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Solid Waste Management in Urban Areas Kenya:

A case study of Lamu Town.

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DECLARATION

This research project is my original work and has never been presented for any award in any other University.

Signature…………………….Date…………………….

Gilbert Omara Monyoncho

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

Signature……………………….Date………………

N.M NZioki

DEDICATION

This work is dedicated to my daughters Sandy, Kim and their grandmother Gesare, more especially for being my sources of   inspiration.

ACKNOWLEDGEMENT.

ABSTRACT

This study set out to establish the actual state of waste management in lamu town, outline success areas and possible barriers to waste management and ultimately propose measures to be undertaken in order to remove those barriers to enhance sustainable waste management in urban areas. The work focuses on types and methods of solid waste management and looks at real impacts of haphazard waste management both on land and water.

The work was undertaken by administering a questionnaire, focused group discussions and observations. Reference was drawn from case studies in other urban areas in developing countries as well as Kenya.

Qualitative data was collected, analyzed and results presented using graphs, tables, photographs and statements.

The study found out that, unlike other urban areas where there is door to door collection of waste, it did not happen in Lamu town. However, it was noted that, despite lack of door to door collection of waste, only a little was visible in the environment

Tourists and investors from the hinterland contributed significantly to the problem of waste. It emerged that presence of waste in the environment affected cost of land and housing negatively. This had a negative impact on the incomes of the property owners.

Whereas presence of animals/donkeys contributed to the problem of waste management through their droppings on the streets, they also ate a huge amount of edible municipal and household organic waste, reducing the amounts going to the dumpsite.

Even though legislation was in place, there were inadequate enforcement plans in place to ensure compliance

The study recommended enactment of County Laws to compel dwellers separate waste at source and get involved in waste management cycle, investing in technologies for energy recovery from waste, covering of open trenches in Lamu town as well as coming up with measures to deal with plastic waste which had become a nightmare in town.

The study suggested further research on the interrelationships between donkeys, people and waste management in Lamu, role of animals in Waste management in urban areas as well as the impacts of the National Museums and cultural Act 2006 on the social and economic development of Lamu town.

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CHAPTER ONE: INTRODUCTION

1.1 Background to the study

The overall goal of urban solid waste management is to collect, treat and dispose of solid waste generated by all urban population groups in an environmentally and socially satisfactory manner using the most economical means available. Local governments are usually authorized to take responsibility for providing solid waste management services and most local government laws give them exclusive ownership over waste once it has been placed outside a home or establishment for collection. As cities grow economically, business activity and consumption patterns drive up solid waste quantities. At the same time, increased traffic congestion adversely affects the productivity of the solid waste fleet. Productivity loss is exacerbated by longer hauls required of the fleet, as open lands for disposal are further and further away from urban centers. The challenge is to rationalize worker and vehicle performance, while expanding services to a growing urban population.

In developing countries, it is not uncommon for authorities to spend 20-50 percent of their available recurrent budget on solid waste management. Yet, it is also common that 30-60 percent of all the urban solid waste in developing countries is uncollected and less than 50 percent of the population is served. In some cases, as much as 80 percent of the collection and transport equipment is out of service and in need of repair or maintenance. In most developing countries, open dumping with open burning are the main methods of waste disposal.

Today, world urban areas which are centers of economic development have become pollution hotspots. The UN conference on Sustainable Development at Rio de Janeiro 1992 popularly known as The Earth Summit called on countries to support social and economic development that takes into account

environmental concerns. Heads of state from different countries pledged political support for the agenda and Kenya was well represented.

For Kenya, major gains have been made at policy level and enactment of legislations such as EMCA 1999 which enhanced formation of regulatory institutions like NEMA, ensures that precautionary principles are applied to mitigate or minimize negative impacts on the environment due to implementation of major projects.

Some of these regulatory measures have been applied in many fields such as in the construction industry, manufacturing, mining and infrastructure development. On matters of waste management, a number of regulations have been formulated by different institutions and applied sparingly thus the impacts have been so minimal. Many municipalities, cities and towns continue to grapple with the problem of Solid Waste Management and the Lamu town in Kenya is no exception.

1.2 Problem Statement.

It is significant to appreciate the fact that in Kenya as well as other developing countries, solid waste in mainly collected and disposed in open dumpsites. It is also important to note that the role of waste management has been relegated to Councils which are the local authorities for urban areas. With increasing urban populations, more waste is generated which strains existing capacity of local authorities to manage. Waste management is not a priority area among the urban poor dwellers, given that they have other urgent needs to address; poverty. Furthermore, in developing countries, waste handling is considered "below acceptable level of dignity". Habitat, (1994)

Poorly maintained equipment and inefficiencies in road design and urban settlement in informal settlements also impedes effective waste management. Additionally, lack of sufficient funds to finance awareness campaigns to encourage waste minimization at source along with minimal workforce impede municipalities' efforts to achieve their vision.

Other obstacles are poor cooperation between the public and private sectors, and inadequate coordination among stakeholders.

Solid waste management is also a non-excludable good as it is difficult to be protected by the general market forces. One way of managing non-excludable goods or services is either by the internalization of costs (by levying charges for the use of the services) or by following a command and control policy or a combination of both. Government intervention is necessary for this. The rationality of the government's intervention can be judged when the costs of producing the good or service decline as more of the good or service is produced and when production or use of the good or service results in "externalities" such as environmental pollution (Macauley and Walls, 1995; Jenkins, 1993). Thus, the major problem for solid waste management is the internalization of costs of waste disposal.

The impacts of waste to the environment, especially non-biodegradables such as plastics cannot be overstated. Land quality is compromised by presence of wastes. Both terrestrial and marine lives are threatened by plastic wastes. Blocked drainage systems and overflowing/burst sewers are sources of diseases that wreck havoc to human health with abandon. The consumer is paying heavy medical bills for diseases which would have been kept at bay if wastes were properly disposed.

Given that government has a duty to protect its people; it has made efforts at policy level to safeguard our living environments together with our health. Non-governmental organizations and individuals too have made attempts to

manage waste on ground. So far, pockets of achievements have been made particularly in recycling some forms of waste; however, with accelerated development, the burden of waste management continues to swell proportionately in urban areas.

This study will evaluate attempts made by various institutions and individuals to address the problem of waste in urban areas, their successes and challenges and ultimately propose means and ways of sustainably addressing the problem in Lamu town.

1.3 Objectives of the Study

The objectives of this work are:

- To investigate the actual state of waste management in Lamu town
- To identify methods of waste management in Lamu town.
- To identify barriers to effective waste management in Lamu town.
- To identify and propose future sustainable waste management strategies for Lamu town.

This work will inform policy makers and further help to remove barriers to waste management in urban areas not only in Kenya but also in other countries in Africa.

1.4 Study Hypothesis

The study made the following hypothesis; *Untidiness of Lamu town is as a result of inefficient solid waste management*. The null hypothesis of the study is, *Untidiness of Lamu town is not as a result of inefficient solid waste management.*

1.5 Research Questions

1. What causes the proliferation of wastes in the environment in Lamu town?
2. How does solid waste affect terrestrial and marine ecosystems?
3. What actions are stakeholders taking to mitigate negative impacts of waste in Lamu town?
4. What factors impede waste management in Lamu?
5. Which regulatory measures have been put in place to effectively manage waste in Lamu town?

1.6 Significance of the Study

Municipal waste in developing countries is such a monumental problem. More especially, plastic waste has already become a serious environmental dilemma in Kenya, particularly in urban areas. Concern has been expressed from many stakeholders ranging from government organizations, environmental NGOs and the public at large.

At policy level, command and control strategies along with economic instruments have been proposed as effective tools to manage wastes (UNEP 2005). Some of these proposals have been implemented however so minimal has been done to resolve the problem of waste in Kenya.

Therefore there is need to identify the barriers to effective waste management and suggest ways to remove them in order to save the environment and human health. This study is essentially meant to contribute to the ongoing efforts in Kenya and the other developing countries to bring about a pattern of sustainable production and consumption of products. It is my hope that this study will contribute to finding a sustainable way of handling the waste menace in Lamu County and indeed the country and beyond.

