

**FACTORS INFLUENCING SOLID WASTE MANAGEMENT  
IN GARISSA MUNICIPALITY, KENYA**

**BY**

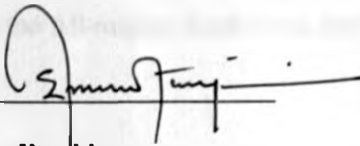
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**SIYAT OSMAN IBRAHIM**  
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**A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF  
REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS DEGREE IN  
PROJECT PLANING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI**

**2012**

## DECLARATION

I declare that this is my original work and has not been presented in any other university or any institution of higher learning for examination what so ever.


Signature: 

**Siyat Osman Ibrahim**

**Reg. No. L50/67882/2011**

Date: 31/07/2012

This research project report was submitted for examination with my approval as the university supervisor.

Signature: 

**Dr. Dorothy N. Kyalo**

**Senior Lecturer,**

**Department of Extra Mural Studies,**

**University of Nairobi**

Date: 31-07-2012

## DEDICATION

I dedicate this research project to my dear wife, children, friends and extended family members for their unyielding support and sacrifices without which this project would not have been success and my supervisor's who was a source of encouragement during my studies. May the All-mighty Allah bless and reward them copiously.

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I intensely salute **Dr. Dorothy N. Kyalo**, my lecturer and supervisor, in the Department of Extra-Mural studies for her steadfast support and guidance during the research period.

I will always remember their concern, sacrifice and guidance of. and extraordinary thanks to **Mr. Yussuf M. Ibrahim Managing Director Garissa Water & Sewerage Company (Ltd)** **Mr. Mohamed A. Noor**, Administrator (Department of Extra-Mural Studies Garissa Centre) University of Nairobi and all my contemporaries for their support. May God exalt them all.

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

<b>DANIDA</b>	Danish International Development Agency
<b>IETC</b>	International Environmental Technology Centre
<b>LGA</b>	Local Government Authorities
<b>MSE</b>	Micro Enterprises or Small Enterprises
<b>MSW</b>	Municipal Solid Waste
<b>MSWM</b>	Municipal Solid waste management
<b>NEMA</b>	National Environment Management Authority
<b>NGO</b>	Non-Governmental Organizations
<b>PHO</b>	Public Health Officer
<b>PPP</b>	Public Private Partnership
<b>SCOPE</b>	Science Committee on Problems of the Environment
<b>SPSS</b>	Statistical Package of Social Sciences
<b>SWM</b>	Solid Waste Management
<b>UN</b>	United Nations
<b>UNEP</b>	United Nations Environmental Programme
<b>USEPA</b>	United States Environmental Protection Agency
<b>USA</b>	United States of America

## **ABSTRACT**

This study aimed at ascertaining factors influencing solid waste disposal and management in Garissa Municipality. The task included; establishing whether the size of human capital directly influences solid waste management in Garissa Municipality, finding out extent to which methods used in collection and disposal influences solid waste management in Garissa Municipality, establishing to what extent technologies used in solid waste management influences waste management in Garissa Municipality and establishing the extent to which community culture/attitude influences Solid Waste Disposal and Management in Garissa Municipality. This study employed quantitative research as the main approach to guide the study. The target population included all Garissa municipal council staff. The research instrument used in data collection was a questionnaire from the respondents. To ensure validity of the instruments, expert opinion was sought. Data analysis was started immediately after the field. Data was summarized into frequencies and percentages presented in tables. The study affirms that understaffing, lack of education, poor supervision, lack of appropriate facilities and lack of resident's support are among reasons leading to poor solid waste management in Garissa Municipality. The study also found that manpower in waste disposal (1), facilities available at the council (2), attitude of community towards waste disposal (3), funding for waste disposal programs (4) and technology used in solid waste disposal (5) are factors influencing solid waste disposal ranked in that order. From the study findings it can be concluded that human capital, level of technology, funding, facilities available and community attitude are factors influencing solid waste disposal and management in Garissa Municipality.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background to the Study

The state of solid waste management in cities of most developing countries is fast assuming the scale of a major social and environmental challenge. In Sub-Saharan Africa (SSA) in particular, the combined influence of poverty, population growth and rapid urbanization has tended to worsen the situation. The gravity of this problem is perhaps best reflected in the level of attention given to it in the United Nations (UN) Millennium Declaration. Three of the eight Millennium Development Goals (MDGs) outlined in the declaration have waste or resource efficiency implications are: ensure environmental sustainability by integrating the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources, eradicate extreme poverty and hunger by halving between 1990 and 2015, the proportion of people whose income is less than \$1 a day and develop a global partnership for development by addressing the special needs of least developed countries, landlocked countries and Small Island Developing States.

In response to the waste challenge many developed countries have embarked upon ambitious environmental reforms, recording remarkable advances in best practices and sustainable management of their Municipal Solid Waste (MSW). However many developing countries such as Kenya have fared less well in this regard as a result of several barriers militating against sustainable municipal solid waste management. To illustrate this point, a four country study by the African Development Bank on Solid Waste Management Options for Africa, revealed: no country in Africa has detailed solid waste management legislation yet, solid waste management in most African countries is characterized by inefficient collection methods, insufficient coverage of the collection area and improper disposal of waste, waste characterization data

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specific to cities in these countries are generally not available and there is a general lack of regulatory initiatives to manage and minimize waste.

In many ways Kenya typifies SSA countries with chronic waste management problems. It has a large population of over 40 million people. Population growth rate is well above global average at 2.6% per annum. Rapid urbanization and an unevenly distributed wealth are other factors influencing waste growth in the country. There is not much literature on the Kenyan solid waste management (SWM) sector with the exception of Nairobi. Even for Nairobi, the available literature dwells largely on performance description and its causes, household waste generation behaviour, and waste characteristics. Though poor management of solid waste is a general problem in Kenya, it is probably worst in Nairobi.

The Municipal Council of Garissa is one such local authority in the country. Garissa is a town in North Eastern Province, of Kenya. It is the capital of the province and Garissa County. It had a population of 65, 881 only according to 1989 census. The Tana River flows through the town of Garissa. Garissa forms a municipality that has six wards (Biashara, Bulla, Jamhuri, Market, Mashambani and Stadium). All of them belong to Dujis Constituency, which has a total of thirteen wards. The remaining seven are located within Garissa County Council, the rural council of Garissa District. The Council is mandated to provide solid waste disposal services to the population of Garissa Municipality of approximately 300, 000 people.

According to a study carried out by DANIDA in 2008, municipal wastes, household waste; food waste, paper, wood, textile fabrics, glass breakage and polymeric materials have increased over the years due to population increase and intense activities of light industries (Jua kali). Plastic containers and polythene bags are especially notorious since they are non-biodegradable. There

is a high intake of bottled water in Garissa due to the high day temperatures. As such, plastic bottles litter the town. They block storm drainage while acting as mosquito breeding grounds. Plastic bags have also been blamed on the death of livestock in this predominantly pastoral area.

## **1.2 Statement of the Problem**

In practice, effective solid waste management has remained a daunting task for many local authorities in developing economies. This is partly due to a number of factors influencing the disposal of solid wastes. In Garissa Municipality, these include funding, inadequate manpower, residents' attitude, institutional capacities, out-dated technology and wanting knowledge and skills to effectively manage solid waste. This poses a great challenge to the disposal of solid waste in Garissa Municipality. Other key factors that affect the potential for resource recovery are the cost of the separated material, its purity, its quantity, and its location with regard to the intermediate and final processing facilities. The costs of storage and transport are major factors that decide the economic potential for resource recovery. It is also not lost that most municipalities employ the services of open tractor pulled trailers to collect and transport their waste.

According to Aden Bille's study, most of the firms dealing with recycled materials are to be found in Nairobi, hence the cost of transporting recyclable materials from Garissa to Nairobi is prohibitive. The main method/technology of waste disposal currently being applied in Garissa Municipality is indicated as open dumping (although the Municipal staff call it landfill), which requires large space and it is costly to manage. Inadequate garbage disposal in an area often results in negative attitudes that contributed to a general deterioration of community development and cohesion. Noting that like any other urban centers and cities, Garissa

Municipality is also growing in terms of population and activities, the impact of solid waste is inevitable.

According to Aden Bille's study, of importance to be noted is the lack of user fee payment (waste collection fee), i.e. residents of Garissa Municipality are not charged for waste collection. When solid waste management systems based on user fees are in place, often the fees only barely cover costs of collection and transport leaving practically no financial resources for the safe disposal of waste. Financing this part of the solid waste management cycle is made even more difficult as most people are unwilling to pay for the removal of the refuse from their immediate environment but the "out of sight - out of mind" attitudes are generally not concerned with its ultimate disposal. Despite this attitude, charging of user fee could help bridge any financial gap that the Garissa Municipality could be facing.

### **1.3 Purpose of the Study**

The purpose of this study was to explore factors influencing solid waste disposal and management in Garissa Municipality, and especially the relationship between human capital and effective solid waste management.

### **1.4 Research Objectives**

The study was guided by the following objectives

- 1) Establishing whether the size of human capital directly influences solid waste management in Garissa Municipality.
- 2) Finding out extent to which methods used in collection and disposal influences solid waste management in Garissa Municipality

- 3) Establishing to what extent technologies used in solid waste management influences waste management in Garissa Municipality.
- 4) Establishing the extent to which community attitude influences Solid Waste Disposal and Management in Garissa Municipality

### **1.5 Research Questions**

The study sought to answer the following questions;

- 1) Does the size of human capital directly influence solid waste management in Garissa Municipality?
- 2) To what extent do methods used in collection and disposal influence solid waste management in Garissa Municipality?
- 3) To what extent do technologies used in solid waste management influence waste management in Garissa Municipality?
- 4) To what extent does community attitude influence Solid Waste Disposal and Management in Garissa Municipality?

### **1.6 Significance of the Study**

The study was anticipated to be of benefit to the Garissa Municipal Council and planners in identifying how best any existing weaknesses in solid waste management could be handled in order to improve solid waste management in the Municipality.

The study would also help the Municipal Council of Garissa to understand how to improve on manpower, hence be in a position to justify any request for increased funding for the solid waste department (or as mostly called, the cleansing department) in the future.

The findings of this study will enrich existing knowledge and hence will be of interest to both researchers and academicians who seek to explore and carry out further investigations. It will provide basis for further research.

### **1.7 Delimitation of the Study**

The study focused on employees of Garissa municipal council. This means that the respondents were supplied with questionnaire with the aim of getting their views regarding the factors influencing solid waste disposal and management in Garissa Municipality. Garissa Municipality was selected as the study site due to its proximity to the researcher, time available for the study and budgetary constraints.

### **1.8 Limitations of the Study**

This study was limited by the following factors:

The respondents that were approached might be reluctant in giving information demanding incentives to participate in the study. The research handled the problem by carrying out an introduction letter from the university and assuring the respondent that the information will be used purely for academic purposes.

Some respondents refused to be interviewed altogether. However the challenge was minimized by asking the respondents not to indicate their names on the research instrument as well as assuring them that the research will only for academic purpose.



## **1.9 Assumptions of the Study**

This study assumed that the stated objectives would be achieved, respondents would cooperate in answering the questionnaires and that all the questionnaires would be returned. The study also assumed that Garissa municipal council administration and staff members would be willing to divulge the required information from their records.

## **1.10 Definition of Terms**

**Composting** is the collection, and processing of organic materials in the solid waste stream to break down the materials through bacterial decomposition to reduce volume and to create a usable soil amendment product, called compost. Composting is considered a form of recycling.

