Equatorial Lakes Subsidiary Action Program

FEASIBILITY STUDY AND PREPARATION OF AN INTEGRATED WATERSHED MANAGEMENT PROGRAM AND INVESTMENT PROPOSAL FOR SIO-MALABA-MALAKISI SUB BASIN

Final Report

Annex 3A - Solid Waste Management Plans for Bungoma and Lwakhakha

Revised Final version - August 2012

egis bceom International

in association with

CAS consultants Ltd

Document quality information

General information

Auteur(s)	Jean-Marc ROUSSEL, Team Leader
Project title	Feasibility Study and Preparation of an Integrated Watershed Management Program and Investment Proposal for the Sio-Malaba-Malakisi Sub-Basin
Document title	Final Report – Investment Project Proposal
Date	August 2012
Reference	GED 10412 X

Addressee(s)

Sent to :		
Name	**Organization**	**Sent on:**
Mohammed BADAZA	Project Manager, Sio-Malaba-Malakisi River Basin Management Project, Kakamega, Kenya	29/08/2012
Copy to:		
Name	**Organization**	**Sent on:**

History of modifications

Version	Date	Written by:	Review by:
Version 0	13/04/2012	Jean-Marc ROUSSEL, Team Leader	Emmanuel DAVAL, Project Director
Version 1	29/08/2012	Jean-Marc ROUSSEL, Team Leader	Emmanuel DAVAL, Project Director

The contents of the present report are the sole responsibility of the Consultant, and should not be taken as reflecting the views of the Nile Basin Authority or the Nile Equatorial Lakes Subsidiary Action Programme.

Content

The present document is Annex 3A to the Final Report for Sio-Malaba-Malakisi Watershed Management Investment Project

IWMP Final Report	
Main report	Investment Project Proposal
Annex 1	Catchment rehabilitation and management and investment plan
Annex 2	Community based wetlands management and investment plan
Annex 3A	Solid waste management plan for Bungoma and Lwakhakha and investment plan
Annex 3B	Storm water drainage plan for Bungoma and Lwakhakha and investment plan
Annex 4	Environmental Social Management Framework
Annex 5	Integrated Watershed Management Investment Project
Annex 6	Institutional set up for Project Implementation

Annex 3A1. Solid Waste Management Project for Bungoma

TABLE OF CONTENTS

LIST OF ANNEXES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1.SWMP General Presentation

1.1 General Context

Over 50% of the global population lives in urban areas characterized by ever increasing consumption of resources and services. The increasing urbanization, rural-urban migration, rising standards of living and rapid development associated with population growth have resulted in increased solid waste generation by industrial, domestic and other activities. Bungoma municipality, like other urban centre in Kenya, is experiencing rapid population growth largely due to rural-urban migration and natural rate of increase. According to the 2009 census currently Bungoma municipality has a core urban population of 55,867 and a total population of 81,151. The rapid increase in population has resulted in the increase in solid waste generation rate which is estimated at 28 tons/day based on the core urban population whereas about 13 tons/day is generated from the peri-urban areas of the municipality.

Solid waste is emerging as a major public health and environmental concern in Bungoma Municipality. Despite increase in solid waste generation, there has not been accompanying increase in the capacity of the municipality to deal with this problem. The proper management of waste has thus become one of the most pressing and challenging environmental problem in Bungoma Municipality. Many studies in the developing countries indicate that more than 50% of solid waste generated in urban areas is not collected nor properly disposed off properly due to inefficiencies in waste collection and disposal. However about 80% of the present waste generation in the core urban area of Bungoma Municipality is left uncollected or illegally dumped within the town and the remaining 20% is carried to the final disposal site. There is hardly any waste collection from the peri-urban areas of the municipality on the other hand.

The adverse impacts of uncontrolled dumping and burning are widely acknowledged but in spite of these, they are still the common methods practiced in disposing solid waste in Bungoma Municipality with a potential of resulting in serious pollution. The Municipal Council of Bungoma disposal site is an open dumpsite and this poses detrimental effects to the surrounding environment. The risk of poor solid waste management practices is that pollutants are dispersed into the environment including heavy metals, organic matter, plastics or synthetic organic compounds such as furans, dioxins or polychlorinated biphenyls. In addition the possible existence of storm drains or leachate from the sites poses risk of dispersing pollutants into the environment through surface and ground water courses. Therefore the impact of solid waste to the environment and to human health has to be managed and disposed off in an environmentally sound manner.

The Nile Basin Initiative has made efforts to improve the sanitary environment of the Sio-Malaba-Malakisi Sub Basin and has sought the consultancy services to conduct this study on solid waste management with the aim of reviewing, revising and formulating proper Solid Waste Management Plan in Bungoma Municipality. This will enhance integrated watershed management within the Nile Basin. The Integrated solid waste management initiative seeks to maximize resource use efficiency through a strategic approach to sustainable management of solid waste considering all sources of wastes and all stages of solid waste management including generation, segregation, sorting, treatment, recovery and disposal in an integrated manner.

The solid waste management study of Municipal Council of Bungoma included evaluating aspects of waste characterization, solid waste management systems and environmental and health impacts. Determination of Waste composition data on the other hand plays a critical role in solid waste system planning and design. Data generated from waste composition studies are used in several ways, including determining the quantity of material available for recovery, measuring the effectiveness of existing recycling programs, and right-sizing solid waste and recycling facilities. The study highlighted the gaps in the institutional framework, legal and policy framework, financing mechanisms, waste management technologies and how stakeholders participate in solid waste management in Bungoma Municipality.

The methodology used in the study involved desk review of solid waste management literature, scheduled interview of District Environmental officer, the public health and environmental department officials from the municipal council as well as field observation, visits to several areas within the municipality including municipal slaughter house, the bus park waste collection chambers, Bungoma-Mumias highway, Chebukube air market, Mjini informal settlement, Mandizini residential areas, Marrel residential areas, the District hospital, Kiringet, Bungoma tourist hotel, Kanduyi area, Tuti disposal site and an illegal dumping point opposite Namuyemba junction. The field visit also involved interviewing the local people to get their views and perception regarding solid waste management practice in the municipality.

The dumpsite is located within the catchment of Sio River which originates from the wetlands west of Bungoma Town and eventually drains into Lake Victoria. This has resulted to environmental, health, hygiene and aesthetic problems for the people of Bungoma town, hence poor solid waste management issue requires urgent intervention.

1.2 Goal of the plan

To develop an economically responsible program for solid waste management that address specific institutional/legal, technical/operational and economic/financial issues and constraints to achieve efficient solid waste management at a sustainable level of service in Bungoma Municipality.

1.3 Objectives of the plan

- To improve the technical capacity of the municipal council to effectively manage solid wastes.
- To improve solid waste collection, storage, transportation and disposal system in Bungoma municipality.
- To enhance public awareness and participation for sustainable solid waste management in Bungoma Municipality.
- To enhance hazardous waste treatment/management, recycling and reuse as a way of reducing solid waste volume and impact to the environment.
- To enhance institutional capacity of the municipal council for solid waste management service delivery and enforcement.
- To reduce degradation of water resources and the environment in general.

1.4 Justification of the plan

Municipal solid wastes (MSW) contain a variety of constituents that are a threat to public health and the environment. The dispersal of the pollutants into the environment causes human, soil, air and water resource pollution. Therefore this plan is prepared with an aim of addressing inadequate solid waste management issues in Bungoma Municipal Council by providing an action plan. It gives a perception of the way forward and what is expected in the future within solid waste management practices.

CHAPTER 2.THE PLANNING AREA

2.1 Study area

National context

The Municipal Council of Bungoma was established under the Local Government Act Cap 265 of the Laws of Kenya to execute three key functions: local services, local governance and local development through strategic leadership.

Other laws governing operations of the Municipality and other local authorities in the country include: Local Government Loan Act Cap 303, Trade Licensing Act Cap 497, Rating Act Cap 267, Valuation for Rating Act Cap 255 and the Agriculture Act Cap 218.

The organization and management of Bungoma Municipal council is structured into two arms; the policy formulation arm headed by His Worship the Mayor comprising eight elected councillors with three nominated while the executive arm implements policy decisions made by the former and it is headed by the Town Clerk.

Committees that exist under the policy formulation arm include:

- Finance,
- Staff and General Purposes Committee
- Town planning and Works Committee
- Education, Housing and Social Services Committee
- Public Health Committee
- Environment Committee
- HIV Aids Committee

Administrative area

Bungoma Municipality is the district headquarters of Bungoma South District and it is the designated headquarter of Bungoma County. The municipality consists of two locations namely Township and Musikoma. Township location consists of the core urban area whereas Musikoma consists of the rural part of the municipality. The municipality is also divided into electoral wards covering an estimated area of about 57.9 km². The wards include:

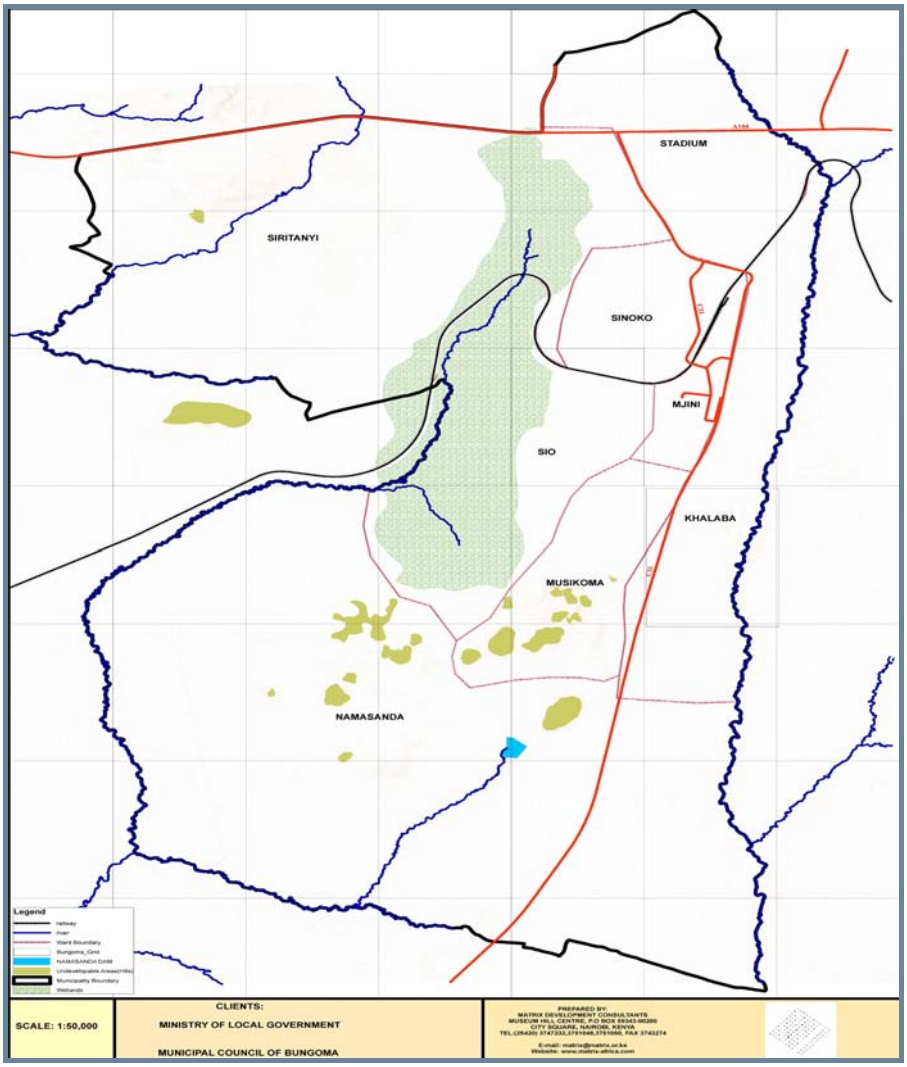
- Namasanda
- Sio

- Musikoma
- Khalaba
- Siritanyi
- Sinoko
- Stadium ward
- Mjini

Location of the study area

Bungoma Municipality is located about 400 km North - West of Nairobi City, and about 30 km from Malaba town, at the Uganda border. It is 61km from Kakamega town, which was the provincial headquarters of former Western Province. It measures 57sq. km and runs from Sibembe in the South, Kanduyi to the North, Sio River to the West and Khalaba River to the East. It is surrounded by the Bungoma County Council and lies between latitude 00281 and latitude 10301 north of the Equator and longitude 340201” East and 350151” East of the Greenwich Meridian.

The figure below shows the location map of Bungoma.


STADIUM
SIRITANYI
SINOKO
MJINI
SIO
KHALABA
MUSIKOMA
NAMASANDA
Legend
SCALE: 1:50,000
CLIENTS:
MINISTRY OF LOCAL GOVERNMENT
MUNICIPAL COUNCIL OF BUNGOMA
PREPARED BY:

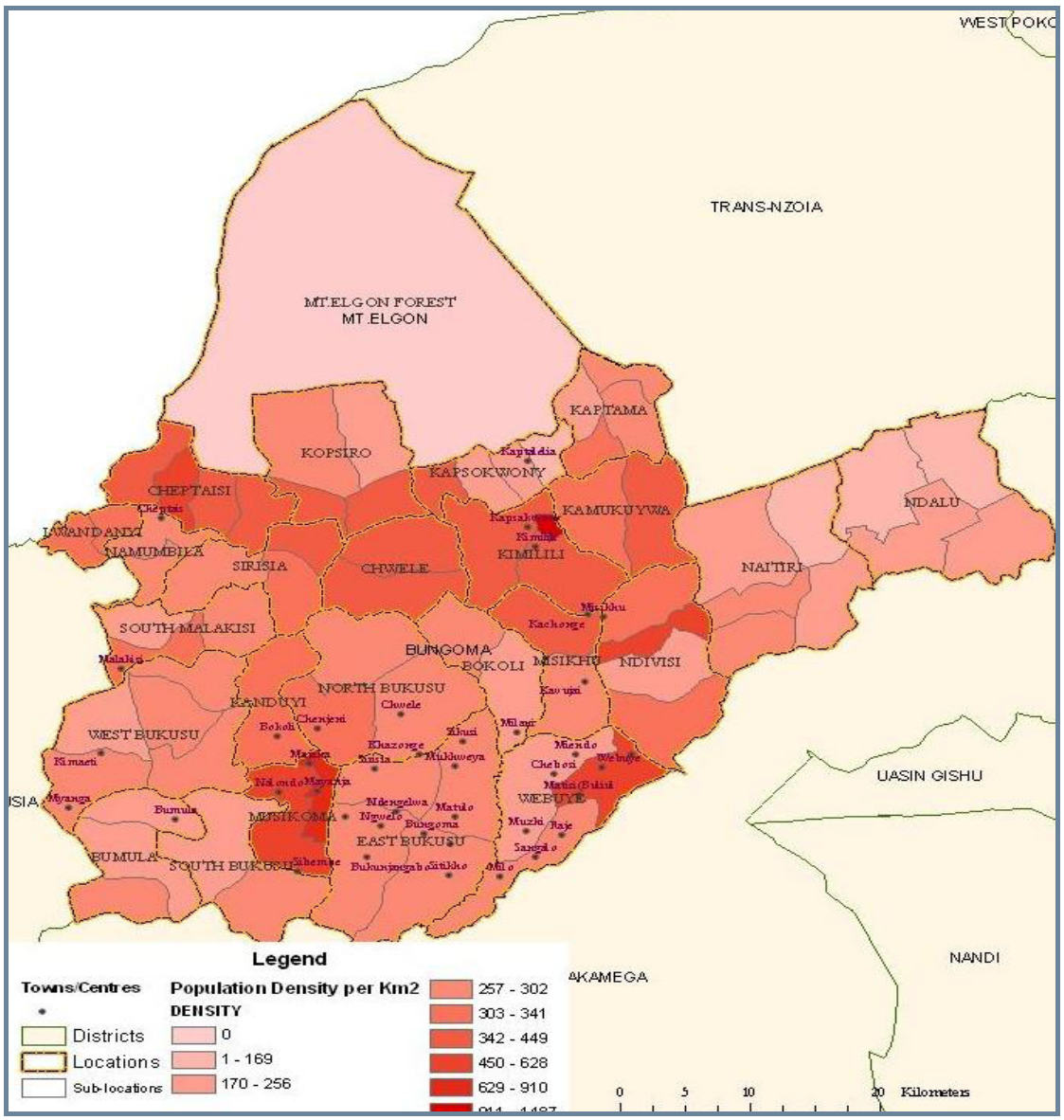


Figure 2-1: Administrative Boundaries of Bungoma District and the Strategic Urban Development Plan

Population

The combined current population of both the core urban and the rural areas *(township location and Musikoma location respectively)* of the Municipality is about 81,449 persons while the average population density is 1407 persons per square kilometre. The Municipality has about 19,500 households with the average household size estimated at 5 persons per household with women population being slightly higher than those of men according to the 2009 Kenya population and housing census. The rapid increase in population within the municipality has been attributed to rural-urban migration a characteristic associated with most urban areas globally. The township location which is the core urban has the highest population density of about 3,133 persons per square kilometre due to the available business opportunities whereas Musikoma Location having more households practicing agricultural activities has a low density of 863 persons per square kilometre. However it is important to note that the municipality has a significant visiting population particularly during the day that work within the town while living in other areas. Such a population influence service delivery of the town.

Socio-economic characteristics of the study area

Main occupation

Bungoma Municipality is characterized by both rural and urban settlement. Where Agriculture activities, business, formal and informal employment as well as tourism to a lesser extent provides occupational opportunities for most household heads. The agricultural farms provide both formal and informal employment whereas urban centres provide business opportunities. There are several education, research, health, financial, transport, Local government agencies and other institutions within Bungoma municipality which provides formal employment to the local people. However commercial activities are the main occupation in the town and this include retail shops, bars and restaurants, tailoring shops, supermarkets, car garages, jua kali services, open air market, hawking, salons and barber shops, groceries, hardware, studios and petrol stations among others.

Infrastructure

The road network within the municipality consists of Tarmac, Marrum and earth roads. The Tarmac roads include but are not limited to streets within the town centre and the roads linking Bungoma town to Malaba, Chwele, Webuye and Mumias towns. The other areas of the municipality are served by Marrum and earth roads. In addition the municipality has an airstrip for light aircrafts and helicopters while the other services include postal services, financial institutions, and electricity, water and telecommunication facilities among others.

Education status

According to the 2009 Kenya population and housing census, over 85% of the population in Bungoma municipality have gone through formal education. About 60% of the 85% have had a primary level education, while the rest have had secondary school and college level education. The municipality has several primary schools, secondary schools and tertiary colleges which are both public and private.

Living conditions

The living conditions in Bungoma municipality are typical of an urban set-up in Kenya with an exception of the outskirts of the core urban area. The town has both affluent as well as informal settlement and waste management is an issue of concern particularly in the informal settlement. Waste water drainage especially in the market area is poor with inadequate drainage facilities.

Sources of income for the household

Sources of income for the local people within Bungoma Municipality are mainly trade and commerce or employment both formal and informal. However comparing the rural areas and urban areas, more women are engaged in farming activities and in the informal sector as opposed to men. The agricultural activities on the other hand consist of sugarcane farming, subsistence farming and horticultural products at small scale.

Well-being and well-being trend

On the Basis of the 2009 Kenya population and housing census report, more men than women are employed and have a sustainable income in the municipality whereas more women provide labour on the farms where the farming activities are seasonal and depend on the availability of rainfall. However Bungoma town provides several opportunities for small businesses which supplements family income.

Housing

Type of settlements

Bungoma Municipality is characterised by both rural and urban settlement. However, the location and the population density are largely influenced by commercial activities and poverty levels. The settlement patterns in the municipality are dictated upon by the potentiality of land, land use system and business opportunities available. The population density is high in the core urban centre and areas with high commercial potential whereas areas with low commercial potential or agricultural activities are sparsely populated.

Housing characteristics

According to the 2009 Kenya population and housing census, some houses in Bungoma municipality are permanent and constructed with iron sheets as roofing materials whilst bricks, blocks or mud for walls. Over 75% of the total housing in the municipality has cement floors whereas some of the houses in the rural areas (Musikoma) are semi-permanent with earth floors. The distribution of houses in the municipality on the other hand is determined by commercial activities with sparse distribution being common in areas of low commercial potential while dense distribution being in areas with high commercial potential or in the core urban centre.

Land use

Bungoma town is a relatively and thus most of the residents practice trade and commerce as a way of earning a living but in addition having a rural set up as well, residents from the surrounding environs practice small scale agriculture and rearing of livestock.

Land ownership within the municipality on the other hand is mostly freehold, trust and public land. However most areas have not been planned for and lack basic infrastructure services. In addition, by 2005 the council had not prepared an integrated physical development plan a tool which comes in hand to assist in understanding the land use pattern within an area. The Land use patterns in the municipality include but are not limited to the following.

Residential

Residential is the dominant land use in the core urban area of Bungoma municipality occupying between 50-60% of the land. Housing may vary significantly between and through residential areas and these include single family/private housing or multi-family/commercials housing.

Bungoma Municipality consists of high, medium and low density residential areas and according to the study, the high density residential areas consist of low income areas such as Mjini informal settlement and Mandizini area. The residential houses in the municipality are both private and of rental/commercial nature.

Commercial

Most trading activities in the study area are concentrated in Bungoma Central Business district and around Kanduyi area. The main businesses in the municipality include retail shops, bars and restaurants, tailoring shops, guest houses, supermarkets, car garages, salons and barber shops, groceries, hardware, studios and petrol stations.

Industrial

Bungoma municipality does not have operating industries and the nearest industry is Nzoia Sugar Company which is not within the municipality. The former Kenya Cooperative Creameries (Kitinda) is yet to be opened.

Agricultural

Agriculture contributes a lot to the economy of those who live in the rural areas of the municipality and they depend on agriculture for food production. Agricultural activities in the Municipality is mainly rainfed with a substantial percentage of the municipality area being under cultivation on small scale producing cereals such as maize, beans, sorghum horticultural products and sweet potatoes. Although sugarcane is also planted, it is done as a cash crop but not many households in the municipality grow it.

Other land uses

The other land uses in the municipality include an airstrip which serves Bungoma town and Kanduyi stadium which is used as sports ground as well as holding political rallies.

Zoning of the study area

According to the Garbage collection plan prepared by the Municipal Council, the municipality is categorized into seven zones where each zone is further subdivided into 3 or 4 sub- zones. The zoning was done with an objective of enabling more households to access the solid waste management services. The zones were categorized as indicated in the table below.

Table 2-1: The existing zones of waste collection in Bungoma Municipality

ZONES	NAME OF ZONE	SUB-ZONES
1	Musikoma	Happy moments
		Lupinda
		Nabongo TTC
		Roots
2	Mjini	K.C.C
		Muslim secondary
		Wings
		Mufutu
3	Chebukube	Bondeni

ZONES	NAME OF ZONE	SUB-ZONES
		Stage
		Mteremuko
4	Khalaba	Lumboka
		Mashambani
		Tourist
		Bungoma TTC
5	Marrel	Country Side
		Blue waves
		Ndekwe
6	Hospital	Milimani
		West FM
		D.C residence
		Bethesda
7	Sinoko	Bungoma high school
		Prisons
		Mandizini

Characteristics of the zones

Zone 1 Musikoma

In this zone, the population per household is small, settlement pattern is scattered and garbage generated is little. The garbage is more of organic and plastic materials which currently are managed by the individual households. There are approximately 1000 households residing in this zone.

Zone 2 Mjini

This is a highly populated area in the municipality due to the informal settlement with households densely clustered. The number of households is approximately 4,000 who are low income earners. In this zone a lot of garbage is generated whereas waste collection and disposal services are inadequate. The zone is further characterized by indiscriminate waste disposal habits.

Zone 3 Chebukube

Majority of the households in this zone are business people with few residential houses, the zone is densely populated during day time and much of the waste is from organic and packaging materials however there is an estimated number of 3,000 households including commercial premises covered in this zone.

Zone 4 Khalaba

This zone covers a large part of the municipality and has a bigger number of households with residential houses. Approximately 2000 households are residing in the zone.

Zone 5 Marrel

Marrel zone has the highest number of households and it is a residential area. Most of the residents are categorized as high income earners in Bungoma Municipality. The waste in the estate is managed at the sources of generation in each plot involving waste burning.

Zone 6 Hospital

The zone has about 1,000 households and is largely covered by government offices as well as few government officers' households. In addition, the zone has commercial premises that generate wastes.

Zone 7 Sinoko

Sinoko zone has both high and low income earners residing in the area. The zone is estimated to have about 3,000 households.

2.2 Physical conditions

Climatology

The relief and landforms surrounding Bungoma town particularly Mount Elgon, influence the climatic conditions of the municipality and is favourable due to adequate rainfall that support a large variety of agriculture. The area has two rainy seasons, the long and short rains where the long rains normally start in March and continue into July while short rains start in August up to October. The mean annual rainfall varies from 1250mm to 1800mm and the rains are heaviest in April and May. The seasonal distribution is 1500- 2000mm during the first rains and 430- 1200mm during the second rains with 60% reliability. December and January have the least amount of rainfall.

The mean annual temperature varies between 21^0c - 23^0c due to different levels of altitude. April to July tend to have low temperature while December to February tend to have high temperatures.

Geology and soils

The Bungoma Municipality land within the new Bungoma County falls under land classified as agricultural with the soils showing considerable variation in fertility and drainage properties. Soils of moderate to high fertility are confined largely to northern part. The soils are well drained, deep and vary from dark red nitisoils and ferrasoils to dark brown acrisoils. In the eastern and southern part, the soils are well drained, moderately deep to very deep. The soils are reddish brown to yellowish brown. Along the river valleys, the soils are fairly shallow due to degradation. These areas are prone to swamps, water logging and flooding. The soils are clay, making roads impassable during rainy seasons and during the dry season they crack making planting and ploughing difficult.

Drainage basins

A large part of Bungoma town has a flat terrain while the altitude rises from 1200m above the sea level in the West to 2000m above the sea level to the North. It is generally the low-lying Nzoia River and its tributaries as well as Sio River that drain the area within the Municipality. The terrain consists of nearly flat land, with shallow river valleys in between. The flat nature of the terrain makes the drainage poor in many areas especially the areas along the rivers which have black cotton soils. Most of the area within the municipality is prone to flooding including the built up areas.

Vegetation cover

Bungoma Municipality falls within agro-ecological zone LM2 (lower midland two) marginal sugarcane zone. The natural vegetation cover has been greatly interfered with by human activities. Such activities include but are not limited to; settlements, farming, infrastructure development and other urban activities. The vegetation cover observed includes a mixture of indigenous and exotic plants species. However a large area of the municipality outside the business and residential areas is under agriculture plants mainly maize and sugarcane farming.

Environmental conditions

There are various environmental challenges that were identified in the environmental strategy part within the “Strategic urban development plan for Bungoma town 2008-2030”. The major issues highlighted in the strategy include solid waste management, waste water disposal, degradation of the water resources, loss of vegetation cover, land degradation, flooding, air pollution as well as noise pollution.

The strategy further points out that the municipality is experiencing loss of vegetation through rapid development including infrastructure development, clearing vegetation for agriculture, energy and building materials. Loss of vegetation cover on the other hand is contributing significantly to water resources degradation and poor sequestration of air pollutants. However Solid waste management was identified as the most significant environmental problem within the town. Its collection, storage, transportation and safe disposal is a major challenge to the town residents and the Municipal Council of Bungoma.

The strategy points out that uncollected solid waste, used oils and greases from the auto garages, fertilizer and agro-chemicals and other waste from various urban activities are degrading the land. The problem is exacerbated by human encroachment on the riparian for settlements and farming activities. In addition the plan highlight flooding as a perennial problem within the municipality because of the flat terrain, lack of and sometimes blocked storm drainage systems, low lying grounds and extensive black cotton soils which are prone to flooding.

CHAPTER 3.SITUATION ANALYSIS OF EXISTING SOLID WASTE MANAGEMENT SYSTEM

3.1 Waste characterization

The Municipal Council of Bungoma is responsible for Solid Waste Management within its area of jurisdiction. The council endeavours to meet its goals of ridding off the municipality problems related to garbage collection and disposal that are exacerbated by flooding during the rainy seasons. To overcome the challenge of solid waste management in the municipality it is necessary to characterize and quantify the municipal solid waste (MSW) generated.

Waste generation

Wastes generated in Bungoma municipality are from various sources including: Household waste or domestic waste from residential areas that were categories mainly into

- Paper and cardboard,
- Glass
- Plastics
- Organic fractions,
- Hazardous waste and
- Bulky waste.

The wastes from the residential areas were from both the informal settlements such as Mjini and middle income areas for instance Marrel estate.

The other source of waste in the municipality is from commercial establishments which include shops and restaurants as well as other service providers whose waste were essentially composed of:

- Packaging waste,
- Glass,
- Paper and cardboards,
- Metals,
- Petroleum product wastes and
- Organic waste from markets and restaurants

There are also institutions such as schools, and government offices as well as private ones whose waste were found to consist of mainly paper waste and plastics.

Waste storage and primary collection

Waste storage in Bungoma municipality is generally poor as the households or streets do not have adequate litter bins. Whereas the municipal council has several garbage collection sites located in Mjini, Mandizini, Kanduyi, Chebukube market and Bungoma main stage. The numbers of garbage collection sites are few compared to the large population as well as the municipal proposed waste management plan and in addition the collection points are poorly maintained. This has led to littering of wastes mostly in the residential areas and in particular Mandizini and Mjini areas. It were further noticed that the few collection chambers are dilapidated exposing waste to wind, storm water and scavenging animals.

Figure 3-1: An informal Waste Collection Point at Mandizini area

However the Municipal council has plans to diversify its service delivery to reach each and every resident of the municipality. For effective service delivery, an increase of the garbage collection sites within the municipality has been proposed. This was informed by the envisioned allocation of the collection points to the private sector ones the privatization program on the garbage collection services has been rolled out.

Waste segregation

Waste segregation in the municipality is an important element as far as waste management is concerned. Careful segregation (separation) of waste into different categories will help to minimize the quantities of hazardous waste that are to be disposed at the dumping site. But in spite of waste segregation being significant to the municipal council and residents, the practice is nonexistent and it was observed during the study that waste is mixed up haphazardly.

The major waste components identified in the hips and at the dumpsite included plastic, paper, glass, metals, wood and organic materials mainly from food leftovers and sugarcane chuff. Nonetheless if the waste is segregated, over 50% will be used as compost in farms hence reducing the waste to be transported to the disposal site. Other than reducing the volume of disposable materials, it will also act as an economic generating activity for the involved stakeholders.

And the most rational way to cope with waste separation in the municipality ought to be at the source at each point of generation and to separate it immediately where possible. The sorting of waste must be organized in away to reflect local disposal systems. The following typical categories are proposed:

- Paper
- Cardboard (including packaging for return to suppliers)
- Glass (clear, tinted – no light bulbs or window panes, which belong to residual waste)
- Plastics
- Scrap metal
- Compost/organic
- Special/hazardous waste
- Residual waste

Figure 3-2: Mixed Waste in a chamber at Bungoma Bus Park

Waste categorization on the other hand was based on visual observation of the inorganic and organic fractions of the total waste generated as well as the average weight over a period of seven days. The results for the main generation areas show that about 75% of the waste generated is organic while about 25% is inorganic. The largest portions of the inorganic fraction were plastics and papers. The table below indicates the unit % of wastes in the survey area.

Table 3-1: Proportions of waste categories generated in Bungoma Municipality

No.	Category of wastes	%
	Organic matter	75
	Plastics	10
	Paper	10
	Glass	1
	Metals	1
	Others	2.5
	Total	99.5

Hazardous waste

Bungoma Municipal Council is predominantly agricultural and commercial centre with limited industrial activity. The minor industries in the municipality are a slaughterhouse as well as garages, filling stations and repair shops, which present potential hazards to the environment. According to environmental regulations, all these entities are required to ensure safe on-site disposal or treatment of their own waste. However it was observed during the study that there is no regard for such and vehicles are washed at river Khalaba whereas used oils from the garages are poorly managed posing a challenge to the river water resources management.

The Municipality also has several medical centres including but not limited:

- Bungoma district hospital
- Elgon view cottage
- St Damiano hospital
- Private clinics, pharmacies and laboratories

These medical institutions produce wastes that require proper management because of their hazardous nature. Proper management practice therefore should ensure that hazardous wastes are collected, stored, transported and disposed off separately, preferably after treatment to make them harmless. They should be segregated at the point of generation, appropriately treated and disposed of safely.

However medical waste treatment within Bungoma municipality does not meet the required standards as most medical facilities do not have incinerators to burn their wastes. For instance waste at the Bungoma District hospital is not incinerated but it is put in a burning chimney that does not produce sufficient temperatures to consume all the waste whereas some of the private clinics make illegal dumping at the municipal disposal site at night.

To discourage such illegal dumping, the municipal council should establish a central place where all medical wastes are treated before being disposed. All medical waste generators on the other hand should have a certificate and a record of wastes being treated at the facility failure to which ones trading license can be revoked. The fee paid at the facility can help maintain it and making it easier to monitor its operations. As for now, Bungoma municipality do not have an incinerator in the really sense of the facility an indication that medical waste is not properly treated and managed as required by the law.

The municipal council in consultation with the all stakeholder should determine the estimated wastes generated by each institution so as to keep track of the same to minimize illegal dumping.

Quantities of waste generated

Quantification of waste in Bungoma Municipality was based on the number of vehicles, their capacities and the number of trips they make in a day. The municipality owns two vehicles .i.e. a tractor with an average 3 tons capacity trailer and a truck of 5 tons average loading capacity. The tractor makes 3 trips on average in total hauling 9 tons while the truck makes an average of 2 trips with a total daily haulage of about 10 tons. Therefore, based on this information, the total waste hauled to the disposal site per day is about 19 tons. However, based on the population statistics and a conservative waste generation rate of 0.5 kg/p/d, it is estimated that the current waste generation in the core urban area is about 45 tons/day and it is estimated that it will increase to 84 tons/day by 2032.

It is therefore estimated that currently only about 20% of the total waste generated is actually collected and disposed off at the dumpsite. Many residential areas in the whole municipality are poorly served and it is estimated that only a small percentage of the waste generated is collected. On the other hand, future amount of waste generation rates in the municipality may change depending on the economic growth of Bungoma town since it will be the headquarters of the new Bungoma County.

Waste generation projections

The current waste generation rates in Bungoma municipality were projected over a period of twenty years within a short term, medium term and long term period. The assumption for the projection is that in the long-term, most of the peri-urban areas of Bungoma municipality will be urban hence requiring solid waste collection and transportation. However the projected data is as indicated in chapter 4 of this report.

Waste collection from transfer areas and transportation

Waste generators collect their refuse to designated transfer areas or waste collection chambers whose state is wanting. The municipality on the other hand transports this waste from the collection area to the disposal site which is located about 3km from the central business district. The wastes are transported by a lorry and a tractor however at the time of the study the lorry had a mechanical breakdown. Both the lorry and the tractor are not designed for the purpose as the waste is open to wind blow and cannot compress the waste. During transportation, it was observed that the waste is not covered hence emitting stench and some of it spilling on the road in the process.

The tractor makes an average of three trips while the truck makes about two and the waste is loaded as well as offloaded manually by council workers. The workers were found operating without protective and safety wear during the field survey by the study team.

It was also observed that the two trucks cannot adequately serve the whole municipality and as a result waste is collected only at the town centre, Chebukube market area, Kanduyi, Mandizini and Mjini area while other areas such as Marrel, Musikoma and others are inadequately served.

Waste disposal

Once the waste is collected, it is transported for disposal to the municipal acquired dumpsite at Tuti off the Bungoma – Malaba highway just after Kibabii junction and about three kilometres from Bungoma town centre. The site is an abandoned Murram quarry occupying about 2.5 acres. The land was acquired by the council from a family but the ownership of the land is still disputed as some of the family members did not agree with the sale. Waste is dumped on the site without being covered whereas the site is not fenced and is close to human settlements who mainly engage in agricultural activities. Cattle and goats were seen grazing in the site and ravaging the dumped waste.

In spite of waste being transported to the dumping site by the council, there was evidence of roadside dumping outside the gates in residential areas in total disregard of the municipal By-laws. Although the municipal council has designated specific areas along the estate roads (Mandizini and Mjini) for primary collection of waste, it was observed that residents generally dump their waste closer to their gates especially if the designated areas are at a distant. Whereas waste from the unserved areas is managed within the compounds through pits that are poorly managed but despite this it was observed that filled up waste pits are emptied in a haphazard manner.

Figure 3-3: A Haphazardly emptied waste pit at Mandizini area

Expenditures for Solid Waste Management

A study of the annual municipal budget over the last five years reveals serious underfinanced public health and environment department. This has in turn hampered effective management of solid waste within the municipality with the results being pollution of the environment. The environmental pollution entails clogging of the storm water drains; emission of foul smell; degradation of the aesthetic value in form of littering and scattered waste. This has left residents yearning for better services and a cleaner town and many of those whose views were sort, are ready to participate in one way or another to achieve these goals.

Figure 3-4: Temporary Receptor (Chamber) near Bungoma Market that is poorly maintained Note that the chamber has been damaged and the waste is scattered by scavengers and wind.

3.2 Environmental and health impacts of Solid Waste Management in the study area

Open dumpsites is the main method of waste disposal in Bungoma municipality as is the case in most local authorities, however this type of waste disposal method is associated with inadequate management of solid Waste material which is a potential risk to both the environment and on human health. The common problems associated with such waste disposal method is the blockage of the storm drains, open burning of the wastes which releases smoke pollutants into the air, scavenging on waste by animals, inadequate containment of the wastes which is an eyesore and improper handling of empty hazardous chemical containers. The risk of haphazard waste disposal methods associated with open dumping although may not be immediately obvious, can pollute the environment and impact negatively on human health in the long-term.

Even though this study appreciates the impact of solid waste on health and the environment in Bungoma Municipality, it did not in any way determine such impacts but relied on similar cases documented elsewhere. The motivation was that open dumping is practiced in the study area and that solid wastes consist of pollutants which are persistent in the environment and can bioaccumulate within the biological systems. Impacts of such toxic substances may spread to a wider region following heavy rains where they dissolve in the storm water. Therefore this section review possible impacts of solid waste management in the Municipal council of Bungoma.

Occupational health impacts

The groups at high risk of improper solid waste handling practice within the municipality include the waste workers, those living near the dumping site and the population living in areas of inadequate solid waste collection. The health impacts may occur from injuries due to sharp objects, direct contact with the toxic waste as a result of mishandling and inhalation of toxic air as a result of waste air pollution. In Bungoma municipality it was observed that waste workers did not have proper clothing during loading and offloading of the waste and this exposed them to health risks. The uncollected mounts of waste in the residential areas also pose a health risk particularly to young children who were seen playing oblivious of the dangers.

Figure 3-5: Council workers offloading waste without proper clothing at the Bungoma Municipal Dumpsite

Breeding of vectors

More than 70% of waste in Bungoma municipality is of organic origin however waste especially of organic type is a potential breeding ground for vectors and rodents especially houseflies, mosquitoes, birds or rats.

It was observed that occasional interruptions in waste collection is common in Bungoma Municipality and this may be a challenge as it provides an opportunity for vectors to breed which spread disease causing organisms such as viruses, protozoa or bacteria. During the period of the survey, it was observed that waste is normally left uncollected at the waste collection and transfer stations where the decaying process take place posing the risk of vector's breeding. This could be disastrous more so during a pandemic posing many health challenges.

