

# **MBALE MUNICIPAL LOCAL GOVERNMENT COUNCIL**

## **ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED WASTE COMPOSTING PROJECT**



**WASTE DUMPING SITE IN DOKO CELL, MBALE**

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**February 2007**

## CERTIFICATION

We certify that this Environmental Impact Assessment was conducted under our direction, supervision and based on the Terms of Reference provided by Mbale Municipal Council Authorities.

We hereby certify that the particulars given in this report are correct and true to the best of our knowledge:

Name and Role on EIA Team	Key Responsibilities	Signature & date
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## LIST OF ACRONYMS

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BCU	Bugisu Cooperative Union
CFR	Central Forest Reserve
COD	Chemical Oxygen Demand
dB	Decibel
DEO	District Environment Officer
DWD	Directorate of Water Development
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
GIS	Geographical Information Systems
LC	Local Council
MMC	Mbale Municipal Council
NEMA	National Environment Management Authority
NWSC	National Water and sewerage Corporation
NGOs	Non Governmental Organizations
OPEP	Opportunities for Environmental Planning
RIAM	Rapid Impact Assessment Matrix
UKI Uganda	Uganda Klere Industries Uganda
WRMD	Water Resources Management Department of DWD
WHO	World Health Organization

## **EXECUTIVE SUMMARY**

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### **Background**

This Environmental Impact Statement presents the results of an environmental study of the likely impacts of the proposed composting project on the biophysical and social-economic environment of Mbale Municipality, Mbale District.

### **Description of the proposed project**

Mbale Municipal Council plans to improve on the municipal waste management practices, through composting of municipal solid waste and marketing the compost. The proposed composting project activities include construction of a slab for materials handling, collecting, transporting, sorting, shredding, composting and dumping non-biodegradable wastes.

The proposed project site has no settlements; however, in the neighborhood there is a wheat flour processing mill. Other land uses around the site include subsistence agriculture, involving growing of food crops like maize; beans and sugar canes.

A composting facility will be constructed and operated by Mbale Municipal Authorities at the present waste dumping site. The composting facility will require 2.5 ha and will include a concrete pad receiving area, processing and storage area of capacity of 70 tons. Capital investments on equipment will include a back hoe tractor; skip lifting trucks, skips, water pumps, waste lifting fork, protective gear and sieving screen that will be purchased. Others include concreted pad, an office block, VIP latrine, water tanks, road construction and maintenance; staff wages and training, siting, and mitigation costs. The estimated cost of the project is Uganda shillings 400,000,000 (Four Hundred Million).

### **Public Consultation**

Stakeholders' concerns and views were collected through personal interviews of the key stakeholders from Mbale Municipality and the Lead Agencies. Interviews were conducted between July 20<sup>th</sup> and September 30<sup>th</sup> 2006 by members of the EIA Team. The following stakeholder categories were represented in the interviews:

- Community members and waste scavengers in Industrial and Northern Divisions;
- Mbale Local Government - District Environment, Health and Water Officers;
- National Water and Sewerage Corporation Manager Mbale Branch;
- Mbale Municipal Council - Town Clerk, Medical Officer of Health, Municipal Engineer and Physical Planner.
- Private tree nursery and flower attendants.
- NGOs involved in composting in Kampala
- Faculty of Agriculture Makerere University, and
- Lead agencies

### **Environmental Impact Assessment**

The National Environment Act, Cap 153, requires that a developer of a project described in the third schedule (**waste disposal, including sites for solid waste disposal**) shall carry out an Environmental Impact Assessment and submit a report to the Environmental Agency (National Environment Management Authority), in the prescribed form and giving the prescribed information. It was under this requirement that the EIA was conducted.

The key objective of the environmental study was to assess the likely impacts of the proposed composting project on social-cultural, economic and biophysical environment and propose mitigation measures.

