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Final thesis

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SOLID WASTE MANAGEMENT IN NAIROBI CITY AND THE TOWN OF LIMURU, IN KENYA

Supervisor Marjukka Dyer, Principal Lecturer, Head of Environmental Engineering.
Commissioned by National Environment Management Authority of Kenya.
Tampere 2006

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ABSTRACT

Very few countries in the developing world, especially in Africa, have properly addressed the issues relating to the environment. Instead, most of them have concentrated on border disputes or wars, internal conflicts, ethics violence, and struggles for political power which have rendered their economies weak, with the consequence that inadequate funds are set aside for environmental issues. In Kenya, over 24 million plastic bags are used and then discarded every month. Plastic bags now constitute the biggest challenge to solid waste management in Nairobi, the capital of Kenya and home to three million people.

The rate of solid waste generation is far greater than the capacity of the city authorities to collect and dispose it. Plastics and other non-biodegradable waste are strewn all over low-income settlements causing great health and environmental concerns. There is a need to find a workable solution to improve efforts of the city of Nairobi and Limuru Town in matters of solid waste management.

The objective of this project work is to outline how these two municipalities in Kenya manage their waste, to discuss those problems that hinder waste collections, and to present proposals in order to involve everyone in this topic to make a better tomorrow for all.

Methods used to collect all the data for this project includes questionnaires answered by officials from both the Nairobi City Council and Limuru Town as well as individual interviews made in those two communities.

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Eunice and Grace Muchane	Nairobin ja Limurun Kaupunkien Jätehuolto Keniassa
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TIIVISTELMÄ

Vain muutama kehitysmaan valtio, etenkin Afrikassa, on kohdistanut huomion ympäristöasioihin. Monet kehitysmaista ovat keskittyneet rajakiistoihin tai – sotiin, sisäisiin konflikteihin, eettiseen väkivaltaan, tai poliittiseen vallankäyttöön. Vallan väärinkäyttö on tehnyt maiden ekonomian heikoksi, jonka vuoksi niillä on hyvin vähän varoja laitettavaksi ympäristöasioihin.

Keniassa käytetään yli 24 miljoonaa muovipussia joka kuukausi. Muovipussit muodostavat Nairobin kiinteän jätehuollon suurimman haasteen. Nairobi on Kenian pääkaupunki, jossa asuu 3 miljoonaa ihmistä. Kiinteää jätettä syntyy niin nopeaan tahtiin, että se ylittää kaupungin kapasiteetin kerätä ja hävittää jätteen. Muovit ja muut maatumattomat jätteet ovat heitteillä joka puolella huonotuloisten asuinalueilla ja jätteet aiheuttavat suuria terveys- ja ympäristöhuolia. Nairobin ja Limurun kunnan tulisi löytää toimiva ratkaisu parantaakseen jätehuoltoaan.
Tämän projektityön tavoite on hahmottaa miten Nairobin kaupunki ja Limurun kunta hoitavat jätteet ja jätteen keräystä koskevat ongelmat. Työ sisältää myös ehdotuksen siitä, miten saada kaikki mukaan rakentamaan parempaa tulevaisuutta.

Projektin tiedonkeruussa käytettiin kyselykaavaketta, johon saatiin vastaus Nairobin kaupungilta ja Limurun kunnalta. Saimme myös muutaman haastattelun molemmista paikoista.

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1. LIST OF ABBREVIATIONS

ABI	African Biodiversity Institute**.**
ACTS	The African Centre for Technology Studies.
AFN	Africa water network
BOD	Biological oxygen demand
CBO	Community-based organizations
CGR	City Garbage Recyclers.
RDSL	Refuse Disposal Services Limited.
EIA	Environmental impact assessment
EIs	Economic instruments
ELCI	Environment Liaison Centre International.
EMCA	Environment Management Coordination Act.
EMS	Environment management system.
EPM	Environmental planning and management.
GOK	Government of Kenya.
IRRI	International Rice Research Institute
ISO	International Standards Organization
JICA	Japanese International Co-operation Agency.
KAM	Kenya Association of Manufacturers.
KEBS	Kenya Bureau of Standards.
KENGO	Kenya Energy & Environment Organization.
KGTPA	Kenya Green Town Partnership.
KIE	Kenya Institute of Education.
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNCPC	Kenya National Cleaner Production Centre.
KRH	Kenya Refuse Handlers
KSH	Kenya shillings
MRC	Mukuru Recycling Centre

NCC	Nairobi City Council.
NEMA	National Environment Management Authority.
NGO	Non-governmental organization.
POPs	Persistent organic pollutants.
SWM	Solid waste management.
SWOT	Strengths, weaknesses, opportunities and threats analysis.
TB	Tuberculosis.
UNEP	United Nations Environment Programme.

2. GLOSSARY

Waste

Anything that is unwanted and is discarded.

Collection

The process of picking up wastes from residences, businesses, or a collection point, loading them into a vehicle, and transporting them to a processing, transfer, or disposal site.

Compost

Material resulting from the natural breaking down of organic material by bacteria, fungi, and other organisms; compost is a product used to enrich soil.

Composting

Biological decomposition of solid organic materials by bacteria, fungi, and other organisms into a soil-like product.

Disposal

The final handling of solid waste, following collection, processing, or incineration. Disposal most often means placement of wastes in a dump or a landfill.

Incineration

The process of burning solid waste under controlled conditions to reduce its weight and volume, and often to produce energy.

Land filling

The final disposal of solid waste by placing it in a controlled fashion in a place intended to be permanent. One source book referred to uses this term for both controlled dumps and sanitary landfills.

Leachate

Liquid (which may be partly produced by decomposition of organic matter) that has seeped through a landfill or a compost pile and has accumulated bacteria and other possibly harmful dissolved or suspended materials. If uncontrolled, leachate can contaminate both groundwater and surface water.

NGO

Nongovernmental organization. May be used to refer to a range of organizations from small community groups, through national organizations, to international ones. Frequently these are non-profit organizations.

Recycling

The process of transforming materials into raw materials for manufacturing new products, which may or may not be similar to the original product.

Recyclables

Items that can be reprocessed into feedstock for new products. Common examples are paper, glass, aluminum, corrugated cardboard and plastic containers

Reduce

To decrease the amount of waste generated.

Reuse

The use of a product more than once in its original form, for the same or a new purpose

Non-Biodegradable material

Any organic material that can not be broken down by microorganisms into simpler, more stable compounds. An example of non-biodegradable material is a plastic bag.

Solid Waste

Solid products or materials disposed of in landfills, incinerated or composted.

Pollution

Contamination of air, water, land or other natural resources that can be harmful to public health and detrimental to the use of such resources for purposes such as commercial, industrial, agricultural and recreational. Pollution also poses a threat to livestock, wild animals, birds, fish and other life.

Scavengers

Scavengers are usually people who treat waste as a source material from which something of value can be extracted.

POPs

Persistent Organic Pollutants (POPs) are chemical substances that persist in the environment, resulting in bio-accumulations throughout the food chain, posing the risks of causing adverse effects to human health and the environment.

Economic Instruments

Economic instruments are important tools that help to reduce the amount of waste generated, as well as the reduction of the proportion of hazardous waste to the total waste generated. They also can be very important tools to encourage recovery, reuse and recycling of wastes.