Air pollution

Open dumpsites are a major challenge to the environment, especially air pollution because they emit obnoxious odours and smoke that cause illness to people living in there vicinity. Burning of waste in the open dumpsite at Tuti is a common practice as well as in compounds with households that do not receive waste collection services. Open unregulated burning on the other hand has a damaging effect on the environment and human health. Waste is supposed to be burned in an incinerator under controlled conditions so as to minimize air pollution from the process. But without observation of such measures, incomplete burning of the waste causes the release of hazardous pollutants with detrimental human health effects.

Emissions resulting from open dumpsite burning and their associated health risks include but are not limited to: benzene (leukemia); toluene diisocyanate (asthma); nitrogen dioxides (lung damage); and nitrite compounds (metabolic poisons and carcinogens), formaldehyde, hydrochloric and sulphuric acid, hydrogen cyanide, polycyclic aromatic hydrocarbons, cadmium, lead, mercury and chromium. It has also been documented that Dioxins which are some of the pollutants released from plastic burning are known to suppress the immune system, cause hormonal imbalances and promote carcinogenesis.

Storm water runoff

Storm water poses a challenge in controlling solid waste dispersion into the environment especially where we have inadequate refuse management. Storm water washes waste from the dumping sites, transfer station or uncollected waste on the streets, whereas the drainage systems of most urban areas are designed to direct urban storm water to the nearest natural water course.

Most of the storm water runoff from Bungoma Municipality drains into River Khalaba and from observation they carry waste which clog up the drainage systems. The uncollected solid waste on the streets is washed away to a river (Khalaba) that is a few meters away from the town. Metal elements particularly lead and cadmium are produced when plastic waste is burned and are present in the resulting ashes that are produced. The elements dissolve in water, react to form other complex compounds which get dispersed easily into the environment. Although the effect of metal pollution may not be apparent, the effects can be felt after some time due to their ability to bioaccumulate in the biological systems.

Leachate

Open dumpsites are characterized by inadequate engineering measure, lack of leachate or discharge management, there are hardly any consideration of landfill gas associated management, few if any operational measures such as registrations of users, inadequate control of the number of tipping fronts or type of wastes disposed or any compaction of waste practices.

Figure 3-6: A clogged drainage system near the abattoir in Bungoma Municipality

The sites are also associated with wash out which may contain chemicals [NO_3^-, CL^-, NH_4^+, HPO_4^-, SO_4^{2-}, VOC, PCBS, PAH, Chlorophenol, Polythene, Particulate organic matter, synthetic organic pollutants, metals (Cd, Cr, Cu, Hg, Pb, Mn, Zn, Mo, Ni, V or Co)] and pathogenic microorganisms. The pollutants from the dumpsite can leach contaminating soil or ground water source. The vulnerability to disseminate the wastes on the other hand is exacerbated by the physical conditions of the land including geology, hydrology and ecological factors.

Bungoma Municipal dumping site is located in an area thought to be the upper source of river Sio which has an underground source in an abandoned quarry however during the study attempts were not made to verify this facts. Therefore it is important that waste management at the site should be handled by care to reduce any deleterious effects that could occur especially during rainy seasons. On the other hand studies indicate that the use of ground water is high in Bungoma municipality an indication that the water table is relatively high.

Aesthetic impacts of inadequate waste management

In Bungoma Municipality, a tractor and a truck are used to collect and transport wastes from the collection chambers to the final disposal site at Tuuti. However waste collection from the residential areas is inadequate and in addition, haphazard and unmanaged waste disposal were observed as one move through the residential areas particularly at Mjini and Mandizini area. Heaps of waste due to irresponsible dumping along the way is evident and such waste may be responsible of non-point pollution which can make waste containment a challenge. The waste particularly plastics are blown by the wind all over the place making it appear unsightly.

Figure 3-7: Haphazard waste disposal in Bungoma Municipality

3.3 Solid Waste Management System in Bungoma Municipality

This section focuses on the solid waste management system in the municipality and reviews the institutional framework, legal and policy framework, financing mechanism, and management technologies and stakeholders participation in waste management.

Institutional framework

There is a number of existing institutions that have interest in Solid Waste management within Bungoma Municipality but the link between the various institutions is not clear. However they can be basically categorized in both public bodies (at national and local levels) and private sector. The public institutions concerned with Solid Waste Management at national level include:

Ministry of the Environment

The Ministry of Environment is responsible for formulating the environmental policy and overseeing implementation of specific environmental programs and strategies through the relevant departments. The ministry through the minister:

- ensures that there is improvement of the Government's policy in environmental protection;
- through coordination with relevant ministries, establishes waste norms for all main sectors (water, industry, agriculture, tourism, energy, transport and other sectors), and monitoring the application of these norms;
- approves investments in environmental protection projects, and monitors their implementation;

Ministry of Local Government

The Ministry of Local Government is responsible for all local authorities. The ministry is concerned with all aspects of managing the public services provided by the local authorities including solid waste management. The ministry has a number of responsibilities including:

- Formulating, overseeing, implementing and improving the Government policy in the municipal development sector.
- Assisting Local Authorities in promoting solid waste management.
- Strengthening municipal capacity for the provision and financing of urban infrastructure including Solid Waste Management.
- Encouraging private sector provision and delivery of urban infrastructure including Solid waste management.
- Monitoring achievements in Solid waste management using objective and verifiable indicators.

- In addition, the Ministry of Local Government has the responsibility of approving Municipal Investment Programs through LATIF and this could mean investment in solid waste management.

Ministry of Public Health and Sanitation

The Ministry of Public Health is involved in the environmental legislation and regulations and coordinating as well as defining strategies, programs and projects dealing with solid waste management. The ministry is also responsible for controlling pollutions or public health issues that could arise from waste in hospitals and clinics. It further has the following additional roles and responsibilities;

- Improving the quality and effectiveness of public health and sanitation services such as waste handling and disposal
- Foster effective governance and partnerships in improving public health and sanitation services

Water Resource Management Authority

The Water Resource Management Authority (WRMA) is the custodian of all water resources in Kenya and has a legal duty to protect the quality and the integrity of these sources. WRMA is mandated to protect water sources against both point and non point sources of pollution. Solid waste management is one of the challenges to the authority is facing because of its potential to course both point and non-point sources of pollution to water resources.

Although generally solid waste management in Kenya is acknowledged as being below per, the authority do not have enough resources be it technologically, finically or enough manpower to effectively monitor the impacts of solid waste management on water resources in the entire nation.

The National Environmental Management Authority

The National Environment Management Authority is responsible for:

- initiating the environmental policy and implementation of specific solid waste management programmes
- implementing and enforcing waste management policies and regulations
- issuing and evaluating permits for institutions or organizations involved in activities linked to solid waste;
- promotion of training, education, studies and research regarding the protection of the environment and the fight against pollution.
- drawing-up an inventory of sources of pollution created by solid waste, and monitoring these sources including controlling trans-boundary pollution issues;
- promoting public participation in solid waste management through awareness programmes

- participating in the improvement of the strategy for solid waste management at the national level as well as the local levels.
- participating in drawing-up regulations and domestication of international conventions dealing with solid waste management;
- assisting industries and other waste generators in the elimination or reduction of pollution.

Although these are some of the roles and responsibilities of the National Environmental Management Authority, there are many challenges that impede the effectiveness of the authority particularly at the local level. It was observed in the study area that NEMA has only one officer to manage all environmental issues in the expansive Bungoma district while at the same time do not have enough financial resources to implement basic projects such as public awareness. Whereas according to the local government act, the local authorities have been given the power to implement and enforce environmental protection laws but since they have an interest in solid waste management they could not be relied upon to audit themselves.

Local Authorities

Bungoma Municipal Council is responsible for the provision of solid waste collection and disposal services in Bungoma Town. The municipal council is the legal owner of waste once it is collected or put out for collection. The responsibility for waste management is specified in the by-laws and supplemented by regulations from other government agencies.

The council has the obligation to enforce by-laws and regulations, and to mobilize the resources required for solid waste management. However this responsibility is in principle conferred upon it by the ministry of local government. But challenges often arise where the council authority to raise revenues is not commensurate with the responsibility for service provision.

Besides the solid waste management services, the municipal council is also responsible for the provision of the entire range of infrastructure and social services. Needs and demands for solid waste management must therefore be weighed and addressed in the context of the needs and relative priorities in all sectors and services.

Solid waste management in the council falls within the department of environment and public health. It was observed during the study that service delivery in the municipality is below per as most residents are not served. It was evident that the council does not have adequate equipment to carry out their duties effectively. For instance, during the study period there was only one tractor for collecting and transporting of refuse to the disposal site as the lorry was reported having a mechanical problem. This led to hips of uncollected waste in most areas of the municipally posing both esthetical and public health risk.

Bungoma Municipal council on the other hand does not have enough capacity to coordinate other government agencies relevant to solid waste management to benefit from a synergetic relationship. The numbers of solid waste enforcement officers were inadequate.

Private Sector Partnerships

The private sector waste collectors are significant and often supplement the local authority's capacity in solid waste management activities. They can either be contracted directly by individual households, neighbourhood associations, business establishments or by the authority. More often, they operate under contractual agreement with municipal authorities. In this case, the authority retains the responsibility for user fee collection. This arrangement ensures more equitable service access as opposed to where the private enterprises depend on the direct collection of user charges as this has little incentive to provide services in low-income areas where revenue potentials are weak.

The partnerships between Bungoma Municipal Council and other agents in sharing of Solid waste Management responsibilities and financial burden are hardly there in spite of such relationships being significant. The study established that there are barely any deliberate and active processes of collaborative action between the councils and stakeholders and if any the relationships are largely informal. Effective coordination among the numerous actors in the Council's solid waste management is absent.

However there ought to be private garbage collection firms operating in an environment of open competition, to supplement municipal authority's efforts or limitations. Although waste picking is critical both in economic sense and waste volumes, due to limited public awareness and negative perception of informal actors in Bungoma Municipality, there is little public participation and support for source separation of waste, waste recycling, re-use, and minimization.

Legal and policy framework

Overview

Both international instruments and the Kenyan constitution in article 42, emphasis the need for a clean and healthy environment through management of substances that may pollute the environment or cause harm to human health. The right to a clean environment is further enforced by article 70 of the new constitution.

Solid waste management is critical in environmental management because of its potential to cause pollution if not well managed. In response to international best practice as well as the constitutional requirement, there are many legislative instruments that have been formulated to govern the management of solid waste. This section reviews the existing Solid waste management policies and legislative framework, economic tools and enforcement mechanisms.

Current waste management is regulated by several policy documents, By-laws, laws, regulations and Acts of parliament. The legal instruments span over a number of institutions and government departments with each having different mandate, approach and regulations of resource management. The section in particular will concentrate on reviewing the legislative impacts on waste management levels from waste generation, reduction, segregation, storage, collection, transportation, disposal, treatment through to waste dispersal and environmental management.

However of significance in our review is the EMCA 1999 which is an Act of parliament that sets out general environmental management and coordination among various stakeholders. The act establishes an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. Although other legislative instruments are equally important, many have been harmonized with the EMCA act and where there is conflict EMCA will be given precedence.

Waste generation and reduction

Solid waste and hazardous substances management is one of the environmental aspects addressed in the EMCA act 1999 in Sections 86 to section 93. Section 87(4) of this Act, stipulates that every person whose activities generate wastes shall employ measures essential to minimize wastes through practices such as waste treatment, reclamation and recycling. Even with such provisions the Municipal council has no programs or incentives for material recovery/recycling involving stakeholders.

In the subsidiary legislation “Environmental Management and Co-ordination (waste Management) Regulations, 2006” in part II section 4, the responsibilities of the waste generator are set out but the residents rarely observe this as waste is indiscriminately scattered especially in Mjini, the market place, bus park and Mandizini areas. Sub-section (5) of the EMCA act 1999 in section 87 on the other hand assert that any person who contravenes this provision shall be guilty of an offence and liable to imprisonment for a term of not more than two years or to a fine of not more than one million shillings or to both such imprisonment and fine. However it is not possible to enforce this law because the council do not have a mechanism of establishing the really culprit while at the same time it contributes to the same by sometimes failing to collect the refuse on time.

The environmental management authority can also in section 90 of the act apply to a competent court for orders compelling any person to stop among other things the generation of waste. Section 5 of waste management regulations set out Cleaner production methods that can ensure waste reduction if observed by the generator responsibly. However this was not immediately established as most premises owners were not willing to disclose much information fearing victimization in case they contravened any laws.

Section 13 of the factory Act requires every factory owner to ensure that the factory environment is kept in a clean state. The provisions outlined in paragraphs (a) and (b) of this section require removal of waste generated and cleaning of the work environment particularly the floors. Even though the Act provides for a section to ensure that the factory environment is kept clean, it does not clarify or provide a section on reduction of the waste generated by such factories or the segregation of the waste cleaned from the stated parts of the factory. Bungoma Municipality on the other hand does not have many factories other than small scale workshops whose waste is mixed with other municipal waste.

Waste segregation

The EMCA act 1999 in section 86 (3) and in section 91 (1) requires the Standards and Enforcement Review Committee to prescribe standards for waste classification and analysis. This has been emphasized in the waste regulation section 6 and 28 where a waste generator is required to segregate waste by separating hazardous waste from non-hazardous waste and dispose of such wastes in such facility as is provided for by the relevant local authorities. Such waste if segregated should be labelled appropriately as stated in section 18 (1) of the same waste regulations.

Even though the law advocates for segregation, it was observed in Bungoma municipality that waste was mixing of both organic and inorganic matter with hardly any segregation. The organic matter made up the highest percentage of the waste and though some residents showed willingness of using the organic matter, they could not take it due to mixing with plastics and other inorganic matters. This is an indication that with proper separation of the matter, the bulkiness of the waste can be reduced as most organic matter can be used by farmers who live near the town. There are hardly any waste pickers in Bungoma municipality in spite of the significance of such activities both in economic terms and waste reduction.

Waste storage and the transfer stations

Section 86(4) of EMCA act stipulates that the Standards and Enforcement Review Committee in consultation with lead agents shall recommend to environmental management authority on regulations regarding storage of waste. In section 18 of the EMCA waste management regulations, several steps have been outlined on waste handling and storage. But this is violated as was observed in the study area. There was poor waste management in the transfer stations with most chambers requiring rehabilitation. Other areas like Mjini and Mandizini need construction of such chambers to reduce waste being blown by wind or carried by storm water. Most business premises or the municipal streets did not have waste bins which are important in keeping the town clean.

The environment minister in section 92 (g) of the EMCA act can prescribe the procedures and criteria of handling and storing of waste. In case there is a discharge from a storage facility, the waste generator should give notice to environmental management authority or other relevant government agency a as well as starting immediate clean-up, section 93-4 (a and b). If the preceding conditions are not adhered to, the authority in section 93 (5) may seize such storage facility from the operator. Following this provisions the municipal council should consider regulating any storm drains from waste storage facilities as most of this will ultimate drain in surface water sources near the town.

It should also be remember that the provisions stated here apply to the transfer stations as well, as indicated in waste management regulations in section 34.

Waste collection

Through the Local Government Act (Cap 265 of Laws of Kenya) which establishes and governs Local Authorities, powers and functions of the Authorities are spelled out. And of significance among most functions undertaken by local authorities is the provision of public services in garbage collection. However in light of this, uncollected waste is common in the commercial, bus parks, markets and residential areas where it is generated. The waste is blown about by the wind and washed by storm water blocking the town storm drainage system. The areas mostly affected by poor waste collection services are the slums (Mjini and Mandizini), bus park and Chepkube open air market as was also observed by the strategic urban development plan for Bungoma town 2008-2030.

The subsidiary laws of the Environmental Management and Coordination “waste management regulations” in section 8(1) stipulates that the collection and transportation of waste should be conducted in a manner that will not cause scattering of the waste. However the regulations are not clear on measures to be taken in case the waste is not collected by one who is supposed to do so. Although residents of the study area pays for waste collection and management, often the council is not capable of collecting waste as it should be. Most parts of the municipality experience a lot of uncollected waste that has led to household burning of wastes by the residents. But such open burning as indicated in several report pose a health challenge to the residents especially the children. Therefore it is essential that such services be privatized if the municipal council does not have the capacity.

Waste transportation

Waste transportation is one of the areas that is most regulated by the EMCA act 1999. The act in section 87 (2) prohibit transportation of waste without a waste transportation license or to an unlicensed disposal site. In fact prior to transportation of any waste one has to apply in writing to the environmental management authority to be granted an appropriate license (section 88 (1)). Section 91(5) on the other hand prohibit transportation of hazardous waste through Kenya without a valid permit granted by the environmental management authority nor export hazardous waste as stated in sub-section 4. And that Waste transportation shall adhere to conditions provided for in section 7, 8 and 9 of waste management regulations.

For the case of Bungoma Municipality, waste is transported by a lorry and a tractor not designed for the purpose, therefore the waste is open to wind blow and is not compress. The refuse transportation vehicles are not licensed by NEMA as required by EMCA waste management regulations 2006. Although waste is supposed to be transported to licensed disposal site, cases of disposing on private land on request was witnessed.

Waste disposal

Waste disposal should be treated with care such that any waste whether generated within or outside Kenya should be disposed in a manner that does not cause pollution to the environment or ill health (section 87-1). And that the disposal should be at a licensed disposal facility (section 87-3). In fact prior to operation of a waste disposal facility one has to apply in writing to the environmental management authority to be granted an appropriate license (section 88 (1)). If granted a license, the environmental management authority expects the applicant to ensure that such waste disposal site or plant operates in an environmentally sound manner. Contrary to this and pursuant to section 90 of the Act, the National Environment Management Authority may obtain court orders stopping any person or institution from disposing any wastes where such activities present an imminent and substantial danger to public health, the environment or natural resources.

EMCA section 93 (1) also prohibits disposal of wastes in a way that can cause water or environmental pollution. And in section 4(1) of Waste Management regulation, it is stated that no person shall dispose of any waste indiscriminately on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. It was observed in the study area that there is indiscriminate solid waste disposal particularly in areas with inadequate waste collection including but not limited to Mandizini and Mjini.

However in the study area it was observed that although there is a waste disposal site, it is poorly managed. It is not fenced and can be accessed by both human and animals. This also encourages illegal dumping of hazardous wastes such as medical waste as is the case.

Waste treatment

The need for waste treatment from the generation point to disposal site is emphasized in section 87(4) of the Environmental Management and Co-ordination Act (EMCA) and in the waste management regulations as stated in section 11. While Section 13 provides that any operator of a disposal site or plant shall apply the relevant provisions on waste treatment under the Local Government Act (Cap 265 Laws of Kenya).

Open burning of waste and incineration is a common waste treatment practice in Bungoma Municipality. Although burning and Waste incinerations reduce waste volumes, the practice is associated with emission of pollutant gases and toxic residues that require proper disposal. Although it is beyond this study to empirically establish impacts of such residues after dispersal in the environment, it is certain that toxic elements from the burning residue are dispersed in the environment. For instance it has been highlighted elsewhere in this report that Bungoma District Hospital do not have a good incinerated, therefore the poorly treated medical waste could have deleterious impact on the environment.

The act in Section78 (1) paragraphs (a)-(f) mandates the Standards and Enforcement Review Committee, in consultation with the relevant lead agencies to set standards for air quality including emissions, ambient and occupational air standards. But the Draft Air Pollution Regulations is yet to be enacted. Therefore it is not clear as of now how the authority enforces subsection 2 and 3 of section 78 of the EMCA act in case of any contravention. The effect on air quality of burning wastes in the residential or municipal dumpsite should be considered.

The waste management regulations section 26(1) provides that every person who generates toxic or hazardous waste shall treat or cause to be treated such hazardous waste using the classes of incinerators prescribed in the Third Schedule of the regulations or any other appropriate technology approved by the Authority. The biomedical waste and industrial waste are the most significant and requires careful handling or treatment at the generation point prior to disposal in the common dumping site.

In Section 36 of waste regulation, an Environmental Impact Assessment is required from bio-medical waste generator while section 37 stipulates that annual environmental audit of the facility should be carried out. This is provided for to ensure that the highest standards of hazardous waste management are adhered to. However evidence indicates that this is not practiced as illegal dumping of medical waste were reported.

The regulations further states that securing and packaging of bio-medical waste and other hazardous waste shall be according to the set standards in part 1 & 2 of the Eighth schedule and further labelled according to provisions in sections 38 and 39 respectively.

Waste dispersal and environmental management

The review entails legal instruments that control the dispersal of waste or pollutants into the environment or natural resources. The environment minister has the power to make procedure and criteria for monitoring of the effect of hazardous substances chemicals and their residue on human health and the environment (Section 92 h). But at this instance there are no such criteria to monitor pollutants from dumpsites to the environment for instance impacts to water sources be it surface or underground. It was also reported that the municipal dumpsite is located in the upper catchments of river Sio and that the river has a sub-terrain source. Section 93 (1, 2 and 3) prohibit any arbitrary dumping of hazardous substances into the environment and also compels such a person to take appropriate remedial measures as directed by the authority stated in subsection 93 (4). However unless a sudden disaster occurs, such provisions are rarely enforced particularly against slow or cumulative impacts occurring as a result of improper solid waste management.

The water act and subsequent subsidiary legislations particularly the water rules protect water resources be it surface or underground against any form of pollution. Part V of the rules address water quality issues and in section 81, water pollution of any kind whether chemical biological or physical is prohibited. Section 82 further stipulates that no person shall discharge effluent in water or environment; without a permit that does not meet discharge standards or without approved discharge control plan. Any person making such discharge is required to maintain a discharge record that should be submitted to Water Resources Management Authority quarterly. The authority shall from time to time have powers to inspect and sample any sources of pollution for enforcement purposes as well as maintain a database of water quality.

Prevention of non-point sources of pollution is stipulated in section 92 where WRMA in consultation with relevant institutions or individuals will ensure proper solid waste management that may be deleterious to water sources. Parts' IX provides for management of water catchment areas which if degraded affects the water quality other than the quantity.

The public health act in section 129 provides that local authorities should prevent any manner of water pollution and where such has occurred remedial measure of treating the water source should be undertaken by the local authority or compel the polluter to purify such water to prevent negative health impacts. And in section 130 the act addresses water quality issues by directing that there should be no pollution as a result of erecting of dwellings, sanitary conveniences, stables, cattle-kraals, pig-sties, ostrich-pens, dipping tanks, factories or other works, or deposit of any manure, filth or noxious or offensive matter or thing in water supplies. Enforcement of the rules as a result of the above sections is the responsibility/prerogative of the local authorities just like in section 129 above. However the act does not address non-point type of pollution such as storm drains.

Economic tools for waste management

There are several provisions for relevant economic instruments to address different aspects of solid waste management chain in quite a number of legislations. There are those that advocate for the employment of financial disincentives (fine, levy, surcharges and penalty) for non-compliance governing the proper management of solid waste. While on the other hand, economic incentives such as subsidies, tax rebates, and exercise waiver are captured in some provisions of the legislations relevant to the management of solid waste such as EMCA.

Section 57 of the Environmental Management and Co-ordination Act (EMCA) provides for the development of economic instruments to be used for enhancing the proper utilization of the environment. The tax, fiscal incentives, disincentives or fees proposed by the environment minister are specified in section 57(2) paragraphs (a), (b), (c) and (d). The relevance of this provision to the solid waste management sector is that it provides room for the development economic tools that may be used to encourage or discourage good or bad solid waste management practices respectively.

Section - of the local authority conservancy by-laws mandates the authority to issue directions on waste collection charges. Such directions are to specify the amount of charge or charges to be imposed for different categories of services or for services in different localities or zones within their area of jurisdiction.

However, the findings of this review indicate that even though there are such legal provisions, very few economic tools have since been developed to encourage good practices in the solid waste management sector such as recycling, re-use and material recovery. Nonetheless, the few that have been developed have not been implemented successfully. The unsuccessful implementation of these economic tools are due to many factors such as lack of awareness among the stakeholders about such tools and the fact that most of the stakeholders in the solid waste management sector do not participate in the process of formulating such economic tools.

More often than not, the economic instruments are of disincentives nature with few if any of the economic incentives particularly for those involved in best solid waste management practices.

Solid waste legislative compliance

Any officer or agent of the Municipal council duly authorized may enter any residential dwelling or trade premises within the area of jurisdiction for the purposes of conducting an inspection. In addition, non-payment of charges for waste management services payable under the By-laws shall be a debt due and owing to collector and may be recovered as a civil debt by suit at the instance of the collector or any person authorized by the collector to collect on its behalf.

In spite of this, the survey indicate that the enforcement process is faced by challenges which included inadequate financial resources, personnel and overwhelming cases of non-compliance with the set standards. Both the environmental management Authority and the municipal council have few officers and find it difficult to send the inspectors to the field regularly as required by the law.

Financing of Solid Waste Management

The waste management is taken care of by local government through its own budgetary resources allocation. However, with rapid increase in waste generation rates, awareness for effective and efficient solid waste management practices to protect public health and the environment, the demands for huge investments to bring improvements in many aspects of the solid waste management chain is rising. This has led to many governments to adopt various financing modes. Some of the widely practiced as suggested in the United Nations Environmental Programs (UNEP) Integrated solid waste management training manual are as follows:

User charges

Due to inadequate funds in most local authorities, the World Bank in early 1990s introduced the concept of cost sharing in order to increase funds available for service delivery. User charges in regard to solid waste collection, transportation and disposal services are being introduced. They are still low or non-existent in many local authorities but the charges are increasingly assisting in subsidizing the costs of solid waste management in accordance with the polluter's pay principle. The charges also motivate waste generators to reduce the wastes in addition to financing the waste management activities. Although there is a plan for user charges in Bungoma Municipality, it is yet to be implemented. However the only user charges currently in operation is the Conservancy fee charged on licenses on commercial establishment/businesses. But of concern to the municipality is to test the response of residents in the willingness and ability to pay during the implementation of user charges for solid waste service.

Penalty, fine and levy

There exist a number of provisions for relevant economic instruments to address different aspects of solid waste management chain in several legislations. Such provisions advocate for the employment of financial disincentives for non-compliance with the provisions governing the proper management of solid waste. The revenue earned from such instruments is a significant financing mechanism for local authorities to finance solid waste management activities.

For the case of Bungoma municipality, the same has been provided for in the solid waste management by-laws in part VII section 8.3. Fines of between Ksh 500 to Ksh 1000 are charged against careless dumping but this only occurs if the enforcement officers find the offenders on site or in the act.

Environmental Funds

There can be fixed or revolving fund set aside to assist local governments in meeting their financing needs for environmental infrastructure and services. The fund may be financed through various modes including national bonds, annual budget, loans from international financing institutions and international cooperation.

EMCA act 1999 on the other hand in section 25 provides for the establishment of a National Environment restoration fund that can be used to finance activities geared towards mitigation of environmental degradation. In spite of such opportunities, the municipality over time has been trying to apply to NEMA for funds towards public awareness campaigns in regard to proper general environmental management but the efforts have not been successful.

Direct loans and international cooperation

Local governments may take direct loans either from domestic or international financing institutions. The loans can be used to develop solid waste management facilities but it is very rare for local authorities to take loans in Kenya to finance such activities. However on the increase is the trend of direct multilateral and bilateral cooperation with local governments. International agencies for example UNEP, Habitat or UNDP provide support to local governments to improve the local environment. Various bilateral initiatives are assisting local governments to seek assistance for financing their development projects which may include solid waste management.

In spite of this, there are no such initiatives in Bungoma municipality with waste management efforts depending on internal financing mechanisms.

Local authority budget and Central Government grants

Local authority budget and central government grants are still major sources to financing environmental infrastructure and services. Local authorities obtain their revenues from a variety of sources such as taxes, fines, and license fees. Such general revenues are used to finance costs associated with service delivery and other overheads. Since the revenues in most cases are insufficient to cover the costs for solid waste services, grants or subsidies from the central government are used to supplement local revenues.

Bungoma Municipality receives grants from the central government through Local Authorities Transfer Funds (LATF) initiative. The fund was established in 1999 through the LATF Act No. 8 of 1998, with the objective of improving service delivery, improving financial management, and reducing the outstanding debt of local authorities (LAs). However the allocation towards solid waste management activities in the municipality is inadequate and does not meet refuse management requirements of the municipality.

Private Sector participation

The provision of solid waste management services is a costly and cumbersome venture for many local authorities throughout the world. The level of cost and degree of difficulty associated with solid waste management service provides an opportunity for participation of the private sector. The private sector participation can plays a key role in increasing the efficiency of the service and to provide the much needed resources to fund projects required in improving effectiveness in solid waste management. However this will only work well if there is a high efficiency in recovering the costs of service through the implementation of user charges. The local authority in this arrangement retains the power to oversee the private firms' activities and collection of the service fees.

Despite the incentives of private sector participation in solid waste management, Bungoma Municipality is yet to procure such services and according to the municipal councils officials plans are underway and proposals have been floated to potential investors although it was not possible at the time of the study to determine their response regarding the venture.

Solid Waste Management Technology

Primary collection and transfer stations

Solid waste collection and transfer is a very important function and is an integral part of integrated solid waste management programs. Its significance is due to the fact that waste collection is one of the most visible public services and failure in the collection system is reflected by anaesthetic conditions that can be observed in the streets and the drainage structures throughout the municipality.

Door to door collection of waste is hardly ever provided for by the municipal council in spite of charging conservancy fee and other council rates from residents. Instead it is up to each householder to convey the refuse from point of generation to designated transfer points located within the residential areas. However not all residential areas in Bungoma municipality have such transfer stations. The chambers are only provided in a few locations including among such areas are the Bus Park, market place, Kanduyi, Mjini and Mandizini. The waste is then collected from these points by the municipal truck, but it was observed during the study that residents pour the waste directly on the ground. Such waste is vulnerable to wind and storm drain if not collected on time. The refuse is also vulnerable to scatter by scavenging animals such as cats, dogs, goats and cows. In fact hips of uncollected waste were witnessed in several areas presenting a potential public health risk to residents and according to one of the council staff a companying the study team, attributed this to inadequate waste collection equipment, staff and finances.

Both residents and the municipal council do not have bins for waste collection while all types of waste were mixed up with hardly any separation in the council's waste collection chambers.

Transportation

Refuse transportation mode is significant in the solid waste management process. The transportation mode chosen can range from muscle powered carts and wagons to sophisticated solid waste compactors. The choice of waste transport means is dependent on many factors including accessibility of the waste generation point, the distance of waste disposal site or transfer station, the bulkiness and volume of the waste, affordability of the transport means and the available options to the waste generator.

Waste transportation in Bungoma municipality is both muscle powered especially to transfer stations/chambers and machine powered where a tractor trailer or a truck is used to transport waste to the municipal councils dumpsites.

The municipally has a tractor and a convectional truck for transporting the waste, they are normally loaded or off loaded manually by people employed by the municipal council. These transporting means are vulnerable to wind blowing the refuse as well as spilling on the way to the dumping site.

Treatment

Solid waste treatment refers to activities that reduce the effects of refuse to the environment through processes such as waste separation, incineration, decomposing or burning. According to observations made in the study area, there is no waste treatment process prior to waste disposal. Wastes were mixed up from the collection points to the uncontrolled open dumping site followed by open burning. Although it emerged that all medical wastes are supposed to be incinerated at the Bungoma district hospital, it was observed that there is some illegal dumping of such untreated waste at the dumping site done at night.

Disposal

Waste disposal lies at the core of municipal solid waste management as waste disposal remains a problem to the environment not only in Bungoma Municipality but in most local authorities in Kenya. Use of uncontrolled waste disposal sites is a potential source of soil contamination, ground and surface water pollution as well as air quality degradation. It is common in many local authorities for waste to be burned in disposal sites as a way of waste treatment and volume reduction. Bungoma municipality operates uncontrolled open dumping site located in the outskirts of the town at Tuti which is about 3 kilometres from the town and it is characterized by open burning of wastes.

Refuse recycling and recovery

Recycling recovers materials by preventing the same from being disposed of but instead converted or made into new goods. The process can involve turning the old material into a new version of the same thing, or materials can be recycled into something completely different. The processes is vital in assisting use resources better and reduce the environmental impacts associated with disposing of refuse hence saving energy, reduce emissions to air and water and enhance sustainable production process.

Despite the significance of recyclable materials, solid waste recycling process is rarely done in Bungoma Municipality. Although organic matter constituted the highest percentage of waste disposed at the disposal site, it was observed that it's mixed with other materials such as glass, plastics, cans, plastic paper, metals and wood. The mixing of the waste makes it a challenge to reuse it because of the high impurities.

Stakeholders participation in waste management

Waste generators

Waste generator refers to any person, by site, whose activities or process produces waste products and this could be from many different types of businesses, industries, government agencies, and institutions. Waste generators can generically be categorized as large generators who usually tend to be manufacturers of various products or small generators who are most often in service-oriented businesses or households.

Waste generators in Bungoma municipality include households, streets, offices, institutions, restaurants, medical facilities, shops, market, and other commercial establishments. The waste generator on the other hand has a duty to ensure that all wastes are transported and disposed in accordance with the law. However due to poor public awareness and inadequate understanding of the law, Bungoma Municipality suffers from non-participation of waste generators in solid waste management processes. There is low public participation in solid waste management in Bungoma, a fact due to most residents not being aware of their rights, roles or responsibilities.

It was observed during the study that the waste generated is generally mixed with hardly any segregation at household levels as well as in commercial premises.

Service providers

Bungoma Municipal Council is responsible for the provision of solid waste collection and disposal services in the municipality. In addition, the council has the role of collecting levies for services provision. But with a healthy relationship with other stakeholders, these services can be transferred to other organizations although supervised by the council.

Nevertheless the council does not have enough capacity to adequately deliver the services and it was reported that only few areas receive such waste collection services. Un-served residents have opted to digging shallow waste pits within their compounds. However it was observed that whenever the pits are full, they are emptied in a haphazard manner living the waste exposed to dispersal into the environment and in anaesthetic manner. In addition residents in some areas have also opted to burning of their refuse polluting the air a practice which may have cumulative effects on health especially to the children.

Regulators

Although there are many legal and best practice instruments used to regulate solid waste management activities, they are scattered over many sectoral institutions. With poor coordination mechanisms among the various institutions, they are applied in isolation denying solid waste management practice the much needed synergy in the Municipality.

The municipal council on the contrary has a duty of enforcing all waste regulations which define stakeholders' roles and responsibilities in solid waste management. The council ensures that rules and regulations are adhered to by the actors but due to several challenges such as understaffing and underfunding, it has not been easy to deliver.

Government Departments

There are several government departments other than the local government which have interest in solid waste management including but not limited to the National Environmental Management Authority, the Public health and sanitation department and the Water Resources Management Authority.

The District environment office is supposed to manage and coordinate other institutions in all environmental issues solid waste being an element. Whereas the public health and sanitation department ought to ensure that waste management does not pose a health risk. The water resources management authority on the other hand has a duty to guarantee that solid waste management within the municipality does not pollute water sources. The district water officer ensures there is no indiscriminate disposal of solid wastes which could be a source of non point pollution. It is demonstrated above that these departments' acts as auditors of the municipal council's solid waste management activities, however it was not clear during the study how they coordinate.

Other Institutions

Although institutions such as recycling organizations, neighbourhood community to dump site, Non-Governmental Organizations (NGOs) or any other private enterprises are significant in solid waste management process, their involvement in Bungoma municipality is nonexistent. But according to the municipal council environment and public health official, there are plans to privatize solid waste management in the council.

3.4 Conclusion

During the study it was evident that Bungoma Municipal council is responsible of handling and delivering all waste management services ranging from collection, transportation, treatment, and disposal. However the following were noted during the study:

- Segregation is not done which were evident from the mixed waste at the dumpsite and the collection points.
- There were no formal collection facilities e.g. bins or other receptors at the household level.
- There was evidence of roadside dumping outside the gates in residential areas in total disregard of the Municipal By-laws.
- Although the municipal council has designated specific areas along the estate roads for primary collection of waste, it was observed that residents generally dumped their waste closer to their gates especially if the designated areas are at a distant.
- Bungoma Municipal Council has provide masonry receptors as temporary storage awaiting collection in some designated areas including the bus park, market area and Kanduyi. However the collection chambers are dilapidated.
- Due to shortage and frequent breakdown of the trucks, the waste is sometimes left to pile up.
- The waste is loaded manually on to the trucks by council workers who were found to be operating without protective and safety wear.
- During transportation, it was observed that the waste is not covered hence emitting stench and some of it spilling on the road in the process.
- The dumpsite is located on a two and half acre plot of land at Tuti which as mentioned earlier is about 3Km away from the CBD.

- A study of the annual Municipal budget over the last five years reveals serious underfinanced public health and environment department. This has in turn hampered effective management of solid waste within the municipality with the resultant pollution of the environment. This environmental pollution entails clogging of the storm water drains; emission of foul smell; degradation of the aesthetic value, littering and scattered waste. This has left residents yearning for better services and cleaner town and many of them are ready to participate in one way or another to achieve these goals.
- But it emerged that medical waste are handled by waste generators and the council has no track of its management. However the council is concerned about illegal dumping of medical wastes at the municipal dumping sites. This indicates that there are no proper mechanisms of knowing and ensuring that all medical wastes are appropriately disposed.
- Although there are several institutions with different roles and responsibilities in solid waste management, their activities are not coordinated and none is aware of what the other department is planning or implementing.

  Reviewing of the legal and policy framework shows that the solid waste management system in the study area does not meet most of the set standards. But of significance is the low public awareness about the provisions in the existing laws and participation in solid waste management. The solid waste management sector is also a victim of many laws and regulations that are mainly sectoral making it difficult to implement. In spite of this, of significance is the lack of effective and efficient enforcement mechanisms for the relevant provisions which has affected the solid waste management system in the municipality.

CHAPTER 4.FORMULATION OF THE SOLID WASTE MANAGEMENT PLAN

4.1 Introduction

This chapter presents the formulation of the solid waste management plan for Bungoma Municipality. It describes the population and the solid waste generation for the entire plan period and the development of the technical aspects of the plan. It also describes the entry point of the private sector participation and community involvement in the management of solid waste in the Municipality. In addition, this chapter presents the implementation plan of the solid waste strategy, the proposed sources of fund and the project costs for the entire period of the plan. It is worth noting that such a plan requires review after a predetermined period which this chapter also presents.

4.2 Population projection

Population census data

The latest population census was carried out by the Kenya National Census of Statistics in 2009.The table below gives the population of Bungoma Municipality for the census period 1999 and 2009.

Table 4-1: Population Census as per the Census Period

Year	1999	2009
Population	60,279	81,449

(Source: Kenya National Bureau of Statistics, August 2010)

From the given populations during the census periods, it can be deduced that the population growth rate for Bungoma Municipality for the last ten years is approximately 3%.

Population projections

Based on the past population, the population projections were carried out using the following formula.

$$P_t = P[1 + r\%]^n$$

Where: Pt = Population after t years, in the future.

P = Present population

r = Population growth rate

n = Duration (n = t)

The table below gives the population projections for a period of twenty (20) years with the initial year 2012, future years 2017, 2022, 2027 and 2032.

Table 4-2: Population Projections for the years 2012 – 2032 for Bungoma Municipality

Year	2012	2017	2022	2027	2032
Resident Population	89,310	104,317	122,103	143,205	168,268
Visiting Population	26,793	31,295	36,631	42,962	50,480

Bungoma Municipality being the focal point of the Bungoma North and South District receives a substantial number of visitors per day. It is estimated that the visiting population per day is 30% of the resident population.

