

**KENYATTA UNIVERSITY**  
**SCHOOL OF ENVIRONMENTAL STUDIES**  
**DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT**

**AN ASSESSMENT OF SOLID WASTE MANAGEMENT IN KISAUNI DIVISION,**  
**MOMBASA COUNTY**

**BY**  
**CERELLA JOHANNA SARRY**

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**A REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS**  
**FOR THE DEGREE OF BACHELOR OF ENVIRONMENTAL PLANNING AND**  
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**DECLARATION**

This report is my original work and has not been presented for a degree award in any university.

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Cerella J Sarry ..... Date.....

This report has been submitted for examination with my approval as supervisor.

Mr. Dekow Mohammed .....Date.....

(Supervisor)

## **ABSTRACT**

The implementation of sustainable integrated solid waste management is one of the key parts to addressing sustainable development in the current generation. Current global trends of population growth urban and consumerism have dramatically increased the generation of waste in urban area. Inadequate waste services have led to informal burning and dumping in streets and open spaces, which is degrading the environment and creating profound public health concerns. With no strategy in place to properly deal with Solid waste management, today's global trends will continue to exacerbate these problems.

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 Kisauni. This study analysed the underlying factors affecting effective solid waste management in the region and suggested possible measures to tackle the problem.

A survey of the households was conclude was conducted to determine reviews of the residents, and this were then incorporated into the findings and recommendations as documented in the last chapter of this report.

Finally the results from the data analysis underscore the necessity of an integrated approach to solid waste management not only in Kisauni but in Mombasa County as a whole.

## **ACKNOWLEDGEMENTS**

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## **DEDICATION**

To my family I thank you for the guidance and moral support.

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## **ABBREVIATIONS**

**AEZ**-Agro-Ecological Zone

**CCM**- City Council of Mombasa

**EIA** – Environmental Impact Assessment

**EMCA**- Environmental Management and Coordination Act

**IPO** – Independent Private Operator

**MSW**- Municipal Solid Waste

**NEMA** - National Environmental Management Authority

**SW** – Solid Waste

**SWM**- Solid Waste Management

**UNDP**- United Nations Development Program

**UNEP**- United Nations Environmental Programme

**WHO**-World Health Organisation

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background to the problem**

Solid waste is any material which comes from domestic, industrial and commercial sources arising from human activities which have no value to people who possess it and is discarded as useless. Before, waste disposal did not pose difficulty as habitations were sparse and there was plenty of land. It became problematic with the rise of towns and cities where large numbers of people started to congregate in relatively small areas in pursuit of livelihoods (Shafiul and Mansoor, 2003). While the population densities in urbanized areas and per capita waste generation increased, the available land for waste disposal decreased proportionately. Through this solid waste management emerged as an essential, specialized sector for keeping cities healthy.

Solid waste management refers to source separation, storage, collection, transportation and disposal of waste in an environmentally sustainable manner. According to World Bank (2007), the overall goal of solid waste management is to treat and dispose of solid wastes generated by all urban population groups in an environmentally and socially satisfying manner, using the most economical means available.

According to Zerbock (2003) developing countries spend about 20-40 percent of their revenues on waste management but are still an unable to keep pace with the scope of the problem. When the governments of African countries were required by the World Health Organisation (WHO) to

prioritize their environmental health concerns, the result revealed that solid waste was identified as the second most important problem after water quality (Senkoro, 2003 cited by Zerbock, 2003).

The United Nation estimates that the world will be 51.3% urban by 2010, meaning the majority of people will be in the cities. Consequently, due to the rapid rate of urbanization a growing strain has been placed on urban governments, which lack capacity, infrastructure and resources to cope with existing population and migrants. One key result is that uncollected waste, which is often mixed with human and animal excreta, and hazardous and medical waste is burned or left dumped in streets and open fields, contributing to serious environmental contamination that gravely affects the health of communities (Markel et al, 2000).

Poorest neighbors in the urban area suffer life-threatening consequences derived from neglected solid waste disposal. When pressed; local governments tend to limit their financial resources to richer areas that hold more political clout. Thus, direct exposure to environmental contamination and its effects are often left the urban and peri-urban populations living in low income neighborhoods. Consequently, without clear global and local strategies for solid waste management, rapid urbanization will continue to exacerbate environmental health and socio-economic problems (Ferrara, 2007).

In Mombasa, the City Council of Mombasa (CCM) is responsible for the collection of solid waste from the county's estates. It has been the responsibility of local authorities through Local Government Act Cap 265 to manage solid waste .However for close to the past two decades,

services provided by the local authorities have been on the decline, and thus other players have come on board.

## **1.2 Statement of the Problem**

Over the years, solid waste disposal has become a major problem in Kisauni division. Indiscriminate dumping, irregular collection of waste generated and inadequate resources are the key problems facing SWM in Kisauni area as result of rapid human increase. This is a growing concern due to the rising population and having the gateway of Kenya's tourism industry drown under mountains of trash is definitely not economically sound. On top of that, mismanagement of solid waste, such as the burning of plastic that produces toxic fumes can also be detrimental to the health of the environment and population.

Solid waste management is a crucial practice in ensuring environmental health and sustainability. However, in Kisauni this is lacking as there is indiscriminate dumping of waste by the roadside and in open spaces. It has led to blocking of drainage tunnels and also emits a foul odour from the rotting waste. This has led to the unaesthetic of the division.

## **1.3 Research Questions**

The study was guided by the following by the following research questions:

- a) What type of solid waste is generated in area?
- b) Which institutions are responsible for the management of solid waste and are they efficient in carrying out their duties?

- c) Are the infrastructural facilities in place adequate to ensure efficiency in garbage collection?
- d) How frequent is the wastes collected and dispose of?

#### **1.4 Research Objectives**

The research aimed at achieving the following objectives:

- a) To assess the types and components of solid waste generated.
- b) To establish the institutions responsible for solid waste management, and their effectiveness in carrying out their duties.
- c) To identify the infrastructural facilities and their adequacy for efficient garbage collection.
- d) To develop a planning matrix detailing recommendations and priority areas of action

#### **1.5 Research Premises.**

The research was guided by the following premises:

- i. The type and nature of solid waste generated correlates to the standard of living.
- ii. The institutions are inadequate in the management of solid waste in the division.
- iii. The growth of the area has an impact to the solid waste management.