3. INTRODUCTION

The situation of solid waste management (SWM) throughout the country is a source of concern. Uncollected solid waste has become a common sight in most urban areas, with associated public heath and environmental risks. High industrial production and urbanization leads to high consumption of natural resources and generation of substantial waste. Most local authorities give priority to waste water treatment giving little attention to solid waste. The authorities have been unable to cope with collection, treatment and disposal of solid waste, due to inadequate capacity and financial constraints. About 68% of solid waste is generated from residential areas while 14%, 8%, 2% 1% and 7% is from Industrial, roadsides, hospitals, markets and other sources respectively. It is a surprising fact that only 37% of waste is collected and taken to an approved dump-site. Although plastic bags may offer some benefits to landfills such as stabilization effects, leachate minimization, and minimization of greenhouse gas emissions, they pose problems that emanate from some of their advantages; namely, they are free therefore they are consumed in excess and often misused. /7/ /14/

3.1 Background

Nairobi, the capital city of Kenya, has a population of over 3 million. Due to a high rate of urbanization, Nairobi is one of the most densely populated cities in East Africa with over 2900 persons per square kilometer, and is affected by a serious solid waste management (SWM) problem. Nairobi is estimated to have a solid waste generation rate of over 1600 tons per day. /19/

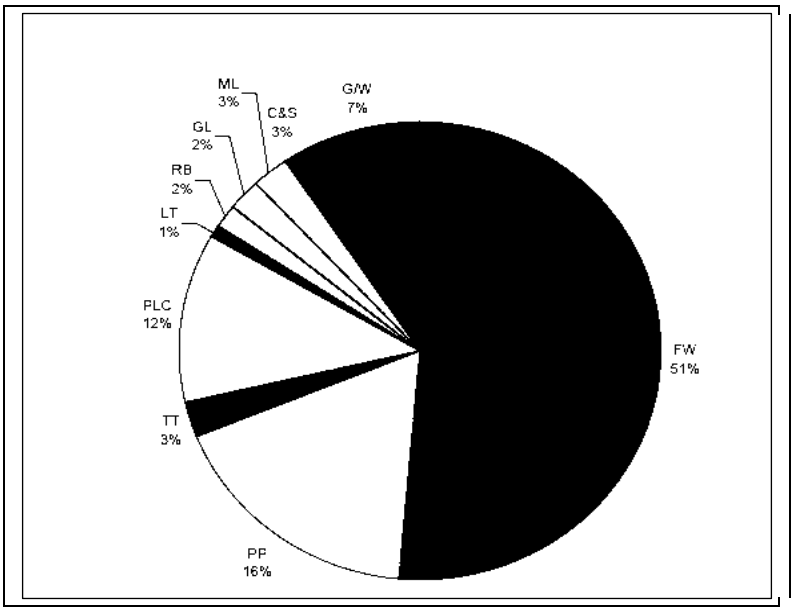


Figure 1: Types of solid waste generated in Nairobi, Kenya.

Key

(FW) - Food Waste: 51.5% (PP) - Paper (Recyclable and Other: 7.3%

(TT) - Textile s: 2.7% (PC) - Plastic (container and others): 11.8%

(LT) – Leather: 0.9% (RB) – Rubber: 1.5%

(GL) - Glass (containers and others: 2.3%

(MT) - Metal (containers and others): 2.6%

(C&S)- Ceramic and Soil: 2.7%

(G/W)- Grass/Wood: 6.7%

According to the figures above we can see that Nairobi's most common waste production is in food waste, followed by plastic waste which is the main problem facing Kenya and other countries because they are non-biodegradable. /19/

3.2 Kenya's present situation

There are more than 70 plastic industries in Kenya with capacities ranging from 800-1000 tons per year. Most of these industries are located in Nairobi, the capital city of Kenya, although some are located in other smaller cities, such as Mombasa, Nakuru, Thika and Eldoret. An estimated 4,000 tons of the thin plastic bags, termed in the report as “flexible”, are produced each month in Kenya mainly for use as shopping bags, but also for covering products such as bread. About half of them are less than 15 microns thick and some are as little as seven microns thick, making them unsatisfactory for use more than once.

With the exception of some paper bags, there are hardly any alternatives to plastic shopping bags. Shopping bags made from natural products are sold in all markets but are seldom used because of the easy and free availability of plastic shopping bags in market outlets and the low price for which they are sold at outdoor markets. Therefore, along with the increase of plastic product manufacture, plastic waste generation has rapidly increased because most of this plastic is non-biodegradable. Blockages of sewers are increasingly being attributed to these materials, and discarded plastic and polythene products clearly add to the expanding amount of waste. It is a most welcome idea to develop some solutions to this matter as some countries have already done. For example, Rwanda has banned plastics less than 100 microns thick and backed this up with public awareness campaigns, and in Kigali, the black plastic bag has now disappeared.

Calculate how much garbage is discarded in Nairobi each day, multiply this amount by 3 million people in the area, and then multiply this figure by 365 days. This is the amount of garbage the city of Nairobi generates in one year. This waste is destroying our environment for much of this waste is not collected as expected. Practicing the use of the “3R's” can be of a great help to our lives, making our city a more pleasant place for ourselves and generations to come. The “3R's” are reduce, reuse and recycle. /19/ /29/

4. WASTE MANAGEMENT AND THE PROBLEMS

The rapid rate of uncontrolled and unplanned urbanization in Nairobi has brought environmental degradation. Indeed, one of the most pressing concerns of urbanization in Nairobi has been the problem of solid-, liquid-, and toxic-waste management.

Kenya's waste situation in terms of the collection, transportation, disposal, reuse, recycling and minimization of waste has become a major problem.

This is mainly caused by:

- Population Growth.
- Rate of urbanization.
- Unplanned dumping.
- Attitudes within the local community.
- Lack of information on waste management within the community. /18/

5. RESPONSIBILITY OF SOLID WASTE COLLECTION

Nairobi City Council (NCC) and other private companies are responsible for solid waste collection. Both Nairobi city council and private companies daily collect about 800-1000 tons from middle class areas, low class areas and slums, leaving about 700-800 tons of solid waste uncollected every day. /11/

6. REASONS FOR THE NON-COLLECTED

- No clearly defined Government policy.
- Rapid population growth.
- Rural to urban migration.
- Lack of awareness by the community about solid waste management.
- Lack of any SWM policy and policy frame work.
- Poor SWM performance.
- Weakness within the Nairobi city council. (NCC).
- The private sector participation is unregulated.
- Low rate of waste recovery and recycling**.**

6.1 Poor performance

The poor SWM performance in Nairobi is attributable to many factors. Expansion of urban, agricultural and industrial activities has generated vast amounts of solid and liquid wastes that pollute the environment and destroy resources. Pollution problems are mainly due to lack of appropriate planning, inadequate political will and governance, poor technology, weak enforcement of existing legislation, as well as the absence of economic and fiscal incentives to promote good practice. Analytical data concerning volumes and compositions of waste substances is also lacking.

6.2 Weaknesses in Nairobi city council

The administration of Nairobi is chaotic, with the NCC and the Central Government often clashing, duplicating roles, and causing confusion (in particular, this is seen in the Ministry of Local Government and the Provincial Administration in the Office of the President). Moreover, policymakers (NCC councilors) are generally poorly educated and lack any power to discipline NCC workers.