4.3 Future waste projections

Assumptions in the projection of future waste generation

Domestic / Residential Waste

These types of waste originate from single or multifamily household units. The wastes are generated from household activities including but not limited to cooking, cleaning, repairs, redecoration, empty containers, used packets, old clothes, books, papers, broken glass, plastic items, broken and useless furniture.

Based on field survey conducted in the study area, a conservative figure of 0.5kg/capita/day of waste generation is used in the estimation of the waste.

Commercial Waste (Hotels, Bars, Restaurants, Wholesale & Retail Shops, Small Shops, etc)

This category includes solid wastes that originate in offices, wholesale and retail markets, restaurants, hotels, warehouses or go-downs and other commercial establishments.

The waste is projected based on the commercial developments within the Municipality. The projected waste generation from commercial establishments is conservatively taken as 25% of the household / domestic waste.

Medical Waste

Medical waste refers to waste generated by health care activities including a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials. And according to WHO, the approximate medical waste generated per person per year is about 0.5kg.

Market Waste

Market waste include refuse from items sold at the market and in Bungoma Municipality, the wastes have a high organic content and are mainly from visiting population. However the future market waste generation will increase based on the increase in population. At Present, Bungoma Municipality has three (3) markets.

Road Waste

The waste include that which is collected from streets, walkways, parks consisting of materials such as dust, dirt, plastic bags (thin), dry leaves, useless papers, cardboard, rags, tyres, and vegetable matter. Road waste can also be generated from residences and establishments. For estimation purposes, road waste generated is computed based on the length of the road network in Bungoma Municipality.

Projection of waste generation

Based on the assumptions above, the following wastes are generated in the Municipal Council of Bungoma.

Table 4-3: Projection of the Total Waste Generation in Bungoma Municipality, (Tons/Day)

Waste Characterization	2012	2017	2022	2027	2032
Residential Waste	45	52	61	72	84
Markets Waste	11	13	15	18	21
Commercial Waste	11	13	15	18	21
Medical Waste	0.122	0.14	0.17	0.20	0.23
Total	67.122	78.14	91.17	108.2	126.23

4.4 Development and evaluation of technical aspects

Collection and transportation plan

Proposed Collection System

According to field survey and a feasibility study report on solid waste management (CAS Consultants, 2005), the general cabbage collection in Bungoma Municipality stands at approximately 10-20% of the total waste generated. This is partly due to lack of efficient solid waste management faced by inadequate funding and poor public participation practices. Waste collection equipment available is a 7 ton tipper and a tractor trailer. This type of transport takes time to load and also high man hours is required.

This plan proposes the use of skip loader and skip loader trucks of carrying capacity 7 tons for ease of movement and the load carrying capacity of the municipal roads. In the long term, we recommend private waste collectors or Community based organizations (CBO's) who can decide the kind of transport they want to use.

Based on the future waste projections and new technologies, the following are the proposed waste collection system.

Table 4-4: Proposed Waste Collection System for Bungoma Municipality

Zone	Collection area	Collection Method	Frequency of Collection	Responsible collector.
Zone 1-7	Middle Income	Skip Loader	Once per week	Municipal Council
	Low Income	Skip Loader	Once per week	Municipal Council
	Informal Settlements	Skip Loader	Twice per week	Municipal Council / CBO
	Commercial areas and Streets/Roads	Litter Bins	Daily	Municipal Council
	Markets	Skip Loader	Daily	Municipal Council

Waste Management Tools and Equipment

Basic tools and equipment like wheelbarrows for street sweeping, sweeping brooms, shovel/spade, hand gloves, rakes etc shall be required for effective solid waste management.

Proposed Collection Skips and Skip Loader

	Short-Term (2012 – 2017)	Medium – Term (2017 – 2022)	Long –Term (2022 – 2032)
Area of the Municipality	Required No. of Skips		
Municipal Market	2	3	4
Mjini	2	2	3
Bondeni	2	2	3
Mandizini	2	2	3
CBD and other areas within the municipality and with substantial municipal solid waste	Skips 2 No. Litter Bins - 50	Skips 3 No. Litter Bins - 50	Skips 4 No. Litter Bins - 50

	Short-Term (2012 – 2017)	Medium – Term (2017 – 2022)	Long –Term (2022 – 2032)
Required Skip Loader Trucks			
Municipal Market	One 7 Ton Skip Loader Truck	One 7 Ton Skip Loader Truck (Additional) One 7 Ton Skip Loader Truck(Old)	One 7 Ton Skip Loader Truck One 7 Ton Skip Loader Truck (Additional)
Mjini			
Bondeni	One 7 Ton Skip Loader Truck	One 7 Ton Skip Loader Truck (Additional) One 7 Ton Skip Loader Truck(Old)	One 7 Ton Skip Loader Truck One 7 Ton Skip Loader Truck (Additional)
Mandizini			
CBD and other areas within the municipality and with substantial municipal solid waste	One 7 Ton Skip Loader Truck.	One 7 Ton Skip Loader Truck.	One 7 Ton Skip Loader Truck (New)
Supervision Vehicle	One Double Cab Pickup	One Double Cab Pickup	One Double Cab Pickup
Disposal Site	Shovel	Shovel	Shovel

The assumptions made for the proposed collection system are:

1. The lifespan of a collection truck is approximately 10 years.
2. The existing 7 ton tipper and 5 ton tractor will still be used until end of 2012.
3. Each of the collection vehicles will make at least three (3) trips per day to the disposal site.
4. The proposed size of skips will be 6 tons.

The figures below give illustrations of a skip loader and skip loader truck

Figure 4-1: Skip Loader Truck

Figure 4-2: Skip Loader full of Solid Waste

Figure 4-3: Proposed Shovel to be used at the Disposal Site

Waste disposal site

Currently, crude/open dumping of waste is being practiced. It is expected that in the short term, the municipal council in consultation with other stakeholders will rearrange the current open dump site to accommodate composting of organic waste. The table below gives the method of disposal for the plan period.

Table 4-5: Method of Disposal and Activities during the Plan Period

Method of Disposal	Short Term 2012-2017	Medium Term 2017-2022	Long Term 2022-2032
	Activities during the Plan period		
Develop controlled dumping and composting	Rearrange the existing site to accommodate controlled dumping and composting. Fencing of the controlled dumping site, construction of dumping site office, hiring of staff to monitor dumping and composting.		
Preparations for Sanitary Land, Controlled Dumping and Composting.		Continue to track collection and disposal of waste, maintain scheduled monitoring of the controlled dumping and composting, purchase land for sanitary land fill.	
Develop Sanitary Landfill and Composting			Establish sanitary land fill and manage, continue with the operations of the composting.

During the medium-term period, the Municipal council should acquire land for the establishment of a sanitary land fill.

The figures below illustrate a landfill and a composting site.

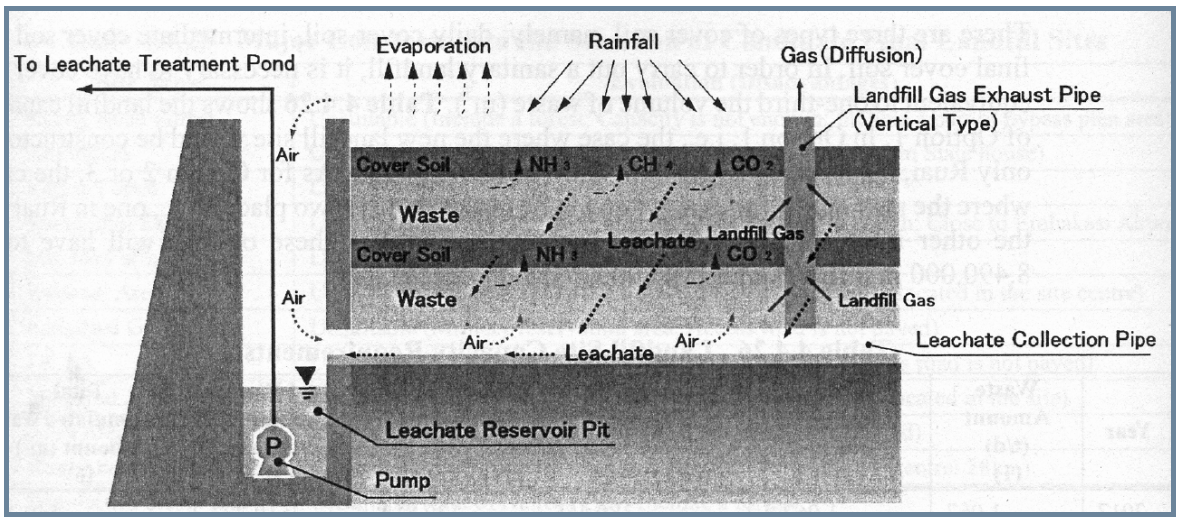


Figure 4-4: Typical Structure of a Sanitary Landfill.

Figure 4-5: Typical Arrangement of a Composting Site.

By-Laws on Solid Waste

The Municipal Council has By-laws regulating solid waste management but its enforcement is weak. We recommend the following

- Increasing the number of enforcing officers
- Training the enforcement officers

Wastes requiring special attention

The following wastes should be collected and disposed off separately from other wastes or treated appropriately before being disposed of at the municipal dumping site.

Medical waste

Medical institutions produce wastes that require proper management because of their hazardous nature. However medical waste treatment within Bungoma municipality does not meet the required standards as most medical facilities do not have incinerators to burn their wastes. Whereas some of the private clinics make illegal dumping at the municipal disposal site at night and to discourage such illegal dumping, the solid waste management plan proposes an establishment of a central place where all medical wastes are treated before being disposed. The fee paid at the facility can help maintain it and making it easier to monitor its operations.

The figures below illustrate a medical waste incinerator.

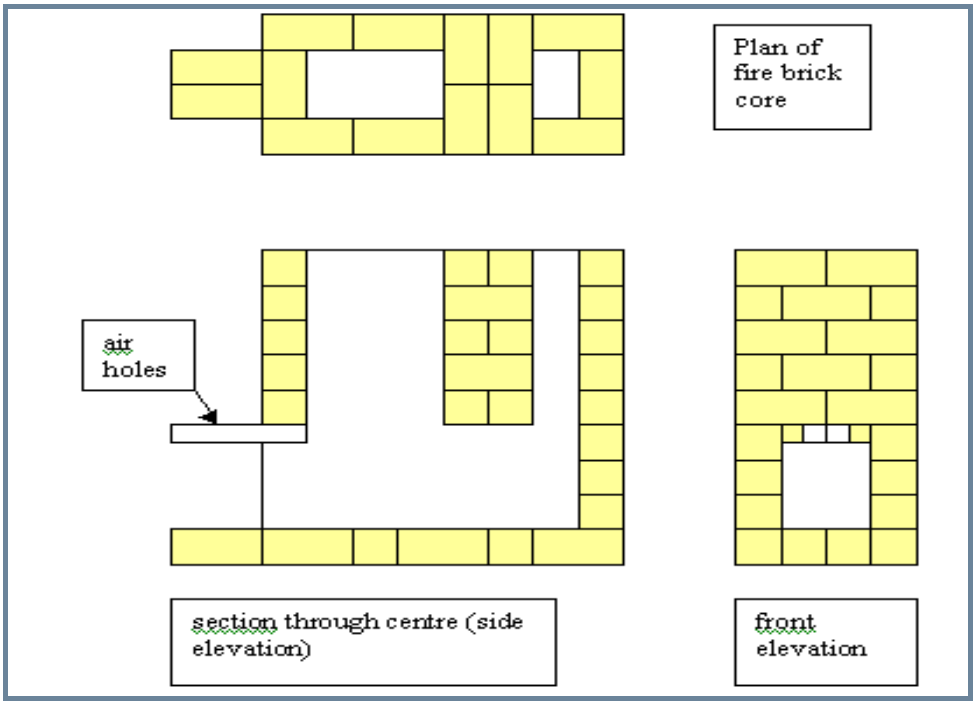


Figure 4-6: Typical Section of an Incinerator

The size of the incinerator depends on the scale of medical waste generated.

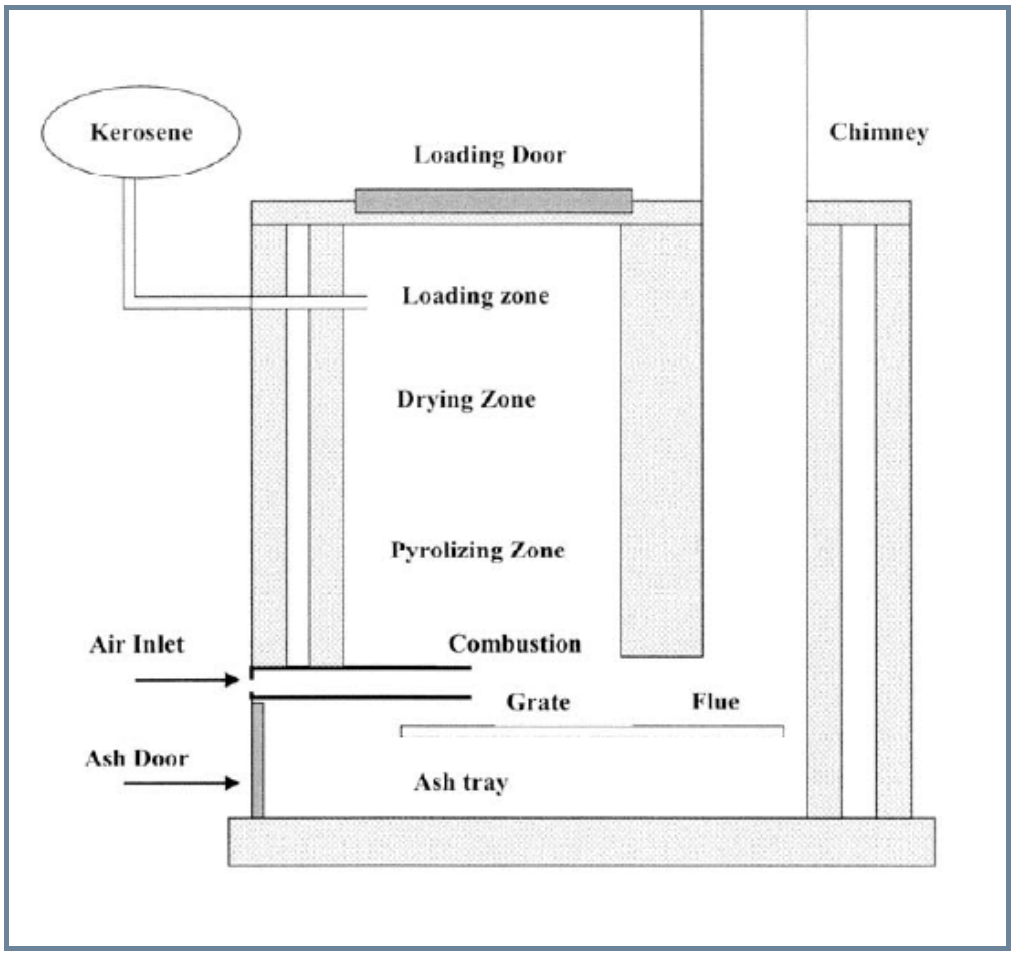


Figure 4-7: Description of Incinerator Areas

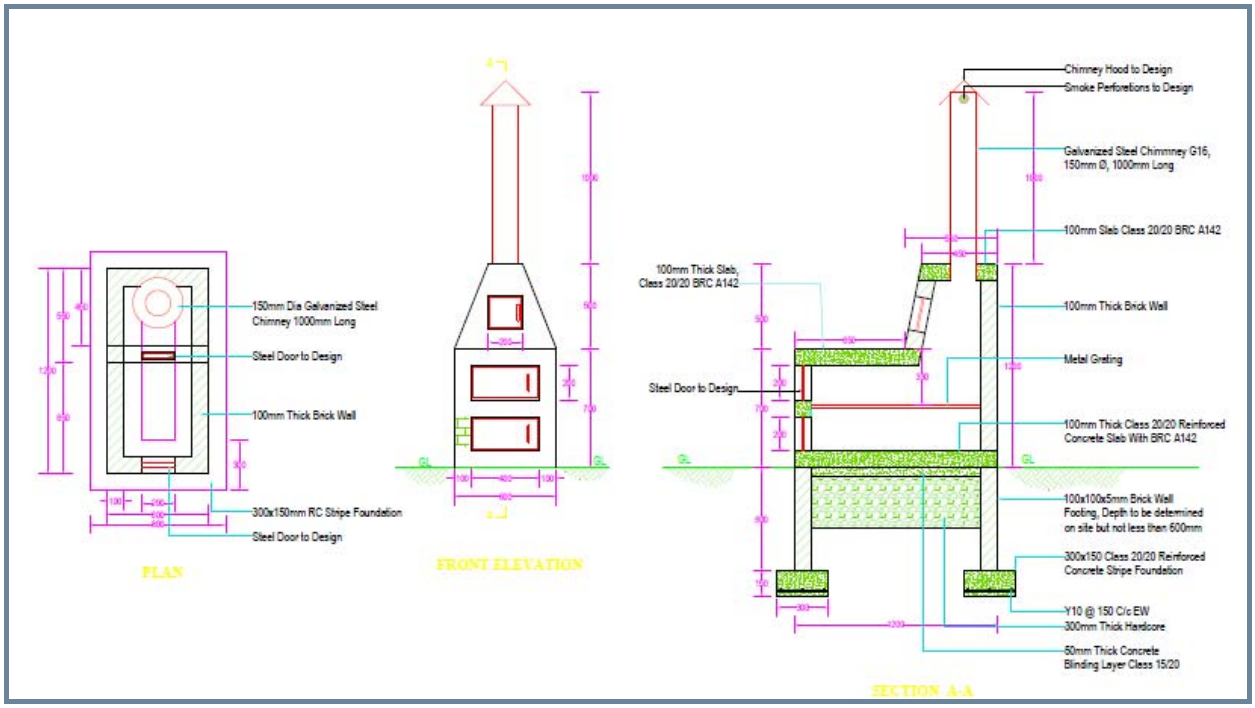


Figure 4-8: General Appearance of an Incinerator that can be enlarged to fit the scale of the medical waste

Oil spills

Petrol stations and garages discharge oil and grease to the environment. These wastes are hazardous to aquatic life and measures should be taken to control the wastes at the source.

This can be done by ensuring that all the traders engaged in activities that generate oils and grease to construct an interceptor at the business location and liaise with Environmental Authorities during emptying of the interceptors.

Construction and demolition debris

These wastes are generated in large quantities at construction sites. The managers of construction sites are encouraged to identify and acquire spoil banks during construction. The waste dumped at the spoil bank should be compacted in layers as approved by the construction project manager. The spoil bank shall be fenced and proper security installed.

Office space and equipment

To be able to manage the solid waste efficiently, the municipal council requires administration offices in the zones and at the dumping site.

The following offices are and staff is proposed for the zonal solid waste management.

Table 4-6: Proposed Zonal Offices, Staffing and Supervision Equipment

Zone / Disposal Site	Size of Office	Supervision Vehicle	Proposed Staff
Zone 1- 7	7 No. Area – 2.5 x 3m ($7.5m^2$)	One Double Cab	▪ 7 No. Supervisors ▪ 6 No. drivers ▪ 6 No. Backsmen for the drivers
Disposal Site	1 No. Area – 2.5 x 3m ($7.5m^2$)		▪ 1 No. Supervisor ▪ 4 No. Watchmen ▪ 1 No. unskilled labourers

Note: Street sweeping will be contracted by the municipal council to private operators who will invoice the council on monthly basis. It is expected that the council will engage one private operator per zone. With organized community participation, the community based organizations (CBO'S) will be allowed to compete with the private operators.

Waste Recycling and Reuse

Through public campaigns, recycling and reuse of waste should be encouraged particularly at the household level or should be recovered at the source/point of generation. Where such has not been done, it should be during transportation stage or at the disposal site. The earlier the waste material is separated, the cleaner the recovered material and the higher the quality as well as value to the end users.

The plan proposes the following solid waste to be recycled and used.

- Glass
- Plastics
- Paper
- Scrap metal
- Organic matter for composting.

The municipal council should ensure that at the locations of the skip loader, different storage bags are available and well labelled.

4.5 Private sector involvement in Solid Waste Management

Private sector waste collectors are significant and often supplement the local authority's capacity in solid waste management activities. However the partnerships between Bungoma Municipal Council and the private sector to facilitate sharing of Solid waste Management responsibilities and financial burden are hardly there in spite of such relationship's significance. The private sector involvement can either be through direct contract by individual households, neighbourhood associations, business establishments or by the authority.

This plan proposes service contract partnership where the private firm provides solid waste management services and the municipal council pays the firms for the services delivered. The private firms will operate under contractual agreement with the municipal authorities where the authority retains the responsibility for user fee collection.

However in the process of procuring these services, several factors should be considered including the contract duration that should be sufficient enough for the investor to have returns for the investment, and five years is proposed as being sufficient. The duration is also reasonable enough to encourage other service providers to reduce the risk of monopoly. The tendering and procurement process should also be competitive throughout the process. In spite of this, it is not advisable to entrust the services to the private sector from the initial phase but the process should be implemented gradually.

The plan also proposes that private firms should be procured to collect waste from all the seven zones to a skip where the municipal council collects the waste using a skip loader truck and transport to the disposal site.

In general, each zone will have a private operator who will collect the waste on a daily or twice a week basis based on the amount of waste generated in the zone and ensures that the waste are sorted and packaged in the labelled bags at the skip loader location. The performance of the private operators will be gauged based on the efficiency of the waste collection and the waste separation both at the skip loader location. The private operators will then invoice the council on a monthly basis.

The private operator together with the municipal council will decide the best location of the skips in relation to the source of the waste, accessibility and easy loading by the skip loading trucks.

4.6 Community participation

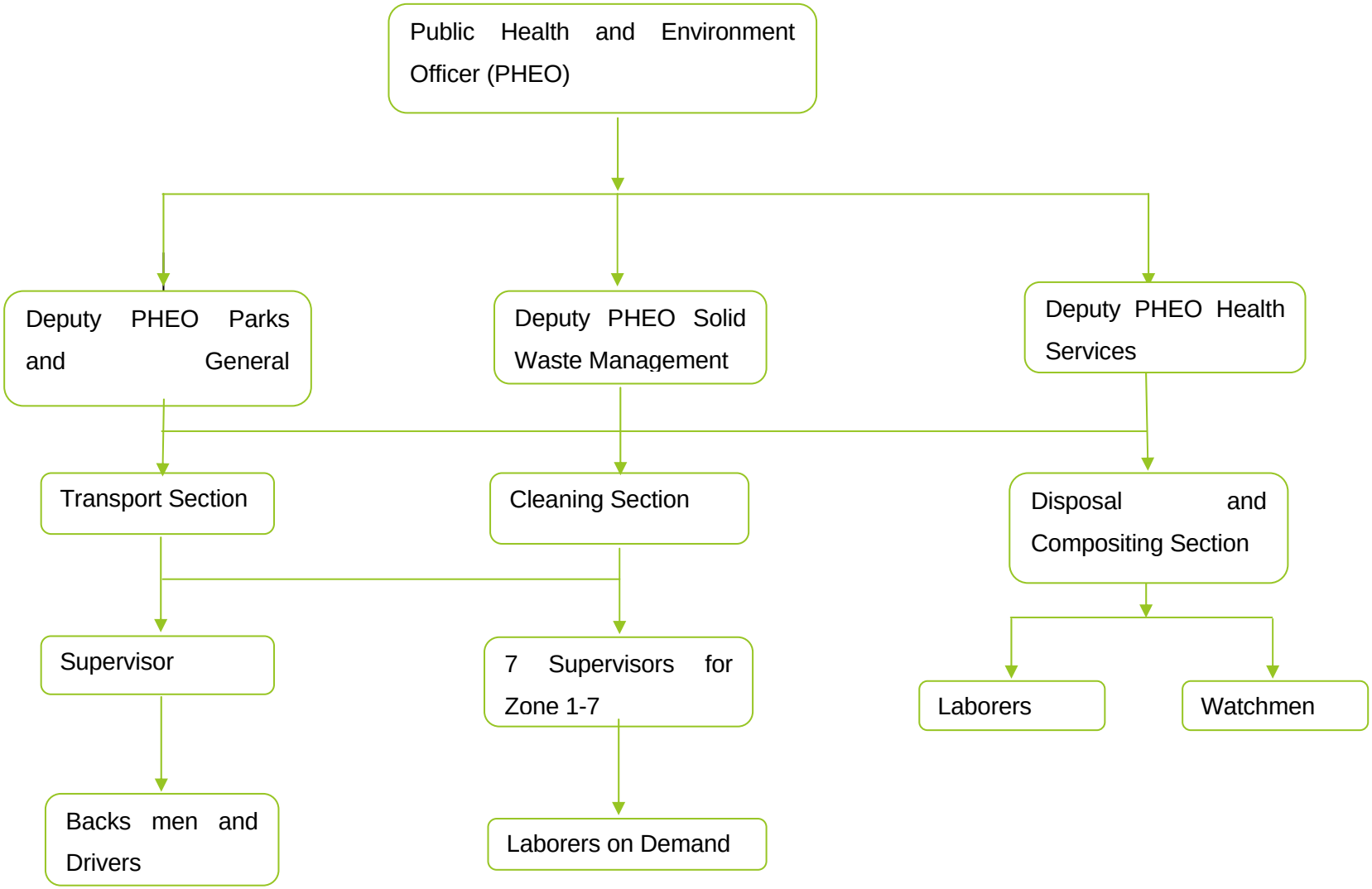
Community participation is significant in strengthening coordination between the municipality, waste generators and community based organization. During the short-term period it is proposed that mass campaign should be done to raise awareness of the people. The campaign is aimed at getting the cooperation and participation of the public in solid waste management in the municipality. It will target waste separation by households, waste reduction by composting, provision of bins for recyclable materials in institutions and strengthening of coordination.

For institutions or individuals willing to engage in waste recycling they should be registered by the council and that the municipal council will regulate and monitor the operations of all the private waste collectors and the CBO's to ensure that there is a fair competition in the market for both parties.

4.7 Proposed institutional structure and staffing

For effective management of solid waste at Bungoma Municipality, the department of Public Health and environment needs to be strengthened. The private sector is proposed to come in to supplement the collection and cleaning of the waste from the household as well as the streets. The Municipal council will only be required providing close supervision on the collection and cleaning and the actual transportation of the waste to the disposal site. Therefore there is need to restructure the current organizational structure of the department for efficient and effective delivery of services to be realized.

The figure below gives the proposed organizational structure of the solid waste management plan.


Public Health and Environment Officer (PHEO)
Deputy PHEO Parks and General
Deputy PHEO Solid Waste Management
Deputy PHEO Health Services
Transport Section
Cleaning Section
Disposal and Compositing Section
Supervisor
7 Supervisors for Zone 1-7
Laborers
Watchmen
Backs men and Drivers
Laborers on Demand

4.8 Implementation Plan

Table 4-7: Implementation Plan for the Solid Waste

ACTIVITY	SHORT TERM 2012-2017	MEDIUM TERM 2017-2022	LONG TERM 2022-2032
COLLECTION AND TRANSPORTATION			
Formulation of the collection and transportation system			
Monitoring of the collection and transportation system			
Procurement of the collection vehicles			
SETTING UP OF THE ZONAL OFFICES			
Setting up of offices			
Maintaining the Zonal Offices			
DISPOSAL SITE PLAN			
Setting up a composting site			
Purchase of land for landfill			
Construction of landfill			
Maintaining the disposal site			
ORGANIZATIONAL RESTRUCTURING OF THE PUBLIC HEALTH DEPARTMENT OF THE MUNICIPAL COUNCIL			
Staffing of the zonal offices			
Training of the zonal staff			
Production of operational manuals			
LEGAL FRAMEWORK			
Enforcing of the by-laws			
FINANCIAL MANAGEMENT			
Setting up of waste charging system			
Review of the charging fees			
PRIVATE SECTOR PARTICIPATION			
Public awareness of the private operators			
Training of the private operators			
COMMUNITY PARTICIPATION PROMOTION PLAN			
Public awareness of CBO's			
Training of CBO's			

Table 4-8: Implementation of Medical Waste Disposal Facilities

ACTIVITY	SHORT TERM 2012-2017	MEDIUM TERM 2017-2022
Construction of incinerators		
Incinerator at the District Hospital		
Incinerator at the Dispensaries / Clinics		

4.9 Source of funds

Financing of solid waste management in Bungoma municipality is mainly through budgetary allocation from LATF as well as charges collected by the municipal council under the Single Business Permit. There are inadequate funds set aside for the management of solid waste management while at the same time the allocation is based on other departments' financial resources needs and priority. This has resulted in under funding of solid waste management activities however future possible sources of funds as proposed by CAS Consultants 2005, for the establishment of a strong solid waste section in the council, construction of facilities and operations of the section include but is not limited to:

- Local Authorities Transfer Fund
- User charges (flat and graded rate). A low rate for a basic amount of garbage and a higher rate for huge garbage generation.
- Development partners grants and loans.

4.10 Review of the plan

The private operators, the CBO's and the municipal council with all other stakeholders should formulate an internal reporting mechanism. The reporting should be agreed upon by all stakeholders so that the information needs are identified and the protocol of reporting agreed upon. The reporting process should be on a daily, weekly, monthly, quarterly and annually on the challenges facing the implementation process of the solid waste management plan. This will translate to a review of the solid waste plan once in every two years through a stakeholder's forum. The review will dictate the subsequent implementation process of the plan.

4.11 Project cost

The project costs include capital cost and operation and maintenance cost; Breakdown of the cost per every stage of waste management is attached in Appendix A.

Table 4-9: Project Cost: Capital Cost and Operation and Maintenance Cost (USD)

Project Cost component	Short Term 2012 - 2017	Medium Term 2017 -2022	Long Term 2022-2032
Capital Cost	1,595,206	543,294	1,812,206
Operation and Maintenance	495,059	555,765	720,941
Total Cost	2,090,265	1,099,059	2,533,147

REFERENCES

GoK 2010: 2009 Kenya population and Housing Census

http://www.kenyalaw.org/klr/index.php

GoK: Feasibility study on solid waste management in Kitale, Bungoma, Kkakamega and Busia.

GoK 2010: Preparatory Survey for Integrated Solid Waste management in the Republic of Kenya

GoK, 2010: District Strategic Plan 2005 - 2010 for Implementation of the National Population Policy for Sustainable Development Bungoma District

Municipal Council of Bungoma 2009: Garbage collection plan for Bungoma Municipality

GoK 2009: Kenya Local Government Reform Program Local Authority Service Delivery Tools Manual *8 Solid Waste Management*

GoK 2010: Strategic Urban Development Plan for Bungoma Town 2008-2030 Environmental Strategy

GoU 2008: Tororo district local government Malaba town council Consultancy services for the Development of a comprehensive Stormwater drainage master plan for Malaba town council, Uganda Draft design report June 2008.

UNEP 2009: *Developing integrated Solid waste Management plan Training manual Volume 1:* Waste characterization and Quantification with projections for future.

UNEP 2009: Developing integrated Solid waste Management plan Training manual Volume 2: Assessment of Current Waste Management System and Gaps therein

Beck R. W. 2006: Solid Waste Management Plan state of Georgia

Jefferson County Solid Waste Management Plan, Final Draft 2000

World Bank (1999): What a waste: Solid waste management in Asia, Urban Development Sector, Unit East Asia and Pacific Region, World Bank Washington, D.C USA

APPENDIX A: PROJECT COST BREAKDOWN

BUNGOMA SOLID WASTE MANAGEMENT PLAN - CAPITAL COST													
			Short-term (2012 - 2017)			Medium-term (2017 - 2022)			Long-term (2022 - 2032)				
Stage of Waste Management	Facilities, Activities / Equipment Required	Unit	Rate USD	Quantity	Estimated Amount USD	Rate USD	Quantity	Estimated Amount USD	Rate USD	Quantity	Estimated Amount USD
Start up Stage	Community Cleaning - tools and labour required for one week cleaning (All the seven Zones)	Item	Sum	1	123,529						
	Two weeks Sensitization Programme on the Solid Waste Management Plan	Item	Sum	1	23,529						
Collection and Transportation	Litter Bins	No	647	50	32,353	882	50	44,118	1,176	50	58,824
	Skip Loaders	No	7,647	10	76,471	8,824	12	105,882	9,412	17	160,000
	Skip loader Trucks	No	141,176	3	423,529				176,471	2	352,941
	Fencing	m	10	1000	10,000				12	5,000	58,824
Disposal Site	Shovel	No	176,471	1	176,471				211,765	1	211,765
	Landfill Site (Purchase of land) and construction	Acres				7,647	15	114,706	294,118	1	294,118
Construction of an Incinerator at Bungoma Town(Land to be provided by the Municipal Council)		No	23,529	1	23,529						
Administration and supervision	Zonal Offices	No	1,588	7	11,118						
	Disposal site office	No	1,588	1	1,588						
	Supervision vehicles	No	52,941	1	52,941				76,471	1	76,471
Design and Construction Supervision Consultancy Cost	Detailed Design	Item	Sum	1	250,000						
	Construction Supervision	Item	Sum						Sum	1	287,500
Oranisational Restructuring	Addition of More staff for the Public Health and Environment Department	Item	Sum	1	31,765	Sum	1	77,647	Sum	1	94,706
	Public awareness of the By-Laws	Item	Sum	1	112,500						
Legal Framework	Enforcement of the By-Laws	Item	Sum	1	88,824	Sum	1	118,588	Sum	1	197,647
Financial Management	Training on Financial management	Item	Sum	1	11,765	Sum	1	23,529	Sum	1	28,412
	Public awareness	Item	sum	1	26,471						
Private sector participation	Training on Private sector participation	Item	Sum	1	35,294	Sum	1	35,294			
	Public awareness	Item	sum	1	26,471						
Community Participation	Training on Private sector participation	Item	Sum	1	47,059	Sum	1	23,529			
Total Capital Cost					1,595,206			543,294			1,812,206

BUNGOMA SOLID WASTE MANAGEMENT PLAN - OPERATION AND MAINTENANCE COST												
Labour Cost	8 No. Supervisors	Item	Sum	1	197,647	Sum	1	237,176	Sum	1	285,294	
	6 No. Drivers	Item	Sum	1	127,059	Sum	1	127,059	Sum	1	127,059	
	2 No. Backsmen	Item	Sum	1	28,235	Sum	1	28,235	Sum	1	28,235	
	4 No. Watchment	Item	Sum	1	50,824	Sum	1	50,824	Sum	1	50,824	
	3 No. Labourers	Item	Sum	1	25,412	Sum	1	25,412	Sum	1	25,412	
Maintenance Cost	Fuel	Item	Sum	1	42,353	Sum	1	63,529	Sum	1	70,588	
	Servicing	Item	Sum	1	11,765	Sum	1	11,765	Sum	1	11,765	
	Wear and Tear	Item	Sum	1	11,765	Sum	1	11,765	Sum	1	11,765	
Total Operation and Maintenance Cost					495,059			555,765			720,941	
Total Cost of the Implementation Plan					2,090,265			1,099,059			2,533,147	

APPENDIX B: INVESTMENT PLAN

Recipient Party	Bungoma Municipal Council
Executing Agency	Nile Basin Initiative
Main Beneficiaries	Bungoma Municipal Council
Estimated Cost (USD)	1. Short Term – 2,090,265 2. Mid Term – 1,099,059 3. Long Term – 2,533,147 4. Total cost - $ 5,722,471
Location/Intervention area	Bungoma Municipality
Duration	20 years

Background

The economic and population growth of Bungoma Municipality has led to an increase in demand for energy and resources. It is apparent that burgeoning consumption of these products and services on the other hand has led to a subsequent increase in waste products that require safe disposal. Inadequate solid waste management on the other hand poses a challenge to the environment and in particular watershed management because of their potential in causing both surface and underground water pollution. Although the imminent impacts of solid waste pollution may not be obvious, it is apparent that it could be detrimental to biodiversity. About 80% of waste in Bungoma municipality is neither collected nor disposed of safely and since this situation is an eminent risk on the environment, health, hygiene and aesthetic conditions of Bungoma town, solid waste management is an issue requiring intervention.

The municipal council of Bungoma though responsible of waste management in Bungoma town, it does not have enough capacity for effective solid waste management service delivery within its area of jurisdiction. The council is in charge of handling and delivery of all waste management services ranging from collection, transportation, treatment, storage and disposal. However there are several challenges impeding the council's ability to deliver solid waste management services effectively and these includes but are not limited to the following: absence of waste Segregation, lack of household waste collection facilities, indiscriminate waste dumping, dilapidated primary collection chambers, inadequate and frequent breakdown of waste transporting trucks, manual loading of waste, spillage of waste during transportation, understaffed and underfunded waste management department, location of the open disposal site at the upper sources of river Sio, lack of coordination among solid waste management institutions, poor public awareness and

participation in solid waste management activities, solid waste management practice that does not meet set standards and regulations in the legal framework, lack of an enforcement mechanism and inadequate medical waste management.

Following insufficient solid waste management practice in Bungoma Municipality, the Nile Basin Initiative is making efforts to improve the sanitary environment of the Sio-Malaba-Malakisi Sub Basin through integrated watershed management strategy. The Integrated solid waste management initiative seeks to maximize resource use efficiency by taking a strategic approach to the sustainable management of solid waste considering all aspects including sources of wastes as well as all stages namely generation, segregation, sorting, treatment, recovery and disposal in an integrated manner.

Justification

Inadequate solid waste management is a challenge not only in Bungoma Municipality but in many local authorities within the Sio-Malaba-Malakisi River Basin leading to subsequent dispersal and degradation of the environment particularly in regard to water quality. The situation in Bungoma municipal council has been exacerbated by increased run-off, low public awareness and discipline, inadequate waste collection system, underfunded public health and environment department, lack of fee collection system to sustain an effective program and lack of legal framework enforcement capacity to prevent littering or haphazard waste disposal within the Municipality. However, solid waste generated in the town needs to be managed properly because of the specific conditions characterized by the area. The high run-off and large amounts of wastes generated in the town require proper management to minimize risks to the environment and human health.

Therefore the implementation of the solid waste management proposal will go a long way in improving and expanding solid waste collection, improving solid waste disposal, enhancing institutional capacity, increasing public awareness and participation in solid waste management. This will reduce pollution effects on the environment occasioned by poor solid waste management and ensuring of a clean environment to the residents of the municipality. The implementation of the proposal will also enhance the technical, human and financial capacity of the municipal council of Bungoma to discharge its functions effectively but of significance is the contribution to the objectives of the Nile Basin Initiative in managing the quality of water resources within the Basin.

Scope of the proposal

The proposed solid waste management investment plan involves short, medium and long term proposals. The scope of the proposal includes but not limited to the following:

- Solid waste sensitization
- Technology of collection, transportation and disposal of solid waste.
- Construction of incinerator for medical waste
- Administration and supervision
- Consultancy services
- Organizational restructuring of the Municipal Council mandated to manage solid waste
- Private sector participation in the management of solid waste
- Community participation in the management of solid waste

Objectives

In view of the above it is the aim of the intervention to achieve the following objectives singly or in combination:

- To improve the technical capacity of the municipal council to effectively manage solid wastes.
- To improve solid waste collection, storage, transportation and disposal system in Bungoma municipality.
- To enhance public awareness and participation for sustainable solid waste management in Bungoma Municipality
- To enhance hazardous waste treatment/management, recycling and reuse as a way of reducing solid waste volume and impact to the environment.
- To enhance institutional capacity of the municipal council for solid waste management service delivery and enforcement.
- To reduce degradation of water resources and the environmental in general.