#### **1.6 Justification of the study**

Solid waste management has become a challenge in Kisauni and not only does it require attention of the CCM and waste institutions but also concerns of corporate organizations and individuals to find a lasting solution to the problem. Vital resources could be lost in through poor waste management .The aim of the study is to find out ways of improving management of solid

waste by ensuring indiscriminate dumping is curtailed and proper measures instituted. Additionally, the study will contribute to existing body of knowledge on solid waste management since due to the immensity of the problem; researches have been carried out on solid waste.

### **1.7 Significance of the Study**

The main aim of the study is to examine factors affecting the solid waste management and suggest possible measures in tackling of then problem. The study also aims to propose alternative ways of ensuring effectiveness in solid waste management in the Kisauni division. It seeks to also propose ways of streamlining solid waste management by the City Council of Mombasa, and find ways of incorporating community participation in solid waste management. It is to create opportunities in relation to solid waste management and to turn the solid waste problem in becoming an economy activity or source for the people in Kisauni area.

### **1.8The Scope of the Study**

The study area is to cover the whole of Kisauni area. Kisauni division is found in Kisauni Constituency of Mombasa County. The study focuses mainly on the assessment of solid waste management. This is because like any other growing division it is facing bigger problem of managing its solid waste effectively. Contextually the study focuses on domestic solid waste management. Figure 1.1 illustrates map of Kisauni division.



**Figure 1: Map of Kisauni Division, Mombasa County**

Source: McMillan Atlas of Kenya

### **1.9 Delimitations of the Study**

The data analysis was faced with various challenges, which included:

- a) Hostility from some household members who did not want to respond some questions in the questionnaires.
- b) Household survey was limited to weekends only or evening hours when the heads of home were home.
- c) Bureaucracy at the City Council offices, the procedure of getting information from the CCM offices was strenuous, as I had to obtain permission from the Director of Environment before any information was given to me.

### **1.10 Definition of terms**

- Solid Waste: Mostly refers to solid debris from households, industries and construction. It contains some liquids, gases and some infectious materials from house bound persons.
- Ash: The largely incombustible residue left after incineration.
- Litter: Waste not managed.
- Recycling: is the recovery of materials from the waste stream.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction.

Solid waste management is one of the most challenging issues in urban cities, which are facing a serious pollution problem due to the generation of huge quantities of solid waste (Sunil Kumar et al, 2008). Solid waste is considered any material that arises from human and animal activities that are discarded as useless or unwanted (Tchobanoglous *et al.*, 1993). It does not mean that the solid waste have no value; it simply means that it has no value to the current owner. If the solid wastes have value for a new owner, these materials are no longer solid wastes but rather raw materials for further use with renewed value until the new owner decides to discard them as solid waste (EPA, 2002).

#### 2.2 Types and components of solid waste

**Table.1 Typical Waste Generation Facilities, Activities, and Locations associated with various Source of Solid Waste**

Source	Type location	Types of Solid Waste
Residential	Single-family and multifamily dwellings, low-medium, and high-rise management	Food wastes, rubbish, ashes, special waste
Commercial/ Municipal	Stores, restaurants, markets, office buildings, hotels, motels, print shops, auto repair shops, medical facilities and institutions.	Food wastes, rubbish, ashes, demolition and construction wastes, special wastes, occasionally hazardous wastes.

Industrial	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants ,lumbering, mining demolition	Food wastes, rubbish, ashes, demolition and construction wastes, special wastes, occasionally hazardous waste.
Open areas	Streets, alleys, parks, vacant plots, playgrounds, beaches, highway and recreational areas.	Special wastes, rubbish
Treatment plant sites	Water, waste water, and industrial treatment processes	Treatment plant wastes, principally composed of residual sludge.
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots and farms.	Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes

Source: Tchobanoglou *et al* 1993 p.52-53

Tchobanoglou *et al* (1993), classified types of solid waste in relation to the sources and generation facilities, activities, or locations associated with each type which is presented in table 2.1 above.

Tchobanoglou *et al* (1993) has further explained the types of solid waste which include food waste, rubbish, ashes and residues and special waste. These are explained below:

*Food waste:* Food wastes are all the animal, plant or vegetable residues resulting from handling, preparation, cooking and eating of foods (also called garbage). The most important characteristics of these wastes is that they are highly putrescible and will decompose rapidly, especially in warm weather. Often decomposition will lead to the development of offensive odors. In many

locations, the putrescible nature of these wastes will significantly influence the design and operation of solid waste collection.

*Rubbish:* Consists of combustible and non-combustible solid wastes of households, institutions and commercial activities. This excludes food wastes or other highly putrescible materials. Typically, combustible rubbish consists of materials such as paper, cardboard, plastics, textiles, rubber, leather, wood, furniture and garden trimmings. On-combustible rubbish consists of glass, tin cans, aluminum cans, ferrous and other non-ferrous metals and dirt.

*Special waste:* Special waste includes street sweepings, roadside litter, and litter from municipal containers, catch-basin debris, dead animals and abandoned vehicles.

*Ashes and Residues:* These are materials remaining from the burning of wood, coal, coke and other combustible wastes in homes , stores, institutions , and industrial and municipal facilities for purposes of heating, cooking and disposing of combustible waste. These are referred to ashes and residues.

### **2.3 Solid waste collection**

The element of collection includes not only gathering of solid waste, but also the hauling of waste after collection to the location where the collection vehicle is emptied (Kreith 1994). In the city of Thimphu in Bhutan the collection of solid waste from households, commercial set-ups were done in concrete receptacles placed at strategic points and conveyed by trucks. Accordingly, there were concrete bins and containers provided at various locations from where the waste was lifted for disposal. Individual bins/containers were also placed alongside the shops

in certain areas, which were emptied directly into the trucks/tippers. This prevents people from dumping waste indiscriminately. However, the building of these concrete bins and containers may be expensive to do in Kenya and for this matter Kisauni.