6.3 Rapid population growth and urbanization

Nairobi, like other developing world cities, is characterized by rapid population growth and urbanization. The city has a population of about 3 million people generating substantial amounts of solid waste every day. In addition, the city is surrounded by 4 satellite towns that are also fast growing and lack waste disposal facilities. Some of the reasons why people move to urban areas are due to problems in rural areas such as:

- Unemployment
- Limited health care.
- Limited education facilities
- Food shortages
- Social problems

6.4 Lack of SWM Policy and framework

Solid waste management problems in Nairobi are largely a result of lack of a waste management policy and framework that would aim at improving the standards by allocating responsibility over each type of problem.

6.5 Unregulated private sector participation

In general, the private companies are operating in open competition purely on a “willing-buyer/willing-seller” basis. They simply obtain a business license and start offering SW collection services, without undergoing any investigation into their qualifications, and during later operations, virtually no regulation. Because of the increasing competition and cases of unsatisfactory service, some of the firms include in their contracts a promise to refund money for unsatisfactory service.

6.6. Low rate of waste recovery and recycling

Recycling, including products such as paper, tires, plastics, used clothes, and metals, is becoming increasingly popular. A kilogram of old newspapers sells for between 15-27 Ksh, while old tires go for Kshs.50-300 depending on the degree of tear and wear and size. Organic wastes are also increasingly being recycled to produce compost products. For example, community-based organizations (CBOs) managed by women are recycling market waste from Korogocho Market to produce organic manure for sale. The percentage of solid waste that is recovered from the municipal point of view is only 8 per cent of the recyclable and 5 per cent of the material that could be composted. Recovery is also taking place in private industry, but the rate is unknown.

6.7 Poor infrastructure road street access

Due to poor road and street access the Nairobi city council (NCC) and other private sectors cannot perform their duties as expected due to bad roads, Traffic during the day is also hectic and vehicles collecting waste can only manage one or two trips daily. /11/

7. SOLID WASTE COLLECTION AND METHODS

7.1 Domestic waste

Communal and house-to-house collection methods are both practiced, however in low-income areas, only communal collection is carried out. House-to-house collection is practiced in high- income residential areas.

7.2 Industrial waste

This is practiced either by communal service, or when the industry takes care of its own waste disposal. The least effort is made in middle to low-income areas.

Table: 1 Relative perceptions of waste collection service in Nairobi, 1998.

Item	High Income Area	Medium Income Area	Low Income Area	Surrounding Areas
Existence of waste collection service	Yes: 74% No: 26%	Yes: 84% No: 16%	Yes: 25% No: 75%	Yes: 26% No: 74%

The table above shows that solid waste collection is only carried out in medium to higher income areas, and less concern is shown for low income and slum areas. /19/ /16/ /15/

7.3 Collection and Transportation of solid waste

The aim of collecting solid waste from any place is to improve its condition, but the types of vehicles used for solid waste collection in Nairobi are unsuitable for the task. Garbage truck drivers also experience problems while transporting the waste to the disposal site at Dandora, as they fear harassments from scavengers in the area. Therefore, most drivers prefer to dump their waste along the road to the dump site, which only adds to making the area look more disgusting. The inadequate fencing and protection has allowed the scavengers and as well as animals the opportunity to cause further harm, resulting in a dangerous situation in which the spread of communicable disease is a threat.

The vehicles used are open trucks, or tractors pulling open trailers, and because they are not covered they spill most of the waste collected on their way to the landfill, since the refuse is normally of a loose nature. Most of the local authority vehicles are also old, resulting in regular breakdown and repairs, and because not all parts are readily available, the cost of normal maintenance is therefore much higher, and consequently breakdowns contribute to a large percent of non-collected waste. /6/

*Picture 1.*The above picture shows an uncovered waste truck. Photo by: James Muchane

8. ROLE OF PRIVATE SECTORS

In Nairobi, there are three significant operators: Kenya Refuse Handlers (KRH), Domestic Refuse Disposal Services Limited (RDSL) and Bins (Kenya) Limited. There are also about 30 smaller companies, which operate completely unregulated and are believed to dispose of much waste by illegal means. A number of private sector firms have been commissioned by the NCC to collect and transfer solid waste within the City of Nairobi.

8.1 Bins

Bins (Nairobi) Services Ltd has been in the garbage collection business since 1989. The company was started by a group of entrepreneurs who recognized that the City Council was no longer in a position to carry out its obligations and decided to fill the gap in the provision of garbage collection and disposal services. In October 2000, BINS had a fleet of 16 trucks ranging from two to eight tons and employed 105 people. BINS offers waste collection and disposal to residential customers, residential blocks compounds, industrial commercial and special services such as one-time removal of a large volume of garbage. The fees depend on volume, collection frequency, and other factors. For example, the amount charged for a 10 kg plastic bag is 50 Kenya shillings.

8.2 Kenya Refuse Handlers

Kenya Refuse Handlers specialize in:

- Environmental and waste management.
- Provision of sanitary bins.
- General cleaning in municipalities, schools, hotels, industrial & commercial establishments and homes.

The firm was established in 1987 and registered in 1992. The company invested in professional staff and equipment, and has carried out major cleaning services for the City of Nairobi from 1997 to 1999.

In addition to waste services, the company has been engaged in educating the general public about waste management through awareness campaigns and by encouraging user participation. /15/