1.7 Scope of the Study

Solid Waste Management all over the world is a complex problem. However, the main focus of this study is to investigate the extent of waste proliferation, the effects of waste to the terrestrial and marine environments, barriers to effective waste management and propose means to overcome them in Lamu County. Specific interest will be on municipal waste from markets and commercial areas as well as and household waste.

1.8 Definition of Key terms

EMCA- Environmental Management and Coordination Act

NEMA- National Environment Management Authority

LC- Lamu County
NCC- Nairobi City Council

MSW- Municipal Solid Waste.

Local Authorities- Councils charged with provision of services to urban areas. They are classified into City, Municipality, Town and County councils.
SWM – Solid waste management

Waste- anything that the holder discards, intends to discard or is required to be discarded or disposed by the provisions of the Law.

Solid Waste- generally defined as hazardous and non hazardous industrial, commercial and domestic refuse such as organic trash, institutional garbage, street waste, construction rubbles

Stakeholders- those who participate in decision making process including those potentially affected by the decision. It also includes those people who have specific concerns or roles to play in the decision of managing waste.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature of some of the municipalities in the world on strategies adapted to address the problem of waste management in urban areas. Further, an in-depth analysis of the strategies is undertaken to determine their effectiveness with an objective of coming up with the best practice that can be proposed for Lamu Town.

2.2 Country Situation Review

In most African cities, solid waste management policies and programmes were formulated and implemented by government agencies without significant public participation. This was the case until around 1980s. Political and social changes including the rise of civil society, NGOs and organized community based groups CBOs have fostered an increased awareness of environmental issues among the general public. The hierarchy ranks of participatory waste management methods prescribe that it is best to reduce the generation of waste at the source, then recycle and compost what cannot be reduced, and finally incinerate or landfill the remainder. Proposals to take waste management at consumer level have been made such as conducting public awareness and education at all levels of society. Further, enhancing waste management by starting to consider waste as an asset have been proposed.

In the case of Rwanda's fiscal decentralization policies USAID (2004), a lot has been achieved in Waste management. Some of the achievements outlined include; three associations in pilot districts in Kigali routinely collecting refuse from some 10,000 households, while collecting higher tariffs in association with City of Kigali, associations preparing and selling compost and fuel briquettes

using recycled materials, decrease in solid waste sent to the landfill, expected decrease in deforestation as sale of cheaper briquettes reduces demand for charcoal The associations are on verge of achieving sustainability due to increased revenues from tariffs and sale of new products(USAID, 2004).

According to Ian, A. Thompson (2010), Accra has an annual growth rate of 4% making it one of the fastest growing metropolises in Africa. This phenomenal growth has contributed to municipal waste production that far outstrips the city's capacity for containment and processing. This has elicited waste management difficulties that extend from the state to the local municipalities, and refuse of all shapes and sizes is a common site in both urban and rural areas. City waste collection and disposal have been delegated to the private companies with the support of Accra Management Authority.

The Accra Management Authority pays those companies with national budgetary allocations from the state government and internally generated funds. Refuse collection is by either house-to-house or central container collection (Ian, A. Thompson 2010).

In high income neighborhoods, this service is fairly good since waste in collected from door to door and residents do pay for the service. But low income neighborhoods with poor infrastructure receive the service for free. Residents avoid dropping their waste at central collection points because they are unwilling to pay for the service and these constitutes over 80% of the population (Ian, A. Thompson 2010).

In many towns of Nepal, solid waste management is a big challenge. Basically municipalities are giving preferences only on collecting the waste and dumping it. The principles of 3R (waste reduction, re-use and recycle) are not prioritized by the municipalities for effective sustainable waste management. Further,

municipalities have not yet fully recognized the important stakeholders of waste management like NGOs/CBOs and private formal and informal sector which can be involved during the planning, implementation and monitoring for effective waste management (Practical Action Nepal, 2008).

Since the mid-1980's and the introduction of economic structural adjustments, the Kenyan government has been reducing its public spending and this has had adverse effect on urban dwellers. The provision of urban services especially in poor neighborhoods will have to rely on a different approach (Mwangi S.W, 2003).

Waste Management challenges in Kenya's urban areas are not different from other towns in Africa.

The ever increasing population in Nakuru town which has led to an increasing dumping of waste has made the town lose its former reputation of being the "cleanest town in East Africa" (Karanja et al, 2005). The demand for provision of basic services especially water supply, garbage collection and sanitation far exceeds the available supply due to rising urban population and the number of informal settlements. A number of actors need to come together to combine resources in order to address urban challenges including waste management (Karanja et al,2005).

Inorganic waste in Nairobi is comprised of licensed waste dealers who buy from large groups of unregistered individual waste pickers and neighborhood based itinerant waste traders who sell in bulk to large scale waste recyclers (Baud et al, 2004). According to Karanja et al, (2005) waste picking in Nairobi is split into street picking- mainly in small open city waste sites, streets and dustbins; and waste dump pickers- pickers that operate at large formal or informal dumpsites mainly Dandora dumpsite. 20% of pickers and Dandora reside at the dump itself and the streets are home to a significant number of pickers who utilize garbage

as a source of cash and non-cash income. Pickers and dealers earning a living off the recovery and sell of recyclables at the Dandora dumpsite alone number over 2000 (Karanja et al, 2005).

Some of the challenges affecting waste management in Nairobi include; lack of physical capacity to manage waste and financial limitations.

Issues of waste management in Kisumu city are not different from other cities and urban areas in Kenya. According to UN Habitat (2010), about 500 tonnes of waste is generated per day, out of which 20% is delivered to dumpsites. The city lacks comprehensive response to solid waste management. Coupled with this, there is poor attitude towards waste management and low capacity to offer waste services management at Municipal Council of Kisumu.

2.3 Present approaches to waste management in Kenya.

2.31 Economic Instruments.

The United Nations defines economic instruments as tools or actions which have the purpose of affecting the behavior of economic agents by changing their financial incentives. Economic instruments can be grouped into two categories: revenue- raising instruments (licenses, user charges), and non-revenue instruments (performance-based management contracting, clean neighborhood competitions, privatization). The problem of waste collection is structurally dissimilar from the problem of waste disposal (UNEP, 2005).

The use of appropriate economic instruments can help to achieve sustainable development by providing the means of internalizing environmental degradation and resource depletion costs into the production and consumption process. Economic instruments can work harmoniously with traditional regulatory mechanisms as well as help to provide the necessary funds for supporting sound environmental management initiatives such as recycling and waste disposal facilities (UNEP, 2005).

Kenya's main economic tool is privatization. Advocates of privatization believe that for-profit competitive systems increase efficiency and better calibrate supply and demand. Opening the waste management market to competition can stimulate development of better pollution control technology and expertise. Before 1995 solid waste management was run purely as a government monopoly. However the government was failing to adequately address the sanitary needs of its citizens. Failures in public servicing opened the domain to various modes of public-private cooperation. Surveys performed in both high and low income households indicate that post-privatization frequency of collection and cleanliness of service has improved. Privatization has permitted waste collection services to be allocated to the parties who value them the most.

The percentage of solid waste that is recovered by the municipality in Nairobi is only about 8 per cent of the recyclables and 5 per cent of the compostables, while private sector participation is un-regulated, with private companies operating in open competition with each other purely on a 'willing-buyer-willing-seller' basis. It is now estimated that there are at least 60 private companies engaged in solid waste collection services in the city (JICA, 1998). Furthermore, while the Nairobi City Council (NCC) and private refuse companies are collecting around three quarters of the waste from high-income homes, formal collection services for waste produced in slums and unplanned settlements are virtually non-existent. Up to 60 percent of Nairobi's residents live in these low income areas (UNEP, 2005).

Opponents to Kenya's privatization program acknowledge that the living standard in higher social economic classes has increased, but they argue that the benefits of privatization are not experienced equally by residents. Poorer

socioeconomic classes have only received marginal benefits. Low-income residential areas (which make up the majority) are still under serviced. Waste collection relies on the government management of infrastructure (ensuring streets are paved and accessible, enforcement of zoning laws against squatters) independent of public or private servicing. Private firms will only be as good as the infrastructure that supports them. Private firms have little incentive (and virtually zero technical capacity) to repair and maintain roads (Ian A. Thompson, 2010). As a result many of Kenya's initial experiences with decentralization of the waste collection market resulted in the neglect of lower income regions.