#### **2.4 Waste disposal**

It is the ultimate fate of all solid wastes whether they are residential waste collected and transported directly to the landfill site. In this case for Kisauni it will be Mwakirunge.

#### **2.5 Gap identification**

Being the comparison of actual performance with potential performance, Kisauni area has the capability of achieving a good solid waste management but the municipal council has to involved too not only to live the work to the community.

#### **2.6 Theoretical and conceptual framework**

According to a theoretical model prescribed by Kumar, the scavenger is seen as playing an active role in solid waste management whereby he goes collecting garbage from house to house and disposes of it in the community bin. In this system, the municipal council does not play a major role in solid waste management in the area, but rather, the community is more involved in the SWM.

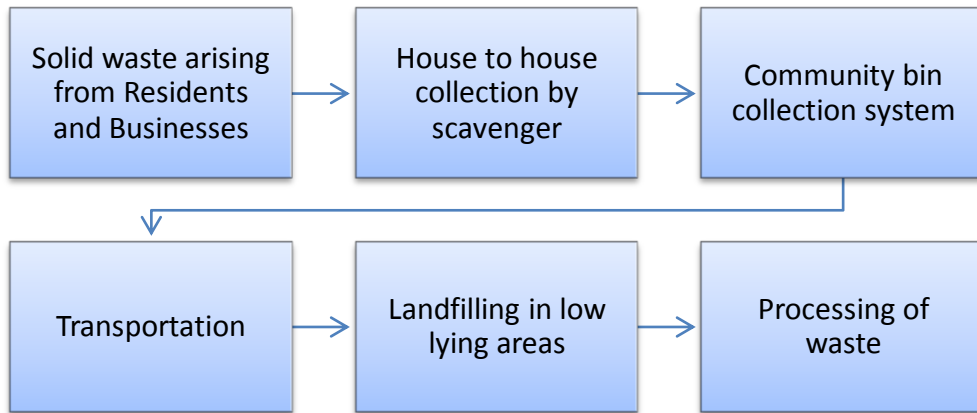


Figure 2: Existing MSW management system in India

The conceptual framework as visualized by Kumar is shown below

### Waste Management Hierarchy

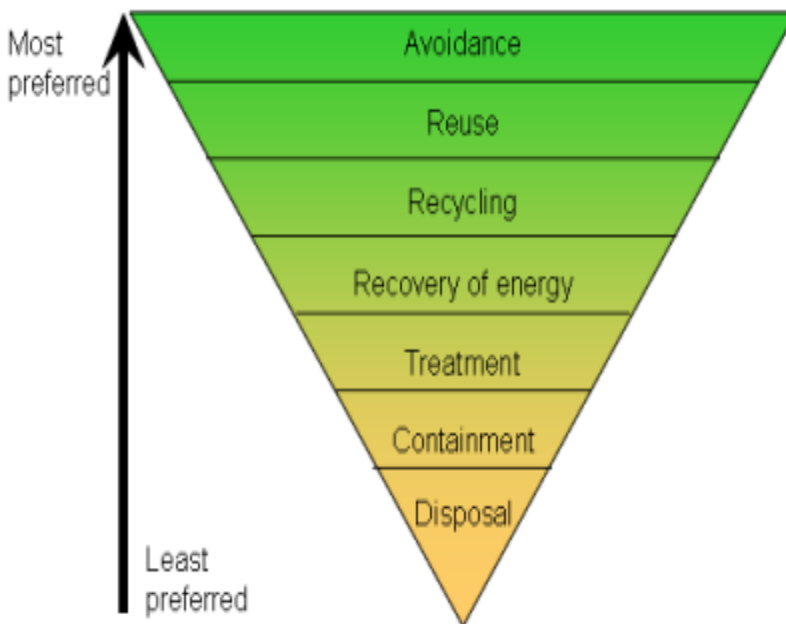


Figure 3 Waste management hierarchy

The only type of solid waste that proceeds on to the disposal stage is waste that cannot be recycled, reused or treated for beneficial use again. This conceptual framework mainly focuses on the reduction of waste stream.

The above conceptual framework can be applied to Kisauni division, as there is dire need for the reduction of the solid waste through such practices as avoidance, recycling, reuse and treatment of waste. This will greatly reduce the instances of open space and roadside dumping, therefore reducing the amount of solid waste that is being generated daily.

## **CHAPTER THREE**

### **AREA OF STUDY**

#### **3.1 Physical Description**

##### **3.1.1 Location and Extent**

Kisauni division is in the Northern part of Mombasa County. It lies between a latitude  $3^{\circ}80'$  and  $4^{\circ}10'S$  and longitude  $39^{\circ} 60'$  and  $39^{\circ} 80'E$  with land mass of  $88.7\text{km}^2$ . The area has seven locations: Bamburi, Mwakirunge, Frere Town, Mtopanga, Magogoni and Junda.

##### **3.1.2 Topography and Drainage**

The division is situated in the coastal lowland with extensive flat areas rising gently from 8Metres above the sea level to 100Metres. Kisauni lies in the flat coastal plan with no permanent and seasonal rivers.

##### **3.1.3 Geology and Soils**

Kisauni is made of young sedimentary rocks. Along the sea the rocks consist of coral limestone of Pleistoceneage. The soils vary greatly both physically and chemically. According to the Kenya Soil Survey (1982), the soils around and in Kisauni are variable and of high fertility.

##### **3.1.4 Climate**

Climatically, Kisauni has a warm humid, hot tropical weather throughout the year, with an average low of  $23.5^{\circ}\text{C}$  and a high of  $31^{\circ}\text{C}$ . The long rains occur between May and June, while the short rains come in early December. There are usually cooler days in June. The sunniest and warmest parts of the year from December to April at a temperature of about  $31^{\circ}\text{C}$  through the day. Overall, the weather in Kisauni is very stable and doesn't change much over the course of the year.