Outputs

- A well-equipped public health and environment department at the Bungoma municipal council.
- Improved waste collection, transportation, storage, and treatment as well as disposal system in the municipality.
- Public awareness and active participation in solid waste management in the municipality
- Treatment of medical wastes generated in the municipality before disposal at the landfill site

- Enhanced institutional capacity at the municipal council to enforce and deliver solid waste management services.
- Reduce waste through recycling and composting of the organic waste
- Reduced pollution of the water resources due to poor solid waste management practices in the municipality.

Deliverables

DELIVERABLES		PERIOD			
	Draft and final formulation of monitoring report of the collection and transportation system of the solid waste management system	End of year 2012			
	Procurement of collection Vehicles	End 2012	End 2013		End 2030
	7 ton skip loaders truck	2 No.	2 No.		2 No.
	Double cab. pickup	1.No	1.No		1.No
	Shovel	End 2012	End 2012		End 2012
	CD6	1.No	1.No		1.No
	Establishing of Zonal Offices	End 2013	End 2014	End 2015	End 2017
	7.5 M^2	1.No	2 No.	2 No.	2 No.
	Setting up of a composite	End 2014			
	Purchasing of landfill site	End 2014			
	Construction of landfill	End 2022			
	Staffing of zonal offices	End 2013	End 2014	End 2015	End 2017
	Supervisors	1.No	1.No	1.No	1.No
	Drivers	2 No.	3 No.	2 No.	
	Backs men	2 No.	2 No.	2 No.	
	Watchmen	End 2022			
		2 No.			

	Cleaners of zonal offices	1.No	2 No.	2 No.	2 No.
	Enforcement of bylaws staff	End 2013	End 2014	End 2015	End 2017
		1.No	2 No.	2 No.	2 No.
	Putting Waste charging system in place	End 2013			
	Engagement of private sector Participation including training	End 2017			
	Public awareness and CBOs	End 2012			
	Construction of an incinerator at municipal level	End 2014			

Implementation Methodologies

Stage of Waste Management	Facilities, Activities / Equipment Required	Project Risks
Start up Stage	Community Cleaning - Tools and labour required for one week cleaning (All the seven Zones)	Willingness of the public to participate
	Two weeks Sensitization Program on the Solid Waste Management Plan	Willingness of the public to participate
Collection and Transportation	Litter Bins Skip Loaders Skip loader Trucks	Willingness of local people to use the skips and the litterbins.
Disposal Site	Fencing Shovel Landfill Site (Purchase of land) and construction	Availability of suitable land Willingness of local people to buy manure from the composite
Construction of an Incinerator at Bungoma Town(Land to be provided by the Municipal Council)		Availability of land
Administration and supervision	Zonal Offices Disposal site office Supervision vehicles	Availability of office space or land for construction
Design and Construction Supervision Consultancy Cost	Detailed Design Construction Supervision	
Organizational Restructuring	Addition of More staff for the Public Health and Environment Department	
Legal Framework	Public awareness of the By-Laws Enforcement of the By-Laws	Participation of other government agencies in enforcement of the legal framework.

Financial Management	Implementation of waste charging system Training on Financial management	Willingness and ability of local people to pay for the services
Private sector participation	Public awareness Training on Private sector participation	Willingness of the private sector to participate. Efficient and effective revenue collection system by the municipal council. An attractive return on investment
Community Participation	Public awareness Training on Private sector participation	Willingness of the public to participate

Required Fund Inputs

Project Cost component (USD)	Short Term 2012 - 2016	Medium Term 2017 -2021	Long Term 2022-2032
Capital Cost	1,595,206	543,294	1,812,206
Operation and Maintenance	495,059	555,765	720,941
Total Cost	2,090,265	1,099,059	2,533,147

Main performance indicators

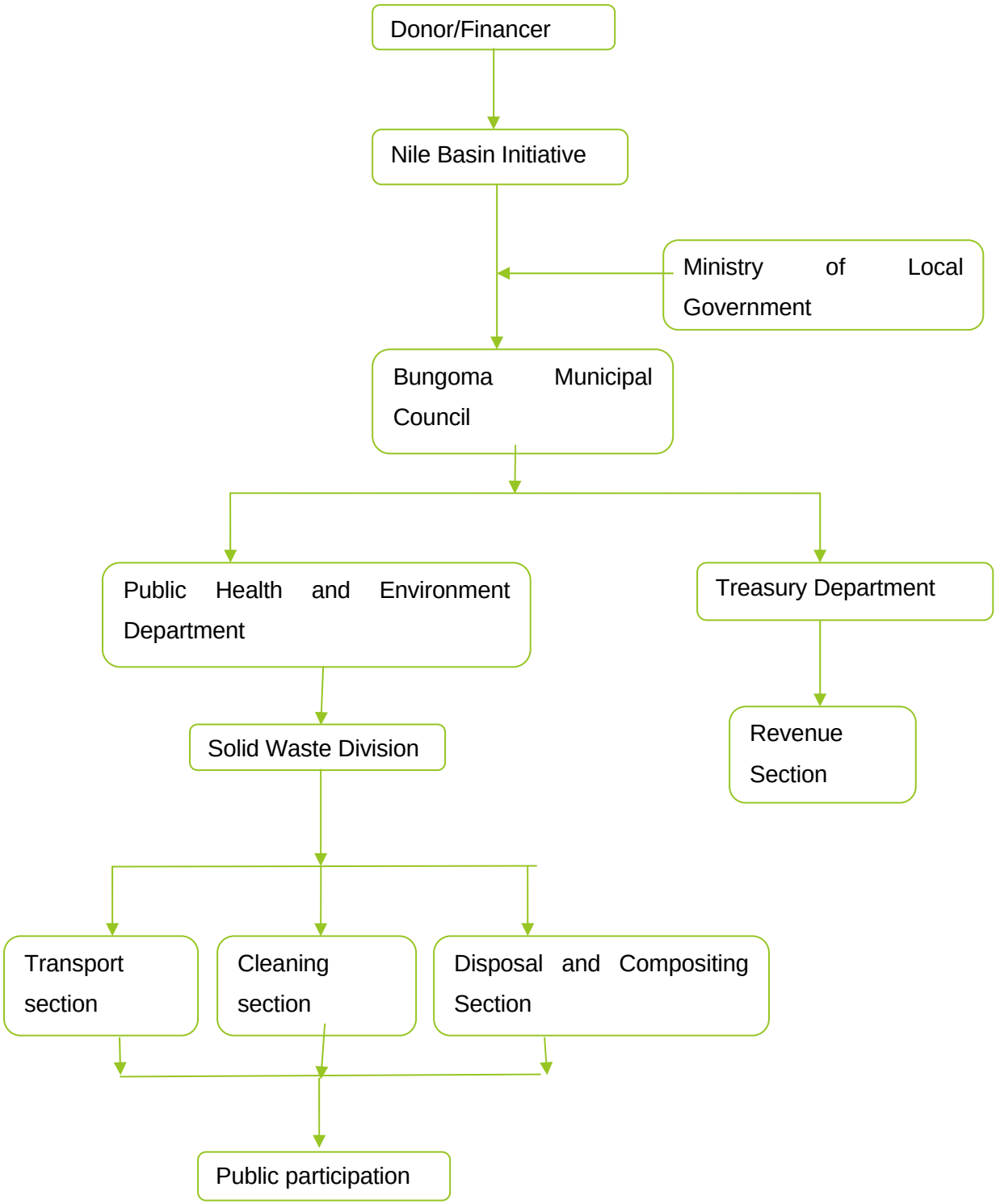
- Installation and management of dust bins and collection chambers/skips at strategic areas in all the zones of the municipality as well as cleaning the Central Business District
- Enforcement and adherence to solid waste management rules and regulations in the Municipality.
- Adequate waste collection capacity from all households within the municipality
- Installation and operation of a landfill disposal site in an environmentally sustainable way

- Ensure an efficient and effective waste transportation system within the municipality.
- Private sector and community participation at all stages of solid waste management process.
- Installation and operation of a medical waste incinerator in the municipality that reduces improper medical waste disposal.
- Public participation in waste reduction through recycling and composting of organic refuse.

Institutional Arrangements

The proposal will be implemented through a participatory process involving several stakeholders including but not limited to the Financier, Nile Basin Initiative, the municipal council of Bungoma and the public at large.

The proposed institutional arrangement is shown on the diagram below:


Donor/Financer
Nile Basin Initiative
Ministry of Local Government
Bungoma Municipal Council
Public Health and Environment Department
Treasury Department
Solid Waste Division
Revenue Section
Transport section
Cleaning section
Disposal and Compositing Section
Public participation

Costs and Benefits

When solid waste are not collected and disposed (removal from source), it causes health, social and economic problems to the community directly or indirectly. The poor or the weak in society more often than not are the ones who bear huge problems. When the community or residence ignore solid waste, the Government are normally forced to intervene at the last minute due to health complications of it population (labour force)

Whether it is Government or community, solid waste management has a cost. This cost ranges consists of the following:

- Fixed costs
- Capital cost
- Depreciation and amortization
- Financial cost
- Variable cost
- Operating costs
- Consultancy costs

Whereas the costs of the proposal can be determine, the value of benefits cannot be easily quantified because of the multiple benefits that results from a clean and health environmental. The benefits of a clean environment though appreciated cannot be given a direct cost as it is a challenge to value factors such as aesthetics, clean air, high quality water resources and clean land that will result from the implementation of the proposal. The effects of environmental pollution on the other hand occur after a long time and one cannot directly link such effect to a certain pollutant or the source because of other factors at play. However the cost benefit table below indicates the monetary value of the benefits based on the following assumptions:

- Pollutants from inadequate solid waste management activities polluting soil, water and air will result into human health problems that will require medical consultations and these pollutants will find their way into the food chains and food web.
- Manure from compost organic matter will be sold to farmers
- Recycling activities from CBOs will generate income from wastes
- Involvement of the private sector will open up employment opportunities to the local people
- Proper waste handling will reduce health effects from the direct contacts with waste from those scavenging or working on the waste directly.
- Government saves a lot of resources that could have been used to manage disease outbreaks

COST / BENEFIT ANALYSIS

S/NO.	COST ANALYSIS			BENEFITS ANALYSIS		
	STAGES	DESCRIPTION	VALUE US$	DESCRIPTION	ELEMENTS	VALUE US$
1	Start up Stage	Community Cleaning - Tools and labour required for one week cleaning (All 7 Zones)	123,529		The local people will appreciate the need for a clean environment	
		Two weeks Sensitization Program on the Solid Waste Management Plan. This will involve the identification of waste recycling companies in the neighbourhood that will utilize the recyclable solid waste.	23,529		Appreciation and familiarization with the plan by all stakeholders and soliciting their participation in the implementation process Identification of stakeholders' roles and responsibilities in the whole process of implementation Identification of the firms or companies involved in recycling solid waste	
2	Collection and Transportation	Litter Bins	135,294	Reduce haphazard disposal of waste	Improves the aesthetic value Easy to collect waste for dumping	58, 000
		Skip Loaders	342,353	Easy transportation of waste to disposal site	Reduction in land, air and water pollution Improves the aesthetic value Reduced land, air and water pollution	705,000

COST / BENEFIT ANALYSIS

S/NO.	COST ANALYSIS			BENEFITS ANALYSIS		
	STAGES	DESCRIPTION	VALUE US$	DESCRIPTION	ELEMENTS	VALUE US$
					Reduced illegal dumping Reduced and reduced vector breeding	
		Skip loader Trucks	776,471	Easy loading of wastes	Reduced time wastage and man power	58, 000
3	Disposal Site	Fencing	68,824	Prevention of site encroachment	Protection of trespassers from infection and unhygienic conditions	76,000
		Shovel	388,235	Compacting of waste	Reduced leachate Reduced wind blow of waste Increased lifespan of the site	58,000
		Landfill Site (land acquisition), design and construction. This will include ancillary works such as fencing, drainage , staff houses and operations of the landfill	408,824	Reduced haphazard waste disposal Composting of organic matter	Improves the Aesthetic value Generation of manure Controlled emission of greenhouse gases (methane) Reduced breeding of vectors Reduced sediment loading to water sources	276,000

COST / BENEFIT ANALYSIS

S/NO.	COST ANALYSIS			BENEFITS ANALYSIS		
	STAGES	DESCRIPTION	VALUE US$	DESCRIPTION	ELEMENTS	VALUE US$
4	Construction of an Incinerator at Bungoma Town (Land to be provided by the Municipal Council)	The costs to include design and construction of the incinerator, necessary compliances such as NEMA regulations and the initial operational costs of the facility	23,529	Treatment of all medical waste	Reduced land, air and water pollution Reduced illegal dumping Reduced infection	705,000
5	Administration and supervision	Zonal Offices	11,118		Efficient Monitoring of solid waste at the field level.	23, 000
		Disposal site office	1,588	Effective management of disposal site	Control of dumping activities	
		Supervision vehicles	129,412	Easy movement	For adequate supervision	
6	Design and Construction Supervision Consultancy Cost	Detailed Design	250,000			
		Construction Supervision	287,500			
7	Organizational Restructuring	Addition of More staff for the Public Health and Environment Department	194,118		For efficient and effective monitoring of solid waste collection, transportation and disposal	

COST / BENEFIT ANALYSIS

S/NO.	COST ANALYSIS			BENEFITS ANALYSIS		
	STAGES	DESCRIPTION	VALUE US$	DESCRIPTION	ELEMENTS	VALUE US$
8	Legal Framework	Public awareness of the By-Laws	112,500		Public appreciation and understanding of solid waste management rules, standards and regulations.	23,00
		Enforcements of the By-Laws	415,059		Ensure adherence to good solid waste management practices by all stakeholders	23,000
9	Financial Management	Training on Financial management	64,706		Ensure efficient and effective management of financial resources	
10	Private sector participation	Public awareness	26,471		Increased community appreciation and participation in solid waste management.	
		Training on Private sector participation	70,588		To enhance investment and awareness of investment opportunities in solid waste management	
		Training on CBOs	70,588	Engagement in recycling activities	To enhance local organizations' capacity to participate in solid waste management. Business opportunities from recycling activities	350,000
TOTAL CAPITAL COST			3,950,706			

COST / BENEFIT ANALYSIS

S/NO.	COST ANALYSIS			BENEFITS ANALYSIS		
	STAGES	DESCRIPTION	VALUE US$	DESCRIPTION	ELEMENTS	VALUE US$
Bungoma Solid Waste Management Plan – Operation and Maintenance Cost						
	Labour Cost	8 No. Supervisors	830,118			
		6 No. Drivers	381,176			
		2 No. Backsmen	84,706			
		4 No. Watchmen	152,471			
		4 No. Labourers	76,235			
	Maintenance Cost	Fuel	176,471			
		Service	35,294			
		Wear and Tear	35,294			
TOTAL OPERATION AND MAINTENANCE COST			1,771,765			
TOTAL COST OF THE IMPLEMENTATION PLAN			5,722,471			2,355,000

Environmental and Social Management Framework considerations

The proposal will be implemented by all stakeholders in a participatory process involving the financiers, the Nile Basin Initiative, the ministry of local government and other government departments, the municipal council of Bungoma, the private sector and the local community. It is anticipated that through public campaigns, all individuals within households will be expected to participate in the waste management process either directly or indirectly. Community involvement on the other hand will ensure that their needs and constraints are integrated in the objectives of the proposal hence its effective implementation. Public involvement will further enhance the sustainability of the proposed project, increase local ownership and a sense of responsibility for maintaining the solid waste management services provided through the proposed project. The delivery of solid waste management service in Bungoma Municipality is expected to cover all areas including the low income areas of the town.

Implementation of the proposal will improve solid waste management hence reducing the associated environmental pollution of air, soil and water. Both human health and environmental degradation will be greatly reduced.

Annex 3A2a. Solid Waste Management Project for Lwakhakha-Uganda

TABLE OF CONTENTS

LIST OF ANNEXES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1.INTRODUCTION

Proper management of waste is one of the most pressing and challenging environmental problems in Lwakhakha town. Solid waste generation rate is emerging as a major public health and environmental concern in Lwakhakha Town council yet the trend has not been countered by an equivalent increase in the capacity to deal with the issue. Many studies in developing countries indicate that less than 50% of waste generated in urban areas is collected or properly disposed off. But due to inefficiencies in waste collection and disposal system, widespread indiscriminate dumping in awkward places is a common occurrence.

Uncontrolled dumping and burning are the common methods practiced in solid waste disposal, however their impacts are widely recognized yet they remain the most common methods of solid waste disposal. Lwakhakha town council disposal sites being open dumping areas remain potentially detrimental on the surrounding environment. The town council had no designated waste disposal site at the time of the study whereas the disposal site that was in use is vulnerable to storm water runoff.

At the back drop of inadequate solid waste management, the Nile Basin Initiative has made efforts to improve the sanitary environment of the Sio-Malaba-Malakisi Sub Basin. As part of its strategy, it sought the consultancy services to conduct a study on solid waste management with the aim of formulating proper Solid Waste Management Plan for Lwakhakha town council in order to manage solid waste generated in the town and thus to enhance integrated watershed management within the Nile Basin. The Integrated solid waste management initiative seeks to maximize resource use efficiency by taking a strategic approach to the sustainable management of solid waste considering all aspects, sources of wastes as well as at all stages namely generation, segregation, sorting, treatment, recovery and disposal in an integrated manner.

The solid waste management study in Lwakhakha town Council included evaluating aspects of waste characterization, solid waste management systems and environmental and health impacts. Determination of Waste amounts data plays a critical role in solid waste system planning and design. Data generated from waste amounts studies are used in several ways, including determining the quantity of materials available for recovery, measuring the effectiveness of existing recycling programs, and right-sizing solid waste and recycling facilities. Waste management system on the other hand highlighted the gaps in institutional framework, legal and policy framework, financing mechanisms, waste management technologies and how stakeholders participate in solid waste management in the town council.

The study involved desk review of solid waste management literature, scheduled interview of District Environmental officer, the public health officials from the town councils, the Lwakhakha town engineer as well as field observations, visits to several areas within the town including abattoir area, the new market waste collection chambers, waste disposal site behind the shops and a visit to two of the clinics in the town. The field visit also involved interviewing the local people to get their views and perception regarding solid waste management practice in the town council.

The dumping areas are located on the slopes, where storm water carries the waste to river Lwakhakha. This situation is creating problems in environmental, health, hygienic and aesthetic conditions for the people of Lwakhakha town, solid waste management is an urgent issue requiring prompt resolution.

1.1 Goal of the plan

To sustain solid waste management practice for reversed environmental degradation and a clean Lwakhakha town.

1.2 Objectives of the plan

- To improve the technical capacity of the town council to effectively manage solid wastes.
- To improve solid waste collection, storage, transportation and disposal system in within Lwakhakha town council.
- To enhance public awareness and participation for sustainable solid waste management in the town council.
- To enhance hazardous waste treatment/management, recycling and reuse as a way of reducing solid waste volume and impact to the environment.
- To enhance institutional capacity of the town council for solid waste management service delivery and enforcement of regulations.
- Reverse water resources and general environmental degradation.

1.3 Justification of the plan

Uncontrolled dumping and burning are the common methods practiced for solid waste disposal resulting in serious land, water, and air pollution problems. However sustainable management of solid waste is an important and challenging environmental issue that Lwakhakha town council faces for sustained environmental management. The town council does not have a designated waste disposal point whereas the current disposal sites are susceptible to storm water runoff. Therefore there is need to set up a strategic action plan of municipal solid waste

(MSW) management within the town council to reverse environmental degradation in the next twenty years.

CHAPTER 2.THE PLANNING AREA

2.1 Jurisdiction

National

The town Council of Lwakhakha was established under the Local Government Act Cap 243 of the Laws of Uganda. It executes three key functions: local services, local governance and local development through strategic leadership.

The organization and management of the Lwakhakha town council is structured into two arms- the political arm headed by the council chairperson who are responsible of policy formulation and the technical arm with the Town Clerk at the apex to implement policy decisions made by the former.

Administrative area

Lwakhakha town is found in Manafwa district, Bubulo county and Lwakhakha sub-county. The town borders Kenya and it is under Lwakhakha town council which is responsible for waste management.

Location of the study area

The town is within the jurisdiction of the Lwakhakha town council and is located at coordinates; N 00^{o}47.691' E 034^{o} 22.701', and elevation of about 1756m above sea level near the councils offices. Lwakhakha town is almost in the middle from Mbale town and Bungoma town in Kenya which is about 40 kms away while Mbale is about 37 km.

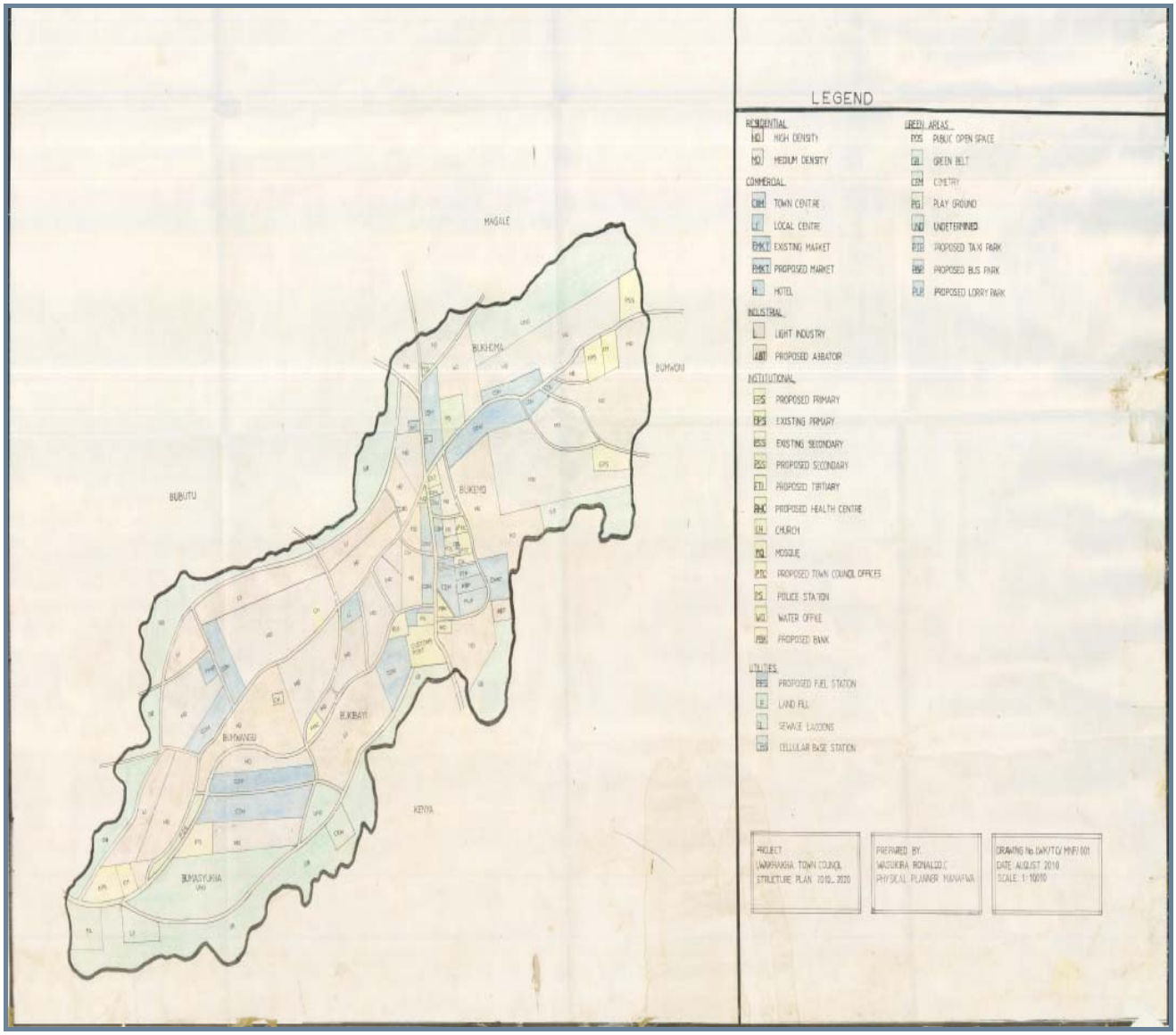


Figure 2-1: Sketch map of Lwakhakha Town

Population

Lwakhakha town has a population of about 13,000 of which about 5,200 live in the urban centre while 7,800 live in the rural area. The population of women is slightly higher than that of men and the town council population growth rate is about 3.3%.

Socio-economic pattern of the study area

Main occupation

Lwakhakha Town is characterized by both rural and urban settlement. Agriculture, business, formal and informal employment provides occupational opportunities for most household heads in this area. The agricultural farms provide both formal and informal employment whereas the urban centre provides business opportunities. The police post, immigration office, the Uganda revenue authority offices and other institutions present in the area provide formal employment. However, business is the main occupation in the core town centre which includes retail shops, bars and restaurants, tailoring shops, jua kali services, open air market, groceries, hawking, salons and barber shops.

Infrastructure

Lwakhakha town has a road network of about 20 Km with the main earth road passing through the main street and across the border. The other areas within the town are served by footpaths. The town has basic services such as tap water, street cleansing services, storm water drainage and a modern market but has no electricity although plans are at an advanced stage and during the time of the study the electric polls had been put up.

Living conditions

Living conditions in Lwakhakha town is typical of a rural area set-up in Uganda with an exception of the main street of the town. The residents are farmers with a few commercial premises. Waste water drainage is in place especially in the main street towards the border. However it was observed that sediment are drained in the river particularly during the rain seasons.

Sources of income for the household

The sources of income for the local people in Lwakhakha Town are mainly from trade and commerce across the border or from informal employment and to a lesser extend formal employment. However in general, more women work on the family farm and in the informal employment as compared to men. The agricultural activities consist of subsistence farming of food crops, livestock keeping and horticultural products on small scale.

Well-being and well-being trend

Basing on the census report of 2002, more men than women are employed and have a sustainable income whereas more women provide labour on the family farm whose farming activities are seasonal and depended on the availability of rainfall. In addition, the urban area of

the town and the border provides opportunities for small businesses which supplement family income for instance bananas are sold across the Kenyan border to supplement family income.

Housing

Type of settlements

Lwakhakha town is characterised by both rural and urban settlement with a linear settlement. However, the location and concentration of the population is largely influenced by Commercial activities and poverty levels. The settlement patterns in the town council are dictated upon by the potentiality of land, land use system and business opportunities available. There are high population densities in urban centres and market areas with high commercial potential while areas with low commercial potential or agricultural are sparsely populated.

Housing characteristics

Most houses in Lwakhakha area are semi-permanent, constructed by iron sheets as roofing materials, unbaked bricks or mud for walls and over 75% of the total housing in the area are earth floors while some houses in the urban area are permanent with cement floors. The pattern of housing distribution on the other hand is determined by commercial activities with sparsely distributed housing being common in areas of low commercial potential while densely distributed housing being in areas with high commercial potential or in urban centres.

Land uses

Land use is the physical manifestation of socio-economic, cultural, political, and environmental forces shaping the use of land in a particular area. Land in urban areas is used for different purposes such as residential areas *(low, medium and high density areas)*, commercial and central areas *(offices, banks, market, shops etc)*, industrial *(factories and warehouse)*, public *(schools, hospitals, police, post office cemetery etc)*, semi-public *(church, mosque)*, circulation/infrastructure *(roads, railways, walkways, airstrips, bicycle tracks etc)* and recreational *(Park, play ground and open spaces)*.

However Lwakhakha town is relatively a small town and most of the town dwellers practice trade and commerce as a way of earning a living. Similarly the surrounding rural set up makes Lwakhakha an agricultural town, residents from the surrounding environs practice small scale agriculture and also rear livestock.

Land ownership in the town is mostly freehold and public land. Although Lwakhakha town Council has been planned for, it lacks basic infrastructure services such as the sewerage system.

- **Residential**

Housing pattern in Lwakhakha town does not give indication of social status of residents but most of the houses are for commercial purpose while most people operate from the rural areas. Residential land use however is the largest consumer of urban land among the various competing urban land use. The proportion covered can be between 50-60% of all total land available in an urban area.

- **Commercial**

Most trading activities in the study area are concentrated on the border of Lwakhakha town and Kenya. The main businesses in the town includes money changing, retail shops, bars and hotels, tailor shops, salons and barber shops, groceries and occasional open air market.

- **Industrial**

Lwakhakha town did not have any industry at the time of the study although most urban areas are characterized by industrial activities.

- **Agricultural**

Agriculture contributes a lot to the economy of those who live in the town and they have been depended much on the performance of agriculture for food production. Major part of agriculture in the town is rainfed, the variation in rainfall also influence the actual land use and vegetation cover available. However, presently a large percentage area of cultivation is on small scale production of banana and cereals such as maize, beans, sorghum, ground nuts and sweet potatoes.

Zoning of the study area

Lwakhakha town Council is zoned into six wards in order to manage the waste efficiently. The zones include Bukemo, Bumwoni, Bukhoma, Bukimayi, Bumwanga and Bumasyukha.

2.2 Physical conditions

Climatology

The relief and landforms surrounding Lwakhakha town particularly mount Elgon affect the climatic conditions of the Town and is favourable with adequate rainfall to support a large variety of agro production. The town is characterized by bimodal rainfall with long and short rains. The long rains start in March and continue to July while short rains start in August and continue to October. The mean annual rainfall varies from 1250mm to 1800mm. the rains are heaviest in April and May and most of it falls in the long rain season.

The seasonal distribution is about 1500- 2000mm during the first rains and about 430-1200mm during the second rains with 60% reliability. December and January have the least amount of rainfall. The mean annual temperature vary between 21.0c- 23.0c due to different levels of altitude. April to July tend to have lower temperature while December to February tend to have higher temperatures.

Geology and soils

Lwakhakha town council consists of land classified as agricultural with the soils showing considerable variation in fertility and drainage properties. The soil fertility is also influenced by erosion that has occurred in the town council over time. Soils of moderate to high fertility are confined largely to Northern part. Theses soils are well drained, deep and vary from dark red nitosoils and ferrasoils to dark brown acri soils. In the Eastern and Southern part of the town council, the soils are well drained, moderately deep to very deep. The soils here are reddish brown to yellowish brown. A long the river valleys, the soils are fairly shallow due to degradation.

Drainage basins

Lwakhakha town council has flat and hilly terrain while the altitude rises from about 1400m to 1800m above the sea level. However Lwakhakha town centre slopes towards river Lwakhakha which is the border between Uganda and Kenya. The town is at an altitude of about 1756m above the sea level from the council's office opposite the immigration offices and it is drained by river Lwakhakha, Namikhoma, and Bitonge River.

Vegetation cover

The original vegetation cover of Lwakhakha town council has been greatly interfered with by human activities. These activities include settlements, farming, infrastructure development and other urban activities. The observed vegetation cover includes a mixture of indigenous and exotic plant species. The bulk of the Town outside the business premises and residential areas was under agricultural ecosystems mainly subsistence farming while livestock identified within the town were cows, goats, donkeys and chicken.

2.3 Environmental conditions

Environmental conditions of Lwakhakha town are mainly influenced by poverty rates of the area surrounding the town. But of significance is the high population density which has exerted increasing pressure on the natural resources in the surrounding areas rendering their current rate of exploitation unsustainable.

There are various environmental issues that were identified in Lwakhakha town and its environs. The major environmental issues noted were solid waste management issues, degradation of the water resources, loss of vegetation cover, land degradation through soil erosion and air pollution from burning of wastes.

Although the town is experiencing loss of vegetation cover contributing significantly to water resources degradation, Solid waste management was identified as the most significant environmental problem within the town. Its collection and safe disposal is a major challenge to the town residents and the Town Council.

Poor disposal and burning of waste in various points vulnerable to storm drainage in the town are degrading the land, water and the soil resources. The problem is exacerbated by proximity of Lwakhakha River and the topography of the land which has a relatively high gradient.

CHAPTER 3.SITUATION ANALYSIS OF EXISTING SOLID WASTE MANAGEMENT SYSTEM

3.1 Waste characterization

The town Council of Lwakhakha is responsible for Solid Waste Management within its area of jurisdiction. The council endeavours to meet its goals of ridding off Lwakhakha town problems related to garbage collection and disposal that are exacerbated by haphazard disposal and flooding during the rainy seasons. To overcome the challenge of solid waste management in the town it is necessary to characterize and quantify the solid waste (SW) generated.

Waste generation

Wastes generated in Lwakhakha town are from various sources including: Household/domestic waste generated from residential areas and can be categorized mainly into

- Paper and cardboard,
- Plastics and organic fractions

The other source is commercial establishments which include waste from shops and other service providers (hotel, etc) and it is essentially composed of

- Packaging waste,
- Paper,
- Cardboards,
- Metals and organic waste from the markets

The town has several institutions such as private clinics, a secondary school, a primary school and government offices. The amount of waste and the composition are often more of paper waste. Although similar to household waste, some extra fractions of

- Paper,
- Glass and plastics were observed.

The medical wastes from private clinics present special challenges to management.

Waste segregation

Waste segregation in Lwakhakha town is significant to the local people and the Town council however the practice is nonexistent and it was observed during the study that waste is mixed up at the disposal site. The major waste components identified included but not limited to

- Plastics,
- Plastic paper,
- Paper,
- Glass,
- Metals,
- Wood and organic material mainly from banana waste.

Nonetheless if the waste is segregated, over 75% will be used as compost in farms hence reducing the waste to be released into the environment. Waste segregation is an important element in waste management and careful segregation (separation) of waste matter into different categories helps to minimize the quantities of hazardous waste.

There is need to collect waste at the source in each area and to separate it immediately where possible. The way that waste is sorted must reflect local disposal systems. The following categories are common sorting categories:

- Paper
- Glass (bottles)
- Plastics
- Scrap metal
- Compost
- Medical waste

Hazardous waste

Lwakhakha Town Council is predominantly agricultural and commercial centre without any industrial activities at the time of the study. However it was observed during the study that there are about three clinics in the town. These medical institutions produce wastes that require proper management because of their hazardous nature. Proper management practice therefore should ensure that biological hazardous wastes are collected, stored, transported and disposed off separately, preferably after treatment to make them harmless.

Medical waste treatment within Lwakhakha town council does not meet the required standards as the medical facilities do not have incinerators to burn their wastes. The waste is put in pit

latrines or burned by the waste generator. However there is need for the relevant stakeholders in consultation with the town council to device ways of safely disposing of the waste.

Quantities of waste generated

The Town Council of Lwakhakha is responsible for Solid Waste Management within Lwakhakha town. The Council is endeavouring to meet its goals of ridding the town off problems related to garbage collection and indiscriminate disposal that are influenced by storm drains during rainy seasons.

To support this work, it was necessary to characterize and quantify the solid waste generated in the Town. Quantification of the waste was based on the number of trips of waste collected from the street cleansing and the population of the town. The town council uses wheel barrows with an average 10 kgs loading capacity.

However, based on the population statistics, the town has an estimated population of about 5,200 people and by using a conservative waste generation rate of 0.5 kilograms/person/day, it is estimated that the current generation of waste in the core urban area of Lwakhakha town is about 2.6 ton/day growing to 12 tons/day by 2030. Thus it can be observed that very little of the 2.6 tons of waste generated daily is actually collected and dumped. All residential areas in the whole town are not served and only a small percentage of waste generated on the street are collected by the town council.

On the other hand, future amount of waste generation rates in the town may change depending on the economic growth of Lwakhakha town since is the major town that joins Uganda to Bungoma Kenya. If the major road joining the towns Mbale-Bungoma is tarmaced, trade is bound to grow at the border town and hence the population will rise as well as waste generated.

Waste generation projections

The current waste generation rates in Lwakhakha Town were projected over a period of twenty years within an interval of short term, medium term and long-term. The assumption for the projection is that in the long-term, most of the rural areas will be urban hence requiring solid waste collection and transportation. However the data is as indicated in section 4 of this report.

Waste characterization on the other hand was based on visual observation of the inorganic and organic fractions of the total waste generated. The results for the main generation areas show that about 75% of the waste generated is organic while about 25% is inorganic. The largest portions of the inorganic fraction were plastics and papers.

Waste disposal

Lwakhakha town does not have a proper area designated as waste disposal site, there is evidence of several haphazard disposal points behind the main street.

Figure 3-1: One of the points behind the main street used as community disposal point in Lwakhakha Town

Expenditures for Solid Waste Management

It was noted that the Town council is underfinanced and this has in turn hampered effective management of solid waste within Lwakhakha town with the resultant pollution of the environment. According to the town council engineer, only 0.1% of the total budget is committed to waste management and the largest portion is used to pay salaries. However it was noted that there is a new market which in future will lead to increased solid waste generation.

Figure 3-2: The new market expected to generate more waste in the future

3.2 Environmental and health impacts of Solid Waste Management in the study area

Open dumpsites is the main method of waste disposal in Lwakhakha town but this type of waste disposal method is associated with inadequate management of solid Waste material which are a potential risk to both the environment and or human health. The common problems associated with such waste disposal method is the existence of storm drains, open burning of the wastes, scavenging, inadequate containment of the wastes and improper handling of empty hazardous chemical containers. The risks of haphazard waste disposal methods although may not be immediately obvious, they can pollute the environment and pose human health risks. Nevertheless the environmental physical conditions including geology, climate, hydrology and ecological factors can exacerbate the rate of dispersion of pollutants into the environment.

Occupational health impacts

There are no waste pickers in Lwakhakha town but the group at risk is the general public due to indiscriminate disposal and burning of wastes. However the groups at high risk of improper solid waste handling practice normally include the waste workers, those living near the dumping site and the population living in areas of inadequate solid waste collection. The health impacts may occur from injuries due to sharp objects, direct contact with the toxic waste, inhalation of toxic air as a result of waste burning or presence of toxic chemicals in the waste.

Uncollected mounts of waste in the residential areas pose a health risk particularly to young children who were seen playing oblivious of the wastes.

Figure 3-3: Waste disposal and burning point at one of the clinics in the Town

Air pollution

Open waste burning is a common practice in Lwakhakha town Council by the households who do not receive waste collection services. However open unregulated burning has a damaging effect on the environment because wastes ought to be burned in an incinerator under controlled conditions so as to minimize most pollusive effects as a consequence of the process. On the other hand, without observation of such measures, incomplete burning of the wastes may cause release of pollutants which have human health effects. Emissions resulting from open burning and their associated health risks include: benzene (leukemia); toluene diisocyanate (asthma); nitrogen dioxides (lung damage); and nitrite compounds (metabolic poisons and carcinogens), formaldehyde, hydrochloric and sulphuric acid, hydrogen cyanide, polycyclic aromatic hydrocarbons, cadmium, lead, mercury and chromium. It has also been documented that Dioxins some of the pollutants associated with plastic burning are known to suppress the immune system, disrupt hormonal balances and promote carcinogenesis.

Storm water runoff

Most of the storm water from Lwakhakha town drains in River Lwakhakha and from observation, there were indications that discarded wastes behind the main street are washed

into the river that is down slope of the town. Storm water on the other hand poses a challenge in controlling solid waste dispersion into the environment especially where we have inadequate refuse management. The storm water can wash waste from the dumping sites, transfer station or uncollected waste on the streets whereas the drainage systems of most urban areas direct urban storm water and waste to the nearest water course. In addition, metals are produced when wastes are burned and are present in the ash produced and such dissolve in water and can react or are dispersed in the environment. Although Metal pollution may not be obvious, the effects can be felt after some time due to their ability to bioaccumulate in the biological systems.