2.32 Controlled Dumping

The sanitation policy recommends controlled dumping with cover as the preferred option for all small towns and rural areas. In practice however, there are few good examples. In most communities controlled dumping sites are located on river banks and in depressed areas such as in borrow pits, surface mining areas, ravines, old quarries and valleys. Generally the standard of operation and maintenance on these landfills is inadequate. There is often no mechanical equipment for spreading and compaction of waste which means little reduction in waste volumes. Fly and rodent control are often neglected and there are serious problems with littering (Mensah A et al 2005).

According to Ian A Thompson (2010), Controlled dumping refers to the use of landfills as terminal endpoints for refuse. It is the most ideal method of disposal in Kenya, because it is the most affordable and requires the least maintenance. Cities are permitted to appoint designated landfill sites, but these sites are more accurately designated as open dumps. Sanitary or engineered terminal end sites for waste deposition are non-existent in Kenya's towns. Engineered landfills are constructed to meet specific environmental standards including low permeability clay liner and natural flow (gravity based) leach ate management.

Kenya's landfills mostly consist of abandoned stone quarry sites, gouged natural depressions in the earth, old mining areas, or man-made holes in the ground. Many of these sites are at the outskirts of the city where the poorly maintained roads present significant risks to waste transport. The trouble with non-engineered landfills is that there is little capacity to protect the surrounding environment from the hazardous chemicals and leachaetes that will invariably be released in the dumped refuse. Leachaetes from these non-engineered dumps can flow into canals and drainage channels as runoff water and pose human health threats. Presently, waste management disposal is underdeveloped. Most of these landfills operate near or beyond maximum capacity, waste is not subject to compaction, volume remains expanded, and as a result these dumps are frequently infested by roaches, rodents, and flies (Ian A. Thompson, 2010).

2.33 Recycling

With a growing population, Nairobi's annual waste production of 3,121 tonnes is set to more than double by 2030, the year by which Kenya is supposed to be a middle-income country, consuming more and therefore generating more waste. As it stands, only about 27% of the solid waste generated daily makes it to the Dandora dumpsite, the city's only official dumpsite, which has been declared a health hazard to the neighboring community. With only 5% of waste recycled, these numbers mean that a staggering 68% of the city's daily waste is improperly disposed. This would explain the multiple mini-dumpsites found along the city's roads and in open spaces (Kamunyori S, 2013)

Recycling is practiced informally, yet the recycling base of Kenya is very weak. Only high value recyclables such as cans, bottles paper, cardboards find their way to recycling firms. In low income areas, recyclable materials are used and reused for domestic purposes and only thrown away when they are no longer of

any use to the owners. In high income areas, domestic servants will sell these materials to middlemen to supplement income instead of disposing them along with the other refuse. There are a few recycling plants in operation in Kenya. Although more waste is generated than can be collected, the recycling plants have been operating under efficiency for years because most of the waste materials are not separated at the source Karanja (2005).

From a research conducted by Gakunju N. K et al (2011) on solid waste management in public institutions, various components of the waste show that there is a substantial amount of recyclable waste that is generated at the institutions. It is generally accepted that recycling as a strategy in SWM has both positive economic and environmental impacts. Recycling can be a source of employment while at the same time ensuring a clean environment since there is always a reduction in the waste stream. They propose, this is an area where institutions are expected to be innovative and adopt technologies could be useful to recycle waste. For example, it would be encouraging to see whether institutions could explore the energy potential of the organic waste in their institutions and develop it as a way of saving the current high energy costs. Further it would be appropriate for students to experiment using recycled materials as a way of developing new materials for use by similar institutions. It was therefore important in the study to establish whether institutions have embraced this strategy. 21 % of the institutions recycle some of the wastes while 79 % do not recycle (Gakunju N.K et al, 2011)

2.34 Incineration

Incineration is a method of burning waste that is combustible at high temperatures in the range of 1000 degrees Celsius to reduce the waste to ashes. It is used primarily as disposal for biological waste associated with medical care. However, a lot non biological waste is burnt openly in Kenya. Policies governing

the appropriate use of incineration exist in Kenya, but incinerators mostly consist of ovens or open pits used to burn bandages and blood products (Karanja, 2005)

2.35 Composting

Composting is the process of turning organic waste into fertilizer through aerobic fermentation. This fertilizer can be used in lawns, parks, and gardens. Composting is a minimally used form of waste disposal in Kenya and does not contribute to the danger of food pollution. In theory composting could reduce environmental pollution and provide job opportunities. Compost fertilizer also could help improve agricultural production and improve soil structure – which means it offers a longer term advantage over other non-compost mineral-based fertilizers. The high percentage of organic material that is disposed as trash suggests that composting could be a viable municipal solid waste technology.

In practice, composting is not a widely employed technology. Greater use of composting requires analysis of the different levels of technical sophistication and the potential transport capacity.

In Kenya, composting is done at small levels. This is particularly so because of lack of markets for the fertilizer and the cost of transporting the manure to the farms which are far away from urban areas could be a lot higher and prohibitive to would be consumers. Where composting is done in small scale, the manure is used for urban agriculture which in most cases is done at subsistence level and not commercial purposes.

Issues Associated with composting.

- Quality assurance: some of the issues under quality assurance include; differences in sources, types quantities of raw materials, non standardized

production process, differences in storage conditions and period and non-existence of quality standards.

- Poor or limited markets for the compost. The market is irregular and seasonal and when available, the amount bought is small. This is because consumers are reluctant to change from artificial fertilizers to compost.

- Most of the compost making groups do it on communal land which most often is grabbed by private developers, leaving the groups with no alternative but to suspend their operations. Location of those compost plots is also inaccessible since it is in informal settlements.

- No clear policies that support urban agriculture and the use of compost in farming, unlike that of using fertilizers. Urban farmers instead are more often seen as a nuisance to the urban environment and this impacts in denying the compost a potential market within reach of most of the compost making groups. There is no mention of compost in any legislation but in the public health act, manure is listed as a nuisance. The Nairobi city council has never integrated compost making into its solid waste management activities (Makopa, J. 2006).

2.36 Anaerobic digestion

This is a process in which biodegradable waste is decomposed in the absence of oxygen to produce biogas (methane and some carbon dioxide) which can be used as a renewable energy source for heat and power, and as a transport fuel. It also produces a nutrient-rich digestate which can be used as fertilizer. This method is particularly suited to treat source segregated food waste being diverted from landfills (Karanja et al 2005)

If this method is exploited to its full potential, it will produce enough electricity to power homes.

2.4 Plastic Waste

The centrality of the household has over the past 3 decades become even more crucial in the wake of the unprecedented urban population growth, increased industrialization and the changing lifestyles from the hitherto rudimental to a more affluent one (UN-Habitat, 1993). A combination of these factors has resulted into greater waste generation and its complexity. In Kenya, approximately 80% of the municipal waste is generated within households of which plastic waste constitutes 25% (Practical Action, 2005). During the past three decades, the Kenyan urban landscape, like in most urban areas the world over, has experienced a series of innovative activities around waste management springing from the consistent decline of the capacity of their national and city authorities to provide adequate and efficient solid waste management services (Mitchell, 1991; Clapham, 2002; Milliken and Krause, 2002; Nyong‟o, 2006; Oosteveer, 2008). These innovations are bi-dimensional in nature: recycling of post consumer plastic wastes and use of alternative packaging bags. While recycling of post consumer plastic waste can be traced back to at least three decades in Kenya, use of alternative packaging bags is a recent phenomena enshrined in the landscape as a consequence of the regulatory regime‟s response to plastic waste problem. The outcome of these emerging practices towards bridging the gap between plastic production and waste management systems which promises to be the panacea for sustainable plastic waste management largely depends on the perspective of the household. As McDonald and Ball (1998: 124) explicitly put it, "Without the public‟s conscious, collective decision to support an alternative route to their waste, there will be no material for the post consumer waste recycling industries." The extent to which households will influence the outcome of such initiatives will be determined by the appropriateness of their perceptions about the problem of plastic relative to

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other components of municipal solid waste, their willingness to participate in the strategies for its solution including use of alternative packaging bags, their plastic waste management practices, namely waste separation and disposal and payment of user charges for the services received.