## **3.2 Ecological Description**

### **3.2.1 Agro-Ecological Zone**

As applied in GOK the agro-ecological zone of Kisauni is combinations of soils, landform and climatic characteristic. Kisauni is generally a flat coastal plain made up of sedimentary rocks within the hot tropical weather throughout the year.

### **3.2.2 Vegetation**

Kisauni vegetation is made up of microscopic marine plants, extensive mangrove swamps, luxuriant palm groves and mangrove swamps and coastal grasslands.

### **3.2.3 Wildlife**

The largest animals' sanctuary is found in Kisauni. Haller Park located in Bamburi boasts an enormous variety of animals, reptiles, insects and botanical garden. Mamba village situated in Nyali is the largest crocodile farm in Kisauni and East Africa as a whole.

## **3.3 Economic Description**

### **3.3.1 Agriculture**

The soils in Kisauni are of high agricultural potential. The low lying areas of Kisauni are dominated by the coconut-cassava (zone L3). The lower part of Kisauni are dominated by coconut-cashew nut .Kisauni is characterized by medium to long cropping season.

### **3.3.2 Trade, Commerce and Industry**

Bamburi Cement industry is the only industry found within Kisauni division. It deals mining of limestone. Most of the area is a trading area, with Kongowea Municipal Market being the biggest market. Other trading and commerce activities include supermarkets like Nakumatt Nyali, restaurants like Mikaye ,banking services like Barclays ,petrol station, discos like Bobs and many more.

### 3.3.3 Tourism

Being on the north part of Mombasa, Kisauni division seems to be the home of tourism industry since most tourist sites are found there. They include: Nyali beach, Kenyatta and Bamburi beaches, Nyali Bridge, many hotels, Nguuni Nature Sanctuary, the Bamburi Haller Park. Along the coastline are beautiful beaches, which together with a variety of coastal resources and a rich biodiversity, has attracted tourists making Mombasa a favorite tourist destination.



Plate 1: Nguuni Nature Sanctuary

Source: Research 2014

### 3.3.4 Transport and Communication

Within Kisauni most local people use *Matatus* (mini vans) for movement between residential areas and *tuks-tuks*. The Nyali Bridge connects Mombasa Island to Kisauni. Highways to other towns like Malindi and Lamu are within Kisauni.

Kisauni has a well established communication system. Safaricom and Airtel provide local and international networks for the servers. Various internet services providers are in Kisauni and anyone can surf the internet in any of the numerous cyber cafes.

### **3.4 Social Description**

Majority of the locals found in Kisauni area are of the Mijikenda tribe, *Swahili* and Arabs mostly of who are Muslims. The traditional Swahili culture features modestly veiled women, flowing robes, henna painted hands, Mijikenda traditional outfits and *Lessos*.

## **CHAPTER FOUR**

### **RESEARCH DESIGN AND METHODOLOGY**

#### **4.1 Research Introduction**

Research introduction discusses the type and sources of data, methods used in data collection, the sample size and frame, sampling procedures, analysis and presentation of data.

#### **4.2 Research Design**

The most effective research design to be used for the research would be descriptive and correlation (this is because observational study will be used/required). Variables are to be measured quantitatively. This would be more flexible for data collection process.

#### **4.3 Nature and Sources of Data**

##### **4.3.1 Nature of Data**

With a view of achieving the objectives of this study data from both the primary sources and secondary sources were used. The study provided an objective assessment of solid waste management, the various actors and roles played by the various institutions in charge of waste management, with a view of improving the solid waste practices of the region. The information collected included: Nature and type of solid waste, the institutions in charge of solid waste management and the infrastructural facilities in place for solid waste management, household waste disposal, waste collection and disposal as well as capacity of waste authorities in managing solid waste and the availability of waste management facilities.

## **4.3.2 Sources of Data**

### **4.3.2.1 Primary Sources**

Primary information comprised of local views and opinion related to physical and environmental impacts of solid waste management and the associated societal implications, strategies or efforts being put in place to address solid waste management.

Primary data were obtained from households, business owners and scavengers; institutional information were obtained from government officers of City Council of Mombasa, NGOs and representatives of the independent private operator companies that deal with solid waste management for the division. This was done mainly through interviews using interview schedules and household questionnaires.

### **4.3.2.2 Secondary Sources**

Secondary data included the recorded and archived information on the various aspects of the study. This information was used partly to give background information to the study and partly in identifying problems that characterize solid waste management efforts and the associated environmental concerns.

Secondary data were obtained from published and unpublished information sources including:

- Data from websites in the internet concerning solid waste management
- Published information from government agencies
- Maps and physical development plans
- Annual and quarterly reports on solid waste management
- Relevant reference publications; and,
- Administrative information compiled by the various government ministries, NGOs, community based organizations and individual organizations in the private sector

#### **4.4 Population description**

The population of Kisauni consists of about 25,000 families according to the City Council of Mombasa. This translates to about 194,000 people of which about 143,000 people are poor. The division is divided into about seven parts which include Mjambere, Bamburi, Junda, Mwakirunge, Mtopanga, Magogoni and Shanzu.

#### **4.5 Sampling Methods**

Being a well defined target population, the other means of ensuring an adequately chosen and representative sample is the use of a complete and correct sampling frame. Probability sampling technique will be applicable since each member of the population under study will have an equal chance to be selected.

- **Simple Random Sampling**

The study was designed to use simple random sampling techniques. To ensure that resultant sample is a representative of the entire target population. Houses were randomly selected. The use of simple random sampling provided an equal opportunity of selection for each house in Kisauni.

- **Purposive Sampling**

The subjects were selected based on characteristics as expertise in solid waste management. For instance the CCM is to provide expert(s) and professional opinion that concern the solid waste management.

#### **4.6 Methods of Data Collection**

Various data collection methods will be used. These will include the following:

- **Photography**

This comprised capturing data using a digital camera. Photographs were taken during data collection and it helped in clarification as an evidence of actual practices taking place in the study area. Photography captures spatial temporal data and according to Mashoeshoe (1990) it involves transferring the real situations on the ground and masking it on paper for easier understanding.