**Human capital** is the stock of competencies, knowledge and personality attributes embodied in the ability to perform labor so as to produce economic value. It is the attributes gained by a worker through education and experience

**Human resources** is a term used to describe the individuals who make up the workforce of an organization, although it is also applied in labor economics to, for example, business sectors or even whole nations

**Recycling** is the collection, separation, processing, and remanufacture of materials in the solid waste stream to make new products.

**Solid waste** is any substance which constitute scrap material or an effluent or other unwanted surplus substance arising from the application of a process, or any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled.

## 1.11 Summary

This chapter is divided into ten sections. Section one gives the background of the study while section two elaborates the statement of the problem. This is followed by section three giving the purpose of the study and section four summarizing the objectives of the study. Section five gives the research questions and section six discusses the significance of the study. The scope of the study is discussed in section seven while delimitation and limitations of the study are discussed in section eight and nine respectively. The chapter ends with section ten which discusses the assumptions of the study.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter presents an overview of existing literature in relation to factors influencing solid waste management in terms of manpower, technology/methods, facilities, funding, and attitude of urban residents towards solid waste management and defines the character of solid waste.

#### **2.2 Solid Waste**

Debate on what constitutes waste is still ongoing within the research community. Contemporary definitions of solid waste are converging on the essential ingredients of the definition i.e. origin or sources of the material, characteristics and potential to cause harm to the environment. Solid waste can be defined as any substance which constitute scrap material or an effluent or other unwanted surplus substance arising from the application of a process, or any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled. On the other hand, Igoni viewed waste as any material which has no value to the producer and must therefore be disposed of. The basic point of agreement between the two definitions is therefore on the issue of value; they both agree this must be defined by the owner or producer of the waste.

For the purposes of this study however, the definition by the EU Framework Directive on waste (91/156/EEC) has been adopted. The document defines waste as any substance or object which the holder discards or intends to discard and which falls into one of the following categories; production or consumption residue, product whose date for appropriate use has expired, contaminated or soiled materials, substances that no longer perform satisfactorily.

### **2.3 Municipal Solid Waste**

Municipal Solid Waste (MSW), has been defined as household waste and any other waste collected by a Waste Collection Authority (WCA) or its agents, including waste from parks, beaches, commercial establishments, offices, industries and fly tipping. Other experts insist that MSW include all non-air and sewage emissions created within and collected by private as well as public authorities in any municipality from domestic, commercial and industrial (non-hazardous) sources. Article 2(b) of the European Union Landfill Directive broadened the definition further by defining MSW as waste arising from households as well as other wastes, which because of their nature and composition are similar to waste from households. This implies that MSW may often include biodegradable components such as food and garden waste, as well as non-degradable fractions such as glass, plastics, tyres and bottles. The various sources of these wastes in any community may include: residential houses, institutions, commercial organizations, municipal services, allotments and treatment sites. In essence, MSW would normally include all wastes from the neighbourhood except industrial, agricultural and hazardous wastes.

### **2.4 Overview of Municipal Solid Waste Management in Developing Countries**

Globally, MSW generation has continued to increase in line with growth in other socio-economic parameters such as population, personal income and consumption patterns. In the last two decades, per capita waste generation in the developed economies has increased nearly threefold. Waste generation in the developing nations is growing rapidly and may double in aggregate volume within this decade, driven largely by growth in population and improvements in living standards. If current trends persist, a fivefold increase in global MSW generation is probable by the year 2025. The Sub Saharan Africa share of projected growths in MSW generation amongst developing nations is difficult to estimate. It is debatable that the complex

relationship between MSW generation, Green House Gas (GHG) emissions and climate change will affect the region more or less than any other in the world. It is therefore of strategic national and regional importance to establish current MSW situations.

#### **2.4.1 Municipal Solid Waste Management in Sub-Saharan Africa**

Until the late 1980s MSW management in most parts of SSA had practically no nationally coordinated institutional or policy framework to rest on. Though Municipal Authorities were often required by law to carry out this function, most of them lacked the capacity to do so. Quite often therefore waste management is very low in their priority list. In the few cases where supervisors are assigned MSW management functions within local authorities, they seldom have the full complement of qualified staff, such as planners, managers or field and technical staff to work with. Since most MSW personnel in these organizations are almost always low cadre staff, they lack the capacity to influence funding decisions. This often results in severe inadequacies in funding and consequently diminished operational capabilities. The consequence is that wastes are quite often dumped at any convenient location by residents and overtime they accumulate into open dumps that have become omnipresent in many cities in SSA.

Lately, as a result of increasing awareness of the deleterious effects waste has on the environment and positive changes in the socio-economic circumstances of some countries in the region, governments are beginning to put in place policies, programmes and institutions to enhance the management of MSW at all levels.

## **2.4.2 An Overview of Municipal Solid Waste Management in Kenya**

Overall responsibility for solid waste management in Kenya rests with the Ministry of Environment and Natural Resources (MENR) and the Ministry of Local Government. The main responsibilities of these ministries as regards waste management include: Environmental legislation, policy formulation, monitoring and evaluation, issuance of licenses and permits to waste operators and environmental standards enforcement amongst others.

As in most countries, local authorities are primarily charged with the responsibility for waste collection, transfer, resource recovery, recycling and disposal within their jurisdiction in Kenya. Estimates by USAID and World Resources Institute (WRI) show that these Authorities were only able to collect and dispose of 50-70% of their MSW, spending over 30% of their annual budget in the process in 1992. At present Kenya has no engineered landfills, hence MSW disposal is carried out in open dumps with attendant deleterious environmental consequences. MSW management in Kenya is still very highly centralized with operational decisions often having to wait for senior management in most Council environmental departments. This often results in long delays before the simplest of tasks could be carried out. Lately a few Councils in Kenya have entered into contractual agreement with private waste operators to complement the efforts of Council waste departments<sup>1</sup>.

### **2.4.2.1 Solid Waste Generation in the Town of Garissa**

Municipal wastes, household waste; food waste, paper, wood, textile fabrics, glass breakage, Dead animal's carcasses and polymeric materials have increased over the years due to population increase and intense activities of light industries (*Jua kali*). Plastic containers and polythene bags are especially notorious since they are non-biodegradable. There is a high intake of bottled water in Garissa due to the high day temperatures. As such, plastic bottles litter these

towns. They block storm drainage and while acting as mosquito breeding grounds. Plastic bags have also been blamed on the death of livestock in this predominantly pastoral area.

The council is in a way incapacitated to manage generated waste from the town. The Public Health Officer is in record as actually having taken the council to court to emphasize the need of the council to put up refuse cleanliness of the town is being compromised so fast, baring in mind that Garissa had been ranked as one of the cleanest towns in 2005. Conflicts within the council's executive arm (Town clerk) and the political wing (Councilors) have affected operations including public health issues.

Influx of refugees to the town is another major threat on waste management. The refugees dispose a lot of plastic waste and food remains. Due to the nature of settlements the refugees mainly lack containers for use in storing household essentials such as food, milk, etc. They result to the use of plastic bags as the cheapest way of handling the commodities. The plastics eventually end up in the town as waste. The invasion of the town by *Prosopis julisflora* the "Mathenge" tree has caused a nuisance in the effort to manage solid wastes. The tree is thorny and it thus holds a lot of polythene papers which are difficult to remove.

#### **i. Estimated waste generation and collection**

In a study done in Nigeria, which focused on Solid Waste Generation, Categories and Disposal Options in Developing Countries, it was revealed that an ordinary person produced an average of 0.64kgs of solid waste per day. Based on this argument, in Garissa Municipality, with a population of 300,000 people, it is estimated that in one day 192, 000kgs of solid waste would be produced. Such a huge amount of solid waste would require about 28 trips of a 7 ton truck to the dump sites or one trip by a fleet of 28 tracks of 7 tons each load capacity. Generally past

experiences from studies on the urban waste disposal and management had fallen short of expectation in addressing the problem of solid waste disposal and management. Similarly research undertaken in Kenya has fallen short of this expectation as well.

In practice, however, this has remained a daunting task for many local authorities in developing economics. This is partly due to a number of factors influencing the disposal of solid wastes. In Garissa Municipality, these include funding, residents' attitude, institutional capacities, out-dated technology and wanting knowledge and skills to effectively manage solid waste. This has posed a great challenge to the disposal of solid waste in Garissa Municipality. According to spoken words of the Garissa Municipal Council Public Health Officer, the council collects a paltry 30tonnes only per day. This makes only for 15.6% of the waste generated. It means that a whopping 162, 000kg is left uncollected every day.

#### **ii. Cultural and Housing structures**

Most structures of these pastoralists who make up large percentage of the population in Garissa municipality either live in temporary or makeshift housing structures. The temporary structures are constructed using makuti thatching materials, local poles, plastic sheeting and sisal. These temporary shelters are known as (*herios*) in local parlance while the other types are done using banana leaves, polythene papers and carton boxes that greatly contribute to the generation of more solid waste in the municipality. Coupled with inadequate skills and education the local community lacks basic understanding of solid waste management techniques".

Sanitation facilities are scanty especially in the absence of running water. Most areas within the municipality known as the *bullas* (informal settlement) do not have toilet facilities, which presents clear environmental and sanitation hazards. In a situation where the few available



toilets are used by many households, there is the likely hood of decess break outs especially during the rainy sessions. Most people in the *bullas* within Garissa municipality also lack means of solid and liquid waste disposal and can often ill afford the cost of Medicare emanating from poor or non existing sanitation facilities. By their very nature pastoralist are used to unregulated free style movement where waste production has always remained minimal thus organized settlement in a municipality and dealing with increasingly generated solid waste is completely an alien to their lifestyle.

These are people whose lifestyle has dramatically been altered by persistent drought and insecurity to the extent that they have lost their livelihood and have been forced to pre-urban areas in search of alternative livelihood. Hence residents have do not pay taxes for waste collection to the local council.

### **iii. Hazardous Wastes**

Health facilities are the main source of hazardous wastes that include sharp and infectious wastes. Management of municipal, hazardous, and toxic waste in the town of Garissa is grossly inadequate. The mushrooming of unregulated health clinics some operated non-practitioners continues to aggravate the situation. Rates of waste generation are virtually unknown and waste is disposed off without due consideration of environmental impacts. Waste disposal sites are not properly planned and there is little or no compliance with the Waste Management Guidelines of gazetted by NEMA in 2007. The absence of proper disposal mechanisms for the solid waste creates various environmental health problems.

#### **iv. Waste Management Practices**

Unsustainable patterns of production and consumption are increasingly generating large quantities and a variety of wastes at unprecedented rates in Garissa municipality. High population increase and urbanization has led to high consumption of natural resources and generation of substantial wastes. The municipal council has been unable to cope with collection, treatment and disposal of wastes due to inadequate capacity and financial constraints. In regard to this, available data reveals that 80% of the residents dispose their waste by burning, 10.9% at a public garbage heap and 7% at a garbage pit. Solid waste disposal systems have seriously deteriorated and remedial measures are urgently required, bearing in mind that waste management has serious implications on public health and welfare. Due to this scenario coupled with lack of proper communication and education on the part of the local authority, there seems to be a certain level of laxity by the residents to support the council on solid waste management.

#### **2.5 Manpower in Waste Management Systems**

Recovering and recycling usually takes place in all elements of the systems and is widely practiced by the informal sector "waste pickers" or by the solid waste management staff themselves for extra income. Recovered and recyclable products then enter a chain of dealers, or processing before they are finally sold to manufacturing enterprise.

##### **2.5.1 Private Companies as Partners in Solid Waste Management**

There is a trend, sometimes driven by failing municipal systems or by pressure from national governments and international agencies, to outsource the provision of services to the private sector. "Public Private Partnerships (PPP)" is a term used for describing a variety of relationships between public and private sector actors. In many countries private companies are

interested in providing solid waste management services and such partnerships are successively implemented by the responsible authorities.