Figure 3-4: Residue of waste carried by storm water from the disposal sites

Leachate

Open dumpsites is common practice in Lwakhakha town however they are characterized by luck of engineering measure, lack of leachate or discharge management, few if any operational measures such as registrations of users, control of the number of tipping fronts or type of wastes disposed or compaction of waste. The pollutants from the dumpsite can leach contaminating soil or ground water source. The vulnerability to disseminate the wastes is exacerbated by the physical conditions of the land including geology, hydrology and ecological factors.

In spite of the above, Lwakhakha town do not have a proper designated dumping site but some residents dispose there waste behind the main street in different dumping points indiscriminately. In addition, the town is located up slope of Lwakhakha River which poses a challenge to surface water pollution control. Therefore it is important that waste management within the town should be handled by care to reduce any deleterious effects that could occur especially during rainy seasons.

Aesthetic impacts of inadequate waste management

In Lwakhakha town, wheel barrows are used to collect and transport wastes from the street cleansing for disposal. However due to lack of a designated waste disposal point in the town, the waste is dumped indiscriminately. The waste particularly plastics are blown by the wind all over the place making it appear unsightly.

Figure 3-5: Haphazard waste disposal behind the main street of Lwakhakha Town

3.3 Solid Waste Management System in Lwakhakha Market

This section focuses on the solid waste management system in Lwakhakha Town Council which is responsible of waste management in the Town. The review will include the institutional framework, legal and policy framework, financing mechanism, technologies and stakeholders participation in waste management.

Institutional framework

There is a number of existing institutions that participate in Solid Waste management within local councils in Uganda and in regard to Lwakhakha town Council, the link between the various institutions is not clear. However they can be basically categorized in both public bodies (at national and local levels) and private sector. The public institutions concerned with Solid Waste Management at national level include:

- **Ministry of Water and Environment**

The ministry of water and environment is responsible for formulating the environmental policy and overseeing implementation of specific environmental programmes and strategies through the relevant departments.

The ministry through the minister ensures that

- There is improvement of the Government's policy in environmental protection;
- Through coordination with relevant ministries, establishes waste norms for all main sectors (water, industry, agriculture, tourism, energy, transport and other sectors), and monitoring the application of these norms;
- Approve investments in environmental protection projects, and monitoring their implementation;

- **Ministry of Local Government**

The Ministry of local government is responsible for all local Councils. The ministry is concerned with all aspects of managing the public services provided by the Councils, including solid waste management. The ministry has a number of responsibilities including:

- Formulating, overseeing implementation and improvement of the Government's policy in the local government's development sector.
- Assisting Local Councils in promoting solid waste management.
- Strengthening capacity for the provision and financing of urban infrastructure including Solid Waste Management.
- Encouraging private sector provision and delivery of urban infrastructure including Solid waste management.
- Monitoring achievements in Solid waste management using objective and verifiable indicators.
- The Ministry of Local Government has the responsibility of approving local councils planning and budgetary programme.

- **Ministry of Health**

The Ministry of Health is involved in the environmental legislation and regulations and in coordinating and defining strategies, programs and projects dealing with solid waste particularly medical wastes. It is responsible for controlling pollutions or public health issues such as waste in hospitals and clinics. It also has the following roles and responsibilities

- Improving the quality and effectiveness of public health and sanitation services such as waste handling and disposal
- Foster effective governance and partnerships in improving public health and sanitation services
- Responsible for the Management of medical wastes

- **The National Environmental Management Authority**

The National Environmental Management Authority is responsible for:

- Initiating the environmental policy and implementation of specific solid waste management programmes
- implementing and enforcing waste management policies and regulations
- Issuing and evaluating permits for institutions or organizations involved in activities linked to solid waste;
- Promotion of training, education, studies and research regarding the protection of the environment and the fight against pollution.
- Drawing-up an inventory of sources of pollution created by solid waste, and monitoring these sources including controlling trans-boundary pollution issues;
- Promoting public participation in solid waste management through awareness programmes
- Participating in the improvement of the strategy for solid waste management at the national level as well as the local levels.
- Participating in drawing-up regulations and domestication of international conventions dealing with solid waste management;
- Assisting industries and other waste generators in the elimination or reduction of pollution.

Although these are some of the roles and responsibilities of the National Environmental Management Authority, there are many challenges that impede the effectiveness of the authority particularly at the local level where understaffing and under financing is common.

- **Local Councils**

Lwakhakha town Councils is generally responsible for the provision of solid waste collection and disposal services. The town council is the legal owner of waste once it is collected or put out for collection. The responsibility for waste management is normally specified in byelaws and supplemented by regulations from other government agencies for instance National Environment Management Authority. Therefore Lwakhakha town Council has the obligation to enforce byelaws and regulations, and to mobilize the resources required for solid waste management. However this responsibility is in principle conferred upon it by the ministry of local government. Challenges often arise where the council authority to raise revenues is not commensurate with the responsibility for service provision. Besides solid waste management, local councils are also responsible for the provision of the entire range of infrastructure and social services. Needs and demands for solid waste management must therefore be weighed and addressed in the context of the needs and relative priorities in all sectors and services.

Solid waste management in the town falls within the department of public health in Lwakhakha town Council. It was observed during the study that solid waste service delivery in the town is below per as most residents burn their waste or dispose of haphazardly. In addition it was evident that the council does not have adequate equipments' to carry out their duties effectively neither do they have enough finances.

- **Private Sector Partnerships**

Private sector waste collectors are significant and can supplement Lwakhakha town council's capacity in solid waste management activities. They can either be contracted directly by individual households, neighbourhood associations, business establishments or by the town council. The private sector if contracted operates under contractual agreement with the town council. In this case, the council retains the responsibility for user fee collection. This arrangement ensures more equitable service access but if private enterprises depend on the direct collection of user charges they have little incentive to provide services in low-income areas where revenue potentials are weak.

However the partnerships between Lwakhakha Town Council and other agents (the private sector, NGOs and communities) to facilitate sharing of Solid waste Management responsibilities and financial burden are hardly there in spite of such relationship's significance. There are barely any deliberate and active processes of collaborative action between stakeholders. It was noted during the study that the council is barely two years old since inception and due to more urgent needs other than solid waste, the concept had not been given thought.

Legal and policy framework

Both international instruments and the Ugandan constitution 1995 in article 39, emphasis the right to a clean and healthy environment through management of substances that may pollute the environment or cause harm to human health.

Solid waste management is critical in environmental management because of its potential to cause pollution if not well managed. In response to international best practice as well as the constitutional requirement, there are many legislative instruments that have been formulated to assist in the management of solid waste. This section assesses the existing Solid waste management policies and legislative framework, economic tools and enforcement mechanisms.

The legal instruments span over a number of institutions with each having different mandate, approach and regulations of resource management. The section in particular concentrate on reviewing the legislative impacts of waste management levels from waste generation, reduction, segregation, storage, collection, transportation, disposal, treatment through to waste dispersal and environmental management.

However of significance in our review is the National Environmental Act, Cap 153 which is an Act of parliament that sets out general environmental management and coordination among various stakeholders in Uganda. The act establishes an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. In spite of this, there are several subsidiary legislations that have been formulated to supplement the implementation of the act.

Waste generation and reduction

Solid waste and hazardous substances management or processes are some of the environmental aspects addressed in the National Environmental Act, Cap 153 in Sections 51 to section 65. Section 52 of this Act, stipulates that every person whose activities generate wastes shall employ measures essential to minimize wastes through practices such as waste treatment, reclamation and recycling. Even with such provisions the town has no programs or incentives for material recovery/recycling involving stakeholders.

In the subsidiary legislation “The National Environmental (waste Management) Regulations, S.I N0 52/1999” in section 4 subsection (4 and 5), the responsibilities of the waste generator are set out. But the residents rarely observe this as waste is indiscriminately scattered behind the shops. However it is not possible to enforce this law because the town council do not have a mechanism of establishing the really culprit while at the same time it contributes to the same by failing to provide solid waste management services to the town.

The act on the other hand stipulates that it is a criminal offence if one does not adhere to the set out standards as the law requires in part XIII of the National Environmental Act, Cap 153.

- **Waste segregation**

The National Environmental (waste Management) Regulations, S.I N0 52/1999" section 4(4) requires that waste generated should be sorted or segregate by separating hazardous waste from non-hazardous waste and dispose off in such facility as is provided for by the relevant Licensed authorities.

Even though the law advocates for segregation, it was observed in the study area that waste were mixed with both organic and inorganic matter together. The organic matter made up the highest percentage of the waste and though some residents showed willingness of using the organic matter, they could not take it due to mixing with plastics and other inorganic matters in the garbage. This is an indication that with proper separation of the matter, the bulkiness of the waste can be reduced as most organic matter can be used by farmers who live near the town.

- **Waste storage and the transfer stations**

The National Environmental (waste Management) Regulations, S.I N0 52/1999 in section 6 provide for storage of waste and the conditions of such facility but it is not very clear. Although it further emphasizes the need to acquire a license for waste storage, it is not explicit on the conditions that should be met or observed by the licensee.

- **Waste collection**

Through the Local Government Act (Cap 243 of Laws of Uganda) which establishes and governs Local Authorities, powers and functions of the Authorities are spelled out. And of significance among most functions undertaken by local authorities is the provision of public services in garbage collection. However in light of this, uncollected waste by the town council is common in the commercial and residential areas where it is generated. Due to poor dumping practice in the town, waste is blown about by the wind and washed by storm water to the nearby river Lwakhakha.

Although residents of the study area are entitled to waste collection and management, often the council is not capable of collecting waste as it should be. Most parts of the commercial and residential areas experience a lot of uncollected waste that has led to household burning of wastes. But such open burning pose a health challenge to the residence especially the children.

- **Waste transportation**

Waste transportation is one of the areas that is most regulated by the National Environmental (waste Management) Regulations, S.I N0 52/1999. The regulations in section 6 and 7 prohibit transportation of waste without a waste transportation license or to an unlicensed disposal site. In fact prior to transportation of any waste one has to apply to the environmental management authority to be granted an appropriate license (section 6 (1)).

However refuse transportation is nonexistent in the study area, other than the use of wheelbarrows to carry waste from street cleansing to the disposal points but the rest of the town does not have the services.

- **Waste disposal**

Waste disposal should be treated with care such that any waste whether generated within or outside Uganda should be disposed in a manner that does not cause pollution to the environment or ill health (National Environmental Act, Cap 153, section 52-2). And that the disposal should be in accordance to the law (National Environmental (waste Management) Regulations, S.I N0 52/1999 in section 16). In fact prior to operation of such a facility one has to apply in writing to the environmental management authority to be granted an appropriate license (National Environmental (waste Management) Regulations, S.I N0 52/1999" in section 13 and 14).

If granted a license, the environmental management authority expects the applicant to ensure that such waste disposal site or plant is at least more than 1 Km from residential areas, commercial area or water sources (National Environmental (waste Management) Regulations, S.I N0 52/1999" in section 14 sub-section 3a).

However in the study area, it was observed that there is no proper waste disposal facility and waste is poorly managed. The lack of waste management facilities encourages indiscriminate dumping of hazardous wastes such as medical waste as was the case. But to discourage such illegal dumping, the town council should establish a central place where all waste particularly medical wastes are treated before being disposed. The town requires a dumping site that meets environmental standards so as to properly manage the waste and reduce environmental pollution runoff or leachates. The current disposal areas are not within the required distance of waste disposal sites as they are less than 1000m from the residential, commercial and the water source (river Lwakhakha).

- **Waste treatment**

This refers to legal instruments that control the treatment of waste or pollutants so as to reduce their impacts to the environment or natural resources. According to the National Environmental

(waste Management) Regulations, S.I N0 52/1999 in section 12, it is upon any industry or factory to treat any waste generated due to its activities. Any person intending to treat waste must acquire a license from the environment authority to treat such wastes. Although the law requires that factories and industries treat their wastes, it leaves loopholes for individual waste generators whose activities can only be punished if there is evidence of environmental degradation.

Household open burning of waste is a common waste treatment practiced in Lwakhakha town. Burning reduces waste volumes but the practice is associated with emission of pollutant gases and toxic residues that require proper disposal. However it is beyond this study to empirically establish impacts of such residues after dispersal in the environment, but it is certain that toxic elements from the burning residue are dispersed in the environment. For instance it has been highlighted above that the town council do not have waste disposal site, therefore the poorly burned waste as well as medical waste could have deleterious impact on the environment after dispersion.

- **Economic tools for waste management**

There are several provisions for relevant economic instruments to address different aspects of solid waste management chain in quite a number of legislations. There are those that advocate for the employment of financial disincentives (fine, levy, surcharges and penalty) for non-compliance governing the proper management of solid waste while on the other hand, economic incentives such as subsidies, tax rebates and exercise waiver encourage investment in proper waste management facilities. However more often than not, the economic instruments are of disincentives nature with few if any of the economic incentives particularly for those involved in best solid waste management practices.

- **Solid waste legislative enforcement mechanisms**

The enforcement of the provisions governing the management of solid waste is done mainly by the National Environmental Management Authority and the Local councils. In spite of this, the field survey indicated that the enforcement process is faced by challenges which included inadequate financial resources, personnel and overwhelming cases of non-compliance with the set standards. Both the environmental management Authority and the town council of Lwakhakha have few officers and find it difficult to inspect as required by the law.

Financing of Solid Waste Management

The waste management is taken care of by local government through its own budgetary resources. However, with rapid increase in waste generation rates and awareness for effective and efficient solid waste management practices to protect public health and environment the

demands for huge investments, to bring improvements in many aspects of the solid waste management chain is rising. This has led to many governments to adopt various financing modes. Some of the widely practiced as suggested in the United Nations Environmental Programmes (UNEP) Integrated solid waste management training manual are as follows:

- **User charges**

Due to inadequate funds in most local authorities, the concept of cost sharing in order to increase funds available for service delivery was introduced. User charges in regard to solid waste collection, transportation and disposal services are being rolled out in many local authorities. However they are still non-existent in Lwakhakha Town council but elsewhere the charges are increasingly assisting in subsidizing the costs of solid waste management in accordance with the polluter's pay principle. The charges also motivate waste generators to reduce the wastes in addition to financing the waste management activities. For the case of Lwakhakha town council, such fees although not yet introduced, it was reported during one of the field meeting that the officials were considering introducing the same in future after public awareness campaigns on solid waste management are held.

- **Penalty, fine and levy**

There exist a number of provisions for relevant economic instruments to address different aspects of solid waste management chain in several legislations. Such provisions advocate for the employment of financial disincentives for non-compliance with the provisions governing the proper management of solid waste. The revenue earned from such instruments is a significant financing mechanism for local authorities to finance solid waste management activities. However in Lwakhakha town council, the instruments are not used and at the time of the study, town council did not have solid waste management byelaws or regulations.

- **Environmental Funds**

In spite of several opportunities, the Lwakhakha town council has not yet made any initiative to acquire funds from other sources for the waste management activities in the town. There can be fixed or revolving fund set aside to assist local governments in meeting their financing needs for environmental infrastructure and services. The fund may be financed through various modes including national bonds, annual budget, loans from international financing institutions and international cooperation.

- **Direct loans and international cooperation**

Local governments may take direct loans either from domestic or international financing institutions. The loans may be used to develop solid waste management facilities but in spite of

this, it is very rare for local authorities to take loans in Uganda to finance such activities. However on the increase is the trend of direct multilateral and bilateral cooperation with local governments. International agencies for example UNEP, Habitat or UNDP provide support to local governments to improve the local environment. Various bilateral initiatives are assisting local governments to seek assistance for financing their development projects which may include solid waste management.

Even though, there are no such initiatives in Lwakhakha town Council with waste management efforts depending on internal financing mechanisms.

- **Local authority budget and Central Government grants**

Local authority budget and central government grants are still major sources to financing environmental infrastructure and services. Local authorities obtain their revenues from a variety of sources such as taxes, fines, and license fees. Such general revenues are used to finance costs associated with service delivery and other overheads. Since the revenues in most cases are insufficient to cover the costs for solid waste services, grants or subsidies from the central government are used to supplement local revenues.

Lwakhakha Town Council receives grants from the central government to finance their activities and supplement this with revenue collections. However the allocation towards solid waste management activities in the Council is inadequate and does not meet refuse management requirements of the county council.

- **Private Sector participation**

The provision of solid waste management services is a costly and cumbersome venture for many local authorities throughout the world. The level of cost and degree of difficulty associated with the service provides an opportunity for participation of the private sector. The private sector plays a key role in increasing the efficiency of the service and to provide the much needed resources to fund projects required in improving effectiveness in solid waste management. However this will only work well if there is a high efficiency in recovering the costs of service through the implementation of user charges. The local authority in this arrangement retains the power to oversee the private firms' activities and collection of the fund.

Despite the incentives of private sector participation in solid waste management Lwakhakha Town council is yet to engage any of such services.

Solid Waste Management Technology

- **Primary collection and transfer stations**

Solid waste collection and transfer is a very important function and is an integral part of integrated solid waste management programs. Its significance is due to the fact that waste collection is one of the most visible public services and failure in the collection system is reflected by anaesthetic conditions that can be seen in the streets and drainage structures throughout the town.

Lwakhakha town council is responsible of waste management in the town however household collection of waste is hardly ever provided for by the Town council but instead ensures cleansing of the street. It is upon each household or business premise to convey the refuse from point of generation to disposal points of one's convenience as designated disposal site is not provided for.

It was noted during the study that only waste from sweeping of the streets is collected by wheelbarrows and disposed at a designated point behind the street. In spite of this, the disposal is below per and the waste was vulnerable to wind and storm runoff. The refuse is also vulnerable to scatter by scavenging animals such as cats, dogs, goats and cows. In fact disposal points were witnessed in several areas where waste is burned presenting a potential public health risk to residents. According to one of the residents a companying the study team, inadequate waste collection equipments, staff and finances or strategy from the town council was cited as the main challenges to proper waste management.

Both residents and the county council do not have bins for waste collection while all types of waste were mixed up with hardly any separation on the street.

- **Transportation**

Wheelbarrows are used to transport waste from cleansing of the street to the temporal disposal points. Otherwise waste generated by households or commercial premises are disposed by the generators.

- **Treatment**

Solid waste treatment refers to activities that reduce the effects of refuse to the environment through processes such as waste separation, incineration, decomposing or burning. According to observations made in Lwakhakha town, there is no waste treatment process prior to waste disposal. Wastes were mixed up and burned occasionally but of significance is the medical wastes generated in the town which is not disposed properly. It was observed that some of the medical facilities put the waste in pit latrines or burn within the compounds that double up as residential areas.

- **Disposal**

Waste disposal lies at the core of the towns solid waste management as refuse disposal remains a problem to the environment not only in Lwakhakha town council but in most towns in Uganda. It was observed during the study that the town does not have a permanent waste disposal site which has led to households and business premises disposing off waste indiscriminately in the town.

Although the Town council collects waste from the streets, it was noted that the collected refuse is inadequately dumped behind the street since the town lack proper waste disposal site. However it was reported by the town engineer that, the council had made attempts to acquire land for sitting a disposal facility but due to procurement rules in Uganda it was not possible to get land as most land owners do not have titles.

- **Refuse recycling and recovery**

Although recycling recovers materials by preventing the same from being disposed, solid waste recycling process is rarely done in Lwakhakha town Council. However it was noted that over 90% of the waste is of organic nature and the town's surrounding communities are farmers and there is potential for organic farming.

Stakeholders participation in waste management

- **Waste generators**

Waste generator refers to any person, by site, whose activities or process produces waste products and this could be from many different types of businesses, industries, government agencies, and institutions. Waste generators can generically be categorized as large generators who usually tend to be manufacturers of various products or small generators who are most often in service-oriented businesses or households. Waste generators in Lwakhakha include households, open air market and commercial premises including shops, hotels and bars. The waste generator on the other hand has a duty to ensure that all wastes are transported and disposed in accordance with the law. However due to poor public awareness and inadequate understanding of the law, many urban areas in Uganda suffer from non-participation of waste generators in solid waste management processes and Lwakhakha town Council is not an exception. There is low public participation in solid waste management best practice in the town a fact attributed to most residents not being aware of their rights, roles or responsibilities.

It was further observed during the study that the waste generated is generally mixed with hardly any segregation at household levels and the same applied to other commercial premises.

- **Service providers**

Local authorities are generally responsible for the provision of solid waste collection and disposal services. In addition, the town council has the role of collecting levies for services provision.

For the case of Lwakhakha town, the Town council has the sole role of providing solid waste management activities from collection to disposal. Nevertheless the council does not have enough capacity to adequately deliver the services and it was reported that only waste from the street receive such services. The residents of the town have resorted to indiscriminately disposing off the waste within their compounds where the waste is burned. However it was observed that the burning is done in a haphazard manner living the burned residue and other waste exposed to dispersal into the environment, with river Lwakhakha being the most affected in particular.

- **Regulators**

Lwakhakha town council has a duty of enforcing all waste regulations in the town which define stakeholders' roles and responsibilities in solid waste management. The Town council ought to ensure that rules and regulations are adhered to by the actors but due to several challenges such as understaffing and underfunding, it has not been easy to deliver. In addition, it emerged that solid waste management is not perceived as a problem for now since the town is only two years old since inception in 2008, other issues are given more priority and attention.

- **Other Institutions**

Lwakhakha town is relatively small and hence does not have the incentives to attract other profit making waste management institutions such as recycling organizations, Non Governmental Organizations (NGOs) or any other private enterprises.

3.4 Conclusion

The town has no proper designated solid waste disposal point and the waste is indiscriminately dumped and burned by the local residents. It was also observed that the current waste disposal point is less than 1000m from residential area, commercial area and water source (river Lwakhakha) contrary to environmental provisions that requires disposal areas to be over 1000 meters from sensitive receptors such as water bodies.

However the council had plans to buy land but most people do not have titles as required by the procurement rules in Uganda which has made it impossible to acquire waste disposal land. The council is both understaffed and under financed to effectively manage the wastes making it cumbersome to have the necessary equipments for solid waste management. This in part has

been attributed to the council being relatively new and there are more pressing needs than solid waste management.

Nonetheless, most of the waste generated is organic an indication that it can be recycled as organic manure to reduce waste volumes significantly but there is no waste separations. It was also noted that the council has a new market which is expected to generate waste that will require regular disposal services and the waste will be better managed if the council will have the necessary tools and equipments.

CHAPTER 4.FORMULATION OF THE SOLID WASTE MANAGEMENT PLAN

4.1 Introduction

This chapter presents the formulation of the solid waste plan for Lwakhakha Town Council. It describes the population and the solid waste generation for the entire plan period and the development of the technical aspects of the plan. It also describes the entry point of the private sector participation and community involvement in the management of solid waste in the Council. In addition, this chapter presents the implementation plan of the solid waste strategy, the proposed sources of fund and the project costs for the entire period of the plan. It is worth noting that such a plan requires review after a predetermined period which this chapter also presents.

4.2 Population projection

Population census data

The estimated population for the entire Lwakakha town council stands at 13,000 people whereas the core urban centre has an approximate population of 5,200 people. In the short term, the solid waste plan intends to serve the core urban, (2012 – 2017), afterwards, the entire town council will be served.

Table 4-1: Estimated Population of Lwakhakha Town Council

Year	2011
Population	13,000

Available information indicates that the population growth rate is estimated at 3%.

Population projections

Based on the past population, the population projections were carried out using the following formula.

$$P_t = P[1 + r\%]^n$$

Where:

Pt = Population at time, t, in the future.
P = Present population
r = Population growth rate
n = Duration

The table below gives the population projections for a period of twenty (20) years with the initial year 2012, future years 2017, 2022, 2027 and 2032.

Table 4-2: Population Projections for the years 2012 – 2032 for Lwakhakha Town Council

Year	2012	2017	2022	2027	2032
Resident Population	5,356	6,209	17,995	20,861	24,184

From 2012 – 2017, the population to be served by plan is the core urban, but for the years 2022 – 2032, the entire town council is expected to be served.

4.3 Future waste projections

Assumptions in the projection of future waste generation

- **Domestic / Residential Waste**

These types of waste originate from single or multifamily household units. The wastes are generated from household activities including but not limited to cooking, cleaning, repairs, redecoration, empty containers, used packets, old clothes, books, papers, broken glass, plastic items, broken and useless furniture.

Based on field survey conducted in the study area, a conservative figure of 0.5kg/capita/day of waste generation is used in the estimation of the waste.

- **Commercial Waste (Hotels, Bars, Restaurants, Wholesale & Retail Shops, Small Shops, etc)**

This category includes solid wastes that originate in offices, shops and retail markets, hotels and other commercial establishments.

The waste is projected based on the commercial developments within the town council. The projected waste generation from commercial establishments is conservatively taken as 25% of the household / domestic waste.

- **Medical Waste**

Medical waste refers to waste generated by health care activities including a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials. And according to WHO, the approximate medical waste generated per person per year is about 0.5kg.

- **Market Waste**

The market waste generation will increase based on the increase in population. Presently, Lwakhakha Town has one open air market which operates on a daily basis. A new modern market is under construction and is due for completion soon.

- **Road Waste**

Road waste is generated from residences and establishments. For estimation purposes, road waste generated is computed based on the length of the road network in the Town Council.

Projection of waste amount generation

Based on the assumptions above, the following wastes are generated in the Lwakhakha Town Council.

Table 4-3: Projection of the Total Waste Generation in Lwakhakha Town Council, (Tons/Day)

Waste Characterization	2012	2017	2022	2027	2032
Residential Waste	2.6	3.0	9.0	10.5	12.0
Markets Waste	0.6	0.7	2.3	2.6	3.0
Commercial Waste	0.6	0.7	2.3	2.6	3.0
Medical Waste	0.007	0.009	0.025	0.029	0.033
Total	3.807	4.409	13.625	15.729	18.807

4.4 Development and evaluation of technical aspects

Collection and transportation plan

- **Proposed Collection System**

Lwakhakha town is small but relatively busy due to the cross border transactions. With huge transactions taking place in the town, we expect the generation of solid waste on daily basis to be on the rising trend. This requires very effective and efficient method of waste collection and disposal.

At the household level the plan proposes individuals to have a waste disposal dust bin. They will then carry the dustbins to the skip loaders when they are full.

We propose the use of skip loader and skip loader tractor of carrying capacity 5 tons for ease of movement and the amount of waste generated.

Based on the future waste projections and new technologies, the following are the proposed waste collection system.

Table 4-4: Proposed Waste Collection System for Lwakhakha Uganda

Zone	Collection area	Collection Method	Frequency of Collection	Responsible collector.
Zone 1-3	Middle to Low Income	Skip Loader	Once per week	Town Council
	Informal Settlements	Skip Loader	Twice per week	Town Council
	Commercial areas and Streets/Roads	Litter Bins	Daily	Town Council
	Markets	Skip Loader	Daily	Town Council

- **Waste Management Tools and Equipment**

Basic tools and equipment like wheelbarrows for street sweeping, sweeping brooms, shovel/spade, hand gloves, rakes etc shall be required for effective solid waste management.

- **Proposed Collection Skips and Skip Loader**

	Short-Term (2012 – 2017)	Medium – Term (2017 – 2022)	Long –Term (2022 – 2032)
Area of the Municipality	Required No. of Skips		
Market	1	1	1
Residential Market	3	3	4
Commercial Centre	2	2	3
Required Skip Loader Tractor			
Market	1	1	1
Residential Market			
Commercial Centre			
Supervision Vehicle	One Pickup	One Pickup	One Pickup

The assumptions made for the proposed collection system are:

5. The lifespan of a collection tractor is approximately 10 years.
6. Each of the collection tractors will make at least three (3) trips per day to the disposal site.

The figures below give illustrations of a skip loader.

Figure 4-1: Skip Loader full of Solid Waste

Waste disposal site

Currently, crude dumping of waste is being exercised within the township. The proposed system of waste disposal requires that the Council acquires land for future waste disposal site. This site will translate from a controlled dumping site to a landfill in the future.

To manage controlled dumping of solid waste, the Town Council should make arrangement with Ministry of Works on monthly basis to have a Shovel / Dozer for spreading of soil layer and compaction of the dumped solid waste. This requires that the Town council manages the dumping in an orderly manner.

Table 4-5: Method of Disposal and Activities during the Plan Period

Method of Disposal	Short Term 2012-2017	Medium term 2017-2022	Long Term 2022-2032
	Activities during the Plan period		
Develop controlled dumping	Acquire 5 acre piece of land for solid waste dumping and fence. Also undertake controlled dumping and composting		
Controlled dumping and composting		Continue to track collection and disposal of waste, maintain scheduled monitoring of the controlled dumping and composting.	

The figures below illustrate a composting site.

Figure 4-2: Typical Arrangement of a Composting Site

By-Laws on Solid Waste

Lwakhakha Town Council should develop Byelaws to regulate the management of solid waste within the jurisdictions of the town council.

Wastes requiring special attention

The following wastes should be collected and disposed off separately and away from the rest of the solid waste stream within the town council.

- **Medical Waste**

Medical institutions produce wastes that require proper management because of their hazardous nature. However medical waste treatment and disposal within Lwakhakha town council does not meet the required standards as most medical facilities do not have incinerators to burn their wastes. The private clinics indiscriminately burn the wastes without due procedure or dispose in pit latrine a situation which poses a challenge to water quality management for both surface and ground sources.

Therefore the solid waste management plan proposes establishment of a central place where all medical wastes are treated before being disposed. The fee paid at the facility can help maintain it and making it easier to monitor its operations.

The figures below illustrate a medical waste incinerator.

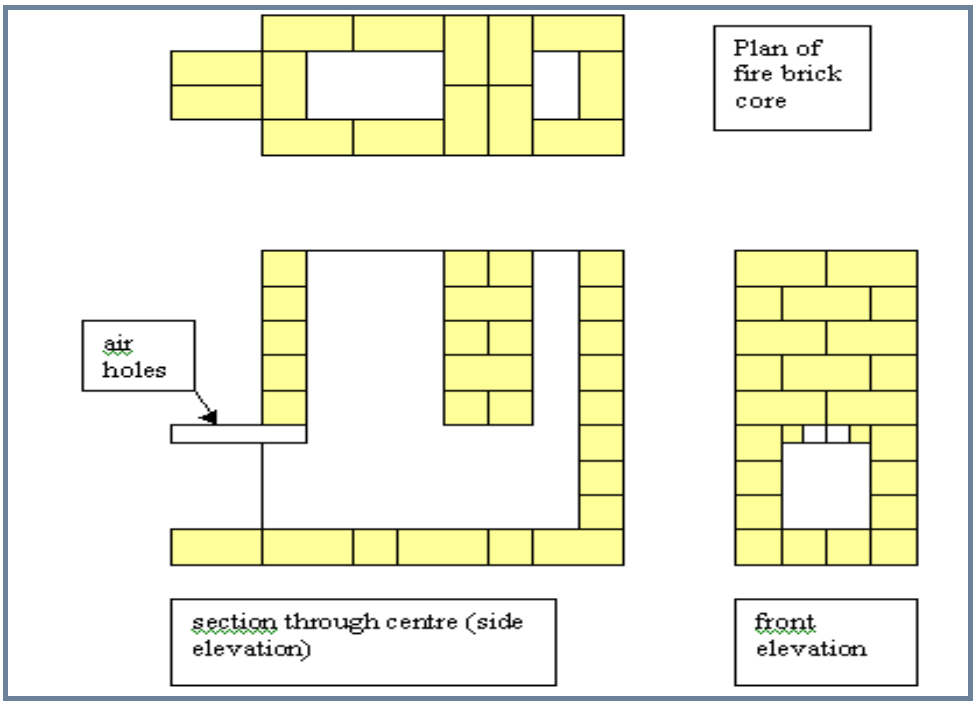


Figure 4-3: Typical Section of an Incinerator

The size of the incinerator depends on the scale of medical waste generated.

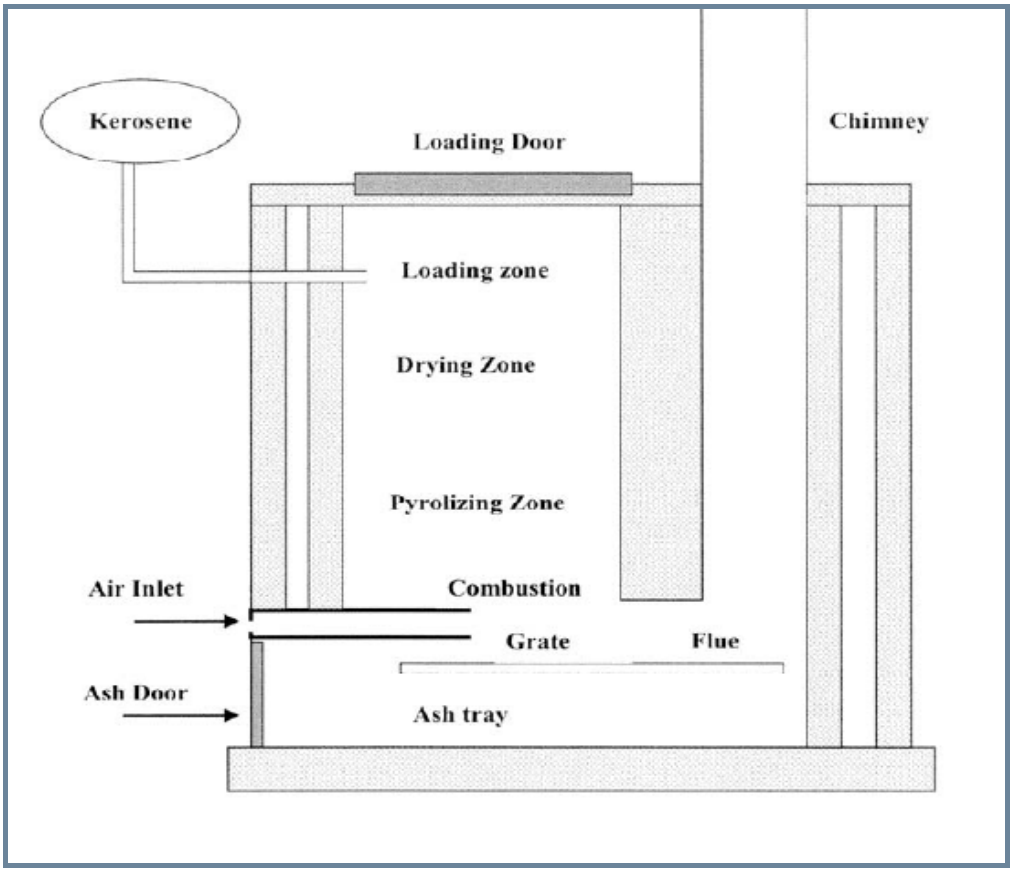


Figure 4-4: Description of Incinerator Areas

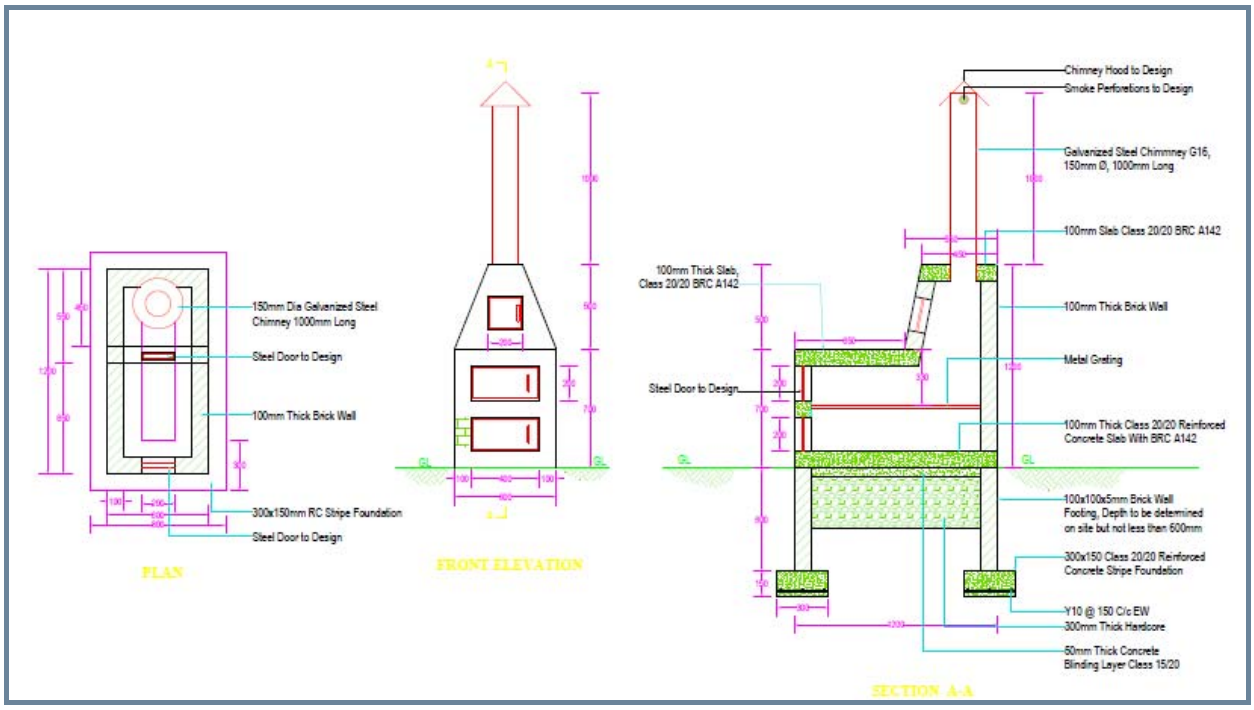


Figure 4-5: General Appearance of an Incinerator that can be enlarged to fit the scale of the medical waste

Office space and equipment

To be able to manage the solid waste efficiently, the Town council requires a solid waste administration office in the town and at the dumping site.

The following offices are and staff is proposed for the zonal solid waste management.

Table 4-6: Proposed administrative Offices, Staffing and Supervision Equipment

Zone / Disposal Site	Size of Office	Supervision Vehicle	Proposed Staff
Ward 1-6	1 No. Area – 2.5 x 3m ($7.5m^2$)	One Pick Up	· 3 No. Supervisors · 2 No. drivers · 2 No. Backsmen for the drivers · 20 No. street sweepers
Disposal Site	1 No. Area – 2.5 x 3m ($7.5m^2$)		· 1 No. Supervisor · 1 No. Watchmen · 1 No. unskilled labourers

Waste Recycling and Reuse

Through public campaigns, recycling and reuse of waste should be encouraged particularly at the household level or should be recovered at the source/point of generation. Where such has not been done, it should be during transportation stage or at the disposal site. The earlier the

waste materials are separated, the cleaner the recovered material and the higher the quality as well as value to the end users.

We propose the following solid waste to be recycled and used.

- Glass
- Plastics
- Paper
- Scrap metal
- Organic matter for composting.

Private firms who use the recyclable materials as raw materials for their industry are located at Mbale and the materials shall be transported once per month to Mbale. Also it is recommended that solid waste management can be packaged and registered under the Climate Change Fund as a Clean Development Mechanism Project.

4.5 Private sector involvement in Solid Waste Management

Private sector waste collectors are significant and often supplement the local authority's capacity in solid waste management activities. However the partnerships between Lwakhakha town Council and the private sector to facilitate sharing of Solid waste Management responsibilities and financial burden are hardly there in spite of such relationship's significance. The private sector involvement can either be through direct contract by individual households, neighbourhood associations, business establishments or by the Council.

This plan proposes service contract partnership where the private firm provides solid waste management services and the Town council pays the firms for the services delivered. The private firms will operate under contractual agreement with the Town Council where the Council retains the responsibility for user fee collection.