- **Observations**

Observations were basic to the collection of data on the current state of solid waste management in Kisauni. Such observations increases the range, relevance and reliability of data obtained (Pidel, 1982). Observation used an observation notebook, where observations will be noted down. These included the day's garbage collection taking place and the subsequent littering that followed the collection of the garbage. It focused on how long it took before dumping takes place after the garbage has been collected.

- **Questionnaires**

There were two different questionnaires schedules, one for the randomly selected household in the villages (with heads of households mostly being the respondents) and the other for government agencies; independent private operator and business in the area have been developed. (The samples of these questionnaires are presented in the appendix.)

- **Oral interviews**

This method involved collecting of data through face interactions with the Kisauni inhabitants. Oral interviews were provided for a possibility of interacting with the residents who gave

information on solid waste management and even the challenges they faced. Oral interviews helped in clarifying issues at a more personal level.

#### **4.7 Data Analysis and Presentation**

A number of techniques and methods were used in the data analysis and presentation. Both qualitative and descriptive techniques were used. In descriptive analysis, proportions percentages and averages were used to arrive at a general picture from which conclusions will be made. Qualitative methods included statistical tables, maps, pie charts and other diagrams that were relevant for the analysis and presentation.

## CHAPTER FIVE

### DATA ANALYSIS AND PRESENTATION

This chapter focuses on the data analysis and presentation. Data was collected from the field, institutions and businesses. Field data was analysed through excel and presented in table, interviews were analysed using content analysis technique. The findings were as follows the nature of solid waste generated, institutions responsible and infrastructural facilities.

#### 5.1 Nature and Type of Solid Waste Generated

Different types of waste are generated from the businesses and households in Kisauni. Some of the businesses include hair salons barber, light industries such as welding and garages. Others include MPESA shops, electronic shop, and discotheque and carpentry business; additionally there is Kongoea Market.

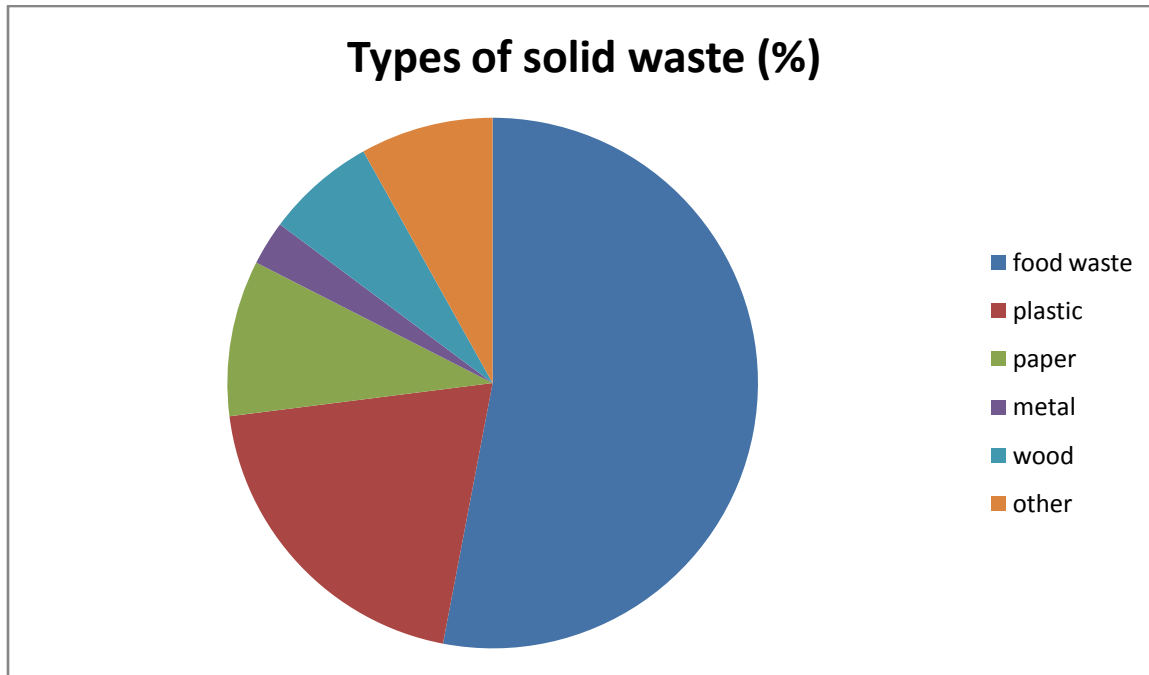
The main types of waste generated are shown in the table below

**Table 2: Types of waste generated**

Types of Solid Waste	Percentage
Food waste	53
Plastic	20
Paper	9.5
Metal	2.7
Wood	6.7
Other (construction waste, hair braids etc)	8.1

This can be further be illustrated using the pie chart below

**Figure 4: Pie chart showing percentage of types of solid waste**



From the foregoing discussion the nature of solid waste generated that is dominant is organic waste (food waste at 53%), this is mainly produced by the households and the market and various food kiosks in the area. In general, organic components of urban sold waste can be classified into three broad categories, according to the director of environment, putrescible, fermentable and non-fermentable waste. Putrescible wastes tend to decompose rapidly and unless carefully controlled, decompose with the production of objectionable odour and visual unpleasantness. A major source of putrescible waste is food production and consumption. As such, its nature varies with lifestyle, standards of living and seasonality of foods.

As food waste is the dominant type of waste produced, the dumpsites are permeated with bad odour due to the putrefaction and decomposition of the waste. Furthermore, it encourages the presence of vermin and vectors, which are a health hazard. 58% of the households complained of the foul odour emanating from the roadside dumpsite mostly in Mwakirunge and Utange area.

The organic fraction of MSW is an important component, not only because it constitutes a sizeable fraction of the solid waste stream, but also because of its adverse impact on public health and environmental quality. A major adverse impact, according to public health officials, is its attraction of rodents and vector insects for which it provides food and shelter. 67% of the residents near the dumpsites cited that they had endured a pest problem in their house, with infestation of mice and cockroaches being the main complaints. Impacts on the environment take the form of foul odour and unsightliness. These impacts are not confined to the 'disposal site', on the contrary, they pervade the area surrounding the site and wherever the wastes are generated spread or accumulated.