There is a high recognition that plastic waste is major problem in solid waste management. However, this high recognition does not correspond with participation in the management of the same on the part of households; Oyake Ombis L (2009). This linkage may be in terms of the households" capacity to undertake activities like separation probably because mechanisms have not been put in place to enable them do so (provision of separate waste disposal bags) or they do not consider themselves part of the waste management system.

2.5 Institutional framework

This section briefly introduces the main actors of Municipal solid waste management issues in Kenya. It should not be considered as an exhaustive description and evaluation of all stakeholders.

2.51 Local Authorities

Local authorities in various urban areas are responsible to ensure proper storage, collection, transportation, safe treatment and disposal of solid waste in those towns/ cities. Their main responsibilities as regards solid waste management are: (a) provision of services for collection, transportation, treatment and disposal; (b) regulating and monitoring the activities of solid waste generators; (c) regulation and monitoring of private companies engaged in solid waste management activities; (d) formulation and enforcement of relevant laws and regulations; and (e) formulation and implementation of MSW policies (Nairobi City, 2005).

Due to failure of some of these authorities to carry out their responsibilities, residential associations have evolved in many middle and high-income areas to supplement waste management services. Currently, an estimated 200 registered resident associations are operating in Nairobi city, concerned, among others, in improving city cleanliness. They contract, organize, and monitor private MSW collection services (UNEP, 2005). As a result, private companies and CBOs have assumed more of these responsibilities in major towns. This also continues to be the case in the future. Hence, the envisioning of such systems as recycling and composting is deemed necessary, which could be essential in source-reduction of waste and could also generate revenues to cover their operation costs (Girum Bahri, 2005).

2.52 The National Environment Management Authority (NEMA)

NEMA was established under EMCA (1999) and became operational in July 2002. Its duties are supervising and co-coordinating all matters related to the environment and serving as the principal agency in the implementation of all policies relating to the environment in Kenya (NEMA, 2005).

NEMA is growing stronger by the day as more resources are being set-aside by the government for its activities. One critical area of improvement is securing sufficient trained manpower; this aside, it is capable of implementing environmental policy interventions (Girum Bahri, 2005)

2.53 Kenya Institute for Public Policy Research and Analysis (KIPPRA)

KIPPRA is an autonomous public institute formed under the provisions of the country's State Corporations Act. Its primary mission is to conduct research and analysis leading to policy advice to government and the private sector. Its main objectives are: (a) to develop capacities in public policy research and analysis and assist the government in the process of policy formulation, implementation

and evaluation; and (b) to conduct policy research in areas such as human resource development, social welfare, environment and natural resources, agriculture and rural development, trade and industry, etc. (KIPPRA, 2005).

KIPPRA has carried out a number of studies in the above named areas. Of special relevance to this research is the one on the use of economic instruments for MSW management in Kenya (Girum Bahri 2005)

2.54 Kenya National Cleaner Production Centre (KNCPC)

KNCPC is an autonomous non-profit institution established in July 2000 as a project of the United Nations Industrial Development Organisation (UNIDO) and the Kenya Industrial Research and Development Institute (KIRDI) (KNCPC, 2004, p.1). The Centre is mandated to build national capacity in preventive environmental management tools through a number approaches comprising, among others, technical support, policy advice and cleaner technology transfer (KNCPC, 2004, p.4).

One of the 'priority sub-sectors' ear-marked by the Centre for cleaner production strategy and implementation is the plastic industry. To this end, KNCPC is working with concerned stakeholders, especially with the plastic manufacturers to come up with a lasting solution to the plastic waste management problem in Kenya (Girum Bahri 2005).

2.6 Legal and Policy Frameworks

2.61 Environmental Management and Coordination Act (EMCA, 1999)

In 1999, the Kenyan parliament passed the Environmental Management and Co-ordination Act (EMCA) which came into force in January 2000. The National Management Authority (NEMA) established by the Act is the main body that coordinates environmental management activities in the country (ELCI, 2005, p.6). The following are the relevant sections of the Act (ELCI, 2005, p.41 & UNEP, 2005, p 15). Section 3 provides every Kenyan with the right to a clean and

healthy environment; grants citizens the duty to safeguard the environment. Section 87 demands that every person whose activities generate waste must ensure that the waste is minimized through treatment, reclamation, and recycling. Section 142 (1) stipulates that any person who pollutes the

environment by discharging dangerous materials into land, water, air or the aquatic environment is guilty of an offence; it also lays down penalty provisions, i.e. if justified, the court may demand the person in question to pay 'the full cost of cleaning up the polluted environment'; in addition, the court may order the polluter to pay any third party who has incurred damages due to the pollution. Part V, Section 57, sub-section I makes provisions for the use of, taxes and other fiscal incentives, disincentives or fees "to induce or promote the proper management of the environment and natural resources or the prevention or abatement of environmental degradation".

UNEP (2005, p14) asserts that the enactment of EMCA and the creation of NEMA for its implementation provide strong institutional base for the use of economic instruments to manage environmental problems from plastic shopping bag waste.

2.62 Local Government By-laws

For a long period, by-laws in Nairobi as we as other towns on solid waste management have not been comprehensive and had no provisions for the categorization of different types of waste; they did not also specify on how best categorization can be done. In the face of growing MSW generation in Nairobi city, due partly to rapid urbanisation, the NCC by-laws have been rendered out-dated and too weak in their penalty to deter offenders (Nema News, 2005, p.22). Although NCC by-laws prohibit illegal disposal of waste, specify storage and collection responsibilities for solid waste generators, and indicate the Council's right to collect MSW management charges, all of these are not

adequately implemented (UNEP, 2005,p.33). This is also true to other towns including Lamu.

2.63 The Public Health Act

Section 116 and 117 of this Act stipulate that local Authorities such as the Lamu county government are responsible to maintain cleanliness and prevent danger to health from 'unsustainable dwellings'. Another relevant section (126A) requires every Council to make by-laws that regulate, among others, the construction of buildings and sanitary conveniences for drainage and sewer. Still another section (129) acknowledges NCC's responsibility in the prevention of pollution of drinking water sources and the prosecution of polluters (ELCI, 2005, p.15).

2.7 Conceptual Framework

A community that generates minimal waste and considers the waste that is produced as a valuable resource can be managed sustainably. The best practice in waste management is to avoid the generation of waste, increase the reuse and recovery of materials from the following waste streams, minimize adverse impacts of waste operations on public and environmental health and safety and ensure the provision of Council's waste services is cost effective and equitable (Shellharbour city council 2002).

Best practice is often the enemy of good practice. Best practice is a technique, method or process that is believed to be more effective or superior at delivering a particular outcome than any other known approach. In developing countries, best practice options are often high technology solutions imported from developed countries that are often not sustainable over the long-term. Good practice however, typically arises from those people who have an intimate understanding of the problems, who work with the challenges daily, and

through often simple approaches and successful, innovative and sustainable solutions (CSIR, 2011).

The principles of the waste hierarchy which include waste minimisation, re-use and recycling, are supposed to reduce disposal at landfill. Some examples may work well in certain areas and not in others. Municipalities should determine the suitability of specific programmes for their specific circumstances.

The purpose of a waste collection service is to separate the generated waste from the community for health reasons.

Linked to the life cycle of a common housefly, the preferred frequency of collection services to households is once a week. A more frequent service i.e. daily removal is required for restaurant putrescible waste (organic waste that quickly decomposes) (CSIR , 2011).

Waste is stored at points of generation before collection. Receptacles at points of generation are intended for the storage of waste between the collection days. Aspects to take into account in the choice of a receptacle are; size, cost, availability, durability, type of waste and ease of handling by waste generators and waste collectors.

The waste hierarchy of waste prevention (reduction), reuse and recycling, energy recovery and finally disposal is applied internationally to reduce the waste ultimately disposed.

CHAPTER THREE: STUDY METHODOLOGY

3.1 Background to the study area.

Lamu town has a population of about 75,000 people. Located off the coastal part of Kenya in the Indian ocean, Lamu is the oldest town in Kenya about 700 yrs old. The main mode of transport is dhows and modern speed boats which transport people and goods from the mainland to and from the Island. On the island, donkeys and carts are used to transport goods. The island is dotted with Arabic architecture and streets are not wide enough for vehicles to pass. There are about three vehicles in town.