However in the process of procuring these services, several factors should be considered including the contract duration that should be sufficient enough for the investor to have returns on the investment. Five year period is proposed as being sufficient as it is reasonable enough and in addition to encourage other service providers to participate in the exercise by reducing the risk of monopoly. The tendering and procurement process should also be competitive throughout the process. Nonetheless it is not advisable to entrust the services to the private sector from the initial phase but the process should be implemented gradually.

In general, the town council with other stakeholders should agree on the zoning of the council where each zone will have a private operator who will collect the waste on a daily or twice a week basis based on the amount of waste generated in the zone and ensure that the waste

are packaged in the labelled bags at the skip loader location. The performance of the private operators will be gauged based on the efficiency of the waste collection and the waste separation both at the skip loader location. The private operators will then invoice the council on a monthly basis.

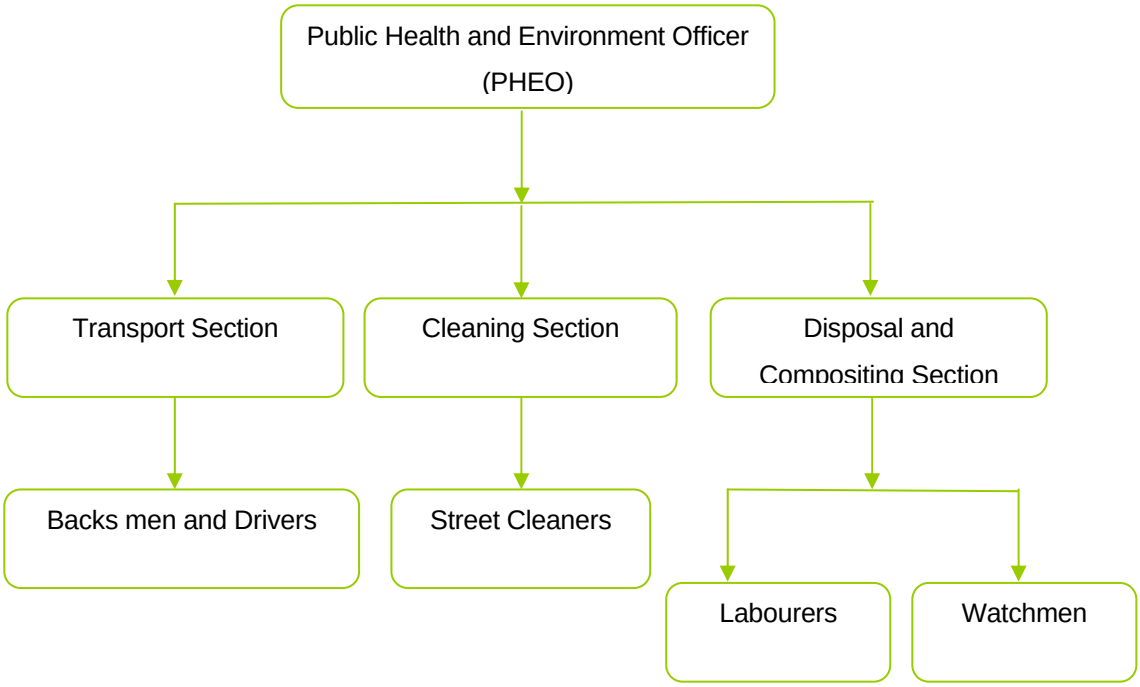
The private operator together with the town council will decide the best location of the skip loaders in relation to the source of the waste and easy loading by the skip loading trucks.

4.6 Community participation

Community participation in solid waste management in Lwakhakha town is significant in strengthening coordination between the town council, waste generators and community based organization. During the short-term period it is proposed that mass campaign should be done to raise awareness of the people. The campaign is aimed at getting the cooperation and participation of the public in solid waste management in the town. It will target waste separation by households, waste reduction by composting, provision of bins for recyclable materials.

The Town council will regulate and monitor the operations of the private waste collectors and the CBO's and ensure that there is a fair competition in the market for all involved parties.

4.7 Organisational Structure and Staffing



4.8 Implementation Plan

Table 4-7: Implementation Plan for the Solid Waste

ACTIVITY	SHORT TERM 2012-2017	MEDIUM TERM 2017-2022	LONG TERM 2022-2032
COLLECTION AND TRANSPORTATION			
Formulation of the collection and transportation system			
Monitoring of the collection and transportation system			
Procurement of the collection vehicles			
SETTING UP OF ZONAL OFFICES			
Setting up of Offices			
Maintaining the Offices			
DISPOSAL SITE PLAN			
Setting up a composting site			
Maintaining the disposal site			
Construction of Incinerator			
ORGANISATIONAL RESTRUCTURING OF THE ENGINEERING DEPARTMENT OF THE COUNTY COUNCIL			
Staffing of the zonal offices			
Training of the Staff			
Production of the Operational Manuals			
LEGAL FRAMEWORK			
Formulation and enforcing of the By-laws			
FINANCIAL MANAGEMENT			
Setting up of waste charging system			
Review of the charging fees			
PRIVATE SECTOR PARTICIPATION			
Public Awareness of Private Operators			
Training of the Private Operators			
COMMUNITY PARTICIPATION PROMOTION PLAN			
Public awareness of CBO's			
Training of CBO's			

4.9 Source of funds

There are no specific funds set aside in the town council or the ministry of local government for the management of solid waste. Possible sources of funds for the establishment of a strong solid waste section, construction of facilities and operations of the section may include but not limited to:

a. Central Government
b. User charges (flat and graded rate). A low rate for a basic amount of garbage and a higher rate for huge garbage generation
c. Sourcing for grants through writing of proposals to funding institutions

4.10 Review of the plan

The private operators, the CBO's and the town council will be reporting on a daily , weekly, monthly, quarterly and annually on the challenges and the implementation of solid waste plan. This will translate to a review of the solid waste plan once in every two years. This review will dictate how the future implementation of the plan.

4.11 Project cost

The project cost for the proposed solid waste management plan for Lwakhaka, (UG) Town Council is as shown below.

Table 4-8: Project Cost for Lwakhakha Town Council Solid Waste Management Plan, USD

Project Cost component	Short Term 2012 - 2017	Medium Term 2017 -2022	Long Term 2022-2032
Capital Cost	573,378	214,200	642,083
Operation and Maintenance	163,333	199,333	372,667
Total Cost	736,711	413,533	1,014,750

REFERENCES

http://www.nemaug.org/environment_regulations.php accessed on 25th May 2011.

GoK: *Feasibility study on solid waste management in Kitale, Bungoma, kakamega and Busia*.

GoK 2010: *Preparatory Survey for Integrated Solid Waste management in the Republic of Kenya*

GoK 2009: Kenya Local Government Reform Program Local Authority Service Delivery Tools Manual *8 Solid Waste Management*

GoU 2008: *Tororo district local government Malaba town council Consultancy services for the Development of a comprehensive Stormwater drainage master plan for Malaba town council, Uganda Draft design report June 2008.*

UNEP 2009: *Developing integrated Solid waste Management plan Training manual Volume 1:* Waste characterization and Quantification with projections for future.

UNEP 2009: Developing integrated Solid waste Management plan Training manual Volume 2: Assessment of Current Waste Management System and Gaps therein

Beck R. W. 2006: *Solid Waste Management Plan state of Georgia*

Jefferson County Solid Waste Management Plan, Final Draft 2000

World Bank (1999): *What a waste: Solid waste management in Asia, Urban Development Sector, Unit East Asia and Pacific Region*, World Bank Washington, D.C USA

APPENDIX A: PROJECT COST BREAKDOWN

LWAKHAKHA UGANDA SOLID WASTE MANAGEMENT PLAN - CAPITAL COST												
			Short-Term (2012 - 2017)			Medium-Term (2017 - 2022)			Long-Term (2022 - 2032)			
Stage of Waste Management	Facilities, Activities / Equipment Required	Unit	Rate	Quantity	Estimated Amount	Rate	Quantity	Estimated Amount	Rate	Quantity	Estimated Amount
			USD		USD	USD		USD	USD		USD
Start up Stage	Community Cleaning - Tools and labour required for two days cleaning - only the core centre	Item	Sum	1	2,778						
	One weeks Senistization Programme on the Solid Waste Management Plan	Item	Sum	1	1,667						
Collection and Transportation	Litter Bins	No	647	15	9,706	833	20	16,667	1,111	25	27,778
	Skip Loaders	No	7,647	6	45,882	8,333	6	50,000	8,889	6	53,333
	Skip loader Tractors	No	141,176	1	141,176				166,667	1	166,667
Disposal Site	Purchase of Disposal and composting site	Acres	5647	5	28,235						
	Fencing of the Disposal Site	m	10	1200	12,000				6	1200	6,667
	Hire of Shovel	Days	329	52	17,129	489	52	25,422	578	52	30,044
Construction of Incinerator	Incinerator	Nr	8,824	1	8,824						
Administration and supervision	Supervision Office(s)	No	1,324	1	1,324						
	Disposal site office	No	1,324	1	1,324						
	Supervision vehicles	No	50,000	1	50,000				61,111	1	61,111
Design and Construction Supervision Consultancy Cost	Detailed Design	Item	Sum	1	125,000						
	Construction Supervision	Item	Sum						Sum	1	168,750
Organisational Restructuring	Creation of Public Health Department	Item	Sum	1	40,000	Sum	1	46,667	Sum	1	53,333
Legal Framework	Formulation and Public awareness of the By-Laws	Item	Sum	1	16,667						
	Enfrocement of the By-Laws	Item	Sum	1	46,667	Sum	1	56,000	Sum	1	93,333
Financial Management	Training on Financial management	Item	Sum	1	5,556	Sum	1	8,333	Sum	1	11,111
Community Participation	Public awareness	Item	sum	1	8,333						
	Training of CBO's	Item	Sum	1	11,111	Sum	1	11,111			
	Total Capital Cost				**573,378**			**214,200**			**642,083**

LWAKHAKHA UGANDA SOLID WASTE MANAGEMENT PLAN - OPERATION AND MAINTENANCE COST												
Labour Cost	2 No. Supervisors	Item	Sum	1	40,000	Sum	1	56,000	Sum	1	93,333
	2 No. Drivers	Item	Sum	1	40,000	Sum	1	40,000	Sum	1	80,000
	1 No. Backsmen	Item	Sum	1	13,333	Sum	1	13,333	Sum	1	26,667
	2 No. Watchment	Item	Sum	1	24,000	Sum	1	24,000	Sum	1	24,000
	2 No. Labourers	Item	Sum	1	16,000	Sum	1	16,000	Sum	1	32,000
Maintenance Cost	Fuel	Item	Sum	1	13,333	Sum	1	33,333	Sum	1	100,000
	Servicing	Item	Sum	1	8,333	Sum	1	8,333	Sum	1	8,333
	Wear and Tear	Item	Sum	1	8,333	Sum	1	8,333	Sum	1	8,333
	Total Operation and Maintenance Cost				**163,333**			**199,333**			**372,667**
	Total Cost of the Implementation Plan				**736,711**			**413,533**			**1,014,750**

APPENDIX B: INVESTMENT PLAN

Recipient Party	Lwakhakha Town Council
Executing Agency	Nile Basin Initiative
Main Beneficiaries	Lwakhakha Town Council
Estimated Cost (USD)	1. Short Term - $ 736,711 2. Mid Term - $ 413,533 3. Long Term - $ 1,044,794 **Total cost $ 2,195,039**
Location/Intervention area	Lwakhakha town Uganda
Duration	20 years

Background

The increase in population and economic activities in Lwakhakha town council have led to an increase in demand for resources. It is evident that rapidly increasing consumption of products and services on the other hand has led to a subsequent increase in waste products that require safe disposal. Inadequate solid waste management in Lwakhakha town poses a challenge to the environment and in particular water quality management because of the potential in causing both surface and ground water pollution in the area. Although the imminent impacts of solid waste pollution may not be obvious, it is apparent that it could be detrimental to the environment. There is no waste collection service in Lwakhakha town other than from the main street cleansing. Lack of a waste disposal site in the area on the other hand has contributed to degradation of the environment, human health, hygiene and aesthetic conditions of the town. Therefore solid waste management is a concern requiring urgent intervention.

Lwakhakha Town Council though responsible of waste management in the town, it has no enough capacity for effective solid waste management service delivery. In spite of this, the council ought to be in charge of handling and delivery of all waste management services ranging from collection, transportation, treatment, storage and disposal. However there are several challenges impeding the council's ability to deliver solid waste management services effectively in Lwakhakha town and these includes but are not limited to the following: lack of a designated waste disposal site, absence of waste segregation, lack of household waste collection facilities, indiscriminate waste dumping, underfunded waste management activities in the public health department, location of the town upslope of Lwakhakha river, un-coordination among solid waste management institutions, poor public awareness and participation in solid waste management activities, indiscriminate waste burning by the local people, solid waste management practice that does not meet set standards and regulations in the legal framework and lack of an enforcement mechanism.

Following insufficient solid waste management practice in Lwakhakha town, the Nile Basin Initiative is making efforts to improve the sanitary environment of the Sio-Malaba-Malakisi Sub Basin through integrated watershed management strategy. The Integrated solid waste management initiative seeks to maximize resource use efficiency by taking a strategic approach to the sustainable management of solid waste considering all aspects including

sources of wastes as well as all stages namely generation, segregation, sorting, treatment, recovery and disposal in an integrated manner with an objective of reversing environmental degradation in the sub basin

Justification

Inadequate solid waste management is a challenge not only in Lwakhakha town council but in most areas within the Sio-Malaba-Malakisi River Basin leading to subsequent dispersal and degradation of the environment particularly in regard to water quality. The situation in Lwakhakha has been exacerbated by lack of a designated waste disposal site, increased storm run-off, low public awareness and discipline, inadequate waste collection system, underfunded public health department, lack of fee collection system to sustain an effective program and lack of byelaws to prevent littering or haphazard waste disposal within the town. However, solid waste generated in the town requires proper management because of the specific conditions characterised by the area. The high run-off, indiscriminate burning and inadequate solid waste disposal need proper management to minimize risks to the environment and human health.

Therefore the implementation of the solid waste management proposal will go a long way in improving and expanding solid waste collection, transportation, disposal, enhanced institutional capacity, increased public awareness and participation in solid waste management. This will reduce pollution effects on the environment occasioned by poor solid waste management and ensuring of a clean environment to the residents of Lwakhakha town. The implementation of the proposal will also enhance the technical, human and financial capacity of the Town Council to discharge its functions effectively however of significance is the contribution to the objectives of the Nile Basin Initiative in reversing environmental degradation.

Scope of the proposal

The proposed solid waste management investment plan involves short, medium and long term proposals. The scope of the proposal includes but is not limited to the following:

1. Solid waste management sensitization
2. Technology of collection, transportation and disposal of solid waste.
3. Administration and supervision
4. Organisational restructuring of Lwakhakha Town Council mandated to manage solid waste in Lwakhakha town.
5. Community participation in the management of solid waste

Objectives

In view of the above it is the aim of the intervention to achieve the following objectives singly or in combination:

1. To improve the technical capacity of the town council to effectively manage solid wastes.
2. To improve solid waste collection, storage, transportation and disposal system in Lwakhakha town.
3. To enhance public awareness and participation for sustainable solid waste management in Lwakhakha town council.

4. To enhance waste recycling and reuse as a way of reducing solid waste volume and impact to the environment.
5. To enhance institutional capacity of the Town council in solid waste management service delivery and enforcement.
6. Reduce water resources and general environmental degradation.

Outputs

- A well equipped public health department at Lwakhakha town council.
- Improved waste collection, transportation, storage, treatment as well as disposal system in Lwakhakha town.
- Public awareness and active participation in solid waste management at Lwakhakha town council.
- Proper management of medical wastes generated in the town council
- Enhanced institutional capacity at the town council to enforce and deliver solid waste management services in the town.
- Reduce waste through recycling and composting of the organic waste
- Reduced pollution of the water resources due to poor solid waste management practices at Lwakhakha town.

Deliverables

	DELIVERABLES	PERIOD			
1.	Formulation of the collection and transportation system and preparation of monitoring report of solid waste management	End of year 2012			
2.	Procurement of collection Vehicles	End of 2013	End of 2030		
	Skips	6.No	6.No		
	Skip loader tractor	1.No	1.No		
3.	Establishing of an Office	End of 2013			
	7.5 M^2	1.No			
4.	Setting up of a composite	End of 2015			
5.	Purchasing of landfill site	End of 2014			
	Construction of landfill	End of 2030			
6.	Staffing of the office	End of 2013	End of 2022		
	Supervisors	1.No	1.No		
	Drivers	1.No	1.No		
	Backs men	1.No	1.No		
	Watchmen	End of 2022			
		2 No.			
	Cleaners of zonal offices	1.No	1.No		
7.	Enforcement of bylaws staff	End of 2013	End of 2014	End of 2015	End of 2017
		1.No	1 No.	1 No.	1 No.
8.	Putting Waste charging system in place	End of 2013			
9.	Engagement of private sector Participation including training	End of 2022			
10	Public awareness and CBOs	End of 2014			
11	Construction of an incinerator	End of 2014			

Implementation Methodologies

Stage of Waste Management	Facilities, Activities / Equipment Required	Project risks
Start up Stage	Community Cleaning - Tools and labour required for two days cleaning - only the core centre	· Willingness of the public to participate
	One weeks Senistization Programme on the Solid Waste Management Plan	· Willingness of the public to participate
Collection and Transportation	Litter Bins Skip Loaders Skip loader Tractors	· Willingness of the public to use the skips and litter bins for waste storage.
Disposal Site	Purchase of Disposal and composting site Fencing of the Disposal Site Hire of Shovel	· Availability of suitable to buy · Willingness of local people to segregate wastes and to buy manure from the composite.
Construction of Incinerator	Incinerator	· Availability of land
Administration and supervision	Supervision Office(s) Disposal site office Supervision vehicles	· Availability of office space or land for construction
Design and Construction Supervision Consultancy Cost	Detailed Design Construction Supervision	
Organisational Restructuring	Creation of Public Health Department	
Legal Framework	Formulation and Public awareness of the By-Laws Enfrocement of the By-Laws	· Participation of other government agencies in enforcement of the legal framework. · Willingness of the public to uphold rules and regulations
Financial Management	Training on Financial management Implementation of a waste charging system	· Willingness and ability of local people to pay for the services
Community Participation	Public awareness Training of CBO's	· Willingness of the CBOs to participate. · An Efficient and effective waste segregation system by the local people. · An attractive return on investment

Required Inputs

Funds

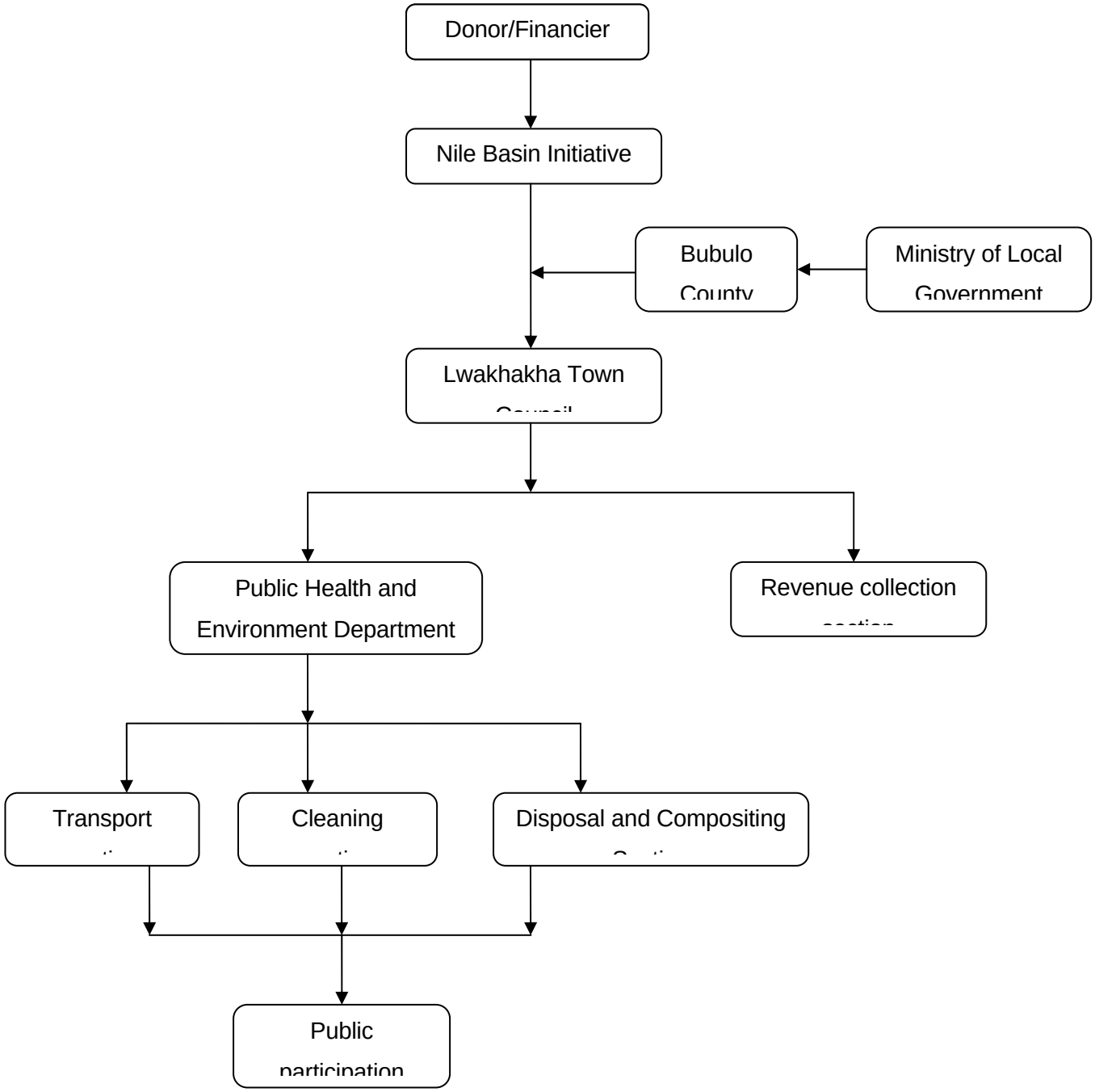
Project Cost component	Short Term	Medium Term	Long Term
	2012 - 2017	2017 -2022	2022-2032
Capital Cost	573,378	214,200	672,128
Operation and Maintenance	163,333	199,333	372,667
Total Cost	736,711	413,533	1,044,794

Main performance indicators

- Installation and management of dust bins and collection skips at strategic areas in all the six wards of the town council.
- Enforcement and adherence to solid waste management rules and regulations in the town council.
- Adequate waste collection capacity from all households within the town
- Installation and operation of a waste disposal site in an environmentally sustainable way.
- Ensure an efficient and effective waste transportation system within the town.
- Private sector and community participation at all stages of solid waste management process.
- Installation and operation of a medical waste incinerator in the town that reduces improper medical waste disposal.
- Public participation in waste reduction through recycling and composting of organic refuse.

Institutional Arrangements

The proposal will be implemented through a participatory process involving several stakeholders including but not limited to the Financier, Nile Basin Initiative, Lwakhakha town council and the public at large. The proposed institutional arrangement is as shown on the diagram below:



Costs and Benefits

When solid waste are not collected and disposed (removal from source), it causes health, social and economic problems to the community directly or indirectly. The poor or the weak in society more often than not are the ones who bear huge problems. When the community or residence ignore solid waste, the Government are normally forced to intervene at the last minute due to health complications of it population (labour force)

Whether it is Government or community, solid waste management has a cost. This cost ranges consists of the following:

- Fixed costs
- Capital cost
- Depreciation and amortization
- Financial cost
- Variable cost
- Operating costs
- Consultancy costs

Whereas the costs of the proposal can be determined, the value of benefits cannot be easily quantified because of the multiple benefits that results from a clean and health environmental. The benefits of a clean environment though appreciated cannot be given a direct cost as it is a challenge to value factors such as aesthetics, clean air, high quality water resources and clean land that will result from the implementation of the proposal. The effects of environmental pollution on the other hand occur after a long time and one cannot directly link such effect to a certain pollutant or the source because of other factors at play. However the cost benefit table below indicate the monetary value of the benefits based on the following assumptions:

- Pollutants from inadequate solid waste management activities polluting soil, water and air will result into human health problems that will require medical consultations and that this pollutants will find their way into the food chains and food web.
- That manure from compost organic matter will be sold to farmers
- That recycling activities from CBOs will generate income from wastes
- That involvement of the private sector will open up employment opportunities to the local people
- That proper waste handling will reduce health effects from the direct contacts with waste from those scavenging or working on the waste directly.

LWAKHAKHA UGANDA COST / BENEFIT ANALYSIS

	COST ANALYSIS			BENEFITS ANALYSIS		
S/NO.	**STAGES**	**DESCRIPTION**	**COST US$**	**DESCRIPTION**	**ELEMENTS**	**COSTS US$**
1	Start up Stage	Community Cleaning - Tools and labour required for two days cleaning - only the core centre	2,778		· The local people will appreciate the need for a clean environment.	
		One weeks Senistization Programme on the Solid Waste Management Plan. This process will involve the identification of companies who recycle solid waste in the neighbourhood.	1,667		· Appreciation and familiarization with the plan by all stakeholders and soliciting their participation in the implementation process · Identification of stakeholders' roles and responsibilities in the whole process of implementation · Identification of solid waste recycling firms	
2	Collection and Transportation	Litter Bins	54,151	· Reduce haphazard disposal of waste	· Improves the Aesthetic value · Easy to collect waste for dumping	
		Skip Loaders	149,215	· Easy transportation of waste to disposal site	· Reduction in land, air and water pollution · Improves the Aesthetic value · Hygienic and reduced vector breeding	

LWAKHAKHA UGANDA COST / BENEFIT ANALYSIS

	COST ANALYSIS			BENEFITS ANALYSIS		
S/NO.	**STAGES**	**DESCRIPTION**	**COST US$**	**DESCRIPTION**	**ELEMENTS**	**COSTS US$**
		Skip loader Trucks	307,843	· Easy loading of wastes	· Reduced time wastage and man power	
3	Disposal Site	Purchase of Disposal and composting site	18,667	· Reduced haphazard waste disposal · Composting of organic matter	· Improves the Aesthetic value · Generation of manure · Controlled emission of green house gases (methane) · Reduced breeding of vectors · Reduced sediment loading to water sources	
		Fencing of the Disposal Site	72,595	· Prevention of encroachment to the site	· Protection of trespassers from infection and unhygienic conditions	
		Hire of Shovel	28,235	· Compacting of waste	· Reduced leachate · Reduced wind blow of waste and · Increased lifespan of the site	
4	Construction of an Incinerator	Incinerator. The cost will include design and construction, compliances to environmental laws and other necessary costs.	8,824	· Treatment of all medical waste	· Reduced land · air and · water pollution · reduced illegal dumping · reduced infection	
5	Administration and supervision	Supervision Office(s)	1,324		· Efficient Monitoring of solid waste management at the field level.	
		Disposal site office		· Effective	· Control of dumping activities	

LWAKHAKHA UGANDA COST / BENEFIT ANALYSIS

	COST ANALYSIS			BENEFITS ANALYSIS		
S/NO.	**STAGES**	**DESCRIPTION**	**COST US$**	**DESCRIPTION**	**ELEMENTS**	**COSTS US$**
			1,324	management of disposal site	· Maintenance of the disposal site	
		Supervision vehicles	111,111	· Easy movement	· For adequate supervision	
6	Design and Construction Supervision Consultancy Cost	Detailed Design	125,000			
		Construction Supervision	168,750			
7	Organisational Restructuring	Creation of Public Health Department	140,000		· For efficient and effective monitoring of solid waste collection, transportation and disposal	
8	Legal Framework	Formulation and Public awareness of the By-Laws	16,667		· Public appreciation and understanding of solid waste management rules, standards and regulations.	
		Enforcement of the By-Laws	196,000		· Ensure adherence to good solid waste management practices by all stakeholders	
9	Financial Management	Training on Financial management	25,000		· Ensure efficient and effective management and control of financial resources	
10	Community Participation	Public awareness	8,333		· Increased community appreciation and participation in solid waste management.	
		Training of CBO's	22,222	· Engaging in recycling activities	· To enhance local organizations' capacity to	

LWAKHAKHA UGANDA COST / BENEFIT ANALYSIS

	COST ANALYSIS			BENEFITS ANALYSIS		
S/NO.	**STAGES**	**DESCRIPTION**	**COST US$**	**DESCRIPTION**	**ELEMENTS**	**COSTS US$**
					participate in solid waste management. · Business opportunities	
		TOTAL CAPITAL COST	**1,459,706**			
LWAKHAKHA UGANDA SOLID WASTE MANAGEMENT PLAN - OPERATION AND MAINTENANCE COST						
S/NO.	**STAGE**	**DESCRIPTION**	**COST**			
	Labour Cost	2 No. Supervisors	189,333			
		2 No. Drivers	160,000			
		1 No. Backsmen	53,333			
		2 No. Watchment	72,000			
		2 No. Labourers	64,000			
	Maintenance Cost	Fuel	146,667			
		Servicing	25,000			
		Wear and Tear	25,000			
Total Operation and Maintenance Cost			**735,333**			
Total Cost of the Implementation Plan			**2,195,039**			

It should be noted that benefit figures were not established but just an indication of the possible value.

Environmental and Social Management Framework considerations

The proposal will be implemented by all stakeholders in a participatory process involving the financiers, the Nile Basin Initiative, the ministry of local government and other government departments, Bubulo County, Lwakhakha town council, the private sector and the local community. It is anticipated that through public campaigns, all individuals within households will be expected to participate in the waste management process either directly or indirectly. Community involvement on the other hand will ensure that their needs and constraints are integrated in the objectives of the proposal hence its effective implementation. Public involvement will further enhance the sustainability of the proposed project, increase local ownership and a sense of responsibility for maintaining the solid waste management services provided through the proposed project. The ultimate delivery of solid waste management service in Lwakhakha town is expected to cover all areas of the council including but not limited to the banana market, open air market and from all households with the six wards.

Implementation of the proposal will improve solid waste management hence reducing the associated environmental pollution of air, soil and water. Whereas human health impacts and environmental degradation will be greatly reduced.

Annex 3A2b. Solid Waste Management Project for Lwakhakha (Kenya)

TABLE OF CONTENTS

LIST OF ANNEXES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 5.Introduction

Solid waste management in Lwakhakha is a challenge to Bungoma county council posing an environmental and health risks to the local people. The increase in solid waste generation has not been countered by an equivalent increase in the capacity of the County Council to deal with this problem. Many studies in developing countries indicate that less than 50% of solid waste generated in urban areas is collected or properly disposed off and because of the inefficiencies in waste collection and disposal, there is widespread indiscriminate dumping. However for Lwakhakha market centre, waste management is inadequate requiring intervention so as to improve the practice.

Although uncontrolled dumping and burning of solid waste are legally banned and their adverse impacts widely recognized, they are common methods of solid waste disposal practiced resulting in serious pollution problems in most urban areas. Waste disposal points in the town are open dumping and burning points, this has a detrimental effect on the surrounding environment. Following such risk solid waste management practices, pollutants are dispersed into the environment as a result of indiscriminate waste disposal including heavy metals, organic matter, plastics or synthetic organic compounds such as furans, dioxins or polychlorinated biphenyls. In addition the possible existence of storm drains from the points poses considerably high risk of dispersing pollutants into the environment through surface and ground water courses. However the impact of solid waste to the environment and to human health has to be managed in an environmentally sound manner.

Following inadequate solid waste management in Lwakhakha market centre, the Nile Basin Initiative is making efforts to improve the sanitary environment of the Sio-Malaba-Malakisi Sub Basin. As part of its strategy, it sought the services of consultants to conduct a study on solid waste management i9n the town with an objective of formulating proper Solid Waste Management Plan as a way of managing solid waste generated in the town and thus to enhance integrated watershed management within the Nile Basin.

The solid waste management study in Lwakhakha market centre included evaluating aspects of waste characterization, solid waste management systems and environmental and health impacts. Determination of Waste amounts data plays a critical role in solid waste system planning and design. The data are used in several ways, including determining the quantity of materials available for recovery, measuring the effectiveness of existing recycling programs, and right-sizing solid waste and recycling facilities. Waste management system on the other hand highlighted the gaps in institutional framework, legal and policy framework, financing mechanisms, waste management technologies and how stakeholders participate in solid waste management in the town council.

The study approach to the study involved desk review of solid waste management literature, scheduled interview of District Environmental officer, the public health officials, council engineer as well as field observations, visits to several areas within the town including the Banana market, waste disposal points along the river and along the main street in the town. The field visit also involved interviewing the local people to get their views and perception regarding solid waste management practice in the town.

The dumping points are located where storm water carries the waste to river Lwakhakha. This situation is has accumulative effect on the environmental, health, hygiene and aesthetic conditions of Lwakhakha market centre. Therefore solid waste management is an urgent issue requiring prompt resolution.

5.1 Goal of the plan

Enhance solid waste management at Lwakhakha market centre for improved public health and environmental management.

5.2 Objectives of the plan

- To improve the technical capacity of Bungoma County council to effectively manage solid wastes in Lwakhakha.
- To improve solid waste collection, storage, transportation and disposal system in Lwakhakha Market centre.
- To enhance public awareness and participation for sustainable solid waste management in the market centre
- To enhance waste recycling and reuse as a way of reducing solid waste volume and their impacts to the environment.
- To enhance institutional capacity of the county council for solid waste management service delivery and enforcement of regulations.
- Reduce water resources and general environmental degradation.

5.3 Justification of the plan

Inadequate management of solid waste material is common in Lwakhakha. Although the risk of haphazard waste disposal may not be immediately obvious, waste can pollute the environment and impact negatively on human health in the long-term. Therefore there is need to address issues impeding effective management of wastes in the market centre through an action plan that guides future waste management strategies.

CHAPTER 6.The Planning Area

6.1 Jurisdictions

National

Lwakhakha market centre is within the jurisdictions of Bungoma Count Council. The County Council was established under the Local Government Act Cap 265 of the Laws of Kenya. It executes three key functions: local services, local governance and local development through strategic leadership.

Other laws governing operations of the County council include: Local Government Loan Act Cap 303, Trade Licensing Act Cap 497, Rating Act Cap 267, Valuation for Rating Act Cap 255 and the Agriculture Act Cap 218.

The organization and management of the County Council of Bungoma is structured into two arms- the policy formulation arm headed by His Worship the Mayor and comprising of fifty four councillors (Forty one elected and thirteen nominated) whereas the executive arm implements policy decisions made by the former with the Town Clerk at the apex.

Administrative area

Lwakhakha market centre is found in Bungoma west district, Malakisi division, Lwandanyi location and Chebukuyi sub-location. The centre borders Uganda and it is under Bungoma County council, which is responsible for, waste management. Politically it is under Lwandanyi ward, which has an elected councillor representing the area in Bungoma County council whose offices are in Bungoma Town.

Location of the study area

The market centre is within the jurisdiction of the Bungoma County and is located at coordinates; N 00^{o}47.608' E 034^{o} 22.765', and elevation of about 1758m above sea level near the banana market. Lwakhakha is almost in the middle between Bungoma town and Mbale town in Uganda, which is about 37 km a way while Bungoma is about 40 km.

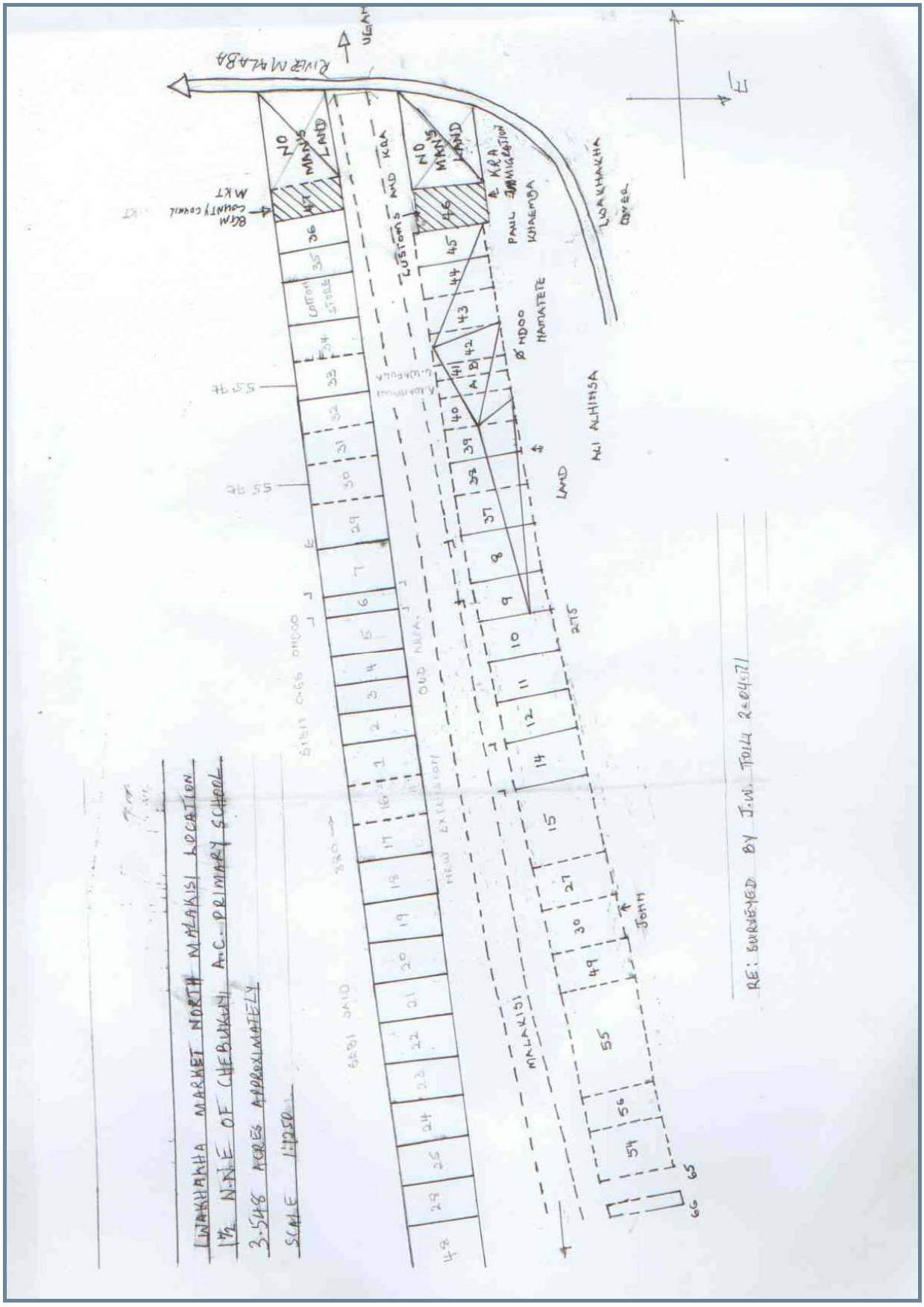


Figure 6-1: A sketch map of Lwakhakha Market centre

Population

Lwakhakha market centre has a population of about 1,000 people whereas the populations of Chebukuyi sub location where the centre falls is as indicated below. The market centre is less than 1 km square but it is thought that in future the surrounding rural areas will be urbanised. Therefore the combined current population of both the market centre and the rural area of Lwakhakha market are 8,000 people (Chebukuyi Sub-location) while the average population density is 536 persons per square kilometre. There are 1600 households with the average household size estimated at an average of 5 persons per household. Women population in Chebukuyi sub location is slightly higher than that of men according to the 2009 Kenya population and housing census.