In Chennai, a major port city in Southern India, the French multinational Onyx won a contract with the municipal corporation to collect the waste and sweep streets in one area of the city. Remuneration per ton of waste collected is significantly lower than the previous expenses of the Municipality and Onyx has won many praises from any residents for good service. An important factor in the success of private sector participation is the ability of the municipal administration to write and enforce an effective contract.

The contract document must be well written to describe in quantitative terms what services are required and to specify penalties and other sanctions that will be applied in case of shortcomings. The ability and willingness of the Municipality to monitor the performance of the private partner and enforce sanctions if necessary are crucial for an effective partnership and for the long-term improvement of the cities situation.

### **2.5.2 Local Micro and Small Enterprises (MSES)**

As an alternative to large (often multinational) company, the local private sector, micro enterprises or small enterprises (MSEs) or even community based organizations can also provide much of the solid waste services for a city. The concept here is that waste management is seen as meeting citizens' needs therefore citizens are entitled to transparency in decision making; waste management is not merely a service delivered by urban authorities but a cooperative undertaking that requires the coordination of informal behaviors and conventional management approaches.

With this concept, citizens can perform some of the work, and people should assess the performance of municipal staff and have the right to raise questions about decisions on, for instance, the siting of dumps and transfer stations. Watchfulness and peer pressure of citizens is then also crucial to monitoring solid waste management activities. Well adapted to the local conditions such small scale approaches often use simple equipment and labour-intensive methods, and therefore can collect waste in places where the conventional trucks of the Municipality or large companies cannot enter.

### **2.5.3 Community - Based Decentralized Approaches**

In Indonesian cities, municipal governments have introduced and promoted the concept of organized citizen participation and involvement in primary collection schemes. In the city of Yogyakarta for instance, such schemes - using handcarts for house to house collection - are managed by the community or neighborhood units and play a significant role in the city's solid waste management system. Based on such existing schemes, further activities such as recycling of the organic fraction by composting have also been initiated. After five years of operating a neighborhood waste collection and decentralized composting scheme, the NGO Waste Concern in Dhaka, Bangladesh, had shown the great potential of community-based decentralized approaches and finally convinced Dhaka's Municipal Corporation and Public Works Department to provide government land on which they can establish more community - based composting plants. International donors have also recognized the potential of such approaches and are supporting the implementation of such schemes in 14 cities of Bangladesh. Waste Concern has been able to demonstrate how new approaches, in which non-governmental and private sector enterprises work together with waste management authorities, can tackle the serious problems of solid waste management.

## **2.6 Technology/Methods in Solid Waste Disposal and Management**

In many low-income Asian countries, recycling and recovery is usually conducted by the informal sector on all levels of the waste management stream. Such work is done in a very labour-intensive and unsafe way, and for very low incomes. The situation in industrialized countries is very different, since resource recovery is undertaken by the formal sector, driven by law and a general public concern for the environment, and often at considerable expense. In the past the role of the informal sector in waste management has hardly been recognized by the responsible authorities. Often the municipal authorities even actively hindered such recycling activities. Now, the importance of recycling activities in reducing waste volume and recovering resources and its economic benefits is being acknowledged.

In the Philippines a growing number of local governments are implementing integrated waste management, which includes waste reduction, recycling, composting and re-use. Estimates have shown that trade in waste materials has increased in volume by 39%. Some key factors that affect the potential for resource recovery are the cost of the separated material, its purity, its quantity, and its location with regard to the intermediate and final processing facilities. The costs of storage and transport are major factors that decide the economic potential for resource recovery. This has really affected the potential for waste recycling in Garissa, since most of the waste recycling enterprises can only be found in Nairobi, as noted by Aden Bille in his 2010 study. It is also not lost that most municipalities employ the services of open tractor pulled trailers to collect and transport their waste, Garissa being a good example.

### **2.6.1 Composting of Waste**

Composting is an excellent method of recycling biodegradable waste from an ecological point of view. However, many large and small composting schemes have failed because not enough attention was given to the marketing and the quality of the product. Current promising developments can be observed in Bangladesh where local government authorities as well as the Ministry of Agriculture is supporting and promoting composting and the use of compost in agriculture.

In India, the new solid waste legislation obliges municipalities to introduce household segregation of organic and non-organic waste (called "wet" and "dry" waste respectively) and to treat the organic fraction by composting or other appropriate means. Composting activities are becoming more and more common as well as pilot plants for bio-methanation of organic wastes, however the challenge to establish a market and demand for the compost product is yet to be tackled.

### **2.6.2 Disposal of the Solid Waste in Open Dump Site**

Open dumps - unfortunately still mostly observed in developing economies - where the waste is dumped in an uncontrolled manner, can be detrimental to the urban environment. Many governments now acknowledge the dangers to the environment and to public health derived from uncontrolled solid waste dumping. However, often officials think that uncontrolled waste disposal is the best that is possible.

### **2.6.3 Determining the Location, Design and Operation of New Landfills**

Another reason for sustaining the current disposal practices are insufficient guidelines for determining location, design and operation of new landfills, or for upgrading of old dumps. Often the only guidelines and training materials available are those from high-income countries. These are based on technological standards and practices suited to the conditions and regulations of high-income countries and do not take into account the different technical, economical, social and institutional aspects of developing countries.

The responsible authorities, seeing no other solution for their disposal situation, then start searching for waste treatment methods like composting or incineration to alleviate their problems. Such treatment methods however do not eliminate the need of a disposal site. For the responsible authorities finding an ideal site, planning and designing a new landfill is a lengthy and costly affair, often only feasible with external financial aid. In some major cities, loans or grants have been used to construct sanitary landfills'. However, if little attention is paid to the training of a site manager and to the provision of sufficient financial and physical resources to all a reasonable standard of operation, the sites quickly degenerate into open dumps.

### **2.6.4 Other Facilities Used for Urban Solid Waste Disposal**

In Brazil, an average of 40% of all domestic and public solid waste produced, totaling around 96,000 tons a day, involves unsuitable disposal. In many of these cases the leachate drains directly into the soil as well as into the water bodies near the landfill with pollution risks of these natural resources. The dynamism of the urban space causes a constant succession of soil uses in most cities. When a waste disposal site is deactivated, its mere abandonment may be hazardous to the environment and communities around it. The deactivation of the areas used as a waste dump, later being reused without undergoing proper treatment, in addition to devaluing the

surroundings, deteriorating the image of the Municipality or city and even contamination may cause potential hazards of environmental degradation.

#### **2.6.5 Recycled Organic Urban Wastes**

Cities have provided a source of nutrients and organic material for farmers in the pen-urban interface for quite some time. There is documented evidence of farmers around the close settled zone of Kano, Nigeria having a long history of applying urban solid waste to their fields. The practice is also known in Bamako, Mali and in Ouagadougou, Burkina Faso. A three-year multidisciplinary project, APUGEDU, involving local researchers and NGOs together with collaborators from Europe examined the constraints and opportunities facing this practice, focusing on solid, as opposed to liquid, waste, in this countries.

Current developments years present interesting opportunities for ensuring a safer and more sustainable recycling of solid urban waste in both Ougadougou and Bamako Mali, where waste management is currently being overhauled. Both cities have grown considerably and, with this, so have the challenges of managing their growing waste production. There seem to be insufficient financial resources available to the municipal authorities charged with ensuring the collection and disposal of urban wastes, and landfills are reaching capacity. But what should be noted is that current plans, backed by foreign financing and expertise, plan to leave recycling as an "end-of-the-pipe" solution.

#### **2.6.6 Upgrading Waste Dumps**

Improving and "upgrading" waste dumps does not necessarily have to be difficult or expensive. It should not be regarded as an alternative to a new site, but it can significantly prolong the existing site's life span and reduce the negative environmental impact that in any case would



have to be dealt with when closing the site. Upgrading does not mean converting a dump to a sanitary landfill in one step. Achieving a controlled, engineered landfill with a minimal level of environmental pollution and health risk to the public (here defined as a "sanitary" landfill), can be a step to step process depending on the financial situation of the authorities. Such a step-wise approach should be supported in standards and legislation for landfill disposal. The upgrading process can prolong the existing sites life span, giving the responsible authorities time to engage in a serious siting procedure for a new landfill.

As an example of step to step improvement, the government of Malaysia formulated an action plan in 1988 on the improvement of their disposal sites. When they considered the limited financial resources and technical know-how that was available, the strategy adopted was to convert open, dumping to sanitary landfills in stages. In Asian low and middle income countries, municipal managers still face many common solid waste management problems. Although in some cities, successful innovative ideas and approaches have been implemented on different levels of the solid waste management system. Sanitary landfills are disposal sites which are built and operated according to engineering principles in order to minimize pollution of air, water and solid, and other risks to man and animals.

## **2.7 Best Practices to Solve Solid Waste Disposal Problems**

The fundamental objective of solid waste management program is to minimize the pollution of the environment as well as utilizing the waste as a resource. These goals should be achieved in a way that is financially sustainable, i.e. using methods that can be afforded by the community over the long term and with minimum risk to the persons involved. Methods of solid waste management vary greatly with types of wastes and local conditions. The best systems are designed by fixing together the fundamental goals, a clear analysis of local conditions and

factors, an understanding of the full range of technology options that are available and an awareness of the traditional wisdom and systems that the local people have developed. It is common knowledge that from household storage to disposal, the know-how and experience is seldom communicated and transferred to others with similar responsibilities.

Rather many municipal officers go through the same trial and error phrases repeating mistakes made elsewhere before. Research institutions, NGOs, and international agencies are seen as very important actors for enhancing and supporting the dissemination of "best practices". It must be recognized, however, that there is not a "package solution" for solving the solid waste problem, although the fundamental aspects of the waste situations and actively involving residents at an early stage in planning and implementation are elements which have shown to be most promising.

Solid waste management is definitely not just a technical challenge but understanding and taking into account the environmental impact, financial and economic calculations, social and cultural issues, and the institutional, political and legal framework, is most crucial for planning and operation of a sustainable solid waste management scheme. SWM problems present a serious challenge to local government authorities (LGAs) in developing countries. The effective way to reduce this tremendous issue is to integrate waste recycling systems into existing and future SWM. Understanding factors influencing recycling performance is the key to achieving sustainable waste management. The purpose of this study was to investigate the factors influencing solid waste management in Garissa Municipality, concentrating on human capital.

## **2.8 Funding in the Management of Solid Waste**

Financial and institutional constraints are one of the main reasons for inadequate disposal of waste, especially where local governments are weak or separated and rapid population growth continues. Many governments even have great difficulties when trying to define their actual solid management costs, as very often no detailed cost accounting is in place.

When solid waste management systems based on user fees are in place, often the fees only barely cover costs of collection and transport leaving practically no financial resources for the safe disposal of waste. Financing this part of the solid waste management cycle is made even more difficult as most people are willing to pay for the removal of the refuse from their immediate environment but the "out of sight - out of mind" are generally not concerned with its ultimate disposal.

## **2.9 Problems and the Challenge of Waste Management**

Problem areas of municipal solid waste management (MSWM) in developing countries can be identified. These are described as inadequate service coverage and operational inefficiencies of services; limited utilization of recycling activities; inadequate landfill disposal, and inadequate management of hazardous and health waste. The quantity of waste arising – solid, liquid and gaseous are generally considered to be growing across the globe as a result of increase in the world's population, increasing industrialization, increasing urbanization and rising standards of living.

Moreover, major advances in the development of new materials and chemicals have increased the diversity and complexity of the waste streams. Consequently, wastes are taking on a new economic importance, not only in terms of revenues generated by the waste treatment and

disposal industry, but also because wastes may have a residual value as a secondary raw material which can be recovered or reused.