Lamu Town is managed by the National Museums and Heritage Act 2006 (that replaced the 1983 National Museums Act CAP 216 and Antiquities and Monuments Act CAP 215) and the Local Governments Act (and the associated by laws). Physical construction is also subjected to the EMCA Act and the 2006 Planning Act, which recognize that archaeology is material for consideration. The Old Town has a gazetted buffer zone that includes the Manda and Ras Kitau mangrove skyline and the Shela sand dunes, also protected by the Forest Act and Water Act respectively (although the buffer zone has not been formally approved by the World Heritage Committee). All the components are legally protected(UNESCO, 2001).

The Lamu Stone Town Conservation Office, now renamed the Lamu World Heritage Site and Conservation Office, was established by the National Museums of Kenya and has been in operation since 1986. A conservation officer is seconded to Lamu County Council to advice on conservation matters. A

planning commission exists since 1991 to play a supervisory role and address emerging issues in the conservation area(UNESCO 2001).

There exists a conservation plan for Lamu Old Town which is used as a guide in balancing the community needs for development and sustaining the architectural values of the town. The property is in a satisfactory state of conservation. Locally embedded institutions ensure the continued importance of Lamu as a centre of Islamic and Swahili cultural learning and practices.

The buffer zone is approximated to be about 1,200 ha covering part of the Indian ocean waters and the Manda island skyline to guarantee the integrity and authenticity of Lamu old town. In addition to the buffer zone, the sand dunes on the southern side of the town, which are the water source for Lamu, have been legally gazetted.

Since the 19th century, Lamu has been regarded as an important religious centre in East and Central Africa due to the *tarika* activities introduced by Habib Swaleh, a Sharif descendant of Prophet Mohamed (P.B.A.H). There are many descendants of the Prophet in Lamu. Their presence has kept up that tradition, which continues to the present day Lamu in form of annual festivals known as '*Maulidi*'. These festivals are endemic to Lamu and draw the Muslim community from all over East and Central Africa as well as the Gulf. Lamu is an Islamic and Swahili education centre in East Africa. Researchers and scholars of Islamic religion and Swahili language come to Lamu to study this cultural heritage, which is relatively unchanged. The island town has adopted very little modern technology due to its isolation.

The only natural resources of Lamu town are fish, mangrove wood and coral stones. The economy largely relies on   tourism. The town is an ideal destination

for both local and international tourists. With the airport located at the adjacent Manda Island, accessibility is highly improved.

3.2 Overview of nature of the research

The study sought to find out the state of municipal solid waste management in Lamu town. In this regard, the process of waste management cycle; generation, collection, storage, transportation, recycling, energy recovery and disposal was probed. The study too sought to find out the consequences of waste to the environment (land, water bodies, people and animals). The study further sought to know if there are any legislative and institutional frameworks in place to combat the challenges as well as levels of awareness among the residents of Lamu on these issues of municipal solid waste management.

The researcher adopted exploratory case study method since he had a *posteriori* hypotheses regarding the phenomenon.

According to Yin (1994), a case study is "*an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident*".

Exploratory studies are often undertaken as an introduction to social research and aim to guide the development of research questions and hypotheses (Nova South Eastern University,1997). Explanatory case studies are suitable for the study on causal relationships.

At specific levels, case studies will be used to gather information on world experiences on the issue. Such contextual information is helpful in extracting experiences from actual implementation of policies which could be useful when exploring policy options for Lamu. Accordingly, the experiences of Nairobi, Nakuru, Kisumu as well as other countries were reviewed.

3.3 Sampling Design

In respect to sample size, researchers have tried to suggest some kind of guidelines for qualitative sample sizes. CHARMAZ (2006) for example suggests that "25 (participants) are adequate for smaller projects"; according to RITCHIE et al. (2003, p.84) qualitative samples often "lie under 50"; while GREEN and THOROGOOD (2009 [2004], p.120) state that "the experience of most qualitative researchers (emphasis added) is that in interview studies little that is 'new' comes out of transcripts after you have interviewed 20 or so people". This study therefore selected a population size of 20 participants.

The researcher adopted purposeful sampling techniques to select subjects for this study. Accordingly, the most productive subjects were identified and selected based on a criterion that the researcher came up with in order to obtain reliable information from which valid judgments would be made regarding the phenomena under study. According to Martin N. Marshal (1996), regarding sample selection, the researcher actively selects the most productive sample to answer the research questions. This can involve developing a framework of the variables that might influence individuals' contributions. Creswell, J. W. (1998) concurs that qualitative studies often use *purposeful* or *criterion-based sampling*, that is, a sample that has the characteristics relevant to the research question(s)

Particularly, the study adopted minimum criteria for the subjects to qualify for selection as follows: lived in the area under study for at least 12 months, had at least secondary education and had a basic knowledge of the relationship between waste and environment. Most of these participants were drawn from government agencies in the area including Health, Environment, Housing, Local Authorities, Water and Forest. Non government agencies too were included such as recyclers, hotel associations and business people.

3.4 Methods of Data Collection

Primary data was collected through administration of questionnaires, interviews, focused group discussions, observations and illustrated presentations (photography). Structured, open-ended interviews were conducted with key informants from the following groups; National Environmental Management Authority (NEMA), Lamu County Council, Ministry of Public Health, Waste Recyclers, CBOs in area of waste management, Hotel Associations in Lamu, business people and Fishermen.

Secondary data was obtained by reviewing existing literature throughout the various phases of the study, i.e. problem description, formulation of contextual framework, assessment of country experiences, etc.

Both electronic and printed materials were reviewed. In particular, different studies, and workshop reports on the issue of MSW management and the problems of waste in Nairobi, Accra, South Africa, Nepal and many other cities were reviewed.

3.5 Analysis Techniques

The primary data was analysed using the researchers own experience (phenomenology) and typology. The researcher classified data into a list to make it less laborious and easy to present.

Both quantitative and qualitative research methods were used to analyze data and findings presented in tables, graphs and photographs.

CHAPTER FOUR: DATA ANALYSIS AND PRESENTATION

4.1 Characteristics of respondents

Most of the respondents had reasonably long periods of living in Lamu. Only respondents who had lived in Lamu for a period of at least 12 months participated. This was meant to ensure that they had sufficient experience about Lamu to provide reliable information that would lead to valid judgments about the phenomenon under investigation. 80% of the respondents who filled the questionnaire had at least a college certificate, 15% of the respondents had secondary school education while 5% did not disclose. All the targeted interviewees worked directly for the local authorities and were cooperative.

Table 1. No of respondents and level of education.

Academic qualification	No. of respondents	%
college	16	80
Secondary school	3	15
other	1	5

4.2 Waste management Practices in Lamu

The study sought to find out the existing waste management practises in Lamu town. In this regard, questions on how much waste is produced, how much waste is collected by the council, how is the waste handled, and how many vevicles the council has for handling waste were raised and discussed.

It was noted that, Lamu municipality owns only one tractor which collects about 2tons of waste from the market daily and deposits at the only dumpsite which is located about 1.5 kilometers away from the market(LC, 2013).

Whereas collecting waste daily is a good practice, having only one tractor would pose challenges in case of breakdowns.

Fig 4.1 Workers collecting Municipal waste from the Market at Lamu town.

Fig 4.2. Lamu Dumpsite.

Fig. 4.3 Waste oil from a generator discharging to the sea at Lamu.
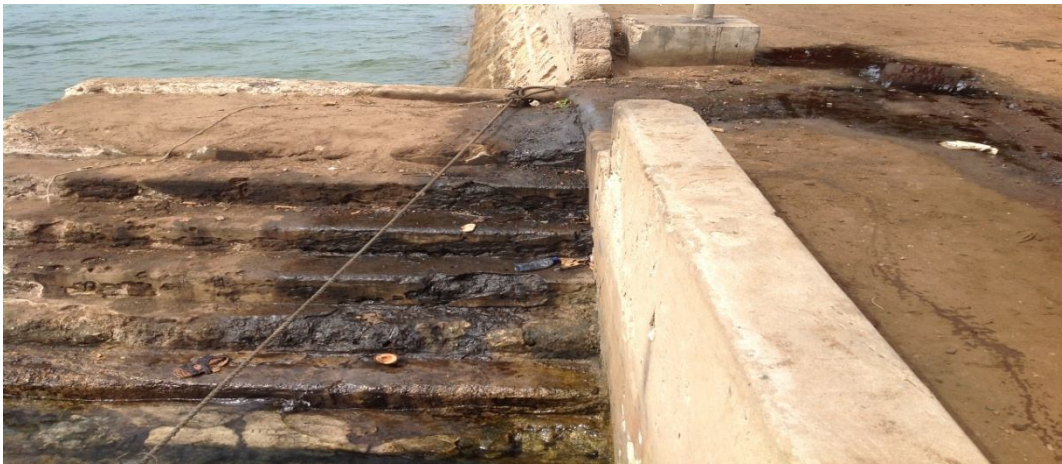
Fig. 4.4 Open trenches at Lamu town carrying waste water from the houses to the sea

Fig.4.5 Waste along the shoreline at Lamu

4.3 Institutions responsible for solid waste management

This study sought to know about the institutions responsible for solid waste management. It was established that, just like in other towns in Kenya, the County Council of Lamu / County government is solely responsible for waste management. However, it was noted that there are other partners in Public health department, NEMA, civil society and resident organizations who are

lending a hand by providing checks and balances to ensure that the laid down procedures on responsible handling and disposal of waste are adhered to in order to safeguard the environment.