Socio-economic pattern of the study area

Main occupation

Lwakhakha is characterized by both rural and urban settlement. Agriculture, business, formal and informal employment provides occupational opportunities for most household heads in this area. The agricultural farms provide both formal and informal employment whereas the market centre provides business opportunities. The police post, immigration office, the Kenya revenue authority offices and other institutions present in the area provide formal employment. However, business is the main occupation which includes retail shops, bars and restaurants, tailor shops, jua kali services, open air market, groceries, hawking, salons and barber shops.

Infrastructure

Lwakhakha market centre consists of a single earth road, which passes through the main street and across the border. The other areas within the centre are served by feeder roads and footpath. The market centre does not have basic services characterized by most urban areas such as tap water, sewerage, solid waste management or modern health centres.

It was reported by residents that river Lwakhakha is the main source of domestic water supplemented by tap water from the Ugandan side as most residents considered the river water unsafe for drinking.

Living conditions

Living conditions in Lwakhakha is typical of a rural area set-up in Kenya with an exception of the main street of the centre. The residents are farmers with a few commercial premises. Waste water drainage especially in the main street towards the border is poor with hardly any or dilapidated drainage facilities.

- **Sources of income for the household**

The sources of income for the local people in Lwakhakha are mainly from trade and commerce across the border or from informal employment and to a lesser extend formal employment. However in general, more women work on the family farm and in the informal employment as compared to men. The agricultural activities in the area consist of subsistence farming of food crops, livestock keeping and horticultural products mainly vegetables on a small scale.

- **Well-being and well-being trend**

Basing on the Kenya population and housing census report of 2009, more men than women are employed and have a sustainable income whereas more women provide labour on the family farm whose farming activities are seasonal and depended on the availability of rainfall. In addition, the market centre and the border provide opportunities for small businesses, which supplement family income.

Housing

- **Type of settlements**

Lwakhakha centre is characterised by both rural and urban settlement. However, the location and concentration of the population is largely influenced by Commercial activities and poverty levels. The settlement patterns in Lwakhakha are dictated upon by the potentiality of land, land use system and business opportunities available. There are high population densities in the market centres and areas with high commercial potential while areas with low commercial potential or agricultural activities are sparsely populated.

- **Housing characteristics**

According to the 2009 Kenya population and housing census, most houses in Lwakhakha area are semi-permanent, constructed by iron sheets as roofing materials, unbaked bricks or mud for walls and over 65% of the total housing in the area are earth floors while some houses in the market centres are permanent with cement floors. The pattern of housing distribution on the other hand is determined by commercial activities with sparsely distributed housing being common in areas of low commercial potential while densely distributed housing being in areas with high commercial potential.

Land use

Land use in Lwakhakha is the physical manifestation of socio-economic, cultural, political, and environmental forces shaping the use of land. Land in the market area is used for different purposes such as residential areas, commercial and central areas, public, circulation, and infrastructure and recreational *(playground and open spaces)*.

In spite of this, the centre is relatively small and most of the residents practice trade and commerce as a way of earning a living. Similarly the surrounding rural set up makes Lwakhakha an agricultural area, residents from the surrounding environs practice small-scale agriculture and also rear livestock.

Land ownership in the town is mostly freehold, trust land and public land. However most areas within the town have not been planned for and lack basic infrastructure services.

- **Residential**

Housing pattern in the town does not give an indication of social status of residents but most of the houses are for commercial purpose while most people operate from the nearby rural areas. Residential land however is the largest consumer of urban land among the various competing urban land use. The proportion covered can be between 50-60% of all total land available in an urban area. The Housing may vary significantly between and through residential areas and these include single family/private housing or multi-family/commercials housing.

- **Commercial**

Most trading activities in the study area are concentrated on the border of Lwakhakha market centre and Uganda. The main businesses in the area include money changing, retail shops, bars and restaurants, tailor shops, salons and barbershops, groceries and occasional open-air market.

- **Industrial**

Lwakhakha market centre did not have any industry at the time of the study although most urban areas are characterized by industrial activities.

- **Agricultural**

Agriculture contributes a lot to the economy of those who live in Lwakhakha and they have been depended much on the performance of agriculture for food production. Major part of agriculture in the area is rain-fed, the variation in rainfall also influence the actual land use and vegetation cover available. However, presently a large percentage area of cultivation is on small-scale production of cereals such as maize, beans, sorghum, groundnuts and sweet potatoes.

Zoning of the study area

Lwakhakha market can be zoned into two basing on economic activities of the resident communities. These are the commercial area, which is characterized by trading activities and the rural area, which is predominately of agricultural activities.

6.2 Physical conditions

Climatology

The relief and landforms surrounding Lwakhakha area particularly mount Elgon affect the climatic conditions of the Town and is favourable with adequate rainfall to support a large variety of agro production. The town is characterized by bimodal rainfall of long and short rains. The long rains normally start in March and continue into July while short rains start in August and continue into October. The mean annual rainfall varies from 1250mm to 1800mm. the rains are heaviest in April and May and most of it falls in the long rain season.

The seasonal distribution is about 1500- 2000mm during the first rains and about 430- 1200mm during the second rains with 60% reliability. December and January have the least amount of rainfall whereas the mean annual temperature vary between 21^0C- 23^0C due to different levels of altitude. April to July tend to have lower temperature while December to February tend to have higher temperatures.

Geology and soils

The entire Lwakhakha County Council land is classified as agricultural with the soils showing considerable variation in fertility and drainage properties. Soils of moderate to high fertility are confined largely to Northern part. Soils of Lwakhakha area which is in the west are well drained, deep and vary from dark red nitosoils and ferrasoils to dark brown acri soils. In the Eastern and Southern part of the County, the soils are well drained, moderately deep to very deep. The soils here are reddish brown to yellowish brown. A long the river valleys, the soils are fairly shallow due to degradation. These areas are prone to swamps, water logging and flooding. The soils are clay, making roads impassable during rainy seasons and during dry season; they crack making planting and ploughing difficult.

Drainage basins

Most of Lwakhakha area has a sloping terrain while the altitude rises from about 1400m to 1800m above the sea level. However Lwakhakha market centre has a hilly terrain sloping towards river Lwakhakha that is the border between Kenya and Uganda. The centre is at an altitude of about 1760m above the sea level and it is drained by river Lwakhakha that also doubles as the source of water for the town.

Vegetation cover

Lwakhakha area falls within agro- ecological zone LM2 (lower midland two). The original vegetation cover has been greatly interfered with by human activities. These activities include settlements, farming, infrastructure development and other urban centre related activities. The observed vegetation cover includes a mixture of indigenous and exotic plants species. The bulk of the market centre outside the business premises and residential areas are under agricultural ecosystems mainly subsistence farming while livestock identified within the area were cows, goats, donkeys and chicken.

6.3 Environmental conditions

Environmental conditions of Lwakhakha are mainly influenced by poverty rates of the area surrounding the market centre. But of significance is the high population density, which has exerted increasing pressure on the natural resources in the surrounding areas rendering their current rate of exploitation unsustainable.

There are various environmental issues that were identified in Lwakhakha and its environs. The major issues noted were solid waste management, degradation of the water resources, loss of vegetation cover, land degradation through soil erosion and air pollution from burning of wastes.

However Solid waste management was identified as the most significant environmental problem within the market centre. Its collection, storage, transportation and safe disposal is a major challenge to the residents and the local authority.

Uncollected solid wastes from various activities are degrading the land, water and the soil resources. The problem is exacerbated by human dumping of waste on the riparian resources from commercial and household activities in addition to storm runoff that carry the waste to the river.

CHAPTER 7.Situation Analysis of Existing Solid Waste Management System

7.1 Waste characterization

Waste generation

Wastes generated in Lwakhakha market centre are from various sources including: Household waste or domestic waste from residential areas and can be categorized mainly into

- Paper and cardboard,
- Glass,
- Plastics,
- Organic fractions,
- Hazardous waste and bulky waste

The other source is commercial establishments which include waste from shops and other service providers (bar, etc) and it is essentially composed of

- Packaging waste,
- Glass,
- Paper,
- Cardboards,
- Metals and organic waste from markets as well as hotels

The centre has several institutions such as chemist and government offices. The amount of waste and the composition are often more of paper waste. Although similar to household waste, some extra fractions of paper, glass and plastics were observed. However the organic waste is of significance particularly from the Banana market.

Figure 7-1: Uncollected waste at the Lwakhakha Banana Market opposite the Immigration office

Waste segregation

Waste segregation is an important element in waste management and careful segregation (separation) of waste matter into different categories helps to minimize the quantities of hazardous waste.

The most rational way to cope with waste is to collect it at source in each area and to separate it immediately where possible. The way that waste is sorted must reflect local disposal systems. The following categories are common:

- Paper
- Glass (bottles)
- Plastics
- Scrap metal
- Compost
- Medical waste
- Residual waste

Although waste segregation can be significant to the local people in Lwakhakha and the county council, the practice is non-existent and it was observed during the study that waste is mixed up. The major waste components identified included plastics, plastic paper, paper, glass, metals, wood and organic material mainly from banana waste. Nonetheless if the waste is segregated, over 75% will be used as compost in farms hence reducing the waste to be released into the environment.

Hazardous waste

Lwakhakha Market centre is predominantly agricultural and commercial centre without any industrial activity as at the time of the study.

However it was reported by the local people during the study that there are some drug selling shops but it was not determined whether they have laboratory services as the owners were not will to speak to the study team. The locals also reported that they are treated at clinics in Lwakhakha Uganda or Korosiandeti, which is about 3 Kilometres away from Lwakhakha Market centre.

Quantities of waste generated

As mentioned above, the County Council of Bungoma is responsible for Solid Waste Management within Lwakhakha market centre. The Council is endeavouring to meet its goals of ridding the town off problems related to garbage collection and indiscriminate disposal that are accompanied by storm drains during rainy seasons.

To support this work, it was necessary to characterize and quantify the solid waste generated in the Town. Quantification of the waste was based on the number of trips of waste collected at the banana market and the population of the town. The County council uses a tractor with an average 3 tons trailer loading capacity. The tractor makes an average of 3 trips with a total haulage of 9 tons whenever the waste is collected from the market. However it is important to note here that waste is supposed to be collected once every month but it was reported that the collection is irregular and this was attributed to financial challenges.

Based on the above information, the total waste hauled from the market alone is about 0.3 tons per day. However, based on the population statistics of the town of about 1000 people and a conservative waste generation rate of 0.5kg/p/d, it is estimated that the current generation of uncollected waste in the core urban area of Lwakhakha market centre is about 0.7 ton/day growing to 1.5 tons/day by 2032. Thus it can be observed that currently of the 0.8 tons of waste generated daily only about 0.3 tons from the banana market is actually collected and dumped. All residential areas in the whole town are not serviced and over than 99% of the waste generated are not collected.

On the other hand, future amount of waste generation rates in the town may change depending on the economic growth of Bungoma town since is the major town that joins Kenya to Mbale Uganda. If the major road joining the town towns Bungoma-Mbale is tarmac, trade is bound to grow at the border town and hence the population will rise as well as waste generated.

Waste generation projections

The current waste generation rates in Lwakhakha were projected over a period of twenty years within a short term, medium term and long term period. The assumption for the projection is that in the long-term, most of the rural areas will be urban hence requiring solid waste collection and transportation. However the data is as indicated in section 4 of this report.

Waste characterization on the other hand was based on visual observation of the inorganic and organic fractions of the total waste generated. The results for the main generation areas show that about 75% of the waste generated is organic while about 25% is inorganic. The largest portions of the inorganic fraction were plastics and papers.

Waste disposal

Lwakhakha does not have a designated waste disposal site and there is evidence of roadside dumping along the main street towards the border and behind the shops particularly along river Lwakhakha. However wastes from the Banana market is dumped in people's farms on request especially during the rain seasons due to high moisture content while it is burned at the market during the dry season.

Expenditures for Solid Waste Management

It was noted that the county council is underfinanced and this has in turn hampered effective management of solid waste within Lwakhakha market centre with the resultant pollution of the environment. Although the council has scheduled to pick waste from the banana market at least ones every month, some time they fail to honour due to inadequate funds while at the same time the council only hires casual labourers to assist in loading the banana waste and does not have permanent workers at the centre.

7.2 Environmental and health impacts of Solid Waste Management in the study area

Open dumping is the main method of waste disposal in Lwakhakha although this type of waste disposal method is associated with inadequate management of solid Waste material, which is a potential risk to both the environment and or human health. In spite of this, official waste disposal services in Lwakhakha from the county council are non-existent and waste generated is disposed indiscriminately by the residents. The common problems associated with such waste disposal method is the existence of storm drains, open burning of the wastes, scavenging, inadequate containment of the wastes and improper handling of empty hazardous chemical containers. The risks of haphazard waste disposal methods although may not be immediately obvious, they can pollute the environment and pose human health risks. Nevertheless the environmental physical conditions including geology, climate, hydrology and ecological factors can exacerbate the rate of dispersion of pollutants into the environment.

Although this study appreciates the impact of solid waste on health and the environment in Lwakhakha, it did not in any way determine such impacts but relied on similar cases documented elsewhere.

Occupational health impacts

There are no waste pickers in Lwakhakha market centre but the group at risk is the general public due to indiscriminate disposal. The health impacts may occur from injuries due to sharp objects, direct contact with the toxic waste, inhalation of toxic air as a result of waste burning or handling of toxic chemicals in the waste. Uncollected mounts of waste in the residential areas pose a health risk particularly to young children who were seen playing oblivious of the wastes.

Figure 7-2: Waste disposal and burning point along the main street in Lwakhakha market centre

Breeding of vectors

Wastes especially of organic types are a potential breeding ground of vectors and rodents for instance houseflies, mosquitoes, birds or rats. There are occasional interruption of trash collection in Lwakhakha from the Banana Market over some period of time and this may be an issue as it could provide an opportunity for different species of animals to breed which are potential disease vectors including viruses, protozoa or bacteria. The presence of these animals and insects could be disastrous more so during a pandemic posing many health challenges.

Air pollution

Indiscriminate waste disposals are a major problem to the environment, especially on the air inhaled by people because wastes emit obnoxious odours and smoke that cause illness to people living in, around, or closer to such waste.

Open waste burning is a common practice in Lwakhakha and it is done by the households who do not have waste collection services. However open unregulated burning has effects on the environment because wastes are supposed to be burned in an incinerator under controlled conditions so as to minimize most pollusive effects as a consequence of the process. On the other hand, without observation of such measures, incomplete burning of the wastes may release pollutants, which have human health effects.

Emissions resulting from open burning and their associated health risks may include but not limited to the following: benzene (leukaemia); toluene diisocyanate (asthma); nitrogen dioxides (lung damage); and nitrite compounds (metabolic poisons and carcinogens), formaldehyde, hydrochloric and sulphuric acid, hydrogen cyanide, polycyclic aromatic hydrocarbons, cadmium, lead, mercury and chromium. It has also been documented that Dioxins, which are some of the pollutants resulting from plastic burning, are known to suppress the immune system, disrupt hormonal balances and promote carcinogenesis.

Storm water runoff

Storm water poses a challenge in controlling solid waste dispersion into the environment where we have inadequate refuse management. The storm water can wash waste from the dumping sites, transfer station or uncollected waste on the streets whereas the drainage systems of most urban areas direct urban storm water to the nearest water course.

Most of the storm water from Lwakhakha drains in River Lwakhakha and from observation, there were indications that uncollected solid wastes on the streets are washed into the river that is down slope of the centre. In addition, metals are mostly produced when wastes are burned and are present in the ash produced and such dissolve in water and can react or are dispersed in the environment. Although Metal pollution may not be obvious, the effects can be felt after some time due to their ability to bioaccumulate in the biological systems.

Figure 7-3: Residue of waste carried by storm water along the main street

Leachate

Open unregulated dumping are characterized by luck of engineering measures, leachate or discharge management, consideration of landfill gas associated management, few if any operational measures such as registrations of users, control of the number of tipping fronts or type of wastes disposed or compaction of waste. The sites are also associated with wash out which may contain chemicals [NO_3^-, CL^-, NH_4^+, HPO_4^-, SO_4^{2-}, VOC, PCBS, PAH, Chlorophenol, Polythene, Particulate organic matter, synthetic organic pollutants, metals (Cd, Cr, Cu, Hg, Pb, Mn, Zn, Mo, Ni, V or Co)] and pathogenic microorganisms. The pollutants from the dumpsite can leach contaminating soil or ground water source. The vulnerability to disseminate the wastes is exacerbated by the physical conditions of the land including geology, hydrology and ecological factors.

In spite of the above, Lwakhakha market does not have a designated dumping site but some residents dispose their waste along the river banks indiscriminately. In addition, the town is located up slope of Lwakhakha River, which poses a challenge to surface water pollution control. Therefore it is important that waste management within the town should be handled by care to reduce any deleterious effects that could occur especially during rainy seasons.

Figure 7-4: Haphazard waste disposal along Lwakhakha river bank

Aesthetic impacts of inadequate waste management

In Lwakhakha, a tractor from Bungoma County Council offices in Bungoma town is used to collect and transport wastes from the Banana market for disposal. However due to lack of a designated waste disposal point in the town, the waste is disposed in people's farms based on mutual request. It was observed during the study that the town do not have permanent waste workers but are hired on casual basis to assist in loading waste whenever a tractor is sent from Bungoma town. It is also important to point out that the general market centre does not have waste collection services and even waste collection from the banana market is not regulator. Due to lack of this services, haphazard and unmanaged waste disposal were observed as one move through the main street of the market towards the border. Heaps of waste due to irresponsible dumping along the way is evident and such waste may be responsible of non-point pollution, which can make waste containment a challenge. The waste particularly plastics are blown by the wind all over the place making it appear unsightly.

Figure 7-5: Waste disposal along the main street

7.3 Solid Waste Management System in Lwakhakha Market

This section focuses on the solid waste management system in Bungoma county Council, which is responsible of waste management in the Town. The review will include the institutional framework, legal and policy framework, financing mechanism, management technologies and stakeholders participation in waste management.

Institutional framework

There is a number of existing institutions that have interest in Solid Waste management within Bungoma County council in regard to Lwakhakha but the link between the various institutions is not clear. However they can be basically categorized in both public bodies (at national and local levels) and private sector. The public institutions concerned with Solid Waste Management at national level include:

- **Ministry of the Environment**

The ministry of environment is responsible for formulating the environmental policy and overseeing implementation of specific environmental programmes and strategies through the relevant departments. The ministry through the minister:

- Ensures that there is improvement of the Government's policy in environmental protection;
- Through coordination with relevant ministries, establishes waste norms for all main sectors (water, industry, agriculture, tourism, energy, transport and other sectors), and monitoring the application of these norms;
- Approves investments in environmental protection projects, and monitors their implementation;

- **Ministry of Local Government**

The Ministry of Local Government is responsible for all local authorities. The ministry is concerned with all aspects of managing the public services provided by the municipalities, including solid waste management. The ministry has a number of responsibilities including:

- Formulating, overseeing implementation and improvement of the Government's policy in the municipal development sector.
- Assisting Local Authorities in promoting solid waste management.
- Strengthening municipal capacity for the provision and financing of urban infrastructure including Solid Waste Management.
- Encouraging private sector provision and delivery of urban infrastructure including Solid waste management.

- Monitoring achievements in Solid waste management using objective and verifiable indicators.
- The Ministry of Local Government has the responsibility of approving Municipal Investment Programs through LATIF.

Ministry of Public Health and Sanitation

The Ministry of Public Health is involved in the environmental legislation and regulations and in coordinating and defining strategies, programs and projects dealing with solid waste. It is responsible for controlling pollutions or public health issues such waste in hospitals and clinics. It also has the following roles and responsibilities

- Improving the quality and effectiveness of public health and sanitation services such as waste handling and disposal
- Foster effective governance and partnerships in improving public health and sanitation services

Water Resource Management Authority

The Water Resource Management Authority (WRMA) is the custodian of all water resources in Kenya and has a legal duty to protect the quality and the integrity of these sources. WRMA is mandated to protect water sources against both point and non-point sources of pollution. And Solid waste management is one of the activities of significance to the authority because of its potential as a non-point source of pollution to water resources. Although generally solid waste management in Kenya has been below per, the authority do not have enough resources be it technologically, financially or enough manpower to effectively monitor the impacts of solid waste management on water resources in the entire nation.

The National Environmental Management Authority

The National Environmental Management Authority is responsible for:

- initiating the environmental policy and implementation of specific solid waste management programmes
- implementing and enforcing waste management policies and regulations
- Issuing and evaluating permits for institutions or organizations involved in activities linked to solid waste;
- Promotion of training, education, studies and research regarding the protection of the environment and the fight against pollution.
- drawing-up an inventory of sources of pollution created by solid waste, and monitoring these sources including controlling trans-boundary pollution issues;

- promoting public participation in solid waste management through awareness programmes
- Participating in the improvement of the strategy for solid waste management at the national level as well as the local levels.
- Participating in drawing-up regulations and domestication of international conventions dealing with solid waste management;
- Assisting industries and other waste generators in the elimination or reduction of pollution.

Although these are some of the roles and responsibilities of the National Environmental Management Authority, there are many challenges that impede the effectiveness of the authority particularly at the local level. It was observed in the study area that NEMA has only one officer to manage all environmental issues in the expansive Bungoma south, central and west districts while at the same time do not have enough financial resources to implement basic projects such as public awareness. Although according to the local government act the local authorities have been given the power to implement and enforce environmental protection laws, but since they have an interest in solid waste management they could not be relied upon to audit themselves.

Local Authorities

Bungoma County Council is responsible for the provision of solid waste collection and disposal services in Lwakhakha. The county council is the legal owner of waste once it is collected or put out for collection. The responsibility for waste management is specified in by-laws and supplemented by regulations from other government agencies. The county council has the obligation to enforce by-laws and regulations, and to mobilize the resources required for solid waste management. However this responsibility is in principle conferred upon it by the ministry of local government. Challenges often arise where the council authority to raise revenues is not commensurate with the responsibility for service provision. Besides solid waste management, the county Council is also responsible for the provision of the entire range of infrastructure and social services. Needs and demands for solid waste management must therefore be weighed and addressed in the context of the needs and relative priorities in all sectors and services.

Solid waste management in Lwakhakha falls within the department of public health in Bungoma County Council. It was observed during the study that solid waste service delivery in the town is non-existent as most residents burn their waste or dispose off haphazardly. In addition it was evident that the council does not have adequate equipment' to carry out their duties effectively. For instance, during the study period there was only one tractor for collecting and transporting of refuse from the banana market and that there was no waste management staff employed at Lwakhakha market centre.

However it was also noted that the tractor is sent once in a month from Bungoma Town, which is about 40 km away. This led to hips of uncollected waste in most areas of the centre posing both aesthetic and public health risks.

Bungoma County council on the other hand does not have enough capacity to coordinate other government agencies relevant to solid waste management to benefit from a synergetic relationship.

- **Private Sector Partnerships**

Private sector waste collectors can be significant to Bungoma County Council and often supplement the local authority's capacity in solid waste management activities. They can either be contracted directly by individual households, neighbourhood associations, business establishments or by the county council. More often, they operate under contractual agreement with local authorities. In this case, the council retains the responsibility for user fee collection. This arrangement ensures more equitable service access however if private enterprises depend on the direct collection of user charges they have little incentive to provide services in low-income areas where revenue potentials are weak.

However the partnerships between Bungoma County Council and other agents to facilitate sharing of Solid waste Management responsibilities and financial burden are hardly there in spite of such relationship's significance. There are barely any deliberate and active processes of collaborative action between stakeholders and if any the relationships are largely informal. Effective coordination among the numerous actors in the Council's solid waste management is absent. But even though there ought to be private garbage collection firms operating in an environment of open competition, to supplement county councils efforts or limitations in the market centre.

Legal and policy framework

Both international instruments and the Kenyan constitution in article 42, emphasis the need for a clean and healthy environment through management of substances that may pollute the environment or cause harm to human health. The right to a clean environment is enforced by article 70 of the new constitution.

Solid waste management is critical in environmental management because of its potential to cause pollution if not well managed. In response to international best practice as well as the constitutional requirement, there are many legislative instruments that have been formulated to assist in the management of solid waste. This section assesses the existing Solid waste management policies and legislative framework, economic tools and enforcement mechanisms.

Current waste management is regulated by several policy documents, By-laws, laws, regulations and Acts of parliament. The legal instruments span over a number of institutions with each having different mandate, approach and regulations of resource management. The section in particular will concentrate on reviewing the legislative impacts of waste management levels from waste generation, reduction, segregation, storage, collection, transportation, disposal, treatment through to waste dispersal and environmental management.

However of significance in our review is the EMCA 1999, which is an Act of parliament that sets out general environmental management and coordination among various stakeholders. The act establishes an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. Although other legislative instruments are equally important, many have been harmonized with the EMCA act and where there is conflict EMCA will be given precedence.

- **Waste generation and reduction**

Solid waste and hazardous substances management is one of the environmental aspects addressed in the EMCA act 1999 in Sections 86 to section 93. Section 87(4) of this Act, stipulates that every person whose activities generate wastes shall employ measures essential to minimize wastes through practices such as waste treatment, reclamation and recycling. Even with such provisions the town has no programs or incentives for material recovery/recycling involving stakeholders.

In the subsidiary legislation “Environmental Management and Co-ordination (waste Management) Regulations, 2006” in part II section 4, the responsibilities of the waste generator are set out. But the residents rarely observe this as waste is indiscriminately scattered especially in the main street of the town and behind the shops along the river. Sub-section (5) of the EMCA act 1999 in section 87 on the other hand assert that any person who contravenes this provision shall be guilty of an offence and liable to imprisonment for a term of not more than two years or to a fine of not more than one million shillings or to both such imprisonment and fine. However it is not possible to enforce this law because the council do not have a mechanism of establishing the really culprit while at the same time it contributes to the same by failing to provide solid waste management services to the town.

The environmental management authority can also in section 90 of the act apply to a competent court for orders compelling any person to stop among other things the generation of waste.

Section 13 of the factory Act requires every factory owner to ensure that the factory environment is kept in a clean state. The provisions outlined in paragraphs (a) and (b) of this section require removal of waste generated and cleaning of the work environment particularly the floors. Even though the Act provides for a section to ensure that the factory environment is kept clean, it does not clarify or provide a section on reduction of the waste generated by such factories or the segregation of the waste cleaned from the stated parts of the factory. Nonetheless Lwakhakha market centre did not have any factory at the time of the study.

- **Waste segregation**

The EMCA act 1999 in section 86 (3) and in section 91 (1) requires the Standards and Enforcement Review Committee to prescribe standards for waste classification and analysis. This has been emphasized in the waste regulation section 6 and 28 where a waste generator is required to segregate waste by separating hazardous waste from non-hazardous waste and dispose of such wastes in such facility as is provided for by the relevant local authorities. Such waste if segregated should be labelled appropriately as stated in section 18 (1) of the same waste regulations.

Even though the law advocates for segregation, it was observed in the study area that waste were mixed with both organic and inorganic matter together. The organic matter made up the highest percentage of the waste and though some residents showed willingness of using the organic matter, they could not take it due to mixing with plastics and other inorganic matters in the garbage. It was also reported that waste from the banana market is disposed in people's farms. This is an indication that with proper separation of the matter, the bulkiness of the waste can be reduced as most organic matter can be used by farmers who live near the town.

- **Waste storage and the transfer stations**

Section 86(4) of EMCA act stipulates that the Standards and Enforcement Review Committee in consultation with lead agents shall recommend to environmental management authority on regulations regarding storage of waste. In section 18 of the EMCA waste management regulations, several steps have been outlined on waste handling and storage.

The environment minister in section 92 (g) of the EMCA act can prescribe the procedures and criteria of handling and storing of waste. In case there is a discharge from a storage facility, the waste generator should give notice to environmental management authority or other relevant government agency a as well as starting immediate clean-up, section 93-4 (a and b). If the preceding conditions are not adhered to, the authority in section 93 (5) may seize such storage facility from the operator. Following this provisions the County council should consider regulating waste disposal practices in the town as storm drains from waste disposal will ultimate drain in surface water sources near the town.

- **Waste collection**

Through the Local Government Act (Cap 265 of Laws of Kenya), which establishes and governs Local Authorities, powers and functions of the Authorities are spelled out. And of significance among most functions undertaken by local authorities is the provision of public services in garbage collection. However in light of this, uncollected waste is common in the commercial and residential areas where it is generated. The waste is blown about by the wind and washed by storm water to the nearby river.

Although residents of the study area are entitled to waste collection and management, often the council is not capable of collecting waste as it should be. Most parts of the commercial and residential areas experience a lot of uncollected waste that has led to household burning of wastes. But such open burning as indicated in several report pose a health challenge to the residence especially the children.

- **Waste transportation**

Waste transportation is one of the areas that is most regulated by the EMCA act 1999. The act in section 87 (2) prohibits transportation of waste without a waste transportation license or to an unlicensed disposal site. In fact prior to transportation of any waste one has to apply in writing to the environmental management authority to be granted an appropriate license (section 88 (1)). Section 91(5) on the other hand prohibit transportation of hazardous waste through Kenya without a valid permit granted by the environmental management authority nor export hazardous waste as stated in sub-section 4. And that Waste transportation shall adhere to conditions provided for in section 7, 8 and 9 of waste management regulations.

However refuse transportation is non-existent in the study area, other than the occasional tractor sent from the county council offices in Bungoma town to carry waste from the banana market but the rest of the town does not have the same services.

- **Waste disposal**

Waste disposal should be treated with care such that any waste whether generated within or outside Kenya should be disposed in a manner that does not cause pollution to the environment or ill health (section 87-1). And that the disposal should be at a licensed disposal facility (section 87-3). In fact prior to operation of such a facility one has to apply in writing to the environmental management authority to be granted an appropriate license (section 88 (1)). If granted a license, the environmental management authority expects the applicant to ensure that such waste disposal site or plant operates in an environmentally sound manner. Contrary to this and pursuant to section 90 of the Act, the National Environment Management Authority may obtain court orders stopping any person or institution from disposing any wastes where such activities present an imminent and substantial danger to public health, the environment or natural resources.

EMCA section 93 (1) also prohibits disposal of wastes in a way that can cause water or environmental pollution. And in section 4(1) of waste management regulation, it is stated that no person shall dispose of any waste indiscriminately on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. However in the study area it was observed that there is no waste disposal facility and waste is poorly managed. The lack of waste management facilities encourages illegal dumping of hazardous wastes such as medical waste as is the case. But to discourage such illegal dumping, the County council should establish a central place where all waste particularly medical wastes are treated before being disposed. The town requires a dumping site that meets environmental standards so as to properly manage the waste and reduce environmental pollution drainage or leachates.

- **Waste treatment**

The need for waste treatment from the generation point to disposal site is emphasized in section 87(4) of the Environmental Management and Co-ordination Act (EMCA) and in the waste management regulations as stated in section 11. While Section 13 provides that any operator of a disposal site or plant shall apply the relevant provisions on waste treatment under the Local Government Act (Cap 265 Laws of Kenya).

Household open burning of waste is a common waste treatment practice in Lwakhakha market centre. Although waste reduces its volumes, the practice is associated with emission of pollutant gases and toxic residues that require proper disposal. It is beyond this study to empirically establish impacts of such residues after dispersal in the environment, however it is certain that toxic elements from the burning residue is dispersed in the environment. For instance it has been highlighted above that the County council do not waste disposal site, therefore the poorly burned as well as medical waste could have deleterious impact on the environment.

The act in Section78 (1) paragraphs (a)-(f) mandates the Standards and Enforcement Review Committee, in consultation with the relevant lead agencies to set standards for air quality including emissions, ambient and occupational air stands. However the Draft Air Pollution Regulations is yet to be enacted. Therefore it is not clear as of now how the authority enforces subsection 2 and 3 of section 78 of the EMCA act in case of any contravention. The effect on air quality of burning wastes by the households in the town should be considered and quantified.

The waste management regulations section26(1) provides that every person who generates toxic or hazardous waste shall treat or cause to be treated such hazardous waste using the classes of incinerators prescribed in the Third Schedule of the regulations or any other appropriate technology approved by the Authority.

The biomedical waste and industrial waste are the most significant and requires careful handling or treatment at the generation point prior to disposal in the common dumping site. In Section 36 of waste regulation, an Environmental Impact Assessment is required from bio-medical waste generator while section 37 stipulates that annual environmental audit of the facility should be carried out. This is provided for to ensure that the highest standards of hazardous waste management are adhered to. However evidence indicates that this is not practice as illegal dumping of medical waste has been reported.

The regulations further states that securing and packaging of bio-medical waste and other hazardous waste shall be according to the set standards in part 1 & 2 of the Eighth schedule and further labelled according to provisions in sections 38 and 39 respectively.

- **Waste dispersal and environmental management**

This refers to legal instruments that control the dispersal of waste or pollutants into the environment or natural resources. The environment minister has the power to make procedure and criteria for monitoring of the effect of hazardous substances chemicals and their residue on human health and the environment (Section 92 h). But at this instance there are no such criteria to monitor pollutants from dumpsites to the environment for instance water sources be it surface or underground. It was also realized that there is haphazard waste disposal in the study area with a direct impact to river Lwakhakha. Section 93 (1, 2 and 3) prohibit any arbitrary dumping of hazardous substances into the environment and also compels such a person to take appropriate remedial measures as directed by the authority stated in subsection 93 (4). However unless a sudden disaster occurs, such provisions are rarely enforced particularly against slow or cumulative impacts occurring as a result of improper solid waste management.

The water act and subsequent subsidiary legislations particularly the water rules protect water resources be it surface or underground against any form of pollution. Part V of the rules address water quality issues and in section 81, water pollution of any kind whether chemical biological or physical is prohibited. Section 82 further stipulates that no person shall discharge effluent in water or environment; without a permit, that does not meet discharge standards or without approved discharge control plan. Any person making such discharge is required to maintain a discharge record that should be submitted to Water Resources Management Authority quarterly. The authority shall from time to time have powers to inspect and sample any sources of pollution for enforcement purposes as well as maintain a database of water quality.

Prevention of non-point sources of pollution is stipulated in section 92 where WRMA in consultation with relevant institutions or individuals will ensure proper solid waste management that may be deleterious to water sources. Parts' IX provides for management of water catchment areas which if degraded affects the water quality other than the quantity.

The public health act in section 129 provides that local authorities should prevent any manner of water pollution and where such has occurred remedial measure of treating the water source should be undertaken by the local authority or compel the polluter to purify such water to prevent negative health impacts. And in section 130 the act addresses water quality issues by directing that there should be no pollution as a result of erecting of dwellings, sanitary conveniences, stables, cattle-kraals, pig-sties, ostrich-pens, dipping tanks, factories or other works, or deposit of any manure, filth or noxious or offensive matter or thing in water supplies. Enforcement of the rules as a result of the above sections is the responsibility/prerogative of the local authorities just like in section 129 above. However the act does not address non-point type of pollution such as storm drains whereas waste from the town is washed into the river by storm drains.

- **Economic tools for waste management**

There are several provisions for relevant economic instruments to address different aspects of solid waste management chain in quite a number of legislations. There are those that advocate for the employment of financial disincentives (fine, levy, surcharges and penalty) for non-compliance governing the proper management of solid waste. While on the other hand, economic incentives such as subsidies, tax rebates, and exercise waiver are captured in some provisions of the legislations relevant to the management of solid waste such as EMCA.

Section 57 of the Environmental Management and Co-ordination Act (EMCA) provides for the development of economic instruments to be used for enhancing the proper utilization of the environment. The tax, fiscal incentives, disincentives or fees proposed by the environment minister are specified in section 57(2) paragraphs (a), (b), (c) and (d). The relevance of this provision to the solid waste management sector is that it provides room for the development economic tools that may be used to encourage or discourage good or bad solid waste management practices respectively.

Section - of the local authority conservancy by-laws mandates the authority to issue directions on waste collection charges. Such directions are to specify the amount of charge or charges to be imposed for different categories of services or for services in different localities or zones within their area of jurisdiction.

However, the findings of this review indicate that even though there are such legal provisions, very few economic tools have since been developed to encourage good practices in the solid waste management sector such as recycling, re-use and material recovery. Nonetheless, the few that have been developed have not been implemented successfully. The unsuccessful implementation of these economic tools are due to many factors such as lack of awareness among the stakeholders about such tools and the fact that most of the stakeholders in the solid waste management sector do not participate in the process of formulating such economic tools.

More often than not, the economic instruments are of disincentives nature with few if any of the economic incentives particularly for those involved in best solid waste management practices.

- **Solid waste legislative enforcement mechanisms**

The enforcement of the provisions governing the management of solid waste is done mainly by the Environmental Management Authority and the Local Authorities. Section - mandates the authority to establish and implement a system of monitoring, inspections and enforcement of waste management activities and keep the public informed of steps taken to implement and improve waste management within the authority and account for the use-cleansing levy annually. However the minister of local government can only approve any by-law made by a municipal council affecting public health by obtaining consent from the Minister of health.

Any officer or agent of the County council duly authorized may enter any residential dwelling or trade premises within the area of jurisdiction for the purposes of conduction an inspection. In addition, non-payment of charges for waste management services payable under the By-laws shall be a debt due and owing to collector and may be recovered as a civil debt by suit at the instance of the collector or any person authorized by the collector to collect on its behalf. Sub-section (4) states that power or a function conferred on the authority under the By-laws which, pursuant to an agreement between it and a third party, may be exercised or performed by the third party, to have been exercised or performed under the authority of these By-laws.

In spite of this, the study indicated that the enforcement process is faced by challenges, which included inadequate financial resources, personnel and overwhelming cases of non-compliance with the set standards. Both the environmental management Authority and the local authority have few officers and find it difficult to send the inspectors to the field regularly as required by the law.

Financing of Solid Waste Management

Waste management is taken care of by local government through its own budgetary resources. However with rapid increase in waste generation rates and awareness for effective and efficient solid waste management practices to protect public health and environment, the demands for huge investments to bring improvements in many aspects of the solid waste management chain is rising. This has led to many governments to adopt various financing modes. Some of the widely practiced as suggested in the United Nations Environmental Programmes (UNEP) Integrated solid waste management training manual are as follows:

- **User charges**

Due to inadequate funds in most local authorities, the concept of cost sharing in order to increase funds available for service delivery was introduced. User charges in regard to solid waste collection, transportation and disposal services are being introduced.

They are still low or non-existent in many local authorities but the charges are increasingly assisting in subsidizing the costs of solid waste management in accordance with the polluter's pay principle. The charges also motivate waste generators to reduce the wastes in addition to financing the waste management activities. However the only user charges currently in operation is the Conservancy fee charged on licenses on commercial establishment/businesses. But even with such, Lwakhakha market centre does not receive waste management services.

- **Penalty, fine and levy**

There exist a number of provisions for relevant economic instruments to address different aspects of solid waste management chain in several legislations. Such provisions advocate for the employment of financial disincentives for non-compliance with the provisions governing the proper management of solid waste. The revenue earned from such instruments is a significant financing mechanism for local authorities to finance solid waste management activities.

For the case of Lwakhakha, the instruments are not used and at the time of the study, Bungoma county council did not have solid waste management by-laws or regulations.

- **Environmental Funds**

There can be fixed or revolving fund set aside to assist local governments in meeting their financing needs for environmental infrastructure and services. The fund may be financed through various modes including national bonds, annual budget, loans from international financing institutions and international cooperation. EMCA act 1999 on the other hand in section 25 provides for the establishment of a National Environment restoration fund that can be used to finance activities geared towards mitigation of environmental degradation.