**Plate 2: Roadside dumping in Utange**

Source: Research, 2014

### **5.1.2 Waste from Businesses**

There are several businesses in the area, which play a key role in the addition of waste to the waste stream in the area, and they include:

- a) Salons**

75% of the hairdresser interviewed cited that main type of waste they produced was plastic material. These included the containers in which the chemicals used for treatment and relaxing hair were stored, the packaging material for the hair braids they used and the hair braids itself. This comprised about 81% of the waste they produced, the others included paper used for labeling which was 11% and the remaining 8% was a mixture from the comb tongs and human hair.

70% of the salons said they employed the services of the independent private operator for solid waste collection from their premises. 1% had reached an agreement with the operator who collected waste from their household to collect the waste from their business premises at an additional fee.

20% of the salon operators paid the street and parking boys' sh.50 to collect the waste once the waste basket was full. The remaining 10% said they dumped the waste by the roadside on their way home once the day was completed.

#### **b) Supermarkets**

There are several supermarkets in the division, such as NakumattNyali and Kiembeni Supermarket. Paper and polythene bags are the main waste are the main waste produced. The paper waste is mainly generated during the delivery when the goods are unpacked; some of the cartons are used to pack goods for the customers with bulky purchases .Scavengers get a small fraction of the cartons for recycling purposes. The polythene bags are mainly used as packaging material for the customers, and usually end up in the waste stream.

### **5.2 Institutions Responsible for Solid Waste Management**

The main institution charged with solid waste management is the City Council of Mombasa. It is charged with the responsibility of managing waste, that is, collection and transportation of the

waste to the dumping site-Mwakirunge. The council aims to provide Mombasa residents with a clean, healthy and safe environment as is captured by its vision.

### **5.2.1 Role of the Department of Environment**

The main role of the department of environment in the CCM is to ensure that Mombasa residents enjoy a clean healthy environment through the provision of services such as cleansing and beautification of the city and improvement of open space.

Various challenges to solid waste management faced by CCM include:

1. Financial constraints: The amount of money allocated for solid waste management constitutes about 20% of the annual budget and this has proved to be inadequate to meet all the SWM needs of the Mombasa area.
2. Inadequate number of garbage trucks. There are about 10 garbage collection trucks which service the whole of Mombasa which break down quite often.



**Plate 3: Garbage truck in Mwakirunge**

Source: Research, 2014

3. Attitudes of the residents to whom they render services; the residents do not take part in solid waste management as they believe it is the sole responsibility of the council to manage waste . This is characterized by indiscriminate dumping and burning of solid

waste in the nearest open spaces or roadside despite attempts by the council to perform clean-up exercises.



**Plate 4: Burning at Landfill site, Mwakirunge**

Source: Research, 2014

The council closely works in conjunction with the private sector on one level: Independent Private Operator.

**i. Independent Private Operator**

The Independent Private Operator came on due to the fact that the services provided by the CCM have declined as they mostly consider the Council estates e.g. Buxton. According to the Assistant Director of Environment, they estimated to be about 50 in number, and they are able to collect about 23% of the waste generated in Mombasa. They reach an agreement with the resident to collect the solid waste and they are regulated through permits issued by the Council.

75% of the respondents cited that they were engaging the services of the independent private operator for garbage collection. They are expected to pay between sh.150-sh 400 per month for the services rendered. The independent private operator collect the garbage either once or twice a week on specified day(s). They provide the households with four to eight polythene bags a month, to act as the receptacle for the garbage produced. The polythene bags are usually black in

colour. Examples of the independent private operator include Gesnatlinks and Keen Cleaners with their garbage disposal services.

### **5.2.2 'Scavenging' Groups**

There are several scavenging groups in Kisauni division which mainly deal with collecting plastic waste for purposes of recycling and they do not charge the households for the services rendered. The scavengers usually rely on garbage collection dates set by the independent private operator, so that they can rummage through the garbage bags set for collection, for plastic containers. They also get the plastic containers from the roadside dumps and from going door to door asking for any available plastic containers mostly the left water bottles. They then take them to the designated area where they sort them out ready for sale to various recyclers located in then industrial area.

The scavengers also deal with collection of glass and plastic bottles. They mainly collect waste paper obtained from cold carton boxes, which they get from supermarkets, shops and kiosks in the area. The glass bottles are sorted out according to colour and some are sold for recycling purposes.

Kitwango is a group that has taken up solid waste management in Mwembelegeza in Bamburi. The group is involved in collection of solid waste from Bamburi. It's a group of underprivileged boys from Husen-Deri in Mwakirunge and Bamburi thus providing them with income. Some of the boys were part of the *scavenging* groups of the area.

### **5.2.3 Assessment of Efficiency**

The people complained that the City Council has not been effective in carrying out its mandate as pertains to garbage. They stated that unlike in the early to mid 90s (when it was still a municipal council) they had slacked in its duty of garbage collection. In effect, the respondent

said that the garbage trucks are never seen. Conversely, on rare occasion that the trucks do make their garbage collection rounds, they are in poor state that some of garbage ends up on the road.

The council attempts to clear up roadside dumpsites but the work is improperly done as most of the solid waste that is dumped by the roadside ends up in drainage tunnels, thereby clogging them. To clear the drainage tunnels, the Council workers place the solid waste removed just beside the tunnel; creating unsightly mounds of rotting waste with foul odour.

69% of the respondent preferred the services of the independent private operator in the solid waste management. They cited the fact that the garbage collection dates were honoured and they provided adequate bags suitable for the amount of waste generated by the average family. 15% stated that they felt the independent private collector was also a cause of the problem of solid waste management in the division, as at times they left some of the garbage bags out for too long that were subsequently ripped up dogs and scavengers which increased the amount of waste lying the streets.