4.4 Diseases associated with solid waste

The study also sought to find out about common diseases affecting people in lamu.

Malaria was found to be most common. This was attributed to blocked drainage channels which act as breeding grounds of mosquitoes. Dysentery and typhoid were also mentioned often and attributed to open discharges of waste which readily finds contaminants back to the food chain. Other respiratory diseases such as that could be associated with burning of plastics were not found to be common. It was found out that the strong winds blowing across the Island quickly blows away the smoke from burning of waste.

The main wastes in Lamu town which contributes to chronic diseases were identified as plastics, biomedical and industrial wastes.

According to B. Ramesh Babu et al, (2009), improper management of bio-medical waste causes stern environmental problems that causes air, water and land pollution. The pollutants that cause damage can be classified into biological, chemical and radioactive. Pathogens present in the waste can enter and remain in the air for a long period in the form of spores or as pathogens. Segregation of waste, pre-treatment at source etc., can also reduce this problem to a great extent. Sterilizing the rooms will also help in checking the indoor air pollution due to biological (Askarian et al 2004; Baveja et al 2000). The indoor air pollution caused due to the above chemicals from poor ventilation can cause diseases like Sick Building Syndrome (SBS).

Open burning of bio-medical waste is the most harmful practice. When inhaled can cause respiratory diseases. Certain organic gases such as dioxins and furans are carcinogenic (Burd 2005). The design parameters and maintenance of such treatment and disposal technology should be as per the prescribed standards (Bdour 2004).

4.5 Causes of Littering

This study sought to find out the causes of littering that is rampant on the streets of Lamu especially along the shoreline. Whereas it was noted there are policies in place to guide waste management in urban areas, the authorities lacked enforcement plans to implement the policies. Levels of awareness on the impacts of waste were found to be too low among the residents. Compliance to environmental procedures was also found to be wanting. The role of waste management has been relegated to the government hence there is apathy from the people since they do not have to account for littering. Lack of litter bins along the streets also made people especially visitors to just dump on the streets and beaches.

The study made an interesting observation that whereas presence of animals/ donkeys in Lamu town exacerbated littering along the streets by their droppings, they also ate a significant amount of organic waste generated both at the households and the municipal market, reducing amount of solid waste going to the dumpsite.

Fig. 4.6 A donkey tethered at the window littering the street with droppings

The study also sought to establish the number of dumpsites in Lamu and found out that the main dumpsite which existed at the sea front area was closed up and developers reclaimed the land to build houses. This was attributed to the increasing demand for land for building guesthouses at the sea front area which were attracting more revenue as compared to the ones located away from the sea front.

Fig 4.7 Houses built on pre- existing Lamu dumpsite.

The study found out that the current dumpsite, which is the only dumpsite, is located away from the beachfront area by about 1.5 kilometers.

Fig. 4.8 Lamu dumpsite

4.6 Common sources, types of waste and disposal methods

The study also sought to establish the common sources and types of solid waste as well as their disposal methods in Lamu town.

A number of sources were identified namely, residential, commercial, municipal, construction and demolition, biomedical. A significant percentage of respondents (90 percent) identified those sources as most common. Other sources including industrial and transport were identified by 10% of the respondents. Regarding the types of waste prevalent in Lamu and disposal methods, garbage, food remains, debris, plastics, sludge, saw dust were identified.

Table.2 Type of waste and management method in Lamu

Type of waste	Disposal Method
Organic(vegetable and fruit remains)	Fed to animals, disposed at the sea, taken to the dumpsite,
Food remains	Fed to animals, taken to dumpsite
Debris from construction	Deposited at the sea, recycled, open dumping
Plastics	Reused, dropped at the sea, taken to the dumpsite,
Sludge	Discharged to the sea, pit latrines
Bio-medical	Burying, Burning
Saw dust	Recycled.
Tins and cups	Deposited to the sea, taken to the dumpsite
Paper	Burning, taken to the dumpsite
Old fabric	Burning, deposited to the sea, taken to dumpsite

Table.3 Represents the findings on methods of waste management in a simplified form.

Type of waste	Organic waste	Food remains	debris	plastics	sludge	biomedical	sawdust	Tins, cups	Old fabric
Method of disposal	R OD SD	R OD	R OD SD	R OD SD	SD SP	BR OD BN	R	R OD SD	BN OD SD

R= Recycling, OD= Open Dumping, SD= Discharge/dumping to the sea, BR= Burying, BN= Burning, SP= Septic Pit

The data was further reorganized to compute the mode.

Method of waste management	frequency
OD	7
SD	5
R	6
BR	1
BN	2
SP	1

Table.4 Histogram presenting data on solid waste disposal methods in Lamu town.

Frequency
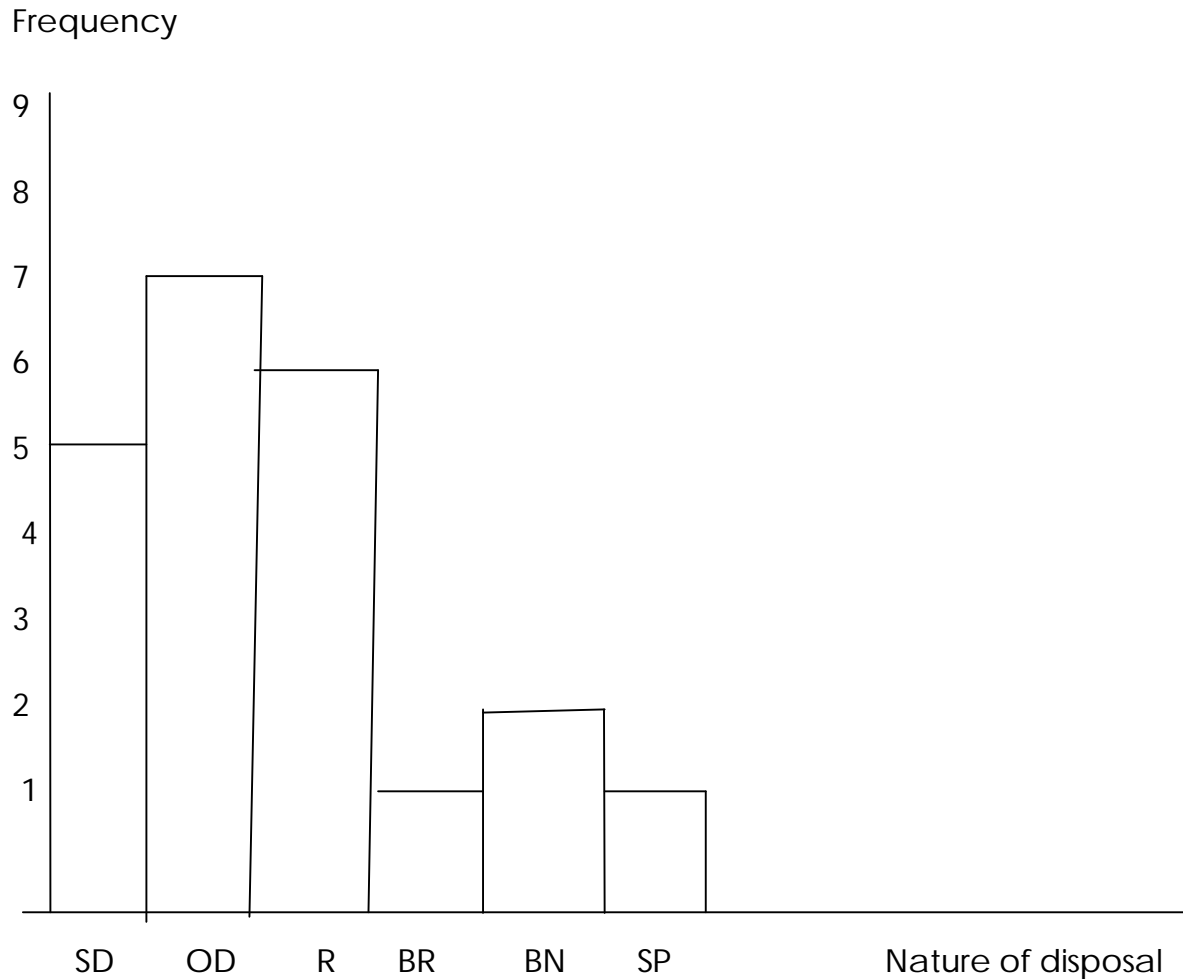
From the analysis of the data above, it was noted that the most preferred method of waste disposal was open dumping (OD), which was closely followed by recycling (R). Discharge to the sea came third and burning came fourth. Both burying and septic pit methods were least preferred.