### **Impacts of the proposed composting project**

Environmental and Social Impact Assessment results reveal that there are likely minor to moderate impacts on the environment, namely:

#### **Positive impacts**

- **Improved waste Management:** The environmental aspects of this project are positive because benefits are derived from the totality of the project's components, namely improved final waste disposal for Mbale Municipality; improved waste collection; reduced illegal dumping; initiation of hazardous waste handling and disposal program; improved institutional ability to manage, regulate and monitor the solid waste sector; educational programs to assist in raising consciousness of the population in composting and recycling:
  - elimination of a potential ground water hazard at dumpsite(s) while producing a safe organic fertilizer product which reduces the requirements for chemical fertilizers;
  - elimination of the obnoxious odours associated with most waste disposal systems,
  - elimination of the discharge of gaseous pollutants, dust, and elimination of vermin infestation common with other disposal methods,
  - extension of dumpsite life once the bulk of the largely organic waste is composted.
  - employment, revenue generation through sale of compost and; sale of recyclable and recoverable items after sorting.
- **Social benefits:** The major social benefit will be an increase in general cleanliness of the Mbale Municipality, which will provide a more pleasant and healthier environment for residents. Improved sanitary conditions of the existing dump site at Doko will reduce odor to the residents and control vermin. Reduction of road-side waste and elimination of dumps in town will have a broad social benefit for town residents and visitors. In addition to employment and increased income to participating community members
- **Reduced Scavenging:** The garbage within the municipality and at the dump site is target for scavengers such as women, children, which endanger their lives and health. The removal of garbage from town will eliminate these dangers to people in town. Since the composting operations will be fenced and guarded; scavengers will have no access to the site.

- **Improved aesthetics:** Mbale Municipality is currently littered with garbage, vultures and vermin such as rats are common site near garbage heaps. The removal of these heaps will greatly improve the aesthetics of the town and minimize the impacts of leachate.

### Short-term negative impacts

- **Erosion and siltation:** Construction activities will loosen soil particles which could in turn accelerate erosion of the loose materials and increase siltation of the drainage downstream. Furthermore, the proposed construction activities could have an impact on existing drainage pattern through increased runoff and soil erosion around the dump site. This could be as a result of leaving the soil bare. It is however expected that the project site will remain vegetated and therefore chances of soil erosion will be minimal.
- **Dust and Nuisance:** Dust will be generated as a result of transportation, excavation and other site preparations-especially if the work is done during windy and dry weather. The noise from transport and construction traffic is expected to be minimal.

### Mitigation of impacts

**Proper waste management:** Collecting, sorting, size reduction, composting, compost marketing and dumping of the waste will be done in a professional way. This will minimize the impact on the environment, create employment and with time generate revenue for Mbale Municipal Council.

All solid waste generated in Mbale Municipality will be sorted into bio degradable and non- biodegradable wastes. Biodegradable will be collected and transported to the composting facility at Doko in the industrial Division. Non-biodegradable waste will be transported and dumped at gazetted waste dump site. Efforts will be made to ensure that plastic minerals and water bottle containers are collected by interested residents for re-cycling at no charge and/or sold for recycling to interested parties. No. solid waste shall be dumped or left scattered within Town and residential areas.

**Occupational health and safety:** Workers exposed to waste management risks shall be trained, sensitized and provided with effective protective gear and clothing. Municipal solid waste management is not new to Mbale Municipal Council; however the component of composting and marketing is new.

**Scavenging** will not be permitted at the composting facility. However, this project will not interfere with the rice scavengers at the dump site, but will train and integrate them into the waste management project – waste sorting. Recycling will be assigned to project workers and/or associated community members. A fence will be constructed to enclose the site to control vermin, dogs, people and unplanned dumping.

**Odour, noise, pests and litter control:** The organic part of the waste stream will be composted and the inorganic parts that are not recycled will be dumped and covered. This will drastically reduce obnoxious odours. The composting facility will operate twenty four (24 hrs). The buffer zone of a live fence will diminish the sound from the composting facility. Incoming vehicles will be covered with nets to avoid littering along the route and

at the composting facility. Site maintenance will include removal of litter that has blown from the working slab. The vermin will diminish through the composting of organic garbage and covering with soil.