### **2.9.1 Inadequate Coverage**

Solid waste collection schemes of cities in the developing countries generally serve only a limited part of the urban population, the majority of the people especially in slum areas remaining without waste collection services. These are usually the low-income earners living in poor conditions in peri-urban areas. One of the main causes of inadequate collection services is the lack of financial resources to cope with the increasing amount of generated waste produced.

### **2.9.2 Operational inefficiencies**

Operational inefficiencies are due to inefficient institutional structures, inefficient organizational procedures, or deficient management capacity of the institutions involved as well as the use of inappropriate technologies. With regard to the technical system, often the “conventional” collection approach, as developed and used in the industrialized countries, is applied in developing countries. The used vehicles are sophisticated, expensive and difficult to operate and maintain, thereby often inadequate for the conditions in developing countries. After a short time of operation usually only a small part of the vehicle fleet remains in operation. Transport also relies on operational vehicles, and frequent breakdowns coupled with parts shortages can immobilize collection vehicles for extended periods of time. For example, UNEP estimated that in cities in West Africa, up to 70% of collection/ transfer vehicles may be out of action at any one time.

### **2.9.3 Hazardous wastes**

Healthcare wastes are generated as a result of activities related to the practice of medicine and sales of pharmaceuticals. Some of the health-care wastes coming from any particular hospital or institution are similar in nature to domestic solid wastes, and may be called “general health-care wastes”. The remaining wastes pose serious health hazards because of their physical, chemical or biological nature, and so are known as “hazardous healthcare wastes”. In many cases the most dangerous items in health care wastes are needles from syringes and drips, because the needles shield the virus from chemical disinfectants and a harsh external environment, and the sharp point allows easy access for the viruses into the blood stream of any one who is pricked by the needle.

The key to improving health care waste management is to provide better methods of storage and to train the staff to adopt safer working practices and segregate as hazardous healthcare wastes from the general health care wastes. Some waste materials need special treatment because their properties make them more hazardous chemicals not only a matter of technology and legislation, but also of enforcement, funding and financial instruments. Changing processes to use less hazardous substitutes and minimizing hazardous waste quantities that are discarded can be seen as preferred options in dealing with any difficult waste.

### **2.9.4 Human health risks Issues**

There are some human health risks associated with solid waste handling and disposal in all countries to some degree, but certain problems are more acute and widespread in underdeveloped nations. Cointreau has classified these into four main categories: 1) presence of human fecal matter, 2) presence of potentially hazardous industrial waste, 3) the decomposition of solids into constituent chemicals which contaminate air and water systems, and 4) the air

pollution caused by consistently burning dumps and methane release. Human fecal matter is present in every solid waste system; in developing nations the problem varies with the prevalence of adequate sanitary disposal systems such as municipal sewerage or on-site septic systems, and outhouses.

In areas where such facilities are lacking (especially shantytowns and over-crowded municipal districts), the amount of human fecal matter present in the solid waste stream is likely to be higher. This presents a potential health problem not only to waste workers, but also to scavengers, other users of the same municipal drop-off point, and even small children who like to play in or around waste containers. Waste pickers are highly susceptible to disease, and it has been proposed to provide low cost or free protective gear, such as gloves, boots, and clothing, to prevent contact injuries and reduce pathogens. Experience in Calcutta, India however has shown that most gear is simply sold by the workers for cash, and they continued to work as before.

### **2.9.5 Environmental issues**

The decomposition of waste into constituent chemicals is a common source of local environmental pollution. This problem is especially acute in developing nations which very few existing landfills would meet acceptable environmental standards, due to limited budgets. The problem is again compounded by the issues associated with rapid urbanization. As land becomes scarce, human settlements encroach upon landfill space, and local governments in some cases encourage new development directly on top of operating or recently closed landfills. A major environmental concern is gas release by decomposing garbage. Methane is a by-product of the anaerobic respiration of bacteria, and these bacteria thrive in landfills with high amounts of moisture. Methane concentrations can reach up to 50% of the composition of landfill gas at maximum anaerobic decomposition.

## 2.10 Potential Strategies and Options for Sound 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 MSW systems in the future. UNEP calls this sound practices.

With that in mind, sound practice is a technology or policy that embodies a reasonable balance of feasible, cost-effective, sustainable, environmentally beneficial, and socially sensitive solutions to SWM problems. 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. This means, that a sound practice not only achieves a specific goal in MSWM, but that, to the extent possible, it takes into account the demands of the specific situation where a proposed solution is to be implemented. In the end, determining what constitutes sound practice is context-specific.

A variety of factors that help determine what sound in a situation is sufficiently large that any recommendation must be tested against the reality of a particular circumstance. Improvements are likely to lead to diminishing returns. Therefore, rather than striving for avoidance of pollution or risk to human beings, policy makers should direct resources where they would yield the greatest return to society. For example, while MSWM decision makers may strive to capture

the recyclable components in the waste stream and to minimize the environmental damage done by the handling and final disposition of waste, sound practice will require that resources be allocated in a way that seeks the balanced achievement of all of society's goals.

***a) Waste Reduction***

It would seem that the easiest and most effective way to manage solid waste is to reduce the amount of waste to be disposed. This is a strategy that seems simple in concept but has shown promise. However the amount of waste produced, even in developed countries, is often a function of culture and affluence. For example the developed countries have developed, a "throw away culture", since consumer goods are cheap has resulted in an increase in packaging (more items are individually packaged), resulting in significant increases in MSW as production becomes cheaper. An emphasis on mass production and the development of cheap consumer goods has caused quality and longevity of goods to be sacrificed in the name of lowest market price, causing people to be more likely to simply throw away and replace items instead of repairing or maintaining them.

***b) Integrated approach***

An integrated approach to waste management will have to take into account community and regional-specific issues and needs and formulate an integrated and appropriate set of solutions unique to each context. As with any issue in developing nations, solutions which work for some countries or areas will be inappropriate for others. Specific environmental conditions will dictate the appropriateness of various technologies, and the level of industrialization and technical knowledge present in various countries and cities will constrain solutions. Studies on MSW issues however repeatedly discuss certain approaches as being at least adaptable to many developing nation scenarios.



United States Environmental Protection Agency, notes that sound environmental management is achieved when the 3Rs approaches are implemented according to the order, first source reduction, second recycling and composting and third disposal to the landfill or waste combustors. These approaches emphasize waste reduction (creation of less waste and increased material recovery) and appropriate disposal options as part of an integrated evaluation of needs and conditions. UNEP laid out a series of questions to be asked when evaluating technologies and policies in the context of an integrated MSW system.

### *c) Recycling*

As noted, one of the approaches to waste management is by separating or sorting waste generated and eventually using it for other form of production. Separating waste materials at the household level occurs to some extent almost universally, and prevents the most valuable and reusable materials from being discarded. Following in-home retention of valuable material, waste-pickers currently remove most valuable materials either before garbage enters the waste stream or en route, especially in the lower and middle-income areas of many municipalities. In these instances, there is little need for additional encouragement of recycling. Even in the more affluent areas of developing cities, often there are found itinerant “buyers” of waste materials such as cardboard and glass.

These buyers could help to divert many materials out of the waste stream. Since recycling materials is a financially viable undertaking, small enterprises have and will continue to spring up whenever there is an opportunity. In fact the theft of source separated recyclable materials has been documented in many pilot schemes in both developed and developing nations. Municipalities should not only recognize the trade in recyclables, they should embrace it. By

allowing small enterprise to address the problem, valuable funds are saved jobs are created, and landfill space is saved. Perhaps through micro-loans or some small-scale assistance, local governments could support and legitimize these entrepreneurs.

Recycling inorganic materials from municipal solid waste is often well developed by the activities of the informal sector although such activities are seldom recognized, supported, or promoted by the municipal authorities. Some key factors that affect the potential for resource recovery are the cost of the separated material, its purity, its quantity and its location. The costs of storage and transport are major factors that decide the economic potential for resource recovery. In many low-income countries, the fraction of material that is won for resource recovery is very high, because this work is done in a very labour-intensive way, and for very low incomes. Recycling has the advantage of: reducing costs of the disposal facilities, prolonging the site span, and also reducing the environmental impact of disposal sites as the organics are largely to blame for the polluting leache and methane problems.

#### *d) Composting*

A somewhat more low-technology approach to waste management is composting. The waste of many developing nations would theoretically be ideal for reduction through composting, having a much higher composition of organic material than industrialized countries. For example, generally, in developing countries, the average city's municipal waste stream is over 50% organic material. Studies in Bandung, Indonesia and Colombo, Sri Lanka have revealed that residential waste composed of 78% compostable material, and market waste 89% and 90% compostable, respectively. However, composting has not been overwhelmingly successful and widespread in practice throughout the developing world. Although well documented in China and other areas of eastern Asia, composting projects have had a spotty record throughout Africa.

There are many advantages to composting. First and foremost, it would reduce, in some cases significantly, the amount of waste requiring ultimate disposal, extending the life of landfills. When done correctly, the end result becomes a useful product, capable of being used at the household or farm level to augment soil nutrient levels and increase organic matter in the soil, increasing soil stability. If the product is of high enough quality and markets exist, the product can be sold. Environmentally, the process by which composting decomposes organic waste is preferable to landfill processes. In a landfill, bacteria break down organics anaerobically in the absence of oxygen, resulting in the releases of methane gas. When properly composted, however, the organic matter is decomposed using an aerobic process, which produces no methane by-product.

#### *e) Dumping*

The dumping of solid waste in landfills is 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 level of 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.

### *f) Incineration*

Another option for waste management is incineration. Incineration should not be considered a 'disposal' option, since following incineration there is still some quantity of ash to be disposed of (probably in a landfill), as well as the dispersal of some ash and constituent chemicals into the atmosphere. It should instead be considered more in terms of its waste-reduction potential, which can be 80-95% in terms of waste volume. This appears to be an extremely attractive option, however, with occasional exceptions; incineration is an inappropriate technology for most low-income countries. Above all, the high financial start-up and operational capital required to implement incineration facilities is a major barrier to successful adoption in developing countries.

Reduction by incineration, along with sanitary disposal of the residue, would therefore be a useful alternative to traditional disposal methods, and have proven useful in Island nations such as Bermuda and the British Virgin Islands. Negative environmental consequences of incineration mostly revolve around airborne emissions. Certainly, incinerators should not be located where prevailing wind patterns would carry emissions over densely settled areas. The use of emissions reduction technology, although expensive, should be mandatory in any new construction. Incineration volatilizes many compounds potentially harmful to human health: metals (especially lead and mercury), organics (dioxins), acid gases (sulfur dioxide and hydrogen chloride), nitrogen oxides, as well as carbon monoxide and dust.

#### **2.10.1 Factors influencing solid waste management in Developing Countries**

There are many factors that vary from place to place and that must be considered in the design of a solid waste management system. These include waste amounts and composition, access to waste for collection, awareness and attitudes:

**a. Waste amount and composition**

Domestic waste from industrialized countries has a high content of packaging made of paper, plastic, glass and metal, and so the waste has a low density. In many developing countries wastes contain large amounts of inert material such as sand, ash, dust, and stones and high moisture levels because of high usage of fresh fruit and vegetables. These factors make the waste very dense (high weight per unit volume). The consequences of this high density are that vehicles and systems that operate well with low-density wastes in industrialized countries are not suitable or reliable when the wastes are heavy. The combination of extra weight, the abrasiveness of the sand and the corrosiveness caused by the water content, can use very rapid deterioration of equipment. If the waste contains a high proportion of moisture, or is mostly inert material, it is not suitable for incineration, and so is the treatment upon is ruled out. Recycling or salvaging operations often reduce the proportion of combustible paper and plastic in waste before it reaches the treatment stage.