In spite of such opportunities, the County council has not yet made any initiative to acquire such funds for the waste management activities in Lwakhakha.

- **Direct loans and international cooperation**

Local authorities may take direct loans either from domestic or international financing institutions. Although the loans may be used to develop solid waste management facilities, it is very rare for local authorities to take loans in Kenya to finance such activities. But on the increase is the trend of direct multilateral and bilateral cooperation with local governments. International agencies for example UNEP, Habitat or UNDP provide support to local governments to improve the local environment. Various bilateral initiatives are assisting local governments to seek assistance for financing their development projects, which may include solid waste management.

Even though, there are no such initiatives in Bungoma County Council with waste management efforts depending on internal financing mechanisms.

- **Local authority budget and Central Government grants**

Local authority budget and central government grants are still major sources to financing environmental infrastructure and services. Local authorities obtain their revenues from a variety of sources such as taxes, fines, and license fees. Such general revenues are used to finance costs associated with service delivery and other overheads. But the revenues in most cases are insufficient to cover the costs for solid waste services, grants or subsidies from the central government are used to supplement local revenues.

Bungoma County Council receives grants from the central government through Local Authorities Transfer Funds (LATF) initiative. The fund was established in 1999 through the LATF Act No. 8 of 1998, with the objective of improving service delivery, improving financial management, and reducing the outstanding debt of local authorities (LAs). However the allocation towards solid waste management activities in the Council is inadequate and does not meet refuse management requirements of the county council.

- **Private Sector participation**

The provision of solid waste management services is a costly and cumbersome venture for many local authorities throughout the world. The level of cost and degree of difficulty associated with the service provides an opportunity for participation of the private sector. The private sector plays a key role in increasing the efficiency of the services and to provide the much-needed resources to fund projects required in improving effectiveness in solid waste management. However this will only work well if there is a high efficiency in recovering the costs of service through the implementation of user charges. The local authority in this arrangement retains the power to oversee the private firms' activities and collection of the fund.

Despite the incentives of private sector participation in solid waste management Lwakhakha market centre is yet to engage any of such services.

Solid Waste Management Technology

- **Primary collection and transfer stations**

Solid waste collection and transfer is a very important function and is an integral part of integrated solid waste management programs. Its significance is due to the fact that waste collection is one of the most visible public services and failure in the collection system is reflected by anaesthetic conditions that can be seen in the streets and drainage structures throughout Lwakhakha Market centre.

However in Lwakhakha, collection of waste is hardly ever provided for by the County council in spite of being their duty and charging conservancy fees from Business premises. Instead it is upon each household or business premise to convey the refuse from point of generation to disposal point of one's convenience as designated disposal site is not provided for.

It was noted during the study that only waste from the banana market is collected by a tractor from Bungoma town whereas waste generated from households being disposed of at the discretion of the generators. It was observed that the disposal is below per and such waste is vulnerable to wind and storm drain if not collected and disposed properly. The refuse is also vulnerable to scatter by scavenging animals such as cats, dogs, goats and cows. In fact hips of uncollected waste were witnessed in several areas presenting a potential public health risk to residents. According to one of the residents a companying the study team, inadequate waste collection equipment, staff and finances or strategy from the county council was cited as the main cause.

Both residents and the county council do not have bins for waste collection while all types of waste were mixed up with hardly any separation on the street.

- **Transportation**

Refuse transportation is non-existent in the study area, other than the occasional tractor sent from the county council offices in Bungoma town to carry waste from the banana market.

- **Treatment**

Solid waste treatment refers to activities that reduce the effects of refuse to the environment through processes such as waste separation, incineration, decomposing or burning. According to observations made in the study area, there is no waste treatment process prior to waste disposal. Wastes were mixed up and burned occasionally but of significance is the medical wastes generated in the town which is not disposed properly.

- **Disposal**

Waste disposal lies at the core of the centre's solid waste management as refuse disposal remains a problem to the environment not only in Lwakhakha but in most towns in Kenya. It was observed during the study that Lwakhakha does not have a waste disposal site, which has led to households and business premises disposing off waste indiscriminately. Although the County council collects waste from the banana market occasionally, it was also noted that the collected refuse is disposed in people's farms since the town lack designated waste disposal site.

- **Refuse recycling and recovery**

Although recycling recovers materials by preventing the same from being disposed, solid waste recycling process is rarely done in Lwakhakha. However it was reported that organic waste from the banana market is disposed in people's farms on request.

Stakeholders participation in waste management

Waste generators

Waste generator refers to any person, by site, whose activities or process produces waste products and this could be from many different types of businesses, industries, government agencies, and institutions. Waste generators can generically be categorized as large generators who usually tend to be manufacturers of various products or small generators who are most often in service-oriented businesses or households.

Waste generators in Lwakhakha include households, open-air market and commercial premises including shops, hotels and bars. The waste generator on the other hand has a duty to ensure that all wastes are transported and disposed in accordance with the law. However due to poor public awareness and inadequate understanding of the law, many residents of Lwakhakha do not participate in solid waste management processes. The low public participation in solid waste management best practice at the market centre is attributed to most residents not being aware of their rights, roles or responsibilities.

It was observed during the study that the waste generated is generally mixed with hardly any segregation at household levels and other commercial premises.

Service providers

Bungoma County Council is generally responsible for the provision of solid waste collection and disposal services in the entire County. The County council also has the role of collecting levies for services provision.

For Lwakhakha, the county council has the sole role of providing solid waste management activities from collection to disposal. Nevertheless the county does not have enough capacity to adequately deliver the services and it was reported that only the Banana Market receive such services. The residents of the town have resorted to indiscriminately disposing off the waste within their compounds where the waste is burned. However it was observed the burning is done in a haphazard manner living the burned residue and other waste exposed to dispersal into the environment, with river Lwakhakha being the most affected in particular.

Regulators

Bungoma County council has a duty of enforcing all waste regulations at the market centre, which define stakeholders' roles and responsibilities in solid waste management. However with poor coordination mechanisms among the various institutions, waste regulations are applied in isolation denying solid waste management practice the much-needed synergy. The County council ought to ensure that rules and regulations are adhered to by the actors but due to several challenges such as understaffing and underfunding, it has not been easy to deliver.

It also emerged that solid waste management administrative offices are about forty Kilometres away in Bungoma Town an indication that the regulator is not able to enforce rules effectively.

- **Government Departments**

Although there are several government departments which have interest in solid waste management including the National Environmental Management Authority, the Public health and sanitation department and the Water Resources Management Authority, the remoteness of Lwakhakha from Bungoma is a disincentive to efficient service delivery by government officers including the District environment officer, the public health and sanitation officer, the district water officer as well as the public and environmental officer working in the county at Bungoma town. However the above departments' ought to act as auditors of the County council's solid waste management activities and their regular inspection are very vital.

- **Other Institutions**

Lwakhakha market centre is relatively small and hence does not have the incentives to attract other profit making waste management institutions such as recycling organizations, Non-Governmental Organizations (NGOs) or any other private enterprises.

7.4 Conclusion

It was noted during the study that Bungoma County council is responsible of handling and delivery of all waste management services ranging from collection, transportation, treatment, and disposal in Lwakhakha. But the service delivery was not to standard and the following were noted during the study:

- Waste is not collected from the general Lwakhakha market centre other than occasional collection from the Banana Market.
- The market centre does not have a designated waste disposal point neither are there formal waste collection facilities e.g. bins or other receptors at the household level.
- The waste is haphazardly disposed of by the local people with river Lwakhakha being the most affected.
- Segregation is not done which were evident from the mixed waste at the community/household disposal sites.
- Reviewing the legal and policy framework show that the solid waste management system in Lwakhakha does not meet most of the set standards. There is also low public awareness about the provisions in the existing laws and participation in solid waste management.
- There is very little that is covered by the existing legislations on the recycling, re-use or material recovery.
- Lack of effective and efficient enforcement mechanisms for the relevant provisions has affected the solid waste management system in Lwakhakha.

CHAPTER 8.Formulation of the Solid Waste Management Plan

8.1 Introduction

This chapter presents the formulation of the solid waste management plan for Lwakhakha market centre. It describes the population and the solid waste generation for the entire plan period and the development of the technical aspects of the plan. It also describes the entry point of community involvement in the management of solid waste in the Municipality. In addition, this chapter presents the implementation plan of the solid waste strategy, the proposed sources of fund and the project costs for the entire period of the plan. It is worth noting that such a plan requires review after a predetermined period, which this chapter also presents.

8.2 Population projection

Population census data

The estimated population for the entire Lwakhakha stands at 8,000 people whereas the core market centre has an approximate population of 1,000 people. This plan intends to serve the core-trading centre.

Table 8-1: Estimated Population of Lwakhakha (K) Town

Year	2011
Population	1,000

From the given populations during the census periods, it can be deduced that the population growth rate for Lwakhakha in the last ten years is approximately 3%.

Population projections

Based on the past population, the population projections were carried out using the following formula.

$$P_t = P[1 + r\%]^n$$

Where: Pt = Population after t years in the future.

P = Present population

r = Population growth rate

n = Duration (n = t)

The table below gives the population projections for a period of twenty (20) years with the initial year 2012, future years 2017, 2022, 2027 and 2032.

Table 8-2: Population Projections for the years 2012 – 2032 for Lwakhakha Town Council

Year	2012	2017	2022	2027	2032
Resident Population	1,030	1,194	1,384	1,605	1,860

8.3 Future waste projections

Assumptions in the projection of future waste generation

- **Domestic / Residential Waste**

These types of waste originate from single or multifamily household units. The wastes are generated from household activities including but not limited to cooking, cleaning, repairs, redecoration, empty containers, used packets, old clothes, books, papers, broken glass, plastic items, broken and useless furniture.

Based on field survey conducted in the study area, a conservative figure of 0.5kg/capita/day of waste generation is used in the estimation of the waste.

- **Commercial Waste (Hotels, Bars, Restaurants, Wholesale & Retail Shops, Small Shops, etc)**

This category includes solid wastes that originate in offices, wholesale and retail markets, restaurants, hotels, warehouses or go-downs and other commercial establishments.

The waste is projected based on the commercial developments within Lwakhakha. The projected waste generation from commercial establishments is conservatively taken as 25% of the household / domestic waste.

- **Medical Waste**

Medical waste refers to waste generated by health care activities including a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials. And according to WHO, the approximate medical waste generated per person per year is about 0.5kg.

- **Market Waste**

The market waste generation will increase based on the increase in population. Presently, Lwakhakha market centre has two open-air markets, which operate on a regular basis, and new modern market is proposed for construction.

- **Road Waste**

Road waste is generated from residences and establishments. For estimation purposes, road waste generated is computed based on the length of the road network in Lwakhakha.

Projection of waste generation

Based on the assumptions above, the following wastes are generated in Lwakhakha.

Table 8-3: Projection of the Total Waste Generation in Lwakhakha, (Tons/Day)

Waste Characterization	2012	2017	2022	2027	2032
Residential Waste	0.50	0.60	0.70	0.90	1.00
Markets Waste	0.10	0.15	0.20	0.22	0.25
Commercial Waste	0.10	0.15	0.20	0.22	0.25
Total	0.70	0.90	1.10	1.34	1.50

8.4 Development and evaluation of technical aspects

Collection and transportation plan

- **Proposed Collection System**

Lwakhakha market centre is small but relatively busy due to the cross border transactions. With such transactions taking place at the centre, we expect the generation of solid waste on daily basis to be on a rising trend. This requires very effective and efficient method of waste collection and disposal.

We propose the use of a tractor of carrying capacity 5 tons for ease of movement and the amount of waste generated.

Based on the future waste projections and new technologies, the following are the proposed waste collection system.

Table 8-4: Proposed Waste Collection System for Lwakhakha

Zone	Collection area	Collection Method	Frequency of Collection	Responsible collector.
Zone 1-3	Residential	Litter Bins	Once per week	Bungoma County Council
	Commercial areas and Streets/Roads	Litter Bins	Daily	Bungoma County Council
	Markets	Litter Bins	Daily	Bungoma County Council

- **Waste Management Tools and Equipment**

Basic tools and equipment like wheelbarrows for street sweeping, sweeping brooms, shovel/spade, hand gloves, rakes etc shall be required for effective solid waste management.

- **Proposed Collection Litter Bins and Tractor**

	Short-Term (2012 – 2017)	Medium – Term (2017 – 2022)	Long –Term (2022 – 2032)
Area of the Municipality	Required No. of Litter Bins		
Market	5	7	10
Residential Market	10	10	15
Commercial Centre	5	5	5
Required Tractor and Trailer			
Market Residential Market Commercial Centre	1	1	1

The assumptions made for the proposed collection system are:

7. The lifespan of a collection tractor is approximately 10 years.

Waste disposal site

Currently, crude dumping of waste is being exercised within the market centre. The proposed system of waste disposal requires that the Council acquires land for future waste disposal site. However the disposal site will involve the controlled dumping and composting.

To manage controlled dumping of solid waste, the Bungoma County Council should make arrangement with Ministry of Works on monthly basis to have a Shovel / Dozer for spreading of soil layer and compaction of the dumped solid waste.

Table 8-5: Method of Disposal and Activities during the Plan Period

Method of Disposal	Short Term 2012-2017	Medium term 2017-2022	Long Term 2022-2032
	Activities during the Plan period		
Develop controlled dumping	Acquire 5-acre piece of land for solid waste dumping and fence. Also undertake controlled dumping and composting	Continue with the controlled dumping of solid waste and composting. The recyclable materials to be assembled and transported to Bungoma on monthly basis.	

The figures below illustrate a composting site.

Figure 8-1: Typical Arrangement of a Composting Site

By-Laws on Solid Waste

Bungoma County Council will need to formulate and enforce its own solid waste management By-laws to regulate the collection, transportation and dumping of solid waste.

Wastes requiring special attention

Currently there are no dispensaries / clinics but it is anticipated that in the future demand for such services will arise. We propose that such medical waste to be transported to Bungoma where an incinerator will have been established.

Office space and equipment

To be able to manage the solid waste efficiently, the market Centre requires a solid waste administration office in Lwakhakha.

The following offices and staff are proposed for the solid waste management.

Table 8-6: Proposed administrative Offices, Staffing and Supervision Equipment

Zone / Disposal Site	Size of Office	Proposed Staff
Lwakhakha Market	1 No. Area – 2.5 x 3m ($7.5m^2$)	· 1 No. Supervisors · 1 No. drivers · 1 No. Backsmen for the drivers · 10 No. street sweepers

Waste Recycling and Reuse

Through public campaigns, recycling and reuse of waste should be encouraged particularly at the household level or should be recovered at the source/point of generation. Where such has not been done, it should be during transportation stage or at the disposal site. The earlier the waste materials are separated, the cleaner the recovered material and the higher the quality as well as value to the end users.

We propose the following solid waste to be recycled and used.

- Glass
- Plastics
- Paper
- Scrap metal
- Organic matter for composting.

Private firms who use the recyclable materials as raw materials for their industry are located at Bungoma and the materials shall be transported once per month to Bungoma Town.

8.5 Community participation

Community participation in solid waste management in Lwakhakha is significant in strengthening coordination between Bungoma County council, waste generators and community based organization. During the short-term period it is proposed that mass campaign should be done to raise awareness of the people. The campaign is aimed at getting the cooperation and participation of the public in solid waste management in the Market centre. It will target waste separation by households, waste reduction by composting, provision of bins for recyclable materials.

Bungoma County council will regulate and monitor the operations of any of the CBO's that may show interest in participating in solid waste management and ensure that there is fair competition in the market for all parties.

8.6 Implementation Plan

Table 8-7: Implementation Plan for the Solid Waste

ACTIVITY	SHORT TERM 2012-2017	MEDIUM TERM 2017-2022	LONG TERM 2022-2032
COLLECTION AND TRANSPORTATION			
Formulation of the collection and transportation system			
Monitoring of the collection and transportation system			
Procurement of the waste collection tractor and trailer			
SETTING UP OF THE ZONAL OFFICES			
Setting up of Offices			
Maintaining the Offices			
DISPOSAL SITE PLAN			
Setting up a controlled dumping and composting site			
Maintaining the disposal site			
ORGANISATIONAL RESTRUCTURING OF THE ENGINEERING DEPARTMENT OF THE COUNTY COUNCIL			
Staffing of the zonal offices			
Training of the Staff			
Production of Operational Manuals			
LEGAL FRAMEWORK			
Formulation and enforcing of the By-laws			
FINANCIAL MANAGEMENT			
Setting up of waste charging system			
COMMUNITY PARTICIPATION PROMOTION PLAN			
Public awareness of CBO's			
Training of CBO's			

8.7 Source of funds

There are no specific funds set aside in the County council or the ministry of local government for the management of solid waste. Possible sources of funds for the establishment of a strong solid waste section, construction of facilities and operations of the section may include but not limited to:

d. Central Government
e. User charges (flat and graded rate). A low rate for a basic amount of garbage and a higher rate for huge garbage generation
f. Sourcing for grants through writing of proposals to funding institutions

8.8 Review of the plan

The private operators in case of any, the CBO's and the county council staff will be reporting to their superior on a daily, weekly, monthly, quarterly and annually on the challenges and the implementation of solid waste plan. This will translate to a review of the solid waste plan once in every two years through a stakeholder's forum. The review will dictate the future implementation process of the plan.

8.9 Project cost

The project cost for the proposed solid waste management plan for Lwakhakha is as shown below.

Table 8-8: Project Cost for Lwakhakha – Kenya – Solid Waste Management Plan, USD

Project Cost component	Short Term 2012 - 2017	Medium Term 2017 -2022	Long Term 2022-2032
Capital Cost	166,188	90,682	200,988
Operation and Maintenance	192,471	232,235	438,353
Total Cost	**358,659**	**322,917**	**639,341**

REFERENCES

GoK 2010: 2009 *Kenya population and Housing Census*

http://www.kenyalaw.org/klr/index.php

GoK: *Feasibility study on solid waste management in Kitale, Bungoma, Kakamega and Busia*.

GoK 2010: *Preparatory Survey for Integrated Solid Waste management in the Republic of Kenya*

GoK, 2010: *District Strategic Plan 2005 - 2010 for Implementation of the National Population Policy for Sustainable Development Bungoma District*

Municipal Council of Bungoma 2009: *Garbage collection plan for Bungoma Municipality*

GoK 2009: Kenya Local Government Reform Program Local Authority Service Delivery Tools Manual *8 Solid Waste Management*

GoK 2010: *Strategic Urban Development Plan for Bungoma Town 2008-2030 Environmental Strategy*

GoU 2008: *Tororo district local government Malaba town council Consultancy services for the Development of a comprehensive Stormwater drainage master plan for Malaba town council, Uganda Draft design report June 2008.*

UNEP 2009: *Developing integrated Solid waste Management plan Training manual Volume 1:* Waste characterization and Quantification with projections for future.

UNEP 2009: Developing integrated Solid waste Management plan Training manual Volume 2: Assessment of Current Waste Management System and Gaps therein

Beck R. W. 2006: *Solid Waste Management Plan state of Georgia*

Jefferson County Solid Waste Management Plan, Final Draft 2000

World Bank (1999): *What a waste: Solid waste management in Asia, Urban Development Sector, Unit East Asia and Pacific Region*, World Bank Washington, D.C USA

APPENDIX A: Project Cost Breakdown

LWAKHAKHA SOLID WASTE MANAGEMENT PLAN - CAPITAL COST												
			Short-Term (2012 - 2017)			Medium-Term (2017 - 2022)			Long-Term (2022 - 2032)			
Stage of Waste Management	Facilities, Activities / Equipment Required	Unit	Rate USD	Quantity	Estimated Amount USD	Rate USD	Quantity	Estimated Amount USD	Rate USD	Quantity	Estimated Amount USD
Start up Stage	Community Cleaning - Tools and labour required for one day cleaning - only the core centre	Item	Sum	1	2,353						
	One weeks Senistization Programme on the Solid Waste Management Plan	Item	Sum	1	1,765						
Collection and Transportation	Litter Bins	No	647	20	12,941	882	22	19,412	1,176	32	37,647
	5 Ton Tractor and Trailer	No	58,824	1	58,824				64,706	1	64,706
Disposal Site	Purchase of Disposal and composting site	Acres	3,529	5	17,647						
	Fencing of the Disposal Site	m	10	1200	12,000				5	1200	5,647
	Hire of Shovel	Days	329	52	17,129	518	52	26,918	612	52	31,812
Administration and supervision	Supervision Office(s)	No	1,324	1	1,324						
	Disposal site office	No	1,324	1	1,324						
Legal Framework	Enforcement of the By-Laws	Item	Sum	1	24,706	Sum	1	29,647	Sum	1	49,412
Financial Management	Training on Financial management	Item	Sum	1	5,882	Sum	1	8,824	Sum	1	11,765
Community Participation	Public awareness	Item	sum	1	4,412						
	Training on CBO's	Item	Sum	1	5,882	Sum	1	5,882			
	Total Capital Cost				**166,188**			**90,682**			**200,988**
LWAKHAKHA SOLID WASTE MANAGEMENT PLAN - OPERATION AND MAINTENANCE COST												
Labour Cost	1 No. Supervisors	Item	Sum	1	21,176	Sum	1	29,647	Sum	1	49,412
	1 No. Drivers	Item	Sum	1	21,176	Sum	1	21,176	Sum	1	42,353
	1 No. Backsmen	Item	Sum	1	14,118	Sum	1	14,118	Sum	1	28,235
	1 No. Watchment	Item	Sum	1	25,412	Sum	1	12,706	Sum	1	25,412
	10 No. Street sweepers	Item	Sum	1	84,706	Sum	1	101,647	Sum	1	169,412
Maintenance Cost	Fuel	Item	Sum	1	14,118	Sum	1	35,294	Sum	1	105,882
	Servicing	Item	Sum	1	5,882	Sum	1	8,824	Sum	1	8,824
	Wear and Tear	Item	Sum	1	5,882	Sum	1	8,824	Sum	1	8,824
	Total Operation and Maintenance Cost				**192,471**			**232,235**			**438,353**
	Total Cost of the Implementation Plan				**358,659**			**322,918**			**639,341**

APPENDIX B: Investment Plan

Recipient Party[2]	Bungoma County Council
Executing Agency	Nile Basin Initiative
Main Beneficiaries	Lwakhakha market
Estimated Cost (USD)	8. Short Term - $ 358,659 9. Mid Term - $ 322,918 10. Long Term - $ 639,341 11. **Total cost - $ 1,320,918**
Location/Intervention area	Lwakhakha market centre
Duration	20 years

Background

The increase in population and economic activities in Lwakhakha market centre has led to an increase in demand for resources. It is evident that rapidly increasing consumption of products and services on the other hand has led to a subsequent increase in waste products that require safe disposal. Inadequate solid waste management in Lwakhakha poses a challenge to the environment and in particular water quality management because of their potential in causing surface water pollution in the area. Although the imminent impacts of solid waste pollution may not be obvious, it is apparent that it could be detrimental to biodiversity. There is no waste collection service in Lwakhakha market apart from occasional collection of banana wastes from the banana market. Lack of a waste disposal site in the area on the other hand has contributed to degradation of the environment, human health, hygiene and aesthetic conditions of the market centre. Therefore solid waste management is a concern requiring urgent intervention.

Bungoma County Council though responsible of waste management in Lwakhakha market centre has no enough capacity for effective solid waste management service delivery. In spite of this, the council ought to be in charge of handling and delivery of all waste management services ranging from collection, transportation, treatment, storage and disposal. However there are several challenges impeding the council's ability to deliver solid waste management services effectively in Lwakhakha and these includes but are not limited to the following: lack of waste disposal site, absence of waste segregation, lack of household waste collection facilities, indiscriminate waste dumping, lack of employed waste workers at Lwakhakha market, underfunded waste management activities in the engineering department at the council, location of the market at up-slope of Lwakhakha river, un-coordination among solid waste management institutions, poor public awareness and participation in solid waste management activities, indiscriminate waste burning by the local people, solid waste management practice that does not meet set standards and regulations in the legal framework and lack of an enforcement mechanism.

Following insufficient solid waste management practice in Lwakhakha market, the Nile Basin Initiative is making efforts to improve the sanitary environment of the Sio-Malaba-Malakisi Sub Basin through integrated watershed management strategy. The Integrated solid waste management initiative seeks to maximize resource use efficiency by taking a strategic approach to the sustainable management of solid waste considering all aspects including sources of wastes as well as all stages namely generation, segregation, sorting, treatment, recovery and disposal in an integrated manner with an objective of reversing environmental degradation in the sub basin.

- **Justification**

Inadequate solid waste management is a challenge not only in Lwakhakha but in many market centres within the Sio-Malaba-Malakisi River Basin leading to subsequent dispersal and degradation of the environment particularly in regard to water quality. The situation in Lwakhakha has been exacerbated by lack of a designated waste disposal site, increased storm run-off, low public awareness and discipline, inadequate waste collection system, underfunded Engineering department, lack of fee collection system to sustain an effective program and lack of legal framework enforcement capacity to prevent littering or haphazard waste disposal within Lwakhakha market centre. However, solid waste generated at the market centre requires proper management because of the specific conditions characterised by the area. The high run-off, indiscriminate burning and inadequate solid waste disposal in Lwakhakha require proper management to minimize risks to the environment and human health.

Therefore the implementation of the solid waste management proposal will go a long way in improving and expanding solid waste collection, improving solid waste disposal, enhancing institutional capacity, increasing public awareness and participation in solid waste management. This will reduce pollution effects on the environment occasioned by poor solid waste management and ensuring of a clean environment to the residents of Lwakhakha market. The implementation of the proposal will also enhance the technical, human and financial capacity of Bungoma County Council to discharge its functions effectively however of significance is the contribution to the objectives of the Nile Basin Initiative in reversing environmental degradation.

- **Scope of the proposal**

The proposed solid waste management investment plan involves short, medium and long-term proposals. The scope of the proposal includes but not limited to the following:

1. Solid waste management sensitization
2. Technology of collection, transportation and disposal of solid waste.
3. Administration and supervision
4. Organisational restructuring of the Bungoma County Council mandated to manage solid waste in Lwakhakha
5. Community participation in the management of solid waste

Objectives

In view of the above it is the aim of the intervention to achieve the following objectives singly or in combination:

- To improve the technical capacity of the county council to effectively manage solid wastes.
- To improve solid waste collection, storage, transportation and disposal system in Lwakhakha.
- To enhance public awareness and participation for sustainable solid waste management in Lwakhakha
- To enhance waste recycling and reuse as a way of reducing solid waste volume and impact to the environment.
- To enhance institutional capacity of the county council in solid waste management service delivery and enforcement.
- To reduce degradation of water resources and the environment in general.

Outputs

- A well-equipped solid management site office at Lwakhakha market.
- Improved waste collection, transportation, storage, treatment as well as disposal system at Lwakhakha.
- Public awareness and active participation in solid waste management at Lwakhakha market centre.
- Proper management of medical wastes generated at the market centre
- Enhanced institutional capacity at Bungoma county council to enforce and deliver solid waste management services in Lwakhakha.
- Reduce waste through recycling and composting of the organic waste
- Reduced pollution of the water resources due to poor solid waste management practices at Lwakhakha market centre.

Deliverables

	DELIVERABLES	PERIOD	
12.	Formulation of the collection and transportation system and preparation of monitoring report of solid waste management	End of year 2012	
13.	Procurement of collection Vehicles	End of 2013	End of 2022
	5 ton Tractor	1.No	1.No
	Trailer	1.No	1.No
14.	Establishing of field Office	End of 2013	
	7.5 M^2	1.No	
15.	Purchasing of land for waste disposal site	End of 2014	
16.	Setting up of a composite	End of 2014	
	Construction of landfill	End of 2027	
17.	Staffing of Field office	End of 2014	End of 2022
	A supervisor	1 No.	1 No.
	A driver	1 No.	1 No.
	A backs man	1 No.	1No.
	Watchmen	1 No.	1 No.
	Street sweepers	10 No.	
18.	Enforcement of bylaws staff	End of 2014	End of 2022
		1.No	1.No
19.	Putting Waste charging system in place	End of 2017	
20.	Public awareness and CBOs training	End of 2017	

Implementation Methodologies

Stage of Waste Management	Facilities, Activities / Equipment Required	Risks
Start-up Stage	Community Cleaning - Tools and labour required for one day cleaning - only the core centre	· Willingness of the public to participate
	One Week Sensitization Programme on the Solid Waste Management Plan	· Willingness of the public to participate
Collection and Transportation	Litter Bins	· Willingness of the local people to use the litter bins.
	5 Ton Tractor and Trailer	
Disposal Site	Purchase of Disposal and composting site	· Availability of suitable land · Willingness of local people to buy the composed for farm use · Availability of shovel for hire
	Fencing of the Disposal Site	
	Hire of Shovel	

Stage of Waste Management	Facilities, Activities / Equipment Required	Risks
Administration and supervision	Supervision Office(s) Disposal site office	· Availability of space for hire or construction of the office
Legal Framework	Enforcement of the By-Laws and other regulations	· Enactment of by-laws and willingness of other public officers/government departments to participate
Financial Management	Implementation of waste charging system Training on Financial management	· Willingness and ability of local people to pay for the services
Community Participation	Public awareness Training on CBO's	· Willingness of the local people to participate

- **Required Funds Inputs**

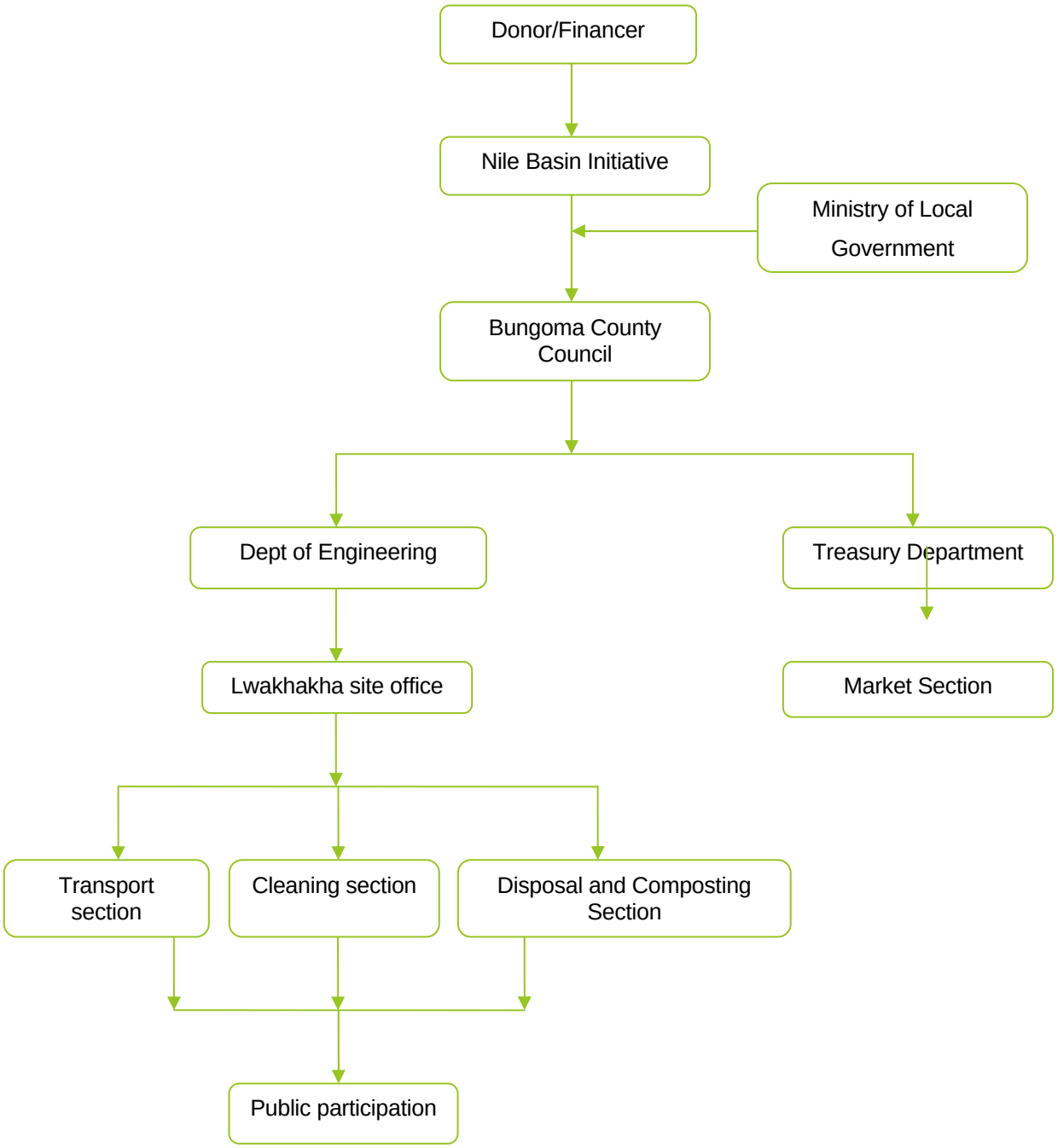
Project Cost component (USD)	Short Term 2012 - 2017	Medium Term 2017 -2022	Long Term 2022-2032
Capital Cost	166,188	90,682	200,988
Operation and Maintenance	192,471	232,235	438,353
Total Cost	358,659	322,918	639,341

- **Main performance indicators**

  - Installation and management of litter bins at strategic areas in all the areas of the market centre as well as cleaning the Central Business street
  - Enactment, Enforcement and adherence to solid waste management rules and regulations in the market centre.
  - Adequate waste collection capacity from all households within Lwakhakha
  - Acquiring and operation of a disposal site in an environmentally sustainable way
  - Ensure an efficient and effective waste transportation system within the market centre.
  - Improved community participation at all stages of solid waste management process.
  - Proper Medical waste management through collection and transportation to Bungoma municipality for treatment and safe disposal.
  - Public participation in waste reduction through recycling and composting of organic refuse.

Institutional Arrangements

The proposal will be implemented through a participatory process involving several stakeholders including but not limited to the Financier, Nile Basin Initiative, Bungoma County council and the public at large. The proposed institutional arrangement is as shown on the diagram below:



Costs and Benefits

When solid waste are not collected and disposed (removal from source), it causes health, social and economic problems to the community directly or indirectly. The poor or the weak in society more often than not are the ones who bear huge problems. When the community or residence ignore solid waste, the Government are normally forced to intervene at the last minute due to health complications of it population (labour force)

Whether it is Government or community, solid waste management has a cost. This cost ranges consists of the following:

- Fixed costs
- Capital cost
- Depreciation and amortization
- Financial cost
- Variable cost
- Operating costs
- Consultancy costs

Whereas the costs of the proposal can be determined, the value of benefits cannot be easily quantified because of the multiple benefits that results from a clean and health environmental. The benefits of a clean environment though appreciated cannot be given a direct monetary cost as it is a challenge to value factors such as aesthetics, clean air, high quality water resources and clean land that will result from the implementation of the proposal. The effects of environmental pollution on the other hand occur after a long time and one cannot directly link such effect to a certain pollutant or the source because of other factors at play. However the cost benefit table below indicates the monetary value of some benefits based on the following assumptions:

- Pollutants from inadequate solid waste management activities polluting soil, water and air will result into human health problems that will require medical consultations and that this pollutants will find their way into the food chains and food web.
- Manure from compost organic matter will be sold to farmers
- Recycling activities from CBOs will generate income from wastes
- Involvement of the private sector will open up employment opportunities to the local people
- Proper waste handling will reduce health effects from the direct contacts with waste from those scavenging or working on the waste directly

COST / BENEFIT ANALYSIS

S/ NO.	COST ANALYSIS			BENEFITS ANALYSIS		
	STAGES	DESCRIPTION	VALUE US$	DESCRIPTION	ELEMENTS	VALUE US$
1	Start up Stage	Community Cleaning - Tools and labour required for one day cleaning – only the core centre	2,353		· The local people will appreciate the need for a clean environment	
		One week Sensitization Programme on the Solid Waste Management Plan. This process will help in identification of companies involved in solid waste recycling	1,765		· Appreciation and familiarization with the plan by all stakeholders and soliciting their participation in the implementation process · Identification of stakeholders' roles and responsibilities in the whole process of implementation	
2	Collection and Transportation	Litter Bins	70,000	· Reduce haphazard disposal of waste	· Improves the aesthetic value · Easy to collect waste for dumping	600
		5 Ton Tractor and Trailer	123,529	· Easy transportation of waste to disposal site	· Reduction in land, air and water pollution · Improves the aesthetic value	8,000
3	Disposal Site	Purchase of Disposal and composting site	17,647	· Reduced haphazard waste disposal · Composting of organic matter	· Improves the aesthetic value · Generation of manure · Controlled emission of green house gases (methane) · Reduced breeding of vectors · Reduced sediment loading to water sources	2,800
		Fencing of the Disposal Site	17,647	· Prevention of site encroachment	· Protection of trespassers from infection and unhygienic conditions	800
		Hire of Shovel	75,859	· Compacting of wastes	· Reduced leachate · Reduced wind blow/scatter of waste · Increased lifespan of the site	8,000
4	Administration and supervision	Supervision Office(s)	1,324		· Monitoring of waste management at the field level	
		Disposal site office	1,324	· Effective management of disposal site	· Control of dumping activities · Maintenance of the disposal site	
5	Legal Framework	Formulation and Enforcement of the By-Law	103,765		· Ensure adherence to good solid waste management practices by all stakeholders	600
6	Financial Management	Training on Financial management	26,471		· Ensure efficient and effective management of financial resources	
7	Community	Public awareness	4,412		· Increased community	

COST / BENEFIT ANALYSIS

S/ NO.	COST ANALYSIS			BENEFITS ANALYSIS		
	STAGES	DESCRIPTION	VALUE US$	DESCRIPTION	ELEMENTS	VALUE US$
	Participation				appreciation and participation in solid waste management.	
		Training on CBOs	11,765		· To enhance local organizations' capacity to participate in solid waste management.	3,500
TOTAL CAPITAL COST			**457,859**			
Lwakhakha Solid Waste Management Plan – Operation and Maintenance Cost						
	Labour Cost	1 No. Supervisors	100,235			
		1 No. Drivers	84,706			
		1 No. Backsmen	56,471			
		1 No. Watchmen	63,529			
		10 No. Street sweepers	355,765			
	Maintenance Cost	Fuel	155,294			
		Service	23,529			
		Wear and Tear	23,529			
TOTAL OPERATION AND MAINTENANCE COST			**863,059**			
TOTAL COST OF THE IMPLEMENTATION PLAN			**1,320,918**			**24,300**

It should be noted that benefit figures were not established but just an indication of the possible value.

- **Environmental and Social Management Framework considerations**

The proposal will be implemented by all stakeholders in a participatory process involving the financiers, the Nile Basin Initiative, the ministry of local government and other government departments, the County council of Bungoma and the local community. It is anticipated that through public campaigns, all individuals within households will be expected to participate in the waste management process either directly or indirectly. Community involvement on the other hand will ensure that their needs and constraints are integrated in the objectives of the proposal hence its effective implementation. Public involvement will further enhance the sustainability of the proposed project, increase local ownership and a sense of responsibility for maintaining the solid waste management services provided through the proposed project. The delivery of solid waste management service in Lwakhakha is expected to cover all areas of the market centres including but not limited to the banana market, open-air market and from all households.

Implementation of the proposal will improve solid waste management hence reducing the associated environmental pollution of air, soil and water whereas human health impacts and environmental degradation will be greatly reduced.