9. NAIROBI DUMP-SITE

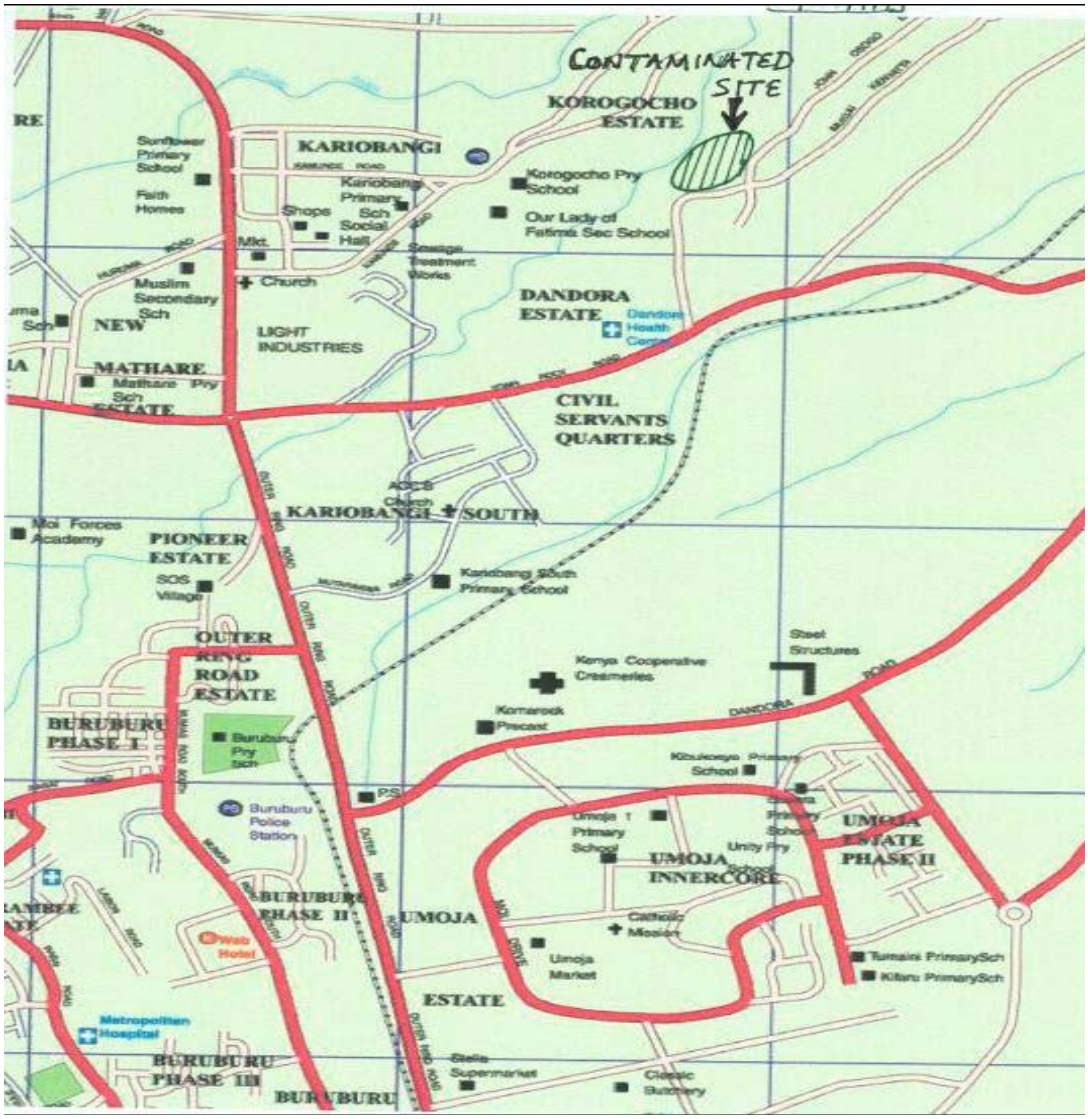


Figure 2. The above map shows the contaminated dump-site at Dandora, Kenya. /22/

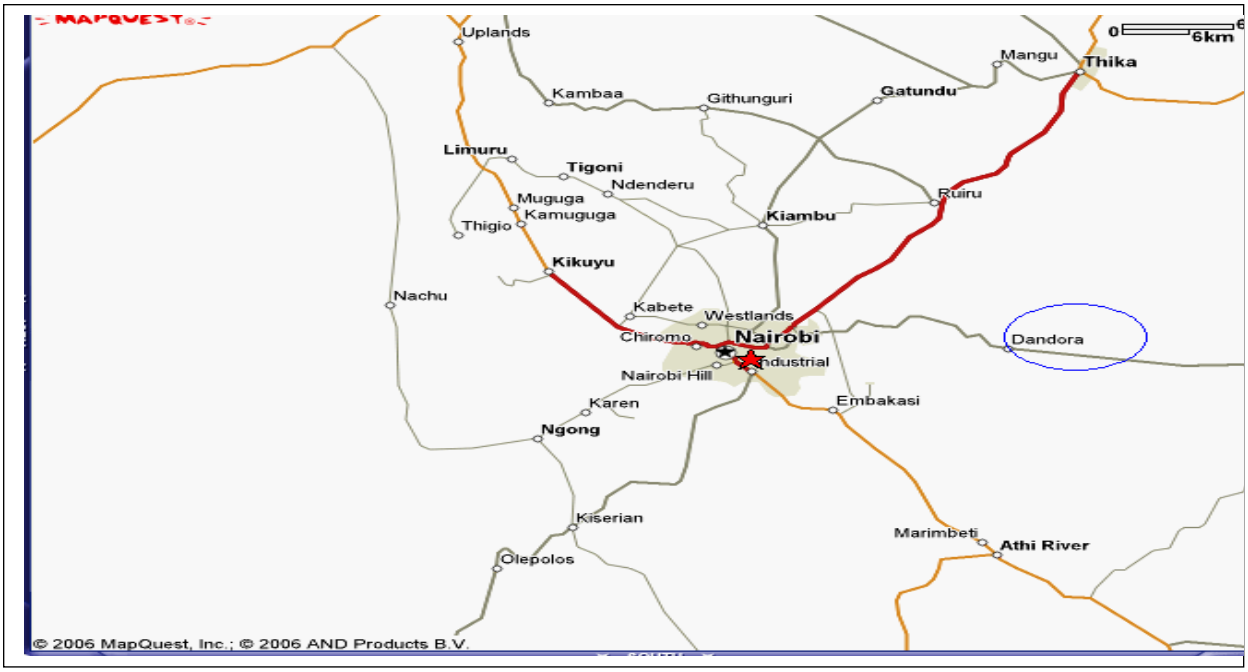


*Figure 3***.** Shows the Dandora dumping site location relative to Nairobi. /22/

Nairobi City has had to change its dumping site at least 7 times, from the late 1960's until 1980. In 1980, the council established the current site in Dandora, a dump-site located in the Eastland's suburb of Nairobi. This area is at an altitude of 2000 meters, with a population density of over 100 persons per square kilometer. Passing below the dump-site is the Nairobi River which eventually flows to the Indian Ocean. The soils that are found on this site are usually moderately to well-drained, which means that chemical compounds such as dioxins and furans in the ash can easily find their way into the ground water sources and therefore end up in the river. Rain can also wash POPs contaminated ash into the Nairobi River. Dandora is located about 17 km from the city centre. It is not a sanitary landfill and consequently lacks containment technology such as leachate or methane extraction. It is also most unfortunate that hazardous waste comprised of both medical and industrial waste is also dumped at the Dandora dump-site. /17/

This area covers about 26.5 Ha. and is estimated to contain some 1.3 million cubic meters of waste. Because the land is not sufficient to handle all this waste, fires are therefore occasionally set to decrease the size of the refuge piles.

Picture 2.Dandora dump-site. Photo by Paul Maina. /13/

As shown in the picture above unmanaged 26.5 hectares result in mounds of waste.

9.1 Scavengers

Many of Nairobi's poor people engage in waste picking as a means of income generation. Scavengers are estimated to collect 20 tons of the approximately 800 to 1000 tons generated daily in the city of Nairobi. Scavenging is so common at the Dandora waste disposal site that during a visit to the site during the day, it appears as if the scavengers are people working in a rice field. The most popular items scavenged include paper, scrap metal, and bottles in that order of preference. Other materials identified included bones and plastics. /16/ /17/

Picture3. Waste pickers on a truck approaching Dandora dump-site/17/

9.2 Dandora dumping site case study

A clinical officer in Dandora, Kenya reported a higher than average incidence of upper respiratory tracts infections as well as stomach ailments, and both are connected to pollution from the dump-site area. Joyce Adhiambo and her husband have lived in Dandora for 5 years and state that they have fallen sick since moving into their apartment, there with recurring colds, coughs, and ear and nose blockage. The incidence of asthma and TB are very high, and residents complain of frequent bouts of typhoid and diarrhea. The pollution does not only affect humans but also animals through digestion, and the inhalation of toxic fumes, and this causes serious economic and other welfare losses. /6/ as seen from the picture below

Picture 4. Animals feeding on plastic bags at the Dandora dump-site/13/

The landfill is not operated in a systematic and planned manner because there are no controls to prevent toxic and hazardous waste from being brought to the site. There is also a high risk that leachate can contaminates surface and ground water nearby the Nairobi River, which can cause water seepage into housing areas and causing serious problems. The Nairobi city council has come up with a new disposal site in Ruai, which is located about 32 km from the city and covers an area of 4,000 acres. About Ksh 80 millions is said to be spent upgrading it, but scavengers don't want this new site to be changed in any way, for as they said "the dump-site feeds our children and sends them to school"

10. COMPOSTING

Composting is a controlled natural process of decomposition of organic waste material. It reduces the cost of waste disposal, minimizes the nuisance potential, with decomposition producing a clean and readily marketable finished product. Composting helps to increase the recovery rate of recyclable materials.