Open dumping becomes the most preferred method of waste disposal even though it is not sustainable. Most of the waste such as plastics and old cloth require systematic collection, facilities and disposal which are inadequate in Lamu. Recycling is scoring high because presence of animals in town eats more of the organic waste both from households and the market, although without

proper separation, animals would be at risk of eating plastics which can be hazardous. Besides, other types of recyclable waste like sawdust are quickly tapped for energy recovery to avoid the high costs of fuel in Lamu town.

The study also found out that incineration is insignificant. This was attributed to lack of incinerators in town which has only two hospitals; the district hospital and private one. It was established that biomedical waste is buried into the ground or burnt. Industrial wastes together with household waste were openly discharged to the sea.

4.7 Impacts of waste to environment.

The study sought to establish the impacts of waste on various aspects of the environment.

On land, it was established that the cost of land was cheaper towards the dumpsite and away from the beachfront, costing twice to three times as much as it would cost at the beach front area. The guesthouses nearer to the dumpsites too were cheaper approximately by Ksh 500 -1000. This was attributed to the lost aesthetics as a result of waste in the dumpsite, as well as access and security. It was noted however, that accommodation costs were not homogenous along the beachfront area and towards the dumpsite. Other factors such as design of rooms and services offered affected the cost of accommodation significantly. The cost of Land at the beach front was not affected significantly, given that most of it is where business is concentrated and considered as the CBD.

Fig.4.9 Distance from the beach front and accommodation costs

Distance in Kms from the Beach front
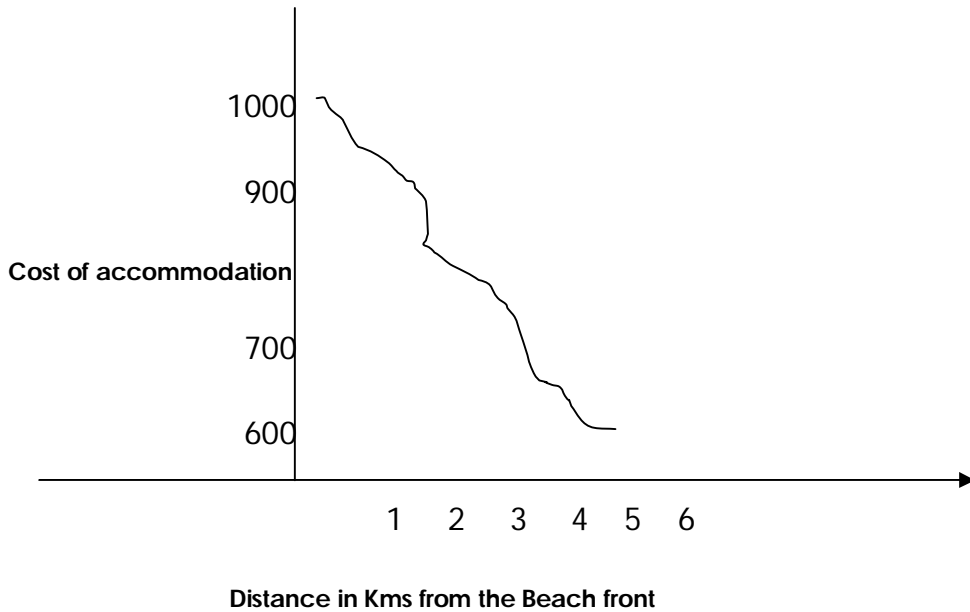
On urban population, children often succumbed to waterborne diseases as well as malaria as opposed to adults. This was attributed to their vulnerability given that they are more exposed than adults. A spot check at the district hospital confirmed this fact that more children needed medical attention than adults. It was further established, of the adult population, more women were significantly affected than men.

Table.5 Adult and children patients at Lamu district hospital on 18-06-2013

No of patients	Ailment	Adults	Children
61	Malaria, typhoid, dysentry	23	38

Source: Lamu District Hospital.

Table. 6 Male and female patients at Lamu District Hospital on 18-06-1013

No of adult patients	Ailment	Male	Female
23	Malaria, typhoid, dysentry	8	15

Source: Lamu District Hospital on 20/06/2013

The study also established that, crude methods of waste management such as burning solid waste emitted smoke which affected the quality of air. Smoke from combustion of engine oils especially boats and generators too contributed to air pollution.

Animals, particularly donkeys being the main transport agents in Lamu foraged on plastics and these threatened their lives.

It was also noted that, waste affects marine life in a number of ways:

Although policies on ocean dumping in the recent past took an "out of sight-out of mind" approach, it is now known that accumulation of waste in the ocean is detrimental to marine and human health. Another unwanted effect is eutrophication. A biological process where dissolved nutrients cause oxygen-depleting bacteria and plants to proliferate creating a hypoxic, or oxygen poor, environment that kills marine life. In addition to eutrophication, ocean dumping can destroy entire habitats and ecosystems when excess sediment builds up and toxins are released. Although ocean dumping is now managed to some degree, and dumping in critical habitats and at critical times is regulated, toxins are still spread by ocean currents. Alternatives to ocean dumping include recycling, producing less wasteful products, saving energy and changing the dangerous material into more benign waste(Marinebio,2013).

4.8 The prevalence of Plastic waste in Lamu

The study also sought to know reasons for the preference of plastic waste along the beaches of Lamu town. The respondents noted that, most people who visit are tourists prefer bottled to ordinary water. They also carry packaged foods and snacks along the beaches. Once they finish eating their food and drinks, they drop the plastics along the beaches. Hundredths of thousands of plastics are evident in Lamu shoreline.

Fig. 4.10 Plastic waste at the Lamu shoreline

Fig. 11 The only litter bin full of plastics at Shella beach in Lamu on 22/06/2013

4.9 Eco-Activities in Lamu

The study also sought to identify what other stakeholders do in Lamu at local level to safeguard the environment from impacts of waste. It was noted that, there are a few civil society and resident organizations engaged in eco-activities such as clean ups and recycling of waste. They include: *Lamu Safi Group* and *Shella Environment Group*. Lamu Safi Group has a plastic bottle shredder project in an attempt to recycle plastic bottles which are ubiquitous in Lamu town. Although the organization faces challenges in collection and processing, it is making commendable contributions to reduce the amounts of waste going to the environment. It was also established that local milk supplies who mainly come from the mainland reuse their containers which are predominantly plastic bottles which they obtain from hotels and shops in Lamu town.

4.10 Challenges of waste management in Lamu Town.

Some of the challenges that emerged clearly out of this study are as follows:

- Lack of enforcement plans to oblige waste producers to pay for waste management services especially households.
- Apathy from households given that it has always been responsibility of county council/government to manage waste.
- The county government is not properly equipped to manage waste.
- The NIMBY syndrome- (Not in my backyard), waste is easily dumped at sea and carried away to distant places.
- Though donkeys in Lamu town forage on household and municipal waste, they also defecate on the streets compounding waste management problem.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on summary of findings, conclusions about the findings and recommendations based on the conclusions.