**b. Access to waste for collection**

Many sources of waste might only be reached by roads or alleys, which might be inaccessible to certain methods of transport because of their width, slope, congestion or surface. This is especially critical in unplanned settlements such as slums or low-income areas and thus largely affects the selection equipment.

**c. Awareness and attitudes**

Public awareness and attitudes to waste can affect the whole solid waste management system. All steps in solid waste management services, the opposition to the siting of waste treatment and

disposal facilities, all depend on public awareness and participation. Thus this is also a crucial issue, which determines the success or failure of solid waste management systems.

#### ***d. Institution and Legislation***

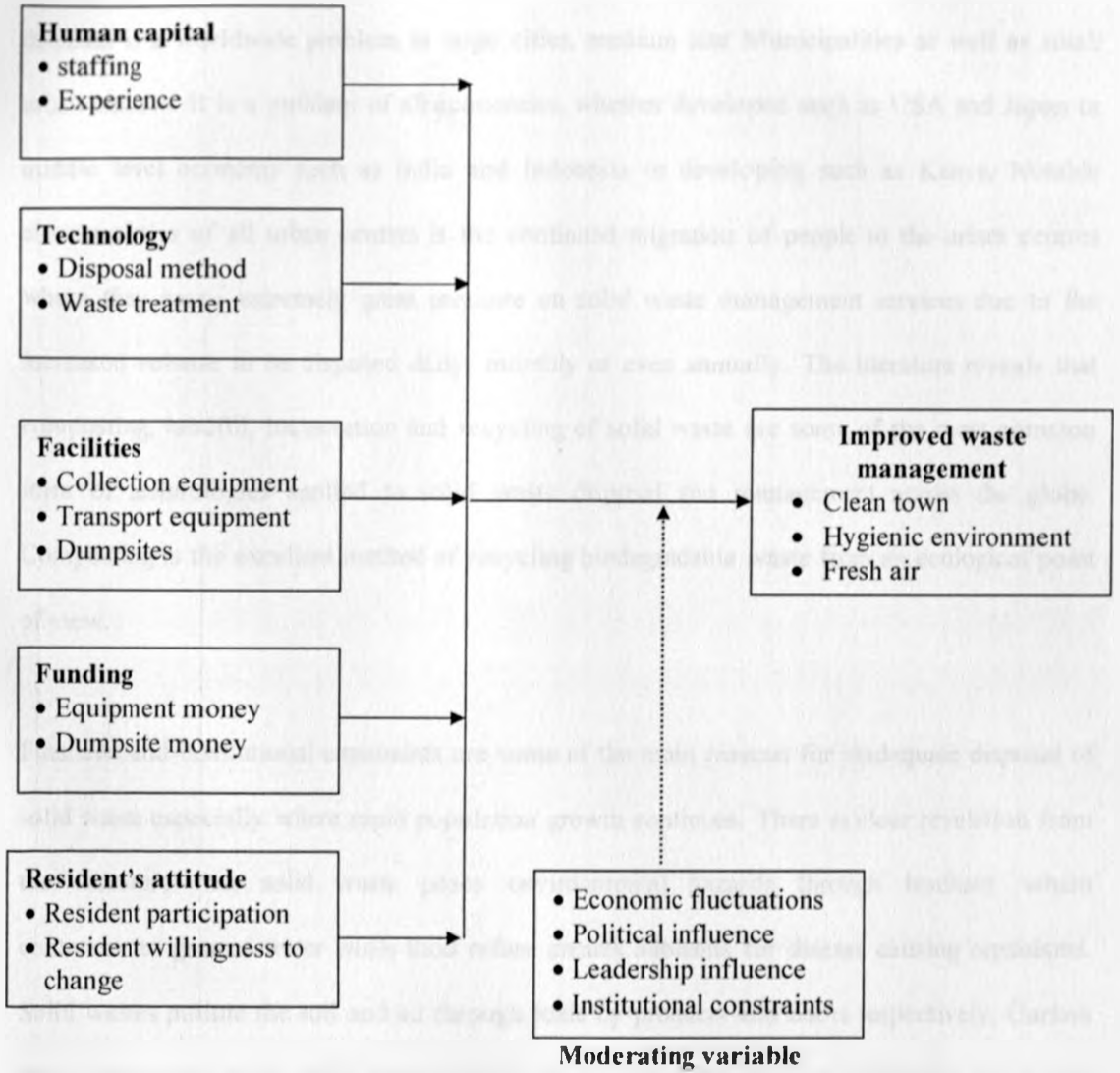
Institution issues include the current and intended legislation and the extent to which it is enforced. Standards and restrictions may limit the technology options that can be considered. The policy of governments regarding the role of the private sector (formal and informal) should also be taken into account. The strength and concerns of trade unions can also have an important influence on what can be done. In conclusion, there are various approaches to addressing and/or affecting the SW problem. Each country needs to study its situation and adapt approaches that are appropriate to its situation. This study will however endeavor to establish factors affecting effective solid waste management in Garissa municipality, Kenya

### **2.11 Conceptual Framework**

The Figure below shows the relationships between the independent, dependent and moderating variables. These have been identified as variables that influence disposal of solid waste in most of the Municipalities of developing countries such as Kenya. This structural model shows that the manpower (human capital), technology, facilities, funding and attitude of the residents toward waste disposal, all play a key role in influencing sold waste disposal. Equally important are the moderating variables which are directly or indirectly influencing solid waste disposal. This include: economic fluctuations, political, leadership and institutional constraints.

**Independent Variables**

**Dependent Variable**



**Figure 2.1: Conceptual Framework**

Source: Researcher (2012)

## **2.12 Summary of Reviewed Literature**

From the empirical literature review it was revealed that there was evidence that solid waste disposal is a worldwide problem in large cities, medium size Municipalities as well as small urban centers. It is a problem of all economies, whether developed such as USA and Japan or middle level economy such as India and Indonesia or developing such as Kenya. Notable characteristics of all urban centers is the continued migration of people to the urban centres where they cause extremely great pressure on solid waste management services due to the increased volume to be disposed daily, monthly or even annually. The literature reveals that composting, landfill, incineration and recycling of solid waste are some of the most common form of technologies applied to solid waste disposal and management across the globe. Composting is the excellent method of recycling biodegradable waste from an ecological point of view.

Financial and institutional constraints are some of the main reasons for inadequate disposal of solid waste especially where rapid population growth continues. There is clear revelation from the literature that solid waste poses environmental hazards through leachate, which contaminates ground water while food refuse creates habitats for disease causing organisms. Solid wastes pollute the soil and air through toxic by-products and odors respectively. Garissa Municipality like many other municipalities faces solid waste disposal challenges due to the rapid growth of businesses and population. However there was no up to date documented information, descriptive or statistical on solid waste disposal and its related management elements.



## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter discusses of the designs and methodologies that the researcher adopted in carrying out his study. It stipulates the systematic research procedure and techniques the researcher applied in the collection and analysis of data. It also describes the sample and the instruments used in data collection and analysis.

#### **3.2 Research Design**

Research is a careful search or to search again, which is capable of withstanding close examination and is aimed at gathering information, which can be used to produce or to enhance knowledge. As pointed out, aggregation of knowledge almost always follows two paradigms (1) quantitative (positivist), (2) qualitative (inter-pretivist) approaches. Solid waste investigation has a very broad outlook overlapping several academic disciplines from the applied to the social sciences. As a result of this overlapping nature, data generated from waste investigations often vary from finite statistical data to the more general descriptive information common with human subject investigation. For this reason, this research adopted aspects of both quantitative and qualitative research approaches.

In the course of this study, the quantitative approach involving waste physical characterization and questionnaire survey was utilized to analyze waste samples as well as understand the nature of the barriers and success factors affecting solid waste management in the case study area. The qualitative approaches namely, focus group discussions, one-on-one discussion with municipal officials and participant observation was however utilized to generate other useful supporting data especially from human subjects so as to strengthen quantitative evidence.

### 3.3 Research Design

This research adopted a descriptive research design. An in-depth investigation was undertaken and the results obtained could be used for any other urban centre sharing similar characteristics with Garissa Municipality. Descriptive research does not fit neatly into the definition of either quantitative or qualitative research methodologies, but instead it can utilize elements of both, often within the same study. The term descriptive research refers to the type of research question, design, and data analysis that will be applied to a given topic. Descriptive statistics tell what is, while inferential statistics try to determine cause and effect. Descriptive research design can acquire a lot of information through description. It is useful for identifying variables and hypothetical constructs which can further be investigated through other means.

### 3.4 Target Population

The target population consisted of employees of Garissa municipal council.

**Table 3.1: Categories of Target Population**

Categories of population	Population
Council Management	5
Council employees	10
The employees working in council health department	5
Selected Stakeholders	7

### 3.5 Sample and Sampling procedure

This researcher adopted probability and purposive sampling methods. A sample of respondents was selected using both stratified sampling and simple random sampling technique. This method was used because each element of the target population was supposed to have an equal

chance of being selected. It offered the researcher the advantages of being able to calculate the sampling error of measurement and able to give a significant level of confidence.

The ultimate test of a sample design is the characteristic of population it represents. In its measurement term the sample must be valid. The validity of the sample depends on accuracy and precision of the sampling procedures. The researcher used random probability sampling design to identify the respondents from the Municipal while he utilized purposive sampling to identify key stakeholders from Garissa Municipality community. Once the population of Garissa Municipal Council was established, the research used the sampling guide (see appendix I), adopted from Kathuri N.J and Pals DA (1993), to determine the sample size.

### **3.5.1 Sample Size**

The sample size was determined by the use of the sampling table guide. It was used to determine the needed size of a randomly chosen sample from a given finite population of N cases such that the sample proportion P was within plus or minus 0.5 of the population proportion P with a 95 percent level of confidence.

### **3.5.2 Sample Frame**

A sample frame was developed from the sample for the randomly selected respondents for this study. The sample size for each category of respondents was based on the approximate total population of that category.

### **3.6 Data Collection Instruments**

Primary data was collected and used for this study. The researcher used structured and semi-structured questionnaires, interviews and observations. The questionnaire's elements were both closed ended and open-ended type. The open-ended questionnaires were used to collect data about the general view of constraints of solid waste management and face-to-face interview was used to collect interactive data to allow the researcher to probe for responses and clarify any ambiguities. Such a probe facilitated collection of more in-depth information and minimizes misinterpretations and inconsistencies.

Personally administered questionnaires were also be used. This helped to establish rapport with the respondents. The collected data was edited to ensure consistence across respondent and locate omissions.

#### **3.6.1 Piloting**

The questionnaires were piloted on a selected sample of the selected respondents, especially of the municipal employees. Questions that were interpreted differently during pre-testing were rephrased so that they could have the same meaning to all respondents. Also comments that were made by respondents during pre-testing were analyzed and considered so as to improve the questionnaires which were finalized and distributed to respective respondents. The pre-testing of questionnaires was conducted in similar procedure like the one which was used during the actual data collection. The pilot study was conducted in order to enhance the validity of the questionnaires.

### **3.6.2 Instrument Validity and Instrument Reliability**

So as to improve validity of the instruments the researcher first pre-tested the questionnaire in a pilot study. The responses from the pilot study were used to guide the researcher in making necessary changes and corrections in the questionnaire in order to enhance its validity. To test reliability test-re-test method was used in which the same test was given to the same people after a period of two/three weeks. The reliability of the test (instrument) can be estimated by examining the consistency of the responses between the two tests.

