate spaces.

Problem	very serious	serious	not so serious	no problem
Inadequate service coverage (some people not given service)				
Lack service quality (not frequent enough, Spill, etc.)				
Lack of authority to make financial and administrative decision				
Lack of financial resources				
Lack of trained personnel				
Lack of vehicles				
Lack of equipment				
Old vehicle/equipment frequent breakdown				
Difficult to obtain spare parts				
Lack of capability to maintain/repair vehicle/equipment				
No standardization of vehicle/equipment				
No proper institutional set-up for solid waste management service				
Lack of legislation				
Lack of enforcement measure and capability				
Lack of planning (short, medium and long term plan)				
Rapid urbanization outstripping service capacity				
Uncontrolled proliferation of squatter settlements				
Difficult to locate and acquire landfill site				
Difficult to obtain cover material				
Poor cooperation by Government agencies				
Poor public cooperation				
Uncontrolled use of packaging material				
Poor response to waste minimization (reuse/recycling)				
Lack of qualified private contractors				

Difficult to control contractual service				
Lack of control on hazardous waste				
Others				

2. Effect of Finance on Solid Waste Management

- (1) Revenue (in Ksh) of the authority where the Department responsible for solid Waste management is located.

Revenue source	Year before last (2010)		Last year (2011)	
	Budgeted	Actual	Budgeted	Actual
Property tax				
License				
Loan				
Grant by Government				
Foreign grant/aid				
User charge for solid waste management				
Other user charge				
Fine/penalty				
Others				
Total				

- (2) Expenditure for solid waste management service (in Ksh)

Expenditure items	Year before last (2010)		Last year (2011)	
	Budgeted	Actual	Budgeted	Actual
Remuneration				
Material & supplies				
Equipment/vehicle				
Others				
Total for solid waste management				
Solid waste management expenditure as % of total expenditure of the authority				

3. Effect of Community Participation on Solid Waste Management.

- 1) What strategies have you put in place to sensitize the public on the importance of Solid Waste Management?

- 2) Is there any legislation or policy governing community participation in Solid Waste Management?

- 3) What is the community participation in Solid Waste Management?

Effect of Policies on Solid Waste Management

- 1) What are the existing policies that govern Solid Waste Management in relation to the Laws/Acts, Regulations Economic instruments and Enforcement of the existing policies

	Laws/Acts	Regulation/Standards	Economic Instruments	Enforcement
Source Reduction(Production &Consumption)				
Segregation of waste (at source)				
Primary storage & collection				
Transportation & Transfer stations				
Treatment				
Landfills				
Incineration				

Recycling				
Resource Recovery				

2)What is the authority/local authority doing to fill the policy gaps mentioned above?

Thank you for your time and assistance

Appendix 6: Interview Guide for NEMA Officials

Name of Department:.....

Designation of officer granting interview.....

Effect of Policies influencing Solid Waste Management

1. When was your office/department established in this city

2. What is the mandate of your office/department?

3. Are you adequately resourced to discharge your functions with regard to funds, logistics and personnel?
 - Yes []
 - No [] what do you lack?

3. How do your functions influence waste management in this city?

4. Do you regulate the siting and maintenance of waste disposal facilities?
 - Yes []
 - No []

5. Are you able to enforce the regulations on waste disposal?

6. What considerations qualify a place as site for a waste disposal facility?

7. Have you approved the siting of any waste disposal facilities in this city?

- Yes [] which ones have you approved?

- No [] why:

8. Are you satisfied with the maintenance of waste disposal facilities in this city?

- Yes []

- No [] why?

9. Are you satisfied with the maintenance of waste disposal facilities in this city?

- Yes []

- No [] why?

Thank you for your time and assistance

Appendix 7: Interview Guide for Private Waste Companies

General Information

Name of company.....

Designation of officer interviewed:

1. When was your waste company started?.....
2. Is the company a local or foreign one? Local [] Foreign []
3. What motivated you into the waste business?
4. Do you have a standing contract with the city waste department?
 - Yes [] what is the duration of this contract?
 - No []*
5. Which parts of the city fall within your contract area?
6. What exactly do you do? (E.g. waste collection, management of disposal sites)
7. Would you be able to handle a larger contract than you currently do?
 - Yes []. How much more? (e.g. 2x or 3x more)
 - No []. Why not?
8. What categories of staff work in your company? (e.g. engineers, health inspectors, labourers)

Category of staff	No. employed	No. required

9. Do you find it easy to attract and retain staff?
 - Yes []

- No [] why not?