10% of the residents stated that scavenging groups were efficient in dealing with the disposal of plastic waste from their households. As a matter of fact, they preferred their service as it was rendered free of charge. 5% of the residents felt that the scavenging groups should be relocated because of their drop off points. 1% of the residents had no idea what a scavenging group was and that the sorting out area of the plastics looked more like a dumping site than an area to sort out plastics for recycling.

### **5.3 Infrastructural Facilities in Place for Efficient Garbage Collection**

Infrastructural facilities that are related to garbage collection include: roads, polythene bags and the garbage collection trucks. According to City Council most of the garbage trucks are not properly maintained thus leading to frequent breakdowns. As a result, though garbage is meant to

be collected often is done according to the availability of trucks and accessibility of the roads for example areas like Utange, Mjambere and Mwakirunge have poor road system. 87% of the households no longer relied on the City Council to pick up the garbage from their houses, 4% dumped the waste by the roadside or put their waste together with their neighbours on the day the private collector picked the garbage. 3% dug holes in their back yards and buried the generated waste whereas the remaining 6% burnt the waste.

The City Council does not provide garbage bins or bags thus making residents who cannot afford to pay for private garbage collection to improvise ways of disposing waste. On the other hand, private waste collectors provide polythene bags, at a minimum fee of about sh.150. The company the collects the household waste weekly on specific days. Additionally, they ensure at the beginning of each week, they supply the households with one or two polythene bags. The private operator also takes care of any extra waste that the average household may produce that does not fit in the polythene bag provided.

## CHAPTER SIX

### SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

#### 6.1 Summary of Findings

- Solid waste management is a practice, which should include all members of the community and not just the institutions charged with the collection and disposal of the solid waste, as this will ensure the success of the solid waste management exercises.
- Inadequate dustbin supply was a major factor affecting waste disposal in Kisauni especially among the low class residential areas. The survey established that most of respondents have no access to for disposing their waste particularly those living in the low class residential area.
- The role of ‘scavengers’ in solid waste management should be recognized as they play a crucial role in reducing the solid waste stream by encouraging recycling. Additionally, they should be equipped so that the work they carry out can be made easier and more effective.
- Road infrastructure in the most part of division is in dire need of repair to ease the collection of garbage.
- Waste management institutions were unable to deliver efficient services as they were under resourced and equipment for waste transportation was also inadequate.
- There was irregular or lack of routine collection of waste by Keen cleaners and Gestanlink ltd especially in the low class residential areas in the division. Waste collection was mostly carried out twice a week and in some areas like middle class residential areas no collection took place. Even in the high class residential areas collection was done once a week.

## **6.2 Conclusion**

Solid waste management is a crucial practice in the maintenance of environmental health and beauty of an area. Sustainable solid waste management practices should be adopted in the area to ensure that, indiscriminate dumping and littering is curbed in the area. Informal sector should be recognized as plays an important role in the management of solid waste in the division. ‘Scavengers’ and other informal solid waste collectors should be provide with the right and adequate equipments to make them more effective and efficient in performance of their duties.

## **6.3 Recommendations**

1. Adequate Resourcing of Waste Management Institutions .The waste management institutions should be adequately resourced by the CCM to ensure efficient and effective waste management in the area. The City Council of Mombasa should liaise with other corporate bodies like the United Nations Development Program (UNDP). With the support, adequate dustbin, and core waste management equipment such as compaction truck. People particularly in the low class residential areas should be made to pay for disposing their waste. This is because they are the very people who generate the waste. That is the ‘pay as you throw principle’ should be introduced. All these should be done through education by letting residents know the importance of environmental cleanliness and how they can contribute to it. This will go to support the financial base of the waste management institutions.
2. Putting in place an ideal waste management system that embraces a technical approach including collection and transportation plans, waste reduction, recycling and disposal plans .It should be improved management and regulatory systems that embraces an institutional and financial approach including legal, private sector and public education and awareness plans.

3. Encourage greater public involvement through intolerance to waste mismanagement. This will exert pressure on the authorities and waste management agencies to better their services to the division.
4. NEMA-Mombasa should be active as close to 90% had no idea that NEMA offices are around the county and operate
5. Waste collection efficiency by both private and public operators should be improved.
6. Proper management of landfill. The landfill site should be properly managed to avoid heaping of waste and burning. Waste dumped in the landfill should be spread, compacted and covered with soil. This will prevent heaping of waste in the landfill. Furthermore, the landfill management should ensure that waste that is carried to the landfill does not contain fire.
7. Support the formation of 'scavenger' micro-enterprises, scavenger co-operatives to facilitate a strong financial support network for the scavengers to carry out their activities.
8. Recognize the role of the informal sector in solid waste management.
9. Legalize scavenging so that they do not have to perform their activities in a manner shrouded with secrecy and suspicion from the residents.
10. Provision of dustbins and other means of collecting solid waste in the area.

## 6.4 Planning Matrix

<b>Problem sector</b>	<b>Issues/Impacts</b>	<b>Current Intervention Measures</b>	<b>Proposed Intervention Measures</b>	<b>Actors</b>	<b>Time-Frame</b>	<b>Follow up measures</b>
<b>Institutional</b>	Formal institutional framework on SWM	Development of rules and policies by NEMA on SWM	Coordination of the sector by NEMA Privatization of the SWM industries	NEMA/CCM/Private Independent Operator	Long term	Evaluation of synergy of SWM industry players
	Laxity of licensing IPO	NEMA developing measures to ensure thorough vetting of IPO	Enforce the NEMA rules Penalize institutions that do not comply with rules	NEMA/CCM/IPO	Long term	Evaluation of efficiency of licensed private waste collection companies
	No policy/framework to realize role of scavengers' in SWM	NONE	Formalize role of 'scavengers' in SWM.  Provide 'scavengers' with proper working equipments e.g. gloves	CCM	Long term	Audit the performance of the 'scavengers' on a quarterly or half basis
<b>Nature and</b>	Odours from	Burning the	Encourage	Residents	Short	Enforcement