### **3.7 Data Collection Procedures**

The researcher first worked on the questionnaires before approaching the targeted area's administrative authorities, to provide permission to conduct the research. Once permission was granted, questionnaires were distributed to those respondents who could not make time for a face to face interview and booking face to face interviews to those who had the time. On the first day of the research, questionnaires were issued to the respondents who had been selected and were collected after three days. The face-to-face interviews were performed a day following the collection of the disseminated questionnaires.

### **3.8 Data Analysis Technique**

During this study, questionnaires were edited for completeness and consistency. Quantitative and qualitative methods were used for data analysis. Data was tabulated and classified into sub-samples for common characteristics. Responses were coded to facilitate basic statistical analysis. Descriptive statistics were used to answer the research questions and objectives in relation to the research area. The simplest way to present data is in frequency or percentage Tables, which summarizes data about a single variable. Quantitative data was analyzed using a computer programme; the statistical package of social sciences (SPSS). Frequencies were

converted into percentage for easier interpretation, analysis and presentation of the findings of the research.

<b>Variables</b>	<b>Operational indicators</b>	<b>Measures</b>
Manpower	<ul style="list-style-type: none"> <li>- Better collection of solid waste</li> <li>- collection frequency Improved</li> <li>- cleanliness of Municipality improved</li> <li>- understanding of SW problems</li> <li>- staff members directly involved in SWM</li> <li>- department dedicated SWM</li> </ul>	Nominal Ordinal
Technology	<ul style="list-style-type: none"> <li>- Effective disposal of solid Waste</li> <li>- Methods of disposal improved</li> <li>- Management of waste improved</li> </ul>	Ordinal
Facilities	<ul style="list-style-type: none"> <li>- Better transportation to dump sites</li> <li>- Rate of waste collection improved</li> <li>- Number of waste trucks increased</li> </ul>	Nominal Ordinal
Funding	<ul style="list-style-type: none"> <li>- Adequate employment</li> <li>- Purchasing of equipment improved</li> <li>- Technology improved</li> </ul>	Interval Ordinal Nominal
Attitude	<ul style="list-style-type: none"> <li>- Participation by the community</li> <li>- Perception of clean environment</li> <li>- Cooperation in activities for solid waste disposal.</li> </ul>	Ordinal Nominal Interval

**Table 3.1: Operational Definition of Variables**

Source: Researcher (2012)

Table 3.2 above shows the operational indicators used during the investigation of the factors influencing solid waste in Garissa Municipality. The manpower or staffing (human capital) is the size of the employment in the municipal council. Inadequate number of workers implies poor waste collection and disposal in Garissa Municipality. The indicator for manpower

includes frequency of waste collection, cleanliness of the Municipality and the staffing in a department of the municipal council dedicated to SWM.

The technology is the method that is used to handle the solid waste. Untreated solid waste poses environmental hazards. Technology for solid waste management depends on the ability of a particular Municipal Council to install it. The common ones include landfill, incineration, composting and recycling. Facilities for solid waste disposal include transportation facilities such as handcarts, wheelbarrows, pickups, trailers pulled by tractors and especially waste design trucks. The indicators for facilities include improved transportation of solid waste, frequency of waste collection and the number of trucks, pickups and handcarts visibly in use.

Funding enables the council to purchase the necessary facilities for collecting and transporting the solid waste to the dump sites. Without sufficient finances the council would encounter difficult challenges in disposing the solid waste. Money is needed to purchase equipment, such as garbage trucks, to construct dump sites and for provision of waste bins. The attitude of the residents of the Municipality can be either positive or negative towards participation in the management of the solid waste. Residents can show positive attitude by picking the solid waste e.g. paper and placing it in the waste bins. Improved waste disposal is dependent on improved manpower, resident's attitude, funding, disposal methods and facilities required to handle the ever increasing volume of the solid waste. The indicator for the dependent variable is a clean and hygienic environment, free from unsightly sites of garbage heaps and polluted air. The moderating variables are those factors that could determine or influence indirectly the success or failure of disposal of solid waste in Garissa Municipality. These include economic fluctuations, political influence, leadership and intuitional constrains.

### **3.9 Ethical Issues**

The respondents were requested not to reveal their identities so as to encourage them to be honest and truthful. This was also meant to remove biasness during data analysis. The researcher was careful not to hurt the feelings of the respondents. Courteous language was used in the face to face interaction to motivate the respondents in answering the questions directed to them. All the information given was treated in total confidentiality.

### **3.10 Summary**

This chapter presents a description of the study design, target population, sampling methods and procedures, description of the research instruments and generation of the data for the current study.



## CHAPTER FOUR

### DATA ANALYSIS, PRESENTATION AND INTERPRETATION

#### 4.1 Introduction

This chapter presents an analysis the results of the research. It tries to connect the questions of the study, the objectives and the literature reviewed. The chapter is organized in sections covering bio-data (gender, age, academic achievements, employment) and factors influencing solid waste disposal (sources of waste, residents' attitude towards organized and hygienic waste disposal, number of employees of the municipal council fully dedicated to solid waste management, facilities used by the council to transport solid waste, potential causes of poor solid waste management among others)

#### 4.1 Response Rate

With a target population of 27 respondents, it was only prudent to administer questionnaires to all of them. Out of the 27, the researcher was able to carryout a one-on-one interview with 22 of the respondents, while the other five where interviewed via the phone due to their busy schedules. Thus, all the council managers, employees in the cleansing department and other employees were interviewed on one-on-one having camped at the municipal offices for five days.

**Table 4.1: Response Rate**

Response Rate	Frequency	Percent
Issued	27	100.0
Returned	27	100.0

Source (Researcher, 2012)

## 4.2 Demographic characteristics of respondents

During the study, respondents were asked to state their bio-data information in order to establish whether it influenced solid waste management in the Municipality. This was in terms of gender, age, education level and where they are employed. The findings are as presented below.

### 4.2.1 Gender

The study sought to find out the distribution of the respondents by gender to find out which gender is the majority in Garissa municipal council. The findings are presented in the Table 4.2:

**Table 2.2: Distribution of respondents by Gender**

<b>Gender</b>	<b>Frequency</b>	<b>Percent</b>
Male	21	77.8
Female	6	22.2
<b>Total</b>	<b>27</b>	<b>100.0</b>

Source (Researcher, 2012)

Table 4.2 reveals majority of the respondents were males (77.8%). Of the total number of respondents, only 22.2 percent were females. Surprisingly, none of those in the management level or from the key stakeholders was a female. Females were only concentrated as normal council employees or in the department of cleansing. To be noted as well is that the females were in positions that are not vital in decision making within the council. The findings give an implication that at Garissa municipal council there is no gender equality in the councils management.

#### 4.2.2 Age of Respondents

Because of differences in the peoples' age groups, the study sought to find out age brackets of the respondents so as to know which bracket are the majority at CIMC. The results are shown in Table 4.3:

**Table 4.3: Distribution of the respondents by age**

AGE	Frequency	Percent
Below 25 years	0	0.0
26-35 years	0	0.0
35-45 years	10	40.0
46-55 years	14	50.0
56 and above	3	10.0
<b>Total</b>	<b>27</b>	<b>100.0</b>

Source (Researcher, 2012)

The response for this part was amazing. This is because none of the respondents was below 35 years old. 40% of the respondents were in the age bracket of 35 - 45 years, while 50% were in the age bracket 46-55 years and the rest above 55 years old. In fact, all the council managers were in the age bracket of 46-55 with one above 55 years.

### 4.2.3 Academic Achievements of Respondents

The study sought to find out the education level of the respondent. The results are shown in the Table 4.4:

**Table 4.4: Distribution of Respondents based on Education Level**

Categories	Council managers	Council employees	Council Health Dept	Key Stakeholders	Total
	(%)	(%)	(%)	(%)	(%)
No education at all	0(0)	0(0)	4(80)	0(0)	4 (14.8)
'O'- level (K.C.S.E)	0(20)	4(40)	1(20)	0(0)	5(18.5)
'A'-level	1(20)	2(20)	0(0)	0(0)	3(11.1)
Professional certificate	1(20)	2(20)	0(0)	0(0)	3(11.1)
Diploma	2(40)	2(20)	0(0)	0(0)	4(14.8)
Bachelor's Degree	1(20)	0(0)	0(0)	3(42.9)	4(14.8)
Master's Degree	0(0)	0(0)	0(0)	4(57.1)	4(14.8)
Any other	0(0)	0(0)	0(0)	0(0)	0(0)
<b>Total</b>	<b>5</b>	<b>10</b>	<b>5</b>	<b>7</b>	<b>27</b>

Table 4.4 shows only one of the council managers had a degree (20%) with other two being holders of diplomas (40%). But none of the other council employees had a bachelor's degree, with only two being holders of diplomas (40%). The health department had only twenty two employees with only one have attained KCSE level of education (20%), while the rest (80%) had no education at all; in fact communicating in one of the national languages (Kiswahili or English) is a problem. These statics tells us that the council is ill prepared professionally. A closer look reveals that the so-called department of health, which is the one concerned with cleaning the town of Garissa (waste management), is filled with employees who have attained very low education level or no education at all. This tells the importance attached to the department, because, if it was a department that was considered as being important in the affairs of the council, it could be seen to attract highly educated people as well as having a higher number of employees. With few lowly educated people in the department, it is difficult to have

any meaningful decisions being made, neither is it possible to have an indigenous strategic plan of waste management being developed from within the council.

### **4.3 Factors Influencing Solid Waste Disposal**

#### **4.3.1 Major Source of Solid Waste**

The researcher also sought to know the major sources of waste in the municipality. The researcher had prompted the respondents by identifying sources such as domestic, business, industrial / manufacturing and other sources, whereby a respondent was supposed to specify he chose "other sources"

Of interest is that "other sources were repeatedly named by individual respondents who identified the issues of plastic water bottles disposal and polythene bags as big source waste. Garissa being a fairly hot town, people depend on bottled water to quench their thirst. The biggest problem with this trend is that people throw the empty bottles anywhere they reach, making Garissa town an eyesore. To make matters worse, nobody is in the business of reclaiming or recycling the plastic bottles. Apart from the plastic bottles, domestic sources were also linked with organic and polythene bags. It was stated that many people go for shopping with no basket to carry their items; hence they end up shopping using polythene bags, which are discarded as soon as the items arrive in the house. These could easily be confirmed with flowery polythene bags on the trees plastic bottles littering every corner of Garissa municipality. Thus, "other sources" received an equal backing of 70% with domestic sources. Business and industrial sources received a backing of 30% of all the respondents.

**Table 4.5: Sources of wealth**

<b>Wealth</b>	<b>Frequency</b>	<b>Percent</b>
Domestic sources	18	70.0
Business sources	8	30.0
Industrial sources	8	30.0
Other sources	81	70.0

Source (Researcher, 2012)

#### **4.3.2 Residents' General Attitude towards Organized and Hygienic Waste Disposal**

During the research, the researcher also wanted to know the feeling of the respondents towards the municipal's residents' attitude towards organized waste disposal method. In this, do the general opinion, receiving 100% support was that majority of the municipal residents (don't respect or do in the affirmative) respect organized waste management. In that regard, they do not care who or how waste is managed. They respondents reported that the residents have the attitude that "the municipal is there to keep the town clean, because they pay taxes" This could also be connected to the problem of people dropping plastic bottles/bags everywhere and anywhere in the town, hence the general feeling "by the municipal residents that they do not have a role to play in waste management".

This calls for professionals to be employed in the department of health so that they could initiate awareness programmes to make the municipal residents know their role in waste management as well as initiating sustainable waste management programmes.

Table 4.6 shows the response of the participants on the issue of community involvement in evolving solid waste management policy.