Decomposition has not been succeeding very well in Kenya due to various reasons:

- Inappropriate technology.
- Mechanical breakdown of equipment.
- Poor maintenance of equipment.
- Lack of operator education and training.
- High operating costs.
- Poor quality material to re-use as food for animals.
- Offensive odor emissions.
- Poor marketing plans for the end product.

Organic wastes are not usually scavenged by waste pickers. Some of the larger restaurants and hotels also sell their waste food to farmers to be used as pig feed. Organic wastes are also important to the urban agriculture sector as all sorts of Livestock, including goats, chickens and the occasional cow, feed on top of waste heaps.

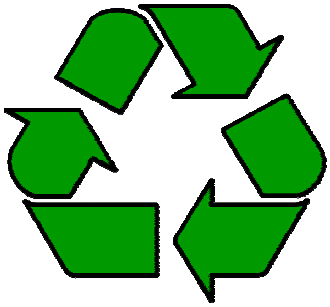
10.1 Local NGOs Promoting Composting

There are composting groups in Nairobi's low-income areas, and these composting groups were established by NGOs through existing community-based organizations, usually women's savings (bank) unions, or church groups. Three local NGOs Uvumbuzi Club, Undugu Society of Kenya, and the Foundation for Sustainable Development in Africa) have provided support and training to approximately 12 CBOs doing composting in several of Nairobi's low-income areas.

10.2 Some environmental benefits of composting

Composting manages to achieve a number of beneficial environmental effects. A reduction in the incidence of environmental illnesses, including diarrhea and malaria (due to a decrease in stagnant water collecting in improperly disposed wastes) is noted. Improvement in the health of their children who previously often played in previously waste-contaminated areas due to a lack of open space for safe play. /28/

11. RECYCLING



Solid waste recovery and recycling is carried out by many of Nairobi's poor people who engage in waste picking as a means of income generation. The estimated quantity of recovered and recycled items ranges from 20 to 30 tons per day. The NCC does not operate any transfer station or composting plant where commercial waste recovery recycling could be implemented.

The materials that are often recycled from solid waste includes,

- Waste paper
- Cardboard
- Glass
- Metal
- Rubber

11.1 Recycling in Nairobi

The Kayole Environment Management Associations was founded in 1999 and is based in Nairobi's Kayole Estate, where it employs about 50 youths to collect household waste from 4500 estate residents for a monthly fee. These wastes are hand sorted into plastics, glass, paper and organic materials, each with a different recycled use. Dark plastics are molded into fence posts and roofing tiles. Clear plastics are woven into handbags. Metal is recycled into briquette making machines and lamp stand. Sorted glass is sold to industrial recyclers. Paper is compressed into fuel briquettes, and kitchen wastes (organics) are composted. KEMA products are marketed at their Kayole office and at many craft fairs and exhibitions throughout Kenya. /25/ /3/ /29/

11.2 City Garbage Recyclers

The aim of the CGR project was to mobilize the low-income settlement of Maringo to develop domestic waste management and encourage environmental conservation through waste recycling. Domestic waste is collected and manually separated into organic and inorganic, with the former turned into fertilizer for sale to local farmers, while the latter is sold as raw materials for recycling or made into alternatives to wood fuel. CGR conducts awareness campaigns, trains NGOs in waste management, and generates work and income for the estate's residents. /26/

11.3 Mukuru Recycling center

Mukuru Recycling Centre was established in 1991 with the engagement of two priests of the Kariobangi Catholic Church to work for the improvement of the scavenging activities in the Dandora dumping ground, by reducing exploitation by waste dealers operating around the dump-site. The other main component of the Mukuru Recycling Centre consisted of the re-education of the scavengers. /21/

12. ENVIRONMETAL EFFECTS FROM THE PLASTIC

The lack of adequate waste collection and disposal systems in developing countries causes public health problems resulting in diseases, which aggravates poverty and leads to negative consequences such as loss of income due to illness, and increased spending on health care (World Bank, 2001).

At least two million plastic bags are now being handed out each year to people shopping at supermarkets and kiosks in Nairobi alone, according to studies by experts at the Kenya Institute for Public Policy Research and Analysis (KIPPRA). These bags are often so thin that they are simply thrown away after one trip from the shop, and have become a familiar eyesore all over the city. /24/

These plastic bags can take between 20 and 1,000 years to decompose, In Nairobi, and indeed all other urban centers in Kenya, plastic bags of all sizes and colours can be seen blemishing the landscape. Besides this visual pollution, plastic bag wastes contribute to the blockage of drains, are consumed by livestock at great danger to themselves, because discarded bags can choke farm animals and marine wildlife, and pollute the soil as well. /1/ /8/ /29/

Picture 5. The picture above shows a drain in Nairobi blocked by plastic bags.
Photo by James Muchane.

Both the Environment Minister of Kenya, as well as one 2004 Nobel Peace Prize winner have linked plastic bag litter with malaria. The bags, when discarded, can fill with rain water offering new and ideal breeding grounds for malaria-carrying mosquitoes. Malaria is Africa's most deadly infectious disease in children, and over 50% of all hospital visits in some areas are malaria-related.

The IRRI (International Rice Research Institute) has found that plastic bags have harmful effects on soil, water and air. When plastic bags are deposited in fields in large quantities they cause soil infertility. The accumulation of plastic prevents the sunlight from entering the soil, thus destroying the beneficial bacteria so necessary for soil fertility. Plastic is not biodegradable and releases harmful dioxins. It is well known that people who work in plastic industries are at a greater risk of cancer and other diseases.

Discarded plastic bags are a notorious for clogging sewage lines and drains because they do not rot and turn into compost. Coloured plastic bags contain harmful toxic metals such as chromium and copper which can cause allergies. Hundreds of thousands of sea turtles,

whales and other marine mammals die every year from eating discarded plastic bags mistaken for food. Turtles assume the bags are jellyfish, their primary food source. Once swallowed, plastic bags choke animals or block their intestines, leading to an agonizing death.

When plastic bags finally break down, small plastic particles can pose threats to marine life and contaminate the food web. Scavengers, as well as municipality waste management staff, usually eat their lunch amid the waste. Sometimes the scavengers collect food waste that has been dumped nearby to hazardous waste.

12.1 Impacts on Government and Politics

Plastic bags also includes high civic costs to governments, most of which are incurred through clean-up efforts. Plastic bags can litter roads, sewers and waterways, making collection and disposal difficult and costly, whereas if all is managed well, the money can be used to do something good in the Kenyan nation. (IRIN, 2005a; National Plastic Bags Working Group, 2002; Reynolds, 2002; Ryan and Rice, 1996; World Watch, 2004).