<b>Type of solid waste</b>	rotting food waste	solid waste	composting of biodegradable waste  Creation of awareness on composting methods		term	o anti-dumping regulation
<b>Infrastructural</b>	Lack of disposal bins	Provision of polythene bags	Designate disposal bins at vantage points in estate	CCM/IPO	Long term	Monitoring to ensure bins are not vandalized
	Poor state of roads	Covering potholes with stones	Allocate a percentage resources from roads rehabilitation	CCM	Long term	Monitor rehabilitation of roads to ensure quality work is done
<b>Uncontrolled growth</b>	Increase of illegal and indiscriminate dumping	Institution of policy to curb unplanned development	Enforce building codes and regulations	CCM	Long term	Thorough vetting of proposed building
<b>Environmental</b>	Pollution of groundwater	Clean up of illegal	Create awareness and build capacity	Residents/ CCM	Long term	Monitoring to ensure cleared

	sources	dumping sites				illegal dumpsites are not reestablished
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## **BIBLIOGRAPHY**

- Afdb. 2002. Study on Solid Waste Management Options for Africa. Project Report. Afd. Washington DC.
- CPCB (Central Pollution Control Board) (2000), Management of MSW, Ministry of Environment and Forests, Government of India.
- GOK (2001) 1999 Population and Housing Census Vol. 1. Central Bureau of Statistics, Mombasa
- GOK Ministry of Agriculture, 1988
- Kreith, F (1994). Handbook of Solid Waste Management. McGrawHill, USA
- Mombasa District Development Plan 1997-2001
- Mungai, G. 1998. Solid Waste Management and its Environmental Impact in Kenya: Solid Waste Management: Critical Issues for Developing Countries (Ed. Elizabeth Thomas-Hope, Kingston: Canoe Press, 1998)
- Municipal Solid Waste Rules, 2000
- Republic of Kenya (2000) Environmental Management and Coordination Act (1999)
- Sharholi M. Ahmed, K. Vaishya, R. Gupta R. 2007. Municipal Solid Waste Management Characteristics and Management in Allahabad India. Indian Press, India
- Tchabanoglous, G. Theisen, Eliassen, R. (1977). "Solid Waste Engineering Principles and Management Issues" McGraw Hill, Inc. Kogakusha.
- Tchobanoglous, G., Theisen, H. and Vigil, S. (1993). Integrated Solid Waste: Engineering principles and management issues. McGraw Hill Publishing Company, USA.
- USPS (2000). Solid Waste Management Plan for Thimphu City, Bhutan, Draft version, April 2000. Bhutan: Urban Sector Programme Support Secretariat

## APPENDICES

### Appendix I

#### Background Information of Respondents

##### Age

Age	Frequency	Percent
20 and below	5	20.8
21-30	5	20.8
31-40	4	16.7
41-50	4	16.7
51-60	6	25
<b>Total</b>	<b>24</b>	<b>100</b>

##### Level of Education

Level of education	Frequency	Percent
None	0	0
Primary	8	33.3
Secondary	7	29.2
Technical	2	8.3
Tertiary	7	29.2
<b>Total</b>	<b>24</b>	<b>100</b>

## Occupation

Occupation	Frequency	Percent
Farming	3	12.5
Trading	7	29.1
Business	10	41.7
Public Servant	4	16.7
Other	0	0
Total	24	100

**Appendix II**

**KENYATTA UNIVERSITY**

**DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT**

Household Questionnaire

Name of interviewer.....

Sub location.....

Location.....

Division.....

Dear Sir/Madam,

I am carrying out a study on “*An Assessment of Solid Waste Management in Kisauni Division*” and would like to request for your assistance in getting the required information by filling this questionnaire. Your views and opinion on the current state of solid waste management will be highly appreciated and information given will be treated as confidential and will only be used for academic purposes. Thank you for your assistance.

- 1. How long have lived here (months/years)?

.....  
.....

- 2. Please fill in the information required in the table below

Household members	Age	Sex	Education level	Occupation	Monthly income


3. Fill in the table below on solid waste disposal mechanism?

Means of Solid Waste	Disposal
Burning	
Burying in own pit	
Open space	
Collected by municipal council	
Collected by private enterprise	

4. How many times is the waste collected in a week?

.....

5. Are you charged for the collection?

.....

6. Which institutions are responsible for solid waste collection in Kisauni?

.....

.....

7. Are they effective in performance of their duties?

.....  
.....  
.....

8. What role does NEMA play in solid waste management?

.....  
.....

9. Which problem do you face with solid waste management?

.....  
.....  
.....

10. How can these problems be solved?

.....  
.....

11. Which environmental problems do haphazard dumping of wastes cause?

.....  
.....  
.....

12. How do you think these problems can be solved?

.....  
.....  
.....

### **Appendix III**

#### **KENYATTA UNIVERSITY**

#### **An Assessment of Solid Waste Management in Mombasa County: The Case of Kisauni Division**

Interview schedule

The research is mainly for academic purpose. Therefore, answers will be treated as confidential.

Thank you

- 1) What are the main types of waste generated?
- 2) What is the schedule of waste collection?
- 3) What challenges does the council/enterprise face in carrying out its duties?
- 4) How can they be solved?
- 5) To what extent is the community involved in solid waste management?
- 6) If they are involved how do you incorporate them into your work?
- 7) What is being done on the ground to control excessive solid waste generation and illegal dumping?
- 8) Do you think you have been effective in performance of your duties, and if so how?

## **Appendix IV**

### **KENYATTA UNIVERSITY**

#### **An Assessment of Solid Waste Management in Mombasa County: The Case of Kisauni**

##### **Division**

Interview schedule for business

The research is mainly for academic purpose. Therefore, answers will be treated as confidential.

Thank you

1. What type of business do you own?
2. On average how much income do you generate per month?
3. What type of solid waste do you generate from your business?
4. How do you get rid of this waste?
5. Are the institutions charged with solid waste management efficient?
6. If not what's your opinion on how they can better their services?
7. Do you employ the services of a private company for solid waste collection?
8. If so, how much do they charge you per month?