10. What equipment do you have for your contract operations?

Equipment type	No. available	No. operational	No. Required

11. Do you consider your equipment adequate for your contract work?

- Yes []
- No []

12. How do you acquire your equipment?

13. What are your sources of finance?

14. Are you able to mobilize adequate finance to cover your operational costs?

- Yes []
- No []

15. Who are your service clients?

16. What type of service do you provide and how do you charge your clients?

Category of client	Type of service	Frequency of service	Service charges

17. How do you hope to improve your finances?

18. How much waste are you able to collect in a day?.....kg/.tonnes.

19. Where do you dispose of the waste you collect?

20. Is the disposal site approved by the NEMA?

- Yes it is []
- No it isn't []
- Don't know []

21. How is waste treated at the disposal site? (e.g. incinerated, land filled, recycled)

22. Who manages the disposal site?

23. How would you describe environmental conditions at the disposal site?

- Yes [] what are these problems?
- No []

24. Are you charged for waste disposal at the site?

- Yes [] How are you charged?
- No []

25. Do you have any problems in the operation of your contract/franchise?

- Yes [] What are they?
- No []*

26. How do these constraints/problems influence your operations?

27. What is your own impression about the waste situation in this city?

28. What are the reasons for the current waste crisis in this city?

29. In your view, how can waste management be improved in this city?

Thank you for your time and assistance

Appendix 8: Interview Guide for Municipal Officials at Waste Disposal Facilities

1. When did waste disposal start at this facility?
2. Which agency is responsible for maintenance of the disposal site?
3. Who bring waste here for disposal?
4. About how much waste is brought here in a day?
5. What types of waste are brought here? (e.g. household, commercial)
6. What do you do with the waste you receive? (e.g. composting, recycling, land filling)
7. What equipment do you have here for operations? (Use table)

Equipment type	Number required	Number available	Number operational

8. Do you consider the equipment adequate for your operations?

- Yes []
- No []

9. How many people work at this facility? (Use table)

Categories of staff	No. required at site	No. employed at site

10. Do you charge those who bring waste here for disposal?

- Yes []
- No [] why not?.....(*proceed to Q.14*).

11. How do you charge them/ how do you determine the charge? (e.g. by weight or per trip)

12. Do you consider environmental conditions at the facility to be satisfactory?

- Yes []
- No [] why not?

13. Do you know of any nuisances or environmental problems associated with this facility?

- Yes [] what are they? No []

14. Do you have any problems or difficulties in managing this facility?

- Yes [] what are they?
- No []

17. Do you have any further comments or questions regarding this discussion?

Thank you for your time and assistance

Appendix 9: Interview Schedule for Key Businesses

1. Name of business/institution:Location:.....

2. About how much waste do you generate in a day? (in kg or other measure:

3. What are the major items of waste you commonly generate? Do you have a waste collection service?
 - Yes []
 - No [] (*proceed to Q.11*)

4. Who is your waste collection service provider?
5. How often is your waste collected by your service provider?
6. Do you find your waste collection service satisfactory?
 - Yes []
 - No [] Why not?
7. How do you store your waste before collection/disposal?

8. Do you pay for your waste collection service? ?
 - Yes []
 - No []

9. How much do you pay? How often do you pay?.....

XXXXXXXXXXXXX *Proceed to Q.16*XX

10. How do you dispose of your waste?
11. Do you need a waste collection service?
 - Yes []
 - No [] why?

.....(*proceed to Q. 16*)

12. How regularly will you want such a service?
13. Will you be willing to pay for the waste collection service if it is provided?
 - Yes []

- No [] why not?

14. How much will you be willing to pay for the service?

15. Are you happy with the waste situation in your surroundings?

- Yes []
- No [] Why not?.....

16. In your view, how can waste disposal be improved in this city?

17. Do you have any further comments or questions regarding this discussion?

.....

Thank you for your time and assistance

Appendix 10: Interview Schedule for CBOs involved in Solid Waste Management

General Information

1. What is the organization structure?
2. How many field staff do you employ?
3. What is your highest education?
4. What are the criteria to be qualified as CBO involved in Solid Waste Management?
5. Where do you provide the service?
6. Why did you choose this area?

Solid Waste Management Policy

7. What are the bylaws that guide you in the provision of solid waste management services?
8. Do you have a contract? Is it renewable?

Partnership Arrangements

9. Can you please tell me the nature of the relationship between a CBO and the Municipality?

CBO accessibility

10. What is your primary role as CBO in providing solid waste services?
11. How many days per week do you collect the waste?
12. How much waste do you collect per day?
13. Can you describe characteristics of waste collected? (Probably in percentages)
14. How do you transport the waste?
15. Where do you take them?
16. What is the final destination of the waste? What do you further do with the wastes?
(dispose, compost, recycling, burry? explain)
17. Why do you choose these options? Do you sell the product? Where?

18. Are there better options than these that could be used in future? Why/why not?

CBO flexibility

19. How is the payment system? Fixed or varying price? explain

20. What is the tariff rate?

21. Is there any government subsidies? Explain. How does it benefit you?

22. Who collects waste collection the fees?

Thank you for your time and consideration