13. CASE STUDY

13.1 Nairobi River

In the early part of the twentieth century, the Nairobi River basin had the best waters in the area, which were clean and potable at the source. Nairobi River is at present severely polluted downstream of the city centre to an extent that the water in the river consists mainly of sewage, especially during the dry season.

This has resulted from population increase, together with urbanization, industrial growth, increase in agriculture and the use of agrochemicals.

Decreased vegetation cover, growth of large informal settlements along the rivers, and poor maintenance of the municipal sewage disposal system and treatment of sewage also play a part in this deterioration.

Lack of solid waste management services is the main problem facing the residents living near the river because they are not provided with any refuse collection services. Consequently solid waste is disposed of in the river, on the river bank, in drains or latrines, or burnt. During rainy seasons, debris, waste water, together with solid waste, are washed into the river.

This has caused serious environmental and health problems for the people living along the rivers. The rivers have suffered accelerated eutrophication and have put stress on the aquatic water system. The Nairobi rivers data suggests that the high BOD is related to combination of raw sewage pollution and industrial pollution.

A study last year by United Nations Environment Programme/Africa Water Network raised questions about the safety of the river as a source of water for irrigation and domestic use.
Could it be that many people are being poisoned? "Certain plants concentrate certain nutrients such as mercury, a highly poisonous element. When you eat the plants (raised from such nutrients), then you are eating higher concentrations of poison," Dr Olago and Dr Apiyo-Aketch warned. /4/ /31/

13.1.1 HUMAN EFFECTS ON THE RIVER NAIROBI

Picture 6. Industrial wastewater is discharged straight into the river at the Mater Hospital Bridge in Nairobi as shown by the blue arrow. /13/

13.1.2 SLAUGHTER HOUSES

It is unfortunate to note how much potential energy is wasted when the numerous slaughterhouses at Dagoretti, on the outskirts of Nairobi, direct discharge of the dung, derived from the slaughter of an average of 400 animals sold daily to butcheries, directly into the river.

Assume all this dung was to be converted into cooking gas by the simple Bio-gas Digester technology, then the whole of the Dagoretti area and probably its environs and even some nearby areas would never have to rely on the petroleum-based cooking gas for their domestic needs. /26/

Picture7. Untreated run-off from slaughter-houses and a meat market enter Nairobi River /26/

Picture 8. Unfortunately, the Nairobi River receives pollutions from farmers who grow their crops near the river. This happens most often when it rains and the fertilizer is swept into the river. /13/

14. LEGISLATION AND ENFORCEMENT

At the present time, what specific legislation on waste management or the environment exists in the Public Health Act (cap 242) and Local government Act (cap 242) is only poorly carried out in practice. Some examples where enforcement was carried out under the Public Health Act, was when a waste incinerator at a shoe factory was closed down for production of smoke and when a factory discharging heavy metals (causing blockage in sewage works) was closed down until a treatment plant was constructed, but such actions are all too rare. /9/

14.1 The Public Health Act

This Act, which deals with discharges into drains and sewers, contains by far the most wide-ranging provisions concerning polluting discharges. */9/*

14.2 The Local Government Act

This act is a mandate to local authorities to establish and maintain sewerage and drainage works, and it also grants local authorities immunity from liability for damage caused by the sewage disposal works if this is the “inevitable consequence” of the operation of the works.

14.3 Environmental Management and Coordination Act

The Environmental Management and Coordination Act of 1999 introduce a compulsory requirement to an EIA in relation to a list of activities set out in a schedule. The Act goes further and sets out the procedure to be followed in applying for an environmental impact assessment license. This must be obtained before any development in respect to the scheduled activities can go ahead. The National Environmental Management Authority is in charge of the process of issuing licenses, however, regulations will still be needed to spell out the details of the process of obtaining the license, the fees to be paid, and the time limits within which the application must be considered, and so on.

15. PUBLIC PERCEPTIONS AND ATTITUDES

It appears that the public are concerned by the inadequate management of MSW and the continuing decline in standards. In Nairobi, a survey showed that 36% of respondents considered the problem of garbage collection was a very serious one, while 22% of respondents saw the problem as only a moderate one. If people are to be expected to pay for a service, however, the quality particularly of collection must be dramatically improved.

It is unlikely however, that low income groups will be prepared to pay anything for such a service. /10//31/

16. GOVERNMENTAL AND NON GOVERNMENTAL ORGANIZATIONS WORKING IN WASTE MANAGEMENT ISSUES

16.1 NEMA National Environment Management Authority

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 instrument 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. /6/

16.2 Green town action group

The Green town action group directly involves the local communities.
They are involved in activities such as waste collection, recycling and composting.
Their main goal is to improve local environment, to create jobs and to improve resources.

16.3 Kenya Green Town Partnership

Kenya Green Town Partnership has been consistently at the forefront in training the community on how to effectively manage solid waste generated by their local environment. They annually conduct public awareness campaigns.

16. 4 ELCI- Environment Liaison Centre International

The Environment Liaison Centre International has a broad global membership of non-governmental and community-based organizations in 104 countries, working for a healthier environment and to improve quality of life. ELCI brings the local perspective to global environment policy making. The project also carries out an awareness campaign on environmental issues. /12/

16.5 Kenya Energy & Environment Organization

Kenya Energy and Environment Organization is an indigenous NGO membership organization established in 1982 to promote organizational involvement at a grassroots level in renewable energy, environmental management and community development. It responds to the needs of its members through advocacy for policies and programs in land use and natural resources management, business, energy, technology development, information networking and environmental quality.

16.6 Mukuru Recycling Centre

Mukuru Recycling Centre was established in 1991 with the engagement of two priests of the Kariobangi Catholic Church to work for the improvement of the scavenging activities in the Dandora dumping ground through reduction of exploitation by waste dealers operating around the dump-site. The other main function of the Mukuru Recycling Centre is the re-education of scavengers. /21/

16.7 African Biodiversity Institute

This organization was established in 1986, and makes a significant contribution to strategic environmental assessment and environmental impact.

16.8 The African Centre for Technology Studies

This centre was established in 1988, and is active in organizing conferences and symposia on environmental law, as well as publishing reports and books on environmental law.

16.9 Kenya National Cleaner Production Centre

This Centre is an autonomous non- profit institution that was founded in July 2000 with support from the United Nations Development Programme.

- KNCPC was founded to contribute to curricula development of tertiary educational institutions in the area of environmental management.
- To provide technical assistance in occupational health and safety, eco-design and ISO 14001 certified companies for purposes of continuous improvement.
- To organize cleaner production demonstration projects.
- To establish a referral documentation centre.
- To contribute to the formulation of policies, strategies and action plans for environmental conservation.

17. SOLUTIONS

1. The only way to solve the waste problem in Kenya, and any country for that matter, is by changing the attitude of the younger generation who will become adults in the near future. This can be done through better education and school campaigns, and information can be made available to schools, to the media, and even more specifically, to waste-handling staffs, and industrial workers. It is important to develop awareness at all levels, from nursery schools to universities.

2. If the landfill site is managed properly, pollution can be reduced to a minimum. Leachate can be safely disposed of, toxic gases filtered, and all dumping closely monitored so that dangerous classes of waste, medical and industrial are prohibited from being dumped in the site, Dandora could then be a better place to live even now and certainly in the near future.