5.2 Summary of findings

The main objective of the study was to investigate the state of waste management in Lamu town, identify barriers to effective management and propose measures to be taken to contain the problem.

The selected respondents to the interviews, most of who were drawn from government agencies in the area of waste management gave information because they are college graduates who were practicing in the field and therefore without doubt presumed to understand the questions and phenomena in detail. Others who took part were business people and fishermen who had lived in Lamu long enough and were deeply affected by the phenomenon. It is therefore true that the views expressed by the respondents were objective and representative.

It emerged that the problem of waste in Lamu town was slowly but surely building up and that the main waste type that constituted the biggest problem was plastics. It was noted that whereas other forms of municipal and household waste were recovered and recycled, plastics were openly dumped to the streets, dumpsite and ocean, posing a lot of challenges. It also emerged that there was no door to door collection of waste and these exacerbated the problem of waste management.

Failure by the town authority to put in place enforcement plans further compounded the problem.

Tourists and investors who move from the hinterland to Lamu town contributed significantly to the problem of waste.

Whereas presence of animals/donkeys in town foraged on organic waste significantly reducing the amount of waste going to the dumpsite, they created another small problem of waste by defecating on the streets.

It emerged that presence of waste in the environment affected cost of land and housing negatively. This had a negative impact on the incomes of the property owners.

Unlike other towns which are troubled by enormous heaps of waste, Lamu town does not have heaps of waste. This study has attributed this phenomenon to waste recovery -feeding the animals with organic waste and dumping to the ocean.

The study found out that in Lamu town, good practices by individuals have contributed to the significant reduction of waste from the streets. Solid waste is fairly managed well in as compared to other towns in Kenya. However, the untidiness of the town was attributed to presence of animals which scattered dung all over the street, making the town untidy but with manageable waste.

5.3 Recommendations

Some of the recommendations the study makes are as follows

- To begin with, there is need for county government to come up with strong enforcement plans to compel Lamu town dwellers separate waste at source, recycle that which can be recycled and then release to the waste pickers that which they cannot recycle.
- The government should also put in place strong monitoring mechanisms to criminalize crude disposal methods such as burning of waste and dumping in the sea.

- There is need for the county government to invest in technology for energy recovery so that the waste that finally gets to the environment has an insignificant negative impact.

- There is need for the county government to cover the open trenches in town.

- Furthermore, the county government should take measures for development of a well managed disposal system to cater for the plastic bags that enter the waste stream.

- The county government should acquire specialized vehicles for waste management.

- There is need for the county government to forge strong partnerships with private waste handlers and come up with policies to encourage recycling and promotion of consumption of finished recycled products by the locals as well as for external markets.

- The county government should restrict movement of donkeys to specific areas within the town, and encourage use of alternative transport means.

5.4 Areas of further study

Due to cultural attachments to the donkey as well as its economic value in Lamu town, the animals are there to stay. Donkey droppings in the streets therefore are unavoidable and will continue to be a nightmare in town. There is need to research on interrelationships between domestic animals, people and the urban environment. In addition, there is need for further study on the role of domestic animals on waste management.

Lamu town is a protected by government as a UNESCO heritage site under National Museums and Heritage ACT 2006. This implies, modern architecture cannot be done and only few alterations can be made to improve the streets and services. Research needs to be done on the impacts of this protection on socio-economic development of Lamu town.

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QUESTIONNAIRE

Introduction

My name is Gilbert Monyoncho, a postgraduate Diploma Candidate at the school of Built Environment, University of Nairobi. I am undertaking a research on SOLID WASTE MANAGEMENT IN URBAN AREAS IN KENYA with reference to Lamu Town.

The over-all objective of this work is to establish the actual state of waste management in urban areas, critic approaches used and propose sustainable ways of managing waste with reference to Lamu.

This work will inform policy makers and further help to remove barriers to waste management in urban areas not only in Kenya but also in other countries in Africa

This questionnaire is designed to facilitate the assessment of the current situation of solid waste management in Lamu town.

Declaration

The information collected by this questionnaire is meant for research only and can be used as basis for further research on solid waste management in *urban areas in Kenya.* To enable an accurate assessment, it is important that all information requested in the questionnaire is provided as completely and accurately as possible.

Name of Respondent

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Occupation

....

Gender ………………… ………….   **Date**…………………………………………………….

1. How long have you stayed in Lamu Town?

2. In what ways is solid waste managed in urban areas in Kenya? (Tick as appropriate)
   [a] open dumping{most often}{often}{less often}
   [b] Composting {Most often} {often} {less often}
   [c] Land filling {Most often} {often} {less often}
   [d] Recycling {Most often} {often} {less often}
   [e] Incineration {Most often} {often} {less often}
   [f] Discharge to water bodies {Most often} {often} {less often}

3. To what extent are the solid waste management practices practiced in Lamu town?
   [a] open dumping{most often}{often}{less often}
   [b]Composting {most often} {often} {less often}
   [c] Land filling {most often} {often} {less often}
   [d] Recycling {most often} {often} {less often}
   [e] Incineration {most often} {often} {less often}
   [f] Discharge to water bodies {most often} {often} {less often}

4. Below are common sources of solid waste in urban areas? Residential, Commercial, Institutional, Construction and demolition, Municipal Services, Treatment plant sites, Industrial, Agricultural, Biomedical

[a] List the sources of wastes in Lamu Town.

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5. List types of solid waste in Lamu town.

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6. Do a list of who is responsible for solid waste management in general

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7. List diseases associated with disposal of various types of solid waste Chronic respiratory or otherwise diseases

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8. List the most prevalent types of solid waste which significantly contribute to chronic diseases

9. Identify three key diseases that commonly affect children in Lamu town. [Tick off]

[a] {Malaria, Dysentery, Typhoid}
[b] {TB, Pneumonia, Brucellosis}
[c] {Asthma, Chickenpox, Measles}

10. Lamu town is littered with waste. Give reasons.[tick off]

[a] Lack of policy on waste management

[b] Lack of capacity to manage waste

[c] Lack of awareness on impacts of waste

[d] Apathy (lack of interest) from residents

[e] Lack of funds to invest in collection and transportation of waste.

[f] Lack of technology on waste management

[g] Cultural factors

[h] Poor infrastructure

[i] Unique architecture

[j] Presence of animals in settlement areas.

11. Outline impacts of wastes on
a) Land quality in Lamu.

b) Urban population distinguish
   adult v children
   women v men

c) Air quality
d) Economic activities
e) Animals
f) People

g) Vegetation

h) Buildings and infrastructure

12. List common eco activities in urban areas especially in Lamu town.

13. In what ways does waste affect marine life?

   [a] Poisoning of living organisms causing disease and reproductive failure and human health risks

   [b] Overloading habitats with nitrogen and phosphorus causes depletion of dissolved oxygen supplies needed by marine animals

   [c]Marine algae bloom can kill animals

   [d]Loss of sea grasses and coral reefs altering the food

   chains that support fish.

14. Plastic wastes are particularly prevalent in Lamu. Briefly outline their impacts on both land and water.

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   ………………………………………………………………………………………

   b) Are there any known actions undertaken by locals or manufacturers/NGO to mitigate the effects of plastic wastes in Lamu?

   [YES] [NO]

c) If YES in (b) above, name the sponsors you are aware of.

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15. Are you aware of the following legislations that deal with waste management?

[a] Environment Management and Coordination Act, 1999
[b] Local Government Act cap 265 Kenya Laws.
[c] Public Health Act cap 242

16. To what extent are the legislations above enforced?

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17. List any challenges to waste management in Lamu Town.

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Appendix II

Interview Questions.

1. How long have you stayed in Lamu Town?
2. How much waste does Lamu town produce per day?
3. How much waste does the county government collect per day?
4. How is the waste handled after collection?
5. How many vehicles that handle waste does the county government own?
6. What are the challenges to waste management?
7. Lamu residents depend on the donkey for transport. What is the impact of the donkey on solid waste management?
8. Where is Lamu county dumpsite located?
9. How many hospitals are there in Lamu town?
10. How does presence of waste in the environment affect the cost of land in Lamu town?
11. How does the presence of waste affect the cost of housing and accommodation in Lamu town?