**Compliance to environmental laws and EIA approval conditions:** The activities of composting and waste management will be carried out according to the EIA approval conditions. Additionally, the specific requirements of the relevant legislation cited in this Environmental Impact Statement and existing standards shall be respected and adhered to, with regard to general project implementation and decommissioning.

### **Monitoring the mitigation measures**

A monitoring process will be introduced to check progress and the resulting environmental and social effects on the environment by the planned activities. This will begin during the collection through to composting and marketing, dumping; it will also include regular reviews of the impacts that could not be adequately assessed before the project started, or which may arise unexpectedly. In such cases, appropriate new actions to mitigate any adverse effects will be undertaken. The impact mitigation measures will require stringent monitoring to ensure compliance; Mbale Municipal Council and the three Divisions of Northern, Wanale and Industrial will conduct environmental audit every year to ensure that their activities do not degrade the environment and conform to the environmental laws and regulations.

### **Conclusion and recommendation**

The composting project will be carried out in an integrated manner involving all waste generators and users within Mbale Municipality and the surrounding villages; this will make Mbale Municipality cleaner and regain its lost glory as the cleanest town in East Africa. Collection, separation, size reduction and mixing are all prerequisites to the biological process of composting. The individual physical processes described herein will be selected and linked together with biological processing to form a complete composting system.

It is evident from the EIA findings that Mbale Municipal Local government is in urgent need of a proper municipal waste management program; this composting project will consolidate our effort in waste management. The likely adverse significant impacts of the proposed project and mitigation measures were identified and local authorities are committed to implementing them, which will significantly reduce the impact on the environment. We therefore request that the National Environment Management Authority (NEMA) approves this Environmental Impact Statement for the proposed Mbale Municipal Composting.

## **1.0 INTRODUCTION**

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### **1.1 Background**

Waste management systems must be designed and located to receive the increasing waste load from development activities and as well meet environmental standards. As environmental regulations become more stringent, land-disposal systems must be located and designed more carefully to both minimise risk to the environment and pass rigorous public scrutiny and approval by lead agencies.

Conscious of the likely environmental impacts that may relate to waste management and in accordance with regulatory requirements, Mbale Municipal Council (MMC) has conducted an EIA for the proposed Mbale Municipal Composting Project to ensure that likely negative adverse effects are mitigated and beneficial ones enhanced.

The Environment Impact Assessment (EIA) was conducted by registered and certified EIA practitioners and other key experts (**Appendix 1**) to identify; predict and evaluate the likely environmental impacts of the proposed composting project.

### **1.2 Objectives of environmental impact assessment (EIA)**

The overall objective of the EIA study was to assess the likely adverse biophysical and social-economic impacts resulting from the implementation of the proposed Mbale Municipal Composting Project and recommend mitigation measures to the adverse impacts.

### **1.3 Methodology and approach to the assignment**

#### **1.3.1 Overview**

This Environmental Impact Study (EIS) was conducted in accordance with the EIA Guidelines (1997) and EIA Regulations (1998) for Uganda. It identified and evaluated positive and negative impacts of the proposed Mbale Municipal Composting Project. It recommended appropriate mitigation measures to minimize and/or eliminate the undesirable effects. An Environment and Social Management Plan was designed.

Details of the methods used in identifying environmental issues included desk research/literature review; physical inspection of the project site, on-spot observations, expert consultation, local community consultations, use of checklists, questionnaires, scientific analysis and professional judgement by the EIA Team.

#### **1.3.2 Literature review**

Relevant policies, regulations, legal framework and literature on Municipal Solid Waste Composting and other documents were reviewed to get information concerning impact of waste management program (**Appendix 2**).