3. Encourage local politicians to introduce legislation taxing or banning plastic bags. A ban on bags less than 30 microns thick, a tax on thicker ones, and efforts to raise consumer awareness about the environmental dangers of plastic bags should be made. Funds should be made available for alternative, more environmental-friendly carriers such as cotton and sisal bags, according to the report.

4. Increasing accessibility to waste disposal areas for households. This is one of the problems facing residents in Kenya at whole. Well implemented, this could be a major solution towards some of the waste problems facing Kenya and other countries.

5. The United Nations Development Programme (UNDP) is currently involved in bringing a number of stakeholder groups together including waste haulers, Community Based Organizations (CBOs), Non-Governmental Organizations (NGOs), and local government officials to form stakeholder meetings with the objective of formulating a public/private action plan for solid waste disposal.

6. To curb any haphazard disposal of waste and the encroachment of the dump-site by some residents, the Authority’s officers are working with residents' associations as well as NCC to enforce the by-laws and environmental and public health standards. It is essential however, that these strategies are already in working order before relocating the dump-site to another more suitable area so that a precedent is set for the new site's operations.

7. KEBS has developed Kenyan standards for acceptable plastic thickness, which are now at the Government printers, and when printed, they will be gazetted. Once the standards are gazetted, NEMA will invoke the "polluter pays principle" on those who fail to comply.

8. Newly recruited District Environment Officers (DEOS) and Provincial Directors of Environment (PDES) are now on site assessing the problem and coming up with an action plan.

9. Authorities should hold several discussions and consultations with various stakeholders, particularly the Kenya Association of Manufacturers (KAM) and the Kenya Bureau of Standards (KEBS) about this main problem facing the country.

18. WASTE MANAGEMENT IN LIMURU TOWN

Figure 4. Map of Kenya showing location of Limuru. /30/

Limuru is a small town about 25 km North of Nairobi with about 30,000 inhabitants. The community has a predominantly agriculture economy, although there is a Bata shoe factory as well as some other factories. Like any other town in Kenya, Limuru town is also affected by a serious solid waste management problem.

Its dumping site is about 6km outside the town, and the waste volume at the site is very low, possibly well below 10 tons per day, because of poor collection service.
The city council organizes about 7 trips a week, either by dump truck or tractors pulling trailers. Of the waste generated, 97% is domestic and 3% is industrial.

The council charges about 250 Kenyan shillings per year which is about 2.5 Euros. The town council collects 12 tons of the waste from Markets, Commercials buildings and Residential areas leaving 2 tons of the waste uncollected. The Bata shoe factory in Limuru town had its own incinerator; this has been lately shut down by the council because most of their waste contains dangerous chemicals not adequately dealt with by incineration The factory is now unfortunately dumping their waste at the Dandora site. /10/

Reasons for the uncollected waste in the town are caused by poor Machinery, lack of personnel, lack of awareness by the community on solid waste management and also the dumping site is not enough to handle all the waste.

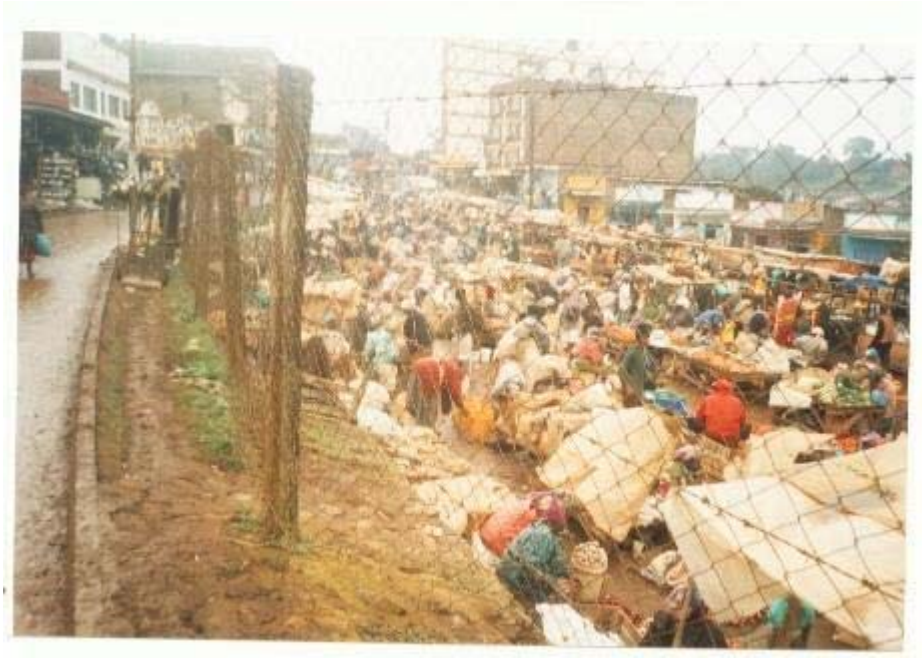
19. BIBIRIONI DUMPING SITE CASE STUDY IN LIMURU

The Limuru dumping site is located 6 km away in Bibirioni. It covers about ½ hectare which is not sufficient for the purpose. All types of waste are dumped at the site some of which is very dangerous not only to nearby residents, but to local animals. One such resident, a farmer, has lost many livestock, after they died from ingesting polythene materials, leading to loss not only to the farmer but to the Kenyan economy as well. Another incident happened in Bibirioni when a very young school child injected himself with a syringe collected in the dump-site on his way home from school, and small children as is well known are not always capable of understanding the possible dangers of such materials. Broken glass is scattered all over the site, and poses obvious danger. /10/ /31/

20. SOLID WASTE PROBLEMS IN LIMURU CITY

Similar to other Kenyan urban areas, Limuru is also affected by serious plastic bags problems with bags scattered all over the communities, and this affects both human and animals as discussed in section about Nairobi City's plastic bag problems.

Most plastic bags are discarded after markets days and because the city lacks garbage disposal units, the bags remain where they are discarded. The picture below shows Limuru's market day.



Picture 9. Limuru market. Photo by James Muchane.

There is need for adequate dumping areas in Limuru because the town has a large market, resulting in considerable waste generation during market days.

Picture 10. Plastic bags lying out side Limuru shopping center. Photo by James Muchane.

As seen in the picture above, such an area is a threat to human health since there are butcheries and other shops within the area which attract flies, and provide them with a place to breed. In addition, plastic bags cause drain blockage making an ideal environment for mosquitoes to breed, which affects both humans and animals.

21. FUTURE PLANS FOR NAIROBI CITY AND LIMURU

- Closure of the existing dumping site.
- Relocating a new dump-site at Ruai.
- Development of an awareness campaign.
- Employment of qualified people in environmental work.
- Employment on recycling areas.
- Acquiring more collection machinery. /11/

21.1 PROPOSAL FROM AGENDA 21

Agenda 21 also plays an important role because it emphasizes minimizing waste, and maximizing environmentally sound waste reuse and recycling. /21 / /9/

22. SWOT ANALYSIS OF NAIROBI CITY AND LIMURU TOWN, KENYA

- Strength

There are some non-governmental organizations trying to fight for improvement in solid waste management such as recycling.