**Table 4.6: Community involvement**

<b>Community involvement</b>	<b>Frequency</b>	<b>Percent</b>
Involved	20	74.1
Not involved	7	25.9
<b>Total</b>	<b>27</b>	<b>100.0</b>

Source (Researcher, 2012)

According to UNEP (1999) broad public participation in decision-making is an important concept of sustainable development. This is because it is combined with greater accountability. The belief is that the communities are the best source of knowledge about the cause of and remedies for many of the environmental problems. Public participation enables such knowledge, skills and resources to be mobilized and to be fully employed so that government initiatives are effective (UNEP, 1999).

#### **4.3.3 Human capital influence on solid waste management**

There was no debate on this question. The number is as indicated in the study, that there were only fifteen employees engaged in solid waste management at any given time which is not adequate to handle solid waste disposal effectively. The key stakeholders indicated that they were not sure of the number, but had a feeling that they felt that there was inadequate number of employees dedicated to waste management within the municipality. The municipal council currently has total of 22 staff in charge solid waste management, 1 public health officer and one sanitation officer. The respondents however indicated the council requires 100 staff for solid waste management to effectively manage solid waste in Garissa County.

The municipality owns two vehicles (an open 10-ton truck and two tractor drawn trailers) to collect and dispose the solid waste. The council requires 10 ten tonners or 14 seven tonners truck to enable it manage solid waste disposal effectively, so far amount of waste collected is about 30 tons a day. The waste, at times, is blown away by wind from the open truck and tractor trailers, resulting in pollution of the environment. Upon arrival to the dumpsite, scavengers mobbed the vehicles and were observed jumping and clinging precariously onto the truck and tractor trailers before they off-load their cargo. All waste collected was disposed of at the municipality dumpsite.

The municipality uses the open dumpsite type of waste disposal. The dumpsite was located about five (5) kilometers out of the town. The choice of the dumpsite was prompted by its proximity to the town and settlements and not as a measure for land reclamation through land filling. The site also took into account the prevailing wind. (north easterly). In view of the town expansion in the direction of the dumpsite, the city council intended to relocate the dump site to a landfill. The council has no special procedures laid for disposal of all industrial wastes, whether toxic or not. The municipal council is involved in partnership with 2 local private waste management companies licensed by ENKA-NEMA.



#### 4.3.4 Methods of solid waste storage by Garissa residents

The study sought to find out the solid waste collection receptacles by Garissa residents. The findings are in Table 4.7;

**Table 4.7: Methods of solid waste storage by Garissa residents**

	Frequency	Percentage
	(%)	(%)
Bins	14	51.9
Sacks	0	0.0
Plastic bags	6	22.2
Backyard pit	25	92.6

Source (Researcher, 2012)

Table 4.7 reveals management highlighted wastes generated by the town are stored in plastic containers and cages awaiting collection by the municipality.

What are the most common methods used by the communities in solid waste disposal?

The study also sought to find out methods used by communities in solid waste disposal. The findings are indicated in Table 4.8:

**Table 4.8: Methods used by communities in solid waste disposal**

	Frequency	Percentage (%)	Rank	Status
Burning	25	92.6	1	illegal
Dumping	27	100.0	2	illegal
Door collection	7	25.9	3	legal
Skips	20	74.1	4	legal

Source: Researcher (2012)

Table 4.8 reveals that dumping which is illegal as per the environmental act is the most common method used by the community in solid waste disposal as indicated by all respondents

(100.0%). Majority of the respondents also indicated the community engages in open burning (92.6%) which is illegal and skips (74.1%) as methods used by communities in solid waste disposal in Garissa County.

As seen from the table above, generally, both legal and illegal approaches are being used. The legal approaches involve door collection or depositing the garbage at the skips from where it is collected and taken to the landfill. The illegal approaches involve such practices as burning and open space dumping which seem to be the most prominent as indicated by rankings above. The people use illegal methods for some reasons. Some claim that it is because the Skips were withdrawn. Others claim that they cannot afford the user fee. While other say that they were not involved in initiating this new approach and so they do not understand its rationale, especially when they pay taxes.

The study further sought to find out how often the council collects waste in the residential areas. The results are shown in the table below:

**Table 4.9: Frequency of waste collection in residential areas**

Frequency	Frequency	Percent
Daily	0.0	0.0
Thrice a week	0.0	0.0
Twice per week	8	29.6
Once per week	25	81.9
<b>Total</b>	<b>27</b>	<b>100.0</b>

Source (Researcher, 2012)

Table 4.9 reveals that the council collects waste in residential areas once per week (81.9%).

The study further sought to find out from the respondent the waste disposal methods commonly used by households in the area. The results are shown in the table below:

**Table 4.10: Waste handling practices at household level**

Frequency	Frequency	Percent
Burning	15	55.5
Burying/open pit	18	67.0
Illegal dumping	27	100.0
Compositing	15	55.5
<b>Total</b>	<b>27</b>	<b>100.0</b>

Source (Researcher, 2012)

The table reveals all respondents indicated illegal dumping (100.0%) as the commonly used waste handling practice at household level. As a result, households are using other methods to dispose their household waste, which include; burning, dumping in open pits and/or burying at home; illegal dumping in the street corners or storm drains and compositing and activities that pose hazards to the environment and increase the health risk of the residents. Fumes from burning wastes cause acute respiratory infections and the odors of the fumes made the residential environment uninhabitable. Open waste dumps are prime breeding sites for houseflies, rodents, mosquitoes, and other vectors of communicable diseases, such as fever, dysentery, diarrhea, cholera and malaria.

#### **4.3.5 Extent technologies used in solid waste management influences waste management**

The study sought to find out from the respondents if the council has sufficient technology for effective solid waste management. The findings are in the table below;

**Table 4.11: Sufficiency of technology**

<b>Technology</b>	<b>Frequency</b>	<b>Percent</b>
Yes	2	7.4
No	25	92.6
<b>Total</b>	<b>27</b>	<b>100.0</b>

Source (Researcher, 2012)

Table 4.11 reveals that majority of the respondents (92.6%) indicated that Garissa municipal council does not have sufficient technology required for effective solid waste management.

The study further sought to find out from the respondent the reason why Garissa municipal council does not have the technology required to provide effective solid waste management.

The results are shown in the table below:

**Table 4.12: Reasons for lack of technology**

	<b>Frequency</b>	<b>Percent</b>
Cost of systems	27	100.0
Lack of necessary internal skills	20	100.0
Management uncertain about investment	27	100.0
Lack of available information about relevant technologies	23	85.2
Lack of top management support/direction/planning	27	100.0
Employees satisfaction with traditional technologies	27	100.0

Source (Researcher, 2012)

Table 4.12 reveals all respondents (100.0%) indicated cost of systems, lack of necessary internal skills, uncertainty by management on investment, lack of top management support and lack of

available information about relevant technologies as reasons for lacking sufficient technologies for solid waste management.

To what level do you agree with the following statements in regard to ICT adoption at Garissa municipal council. On a scale of one to five, where; 5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1 = Strongly Disagree

**Table 4.13: Statements regarding ICT adoption at GMC**

	Strongly Agree 5 (%)	Agree 4 (%)	Neutral 3 (%)	Disagree 2 (%)	Strongly Disagree 1 (%)
In our organization we need computers to do our work	100.0	0.0	0.0	0.0	0.0
Most of the staff use the internet on a daily basis	0.0	20.0	20.0	60.0	0.0
In our organization we use ICT to share information	0.0	0.0	0.0	0.0	0.0
In our organization we use ICT to collect information	0.0	0.0	0.0	100.0	0.0
Our employees are encouraged to use e-mail	0.0	0.0	0.0	100.0	0.0
Our employees are encouraged to use the internet	0.0	0.0	0.0	100.0	0.0
Our organization should support professional (skill) development better	100.0	0.0	0.0	0.0	0.0

The table reveals all respondents strongly agreed the need for computers at the council to do their work and the council should support professionalism development. However all respondents disagreed that the council uses ICT in collecting information and employees are encouraged to use email and the internet in their work. The findings on technology are related to education levels at the council and funding.

#### 4.3.6 Reasons for poor solid waste management

The study sought to find out the level of agreement on the reasons for poor solid waste management. The findings are revealed in Table 4.11;

**Table 4.14: Level of agreement on the reasons for poor solid waste management**

	Strongly agree (%)	Agree (%)	Indifferent (%)	Disagree (%)	Strongly disagree (%)
Due to understaffing	100.0	0.0	0.0	0.0	0.0
Due to lack of education	100.0	0.0	0.0	0.0	0.0
Due to poor supervision	91.5	8.5	0.0	0.0	0.0
Due to lack of appropriate disposal facilities	75.0	25.0	0.0	0.0	0.0
Due to lack of residents support	100.0	0.0	0.0	0.0	0.0

Source: Researcher (2012)

Table 4.14 reveals majority of the respondents strongly agreed to understaffing (100.0%), lack of education (100.0%), poor supervision (91.5%), lack of appropriate facilities (75.0%) and lack of resident's support (100.0%) as reasons leading to poor solid waste management in Garissa Municipality.

#### 4.3.7 Rating factors influencing solid waste disposal

The study sought to find out the level of agreement on the factors influencing solid waste disposal. The findings are revealed in Table 4.11;

**Table 4.15: Level of agreement on the reasons for poor solid waste management**

	Great extent (%)	Some extent (%)	Little extent (%)	No extent (%)	Rating *
The manpower in waste disposal	100.0	0.0	0.0	0.0	1
Technology used in solid waste disposal	100.0	0.0	0.0	0.0	5
Facilities available at the council	100.0	0.0	0.0	0.0	2

The funding for waste disposal programs	100.0	0.0	0.0	0.0	4
Attitude of residents towards waste disposal	100.0	0.0	0.0	0.0	3

Source: Researcher (2012)

Table 4.15 reveals all respondents agreed to; manpower in waste disposal (1), facilities available at the council (2), attitude of community towards waste disposal (3), funding for waste disposal programs (4) and technology used in solid waste disposal (5) as factors influencing solid waste disposal ranked in that order.

#### 4.4 Summary

The researcher targeted 27 respondents, of which 22 were to be from the Municipal Council of Garissa, while the remaining five were Key stakeholders. Interestingly, all those approached were willing to participate in the study. The willingness of all to participate in the research can be attributed to the fact that the issues of solid waste management is slowly but surely getting out of hand in Garissa. Hence, the municipal council of Garissa and other key stakeholders are keen to listen to anybody who might come up with a sustainable solution to the problem.

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

**5.1 Introduction**

The basic purpose of this chapter is to give the summary, conclusions and recommendation of the study. This was based on the research findings that is presented and discussed in the previous chapters.

**5.1 Summary of Findings**

This study aimed at ascertaining factors influencing solid waste disposal and management in Garissa Municipality. The task included; establishing whether the size of human capital directly influences solid waste management in Garissa Municipality, finding out extent to which methods used in collection and disposal influences solid waste management in Garissa Municipality, establishing to what extent technologies used in solid waste management influences waste management in Garissa Municipality and establishing the extent to which community attitude influences Solid Waste Disposal and Management in Garissa Municipality

The researcher reviewed previous studies with a view to establish academic gaps which the present study sought to bridge. This was done through library research. The procedure included: reading, evaluating the methodology employed in terms of design choice, target population, sample and sampling procedure data collection instruments (that is suitability, validity and reliability), data collection procedures, data analysis, findings and recommendations. The researcher benefited so much from the literature review for it guided the present study by pointing to areas that needed to be investigated.



This study employed quantitative research as the main approach to guide the study. The target population included all Garissa municipal council staff. The research instrument used in data collection was a questionnaire from the respondents. To ensure validity of the instruments, expert opinion was sought. Data analysis was started immediately after the field. Data was summarized into frequencies and percentages presented in tables.