#### **1.3.3 Public consultation**

Socio-economic issues were assessed through semi-structured interviews with several stakeholders including opinion leaders, Local Council I and III leaders, Town Clerk, District

Environment Officer, Health Inspector, Town Engineer and other lead agencies particularly the National Water and Sewerage Corporation Area Manager Mbale and Department of urban planning. Focus Group Discussions (FGDs) were conducted in the local languages interpreted into English to the consultants by a person selected amongst the community members (**Appendix 3 and 4**).

#### **1.3.4 Mapping and photography**

Mapping and photography were some of the tools used to generate the maps and photographs, some of which are included in this report.

#### **1.3.5 Identification of health and safety Risks**

Possible sources of occupational hazards to the workforce were identified and proposed plans and measures to overcome them recommended. Occupational Health and Safety (OHS) impacts of development and operational phases were predicted basing on nature of composting activities and occupational safety risks involved.

#### **1.3.6 Assessment of Impact of waste haulage**

Municipal solid waste comprised of organic and inorganic wastes will be transported to the waste management facility and compost transported out of the site. The major issue investigated was the vehicular volume, potential for compacting the site and impact on the access roads and drainage.

#### **1.3.7 Baseline water quality**

Baseline water quality (of river Namatala) was established by measuring critical parameters namely; nitrogen, phosphorus, suspended solids, BOD<sub>5</sub>, COD, turbidity and microbiological content of the water at points upstream and downstream the project site (**Appendix 5**). Laboratory tests, using standard methods for the examination of water and wastewater and microbiology of the water were analysed using membrane filtration method.

The EIA team didn't investigate the ground water quality and depth.

#### **1.3.8 Soil analysis**

Soil samples from the current waste dumping site in the Industrial Division were taken from depths of 4 to 8 inches with a soil augur, mixed thoroughly in a plastic bag and clearly labeled. The samples were then taken to Makerere University Faculty of Agriculture Laboratory for analysis (**Appendix 6**).

#### **1.3.9 Checklists**

A checklist (**Appendix 7**) structured on the basis of environmental components in the case of the biophysical environment, and of socio-economic concerns with regard to activities, man-made structures, institutions or demographic-economic changes brought about or needed by the proposed project was used to screen the major impacts. For

each of the components or concerns, specific aspects that are liable to be modified by the proposed project were listed.

### 1.3.10 Waste composition sampling

Solid Waste generated by Mbale Municipality was characterised to establish its constituents. Different samples of waste were randomly extracted from 7 waste collection points in both Industrial and Northern Divisions of Mbale Municipality and for every unit sampled, waste were manually sorted into 3 major classes. The classes were A (Organic waste), B (Polythene and plastic) and C (metals & glasses). The three classes (A, B & C) were then weighed. Since the average number of skips collected from each division is known the quality (composition) and quantity (amount {in tons}) of waste generated by the municipality was then estimated (Table 1 - 3). One (1) skip of waste was approximated to be 1.8 tons.

### 1.3.11 Waste quantification and classification

**Table 1: showing results of quantity and quality of waste sampled**

Sample No	Division	Skip location	Amount in (Kg) sampled	Composition of waste sample (Kg)		
				Organic waste	Polythene & Plastics	Metals & Glasses
1	Industrial	Busiifa cell ( near MMC office)	23.60	19	4.5	100g = 0.1
2	Industrial	St. Andrews cell, Mpologoma	46.20	38.5	7.5	200g = 0.2
3	Industrial	Park cell, Bus park	29.62	21	8.5	120g = 0.12
4	Industrial	Cathedral cell, old bus park	51.15	47	4.0	150g = 0.15
5	Northern	Nkoko Njeru Terrace, Jambula	25.3	20	5	300g = 0.30
6	Northern	Hospital cell, Kumanda	34.15	28	6	150g = 0.15
7	Northern	Clock tower cell, Masaba wing	30.3	27	3	300g = 0.30