- Weakness

Although the laws have been enacted, waste management and enforcement have not been carried out in practice. There is a lack of commitment to carrying out solid waste management, and there is also a lack of technical support service.

Other problems are the lack of a proper budget for solid waste management, a lack of a proper planning concept of a solid waste system, and a lack of qualified, experienced and trained municipal personnel.

- Opportunities

Much research is being done in this field, and the results are readily available to all to start implementing projects.

- Threats

There is a general lack of faith among the public about the capability of policy makers to enforce the laws.

23. CONCLUSIONS

Each developing country should develop its own solid waste management policy that best suits its own economy and environment. With a simple change in thinking and a little effort, we can turn garbage from a dangerous problem into a profitable industry. Garbage can help us grow our crops, create employment, and the methane originating from waste may be used as fuel and this could reduce the dependence on oil products and charcoal. This all will make our lives to be easier, at the same time make our city a more pleasant place for ourselves and generations to come. Each individual has a role in building a sustainable future, and in our homes, schools, and at work, we can make these changes that will help preserve our resources for future generations.

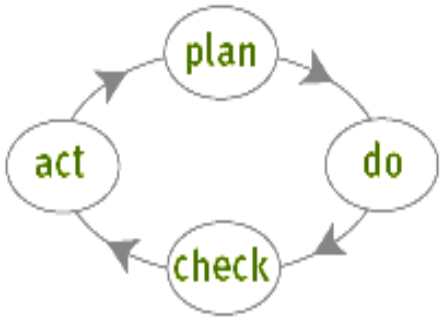
If we want our children to live a clean, healthy environment tomorrow, let's help them learn how to care for it today. Let's all join hands and make our country cleaner for a better tomorrow. **/7/**

24. RECOMMENDATIONS

- A system for classifying waste according to its toxic level (harmful or infectious characteristics) needs to be developed.
- If waste classification is done not a single waste would be rejected.
- For the provision of more waste bins in the two areas, and their regular emptying.
- Public awareness about waste management is most important.
- The only way to significantly overcome many of the waste problems in Nairobi and Limuru is by changing the attitude of the younger generation through better education and school campaigns
- The costs imposed upon the public health system and economy in general on a daily basis, are enormous.
- Discontinuation of giving out free bags in supermarkets.

- To foster the mentality in the public that all acknowledge and conform to the NEMA ACT, which states every person in Kenya, is entitled to a clean and health environment, but at the same time has the duty to safeguard and enhance the environment.
- Nairobi city council should take over the work of sorting waste now done by the scavengers in East Leigh and Dandora, creating paid jobs and promoting Kenya's economy.
- Fencing of both Dandora and Bibirioni dump-site.
- A ban on bags less than 30 microns thick and the levy on thicker ones are among a raft of proposals aimed at reducing the use of polythene bags and providing funds for alternative, more environmentally-friendly, carriers such as cotton or sisal bags.
- Support for a proper plastic bag recycling scheme.
- Working and collaborating with Kenya Institute of Education to introduce environmental enlightenment into the Nairobi school curricula, so that children can educate their parents too.
- The Authority should work with local authorities and other bodies engaging in garbage collection to institute a mechanism where plastic waste can be sorted and then collected separately in readiness for recycling.
- A River Restoration Action Plan should be developed for the Nairobi river basin.
- The use of economic instruments (EIs) which could be of a great help to reduce the amount of waste generated, and reduce the proportion of hazardous waste in the total waste generated. These can be a very important tool to encourage recovery, reuse and recycling of wastes
- An environment management system (EMS) should also be implemented because it helps businesses to evaluate, manage and reduce their environment impacts by providing a methodology to integrate environment management into business operations in a systematic manner.

- Its also builds awareness of environmental concern among employees .EMS is based on the total quality management (TQM) process as shown below.



The diagram shows the process of first developing an environmental policy, planning the EMS, and then implementing it. The process also includes checking the system and acting on it. The model is continuous because an EMS is a process of continual improvement./14//31/

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26. APPENDICES.

26.1. Nairobi city Questionnaires (also showing correct answers)

1. What is the amount of solid waste collected per day (tons) in Nairobi City
   - 800-1000 Tons.

2. What is the amount of the uncollected solid waste per day (tons) in Nairobi City?
   - 700-800 tons

3. Among the waste collected, what is the percentage of domestic and industrial waste?
   - Domestic 51%.
   - Industrial 20%.

4. From which estates do you collect waste?
   - Middle class.
   - Low class.
   - Slums.

5. What are the reasons for the uncollected waste?

- Poor infrastructure road accesses.
- Inadequate resources in terms of equipment.
- Population explosion.
- Rural- urban migration.
- Lack of awareness by the community on solid waste management.

6. Where do you dump the collected waste?

- Collected waste is dumped at the only officially recognized disposal site of Dandora.

7. Are there any private sectors that collect waste?

- Yes there are private waste collectors.

8. Which estates are served by the private sectors?

- High and middle income estates.

9. What is the approximated area (m) covered by the dump-site?

- The area is only 25 hectares.

10. Is the land or place of disposal enough to dump all the waste?

- The land is adequate only if upgraded.

11. What are the various types of wastes dumped at the site?

- All kinds of waste.

12. Do you have any recycling sectors?

- Yes there are several recycling sectors.

13. What type of waste do you recycle?

- Plastics.
- Papers.
- Metals.
- Agriculture waste.

14. Do you have any public awareness on how to separate their waste?

- There is no public awareness, although there is a program which is yet to be launched.

15. What is the future plan on how to improve waste problems facing the city?

- Closure of the existing site.
- Relocating it in Ruai.

16. How many cases of sickness, infections have been reported being associated with the disposal site.

- Reports of recurring and chronic of health problems especially among those living near the Dandora dump-site.

26.2 Limuru Town questionnaires and the correct answers

1. What is the amount of solid waste collected per day (tons) in Limuru municipality (Kiambu District)?

- About 12 tons

2. What is the amount of the uncollected solid waste per day (tons) in Limuru municipality (Kiambu District)?

- About 2 tons

3. Among the waste collected, what is the percentage of domestic and industrial waste?

- 97 % of the waste is generated from domestic sources
- 3% of the waste is generated from industrial sources

4. From which estates do you collect waste?

- Markets
- Commercials buildings
- Residential areas

5. What are the reasons for the uncollected waste?

- Poor machinery.
- Lack of personnel.
- Lack of awareness by the community about solid waste management.
- The dumping site is not enough to handle all the waste.

6. Where do you dump the collected waste?

- At the Bibilioni dump-site.

7. What is the approximated area covered by the dump-site?

- About one-half an acre

8. Is the land or place of disposal adequate in size to handle all the waste?

- It is not.

9. What are the various types of wastes dumped at the site?

- All types.

10. Do you have any recycling sectors?

- Yes

11. What type of waste do you recycle?

- Plastics
- Papers
- Metals

12. Do you have any public awareness on how to separate their waste?

- No plans have yet been formulated.

13. What is the future plan on how to improve waste problems facing the city?

- Developing public awareness about solid waste problems.
- Employment of qualified people in environmental areas.
- Acquire more suitable machinery.

14. How many cases of sickness, infections have been reported being associated with the disposal site?

- Frequent reports of recurring and chronic of health problems especially among those living near the Bibirioni dump-site.