### 5.3 Discussions

This section comprises of discussion based on the specific research objectives of the study.

Of the 27 respondents, only 22.2 percent were females and none of them was in the management level or from the key stakeholders. Females were only concentrated as normal council employees or in the department of cleansing. To be noted as well is that the females were in positions that are not vital in decision making within the council. Noted was that none of the respondents was below 35 years old. Some of the respondents were in the age bracket of 35 - 45 years, while majority were in the age bracket 46-55 years and the rest above 55years old. In fact, all the council managers were in the age bracket of 46-55 with one above 55 years.

In education matters, only one of the council managers had a degree with other two being holders of diplomas. However, none of the other council employees had a bachelor's degree, with only two being diplomas holders. The health department had only five employees a whooping majority having attained no formal education at all; hence communicating in national languages (Kiswahili or English) was a problem.

The researcher also sought to know the major sources of waste in the municipality. The researcher had prompted the respondents by identifying sources such as domestic, business,

industrial / manufacturing and other sources, whereby a respondent was supposed to specify he chose "other sources". Of interest is that "other sources", where individuals, was repeatedly named. By individuals, the respondents identified the issues of plastic water bottles disposal and polythene bags. Garissa being a fairly hot town, people depend on bottled water to quench their thirst. The biggest problem with this trend is that people throw the empty bottles anywhere they reach, making Garissa town an eyesore. To make matters worse, nobody is in the business of reclaiming or recycling the plastic bottles. Apart from the plastic bottles, domestic sources were also linked with organic and polythene bags. It was stated that many people go for shopping with no basket to carry their items; hence they end up shopping using polythene bags, which are discarded as soon as the items arrive in the house. These could easily be confirmed with flowery polythene bags on the trees plastic bottles littering every corner of Garissa municipality.

It was also established that majority of the municipal residents don't respect organized waste management. In that regard, they do not care who or how waste is managed. They respondents reported that the residents have the attitude that "the municipal is there to keep the town clean, because they pay taxes!" This could also be connected to the problem of people dropping plastic bottles/bags everywhere and anywhere in the town, hence the general feeling "by the municipal residents that they do not have a role to play in waste management"

## **5.2 Conclusions**

Based on the findings of the study, the following main conclusions were made for factors influencing solid waste disposal and management in Garissa Municipality.

The study affirms that understaffing, lack of education, poor supervision, lack of appropriate facilities and lack of resident's support are among reasons leading to poor solid waste

management in Garissa Municipality. The study also found that manpower in waste disposal (1), facilities available at the council (2), attitude of community towards waste disposal (3), funding for waste disposal programs (4) and technology used in solid waste disposal (5) are factors influencing solid waste disposal ranked in that order.

The study found that there were only five employees in solid waste disposal department which is not adequate to handle solid waste disposal effectively. Inadequate number of workers implies poor waste collection and disposal. The indicator for manpower includes frequency of waste collection, cleanliness of the Municipality and the staffing in a department of the municipal council dedicated to SWM.

The study reveals that the council is ill prepared professionally. A closer look reveals that the so-called department of health, which is the one concerned with cleaning the town of Garissa (waste management), is filled with employees who have attained very low education level or no education at all. This tells the importance attached to the department, because, if it was a department that was considered as being important in the affairs of the council, it could be seen to attract highly educated people as well as having a higher number of employees. With few lowly educated people in the department, it is difficult to have any meaningful decisions being made, neither is it possible to have an indigenous strategic plan of waste management being developed from within the council.

The study found that the municipal council of Garissa lacks technology that is used to handle the solid waste. Untreated solid waste poses environmental hazards. Technology for solid waste management depends on the ability of a particular Municipal Council to install it. The common ones include landfill, incineration, composting and recycling. Facilities for solid waste disposal

include transportation facilities such as handcarts, wheelbarrows, pickups, trailers pulled by tractors and especially waste design trucks. The indicators for facilities include improved transportation of solid waste, frequency of waste collection and the number of trucks, pickups and handcarts visibly in use.

The study also found that Garissa municipal council lacks proper funding to enable it purchase the necessary facilities for collecting and transporting the solid waste to the dump sites. Without sufficient finances the council encounters difficult challenges in disposing the solid waste.

The study findings found that the respondents, who are mostly council employees, indicated that the municipality residents have a bad attitude towards waste management, but it is lost on them that nothing has been done to change the attitude. Residents can show positive attitude by picking the solid waste e.g. paper and placing it in the waste bins. Improved waste disposal is dependent on improved manpower, resident's attitude, funding, disposal methods and facilities required to handle the ever increasing volume of the solid waste. From literature review the indicator for the dependent variable is a clean and hygienic environment, free from unsightly sites of garbage heaps and polluted air.

From the study findings it can be concluded that human capital, level of technology, funding, facilities available and community attitude are factors influencing solid waste disposal and management in Garissa Municipality.

### **5.3 Recommendations**

The study gives the following recommendations towards solid waste management in Garissa municipal council;

#### **5.5.1 Recommendations for improvement**

On the basis of the above, conclusions, the following recommendations were made for the factors influencing solid waste disposal and management in Garissa Municipality.

The study recommends that the council should initiate immediately is an audit of its employees. This should be done by a very independent and competent firm like Price Water Coopers (PWC). Such an audit should also come up with recommendations of the qualifications of those who should work in different departments, the optimal number and duties. Implementation of the following points will depend, and is tied on hiring competent staff, particularly in the department of health and/or cleansing.

The study also recommends that the council should develop specific legislation, by laws and regulations, to regulate solid waste management and disposal within the municipality it is important that the full impact of individual legislative or regulatory provisions be monitored after the program has been implemented through effective enforcement department. That process must continually ensure that the plan mirrors reality and that implementation obstacles are addressed expeditiously

The study further recommends that a variety of programs and policies can be used to encourage or require participation in waste reduction. The central government and local governments have the ability to implement measures that will reduce the amount of waste generated, including: restrictions on packaging and products, establishing procurement guidelines, bans on the

disposal of certain materials and products, legislation requiring manufacturers to meet certain packaging and product guidelines, taxes proportional to material use and waste fraction of a product, outreach and education programs, information clearinghouses and need for waste audits and the development of source reduction plans

Finally the study recommends that materials and items that are compostable, recyclable, repairable, or large in quantity and toxicity can be banned or restricted to keep them out of waste disposal systems. Placing bans on materials can encourage consumers and establishments to participate in source reduction activities because of the problems associated with restricted disposal. When a material or product is banned, manufacturers are also pressured to provide items that can substitute for the banned materials

#### **5.6 Suggestions for further studies**

This study sought to determine factors influencing solid waste disposal and management with the case of Garissa Municipality attempting to bridge the gap in knowledge that existed. Although the study attained these, it mainly focused on one municipal council.

Therefore there is need to replicate the study using other municipalities/county councils so as to compare the findings. There is need to conduct a similar study which will attempt to find out the challenges facing Municipal solid waste management in Kenya.

In particular there is need to study the correlation between proper physical planning and solid waste management in Cities and Municipalities of Kenya. Study the volume of waste generated in municipalities as compared to population.

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## 7. APPENDICES

**Appendix I: Sampling guide Table**

N	S	N	s	N	S
10	10	320	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	241	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

N= population size; S= sample size (Adapted from: Kathuri N.J and Pals D A (1993/-

*Introduction to Educational Research. Agricultural Education and Extension. Pg 55.)*

**Appendix II: Letter of Introduction**

**SIYAT OSMAN IBRAHIM**

**L50/67882/2011**

**P. O. Box 542,**

**Garissa**

Dear respondent

**RE: Study of Factors Influencing Solid Waste Management in Garissa Municipality.**

I am a student of University of Nairobi School of Continuing and Distance Education carrying out a study of factors influencing solid waste management in Garissa Municipality.

The questionnaire attached herewith is for gathering requisite information for this research from you. All answers will be treated confidentially.

Do not write your name or any form of identity.

Thank you

**Yours sincerely**

**Siyat Osman Ibrahim**

## Appendix III: Questionnaire for Municipal Council Management and Workers

This questionnaire is designed to gather data about you and your organization to be used in the study of factors influencing solid waste management in Garissa Municipality. Your response will be accorded total confidentiality.

### Instructions

Please do not indicate your name. Kindly put a tick against the appropriate option(s) as honestly as possible. I thank you in advance.

### SECTION A - Bio Data

#### 1. Gender

(a) Male ( )

(b) Female ( )

#### 2. Age bracket

(a) Below 25 years ( )

(b) Between 26 - 35 years ( )

(c) Between 35 - 45 years ( )

(d) Between 46-55 years ( )

(e) 56 years and above ( )

#### 3. Highest academic level

(a) 'O'- level (K.C.S.E) ( )

(b) 'A'-level ( )

(c) Professional certificate ( )

(d) Diploma ( )

- (e) Bachelors Degree ( )
- (f) Masters Degree ( )
- (g) Any other (specify) ( )

4. Position in municipal council

- a) Administrator ( )
- b) Head of section/department ( )
- c) Employee of transport section ( )
- d) Worker in health department ( )
- e) An account clerk ( )
- f) Administrator ( )
- g) Head of section/department ( )
- h) Employee of transport section ( )
- i) Worker in health department ( )
- j) An account clerk ( )
- k) Interested Stakeholder ( )

**SECTION B - Factors influencing solid waste disposal**

5. Which one of the following would you consider to be the major source of solid waste?

- (a) Domestic sources ( )
- (b) Business sources ( )
- (c) Industrial / manufacturing sources ( )
- (d) Other sources (please specify).....

.....



6. In your own opinion, what is the residents' general attitude towards organized and hygienic waste disposal

- (a) Majority of residents respect it ( )
- (b) An average number respect it ( )
- (c) Only a few respect it ( )
- (d) Majority disrespects it ( )

7. Does the municipal involve the community in solid waste management?

- ( ) Yes ( ) No

8. How many employees of the municipal council are fully dedicated to the cleansing department (solid waste management department)?

Please state.....

9. According to your opinion, is the number of staff stated above adequate to handle solid waste disposal effectively?

- (a) Yes ( )
- (b) No ( )

Please explain your answer.....

.....

10. According to your opinion, what is the optimal number of staff needed in the cleansing/solid waste management department?

Please state.....

11. What are the most common methods used by the communities in solid waste disposal?

(please specify) .....

12. Which facilities does the council use to transport solid waste?

(please specify) .....

13. In your opinion is the municipal council equipped with sufficient technology to undertake effective solid waste management?

( ) Yes ( ) No

14. If No to Q.13 kindly give reasons for your choice .....

15. Which one of the following reason(s) could be leading to poor solid waste management in Garissa Municipality according to your knowledge.

Reasons	1	2	3	4	5
a) Due to under staffing					
b) Due to lack of training					
c) Due to poor supervision					
d) Due to lack of appropriate disposal facilities					
e) Due to lack of community support					

**SECTION C - Rating the strength of factor influencing the solid waste disposal**

16. The following are some of the factors, (a) to (e), influencing the solid waste disposal in Garissa Municipality

Please rate the extent to which they influence the solid waste disposal according to your experience and knowledge using the scale 1 to 5 below.

- 1. to great extent
- 2. to some extent
- 3. to a little extent
- 4. not at all
- 5. Not sure

Factors influencing waste disposal	1	2	3	4	5
a). The manpower in waste disposal					
b). Technology used in solid waste disposal					
c). The facilities available to the municipal council					
d). The funding for waste disposal programs					
e). Attitude of the residents towards waste disposal					

**Thank you for your co-operation and honesty.**