**Table 2: Quantity and composition of waste sampled in percentage (%)**

Sample No	Division	Skip location	Amount in (%) sampled	Composition of waste sample (%)		
				Organic waste	Polythene & Plastics	Metals & Glasses
1	Industrial	Busiifa cell	100	80.508	19.0678	0.423729
2	Industrial	St. Andrews cell, Mpologoma	100	83.333	16.23377	0.4329
3	Industrial	Park cell, Bus park	100	70.898	28.69683	0.405132
4	Industrial	Cathedral cell, old bus park	100	91.887	7.820137	0.293255
5	Northern	Nkoko Njeru Terrace, Jambula	100	79.051	19.76285	1.185771
6	Northern	Hospital cell, Kumanda	100	81.991	17.56955	0.439239
7	Northern	Clock tower cell, Masaba wing	100	89.109	9.90099	0.990099
		<b>Average percentage</b>	<b>100</b>	<b>82.397</b>	<b>17.00742</b>	<b>0.595732</b>

**Table 3: Quality and quantity of waste generated daily in Mbale Municipality**

Division	No of skips	Total waste	Composition of waste in tones
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	collected/day	Quantity in tones	Organic waste	Polythene & Plastics	Metals & Glasses
Industrial	15	27	22.24719	4.5920034	0.1608476
Northern	5	9	7.41573	1.5306678	0.0536159
Wanale	3	5.4	4.449438	0.9184007	0.0321695
Total for the municipality	23	41.4	34.112358	7.0410719	0.246633
<b>Total in %</b>		<b>100</b>	<b>82.397</b>	<b>17.00742</b>	<b>0.595732</b>

### 1.3.12 Evaluation and analysis of impacts

Subsequent to preliminary screening, adverse impact were analysed using the Rapid Impact Assessment Matrix (RIAM) program; the results are outlined in Chapter 8. The RIAM uses a scoring within a matrix (**Appendix 8**) that has been designed to allow subjective judgments to be quantitatively recorded, thus providing both an impact evaluation and a record that can be re-assessed in future (Olsen and Olsen-Fredensberg, and Pastakia 1998). The assessment criteria use five criteria namely; importance of condition; magnitude of change/effect; permanence; reversibility and cumulative criteria that represent the most important fundamental assessment conditions for all Environmental Impact Assessments.

### 1.4 Site assessment

The EIA team visited proposed locations for waste management and composting facilities with Mbale Municipal Council staff to advise on and discuss the suitability of the site with regards to layout and position. This was done prior to consulting the affected and interested parties; site assessment considered drainage and slopes, neighbours, and the potential for expansion.

### 1.5 SWOT Analysis

A SWOT analysis stands for Strengths, Weaknesses, Opportunities, and Threats and is a simple way to analyze the company's present marketing situation. A SWOT Analysis is an integral part of a marketing plan and can also be part of a business plan.

The SWOT analysis was done to provide information that is helpful in matching Mbale Municipality's resources and capabilities to the competitive environment in which it is operating. The results revealed that:

**1.0 Strengths:** Mbale Municipality's strengths are its resources and capabilities that can be used as a basis for developing a competitive advantage. These include:

- i) existing dumping site
- ii) access to targeted beneficiaries (market)
- iii) available trucks for garbage transportation
- iv) available skips for depositing solid wastes.

**2.0 Weaknesses:** The weaknesses identified were:

- i) limited resources -trucks and skips.
- ii) lack of capacity in waste garbage management and marketing and/or inexperienced staff.

- iii) lack of distribution channels for recyclable wastes
- iv) unknown products (compost manure and other recyclable products)
- v) poor waste management practices – it takes long to empty the skips, mixed wastes

**3.0 Opportunities:** The external environment analysis revealed new opportunities to exploit; these were:

- i) income from the selling of the compost manure and other recyclable products.
- ii) readily available raw materials – garbage.
- iii) An unfulfilled customer need - potential customers around town e.g. Mbale Resort Hotel, the manager Mr. Kinyua G. Lawrence when contacted was willing to buy the compost manure as soon as it was available. Since FORRI/NARO tree nursery department is around Mbale town and requires compost manure of which they have been substituting with cow dung from the abattoir which is even harmful to human health. The steel rolling mills create market for the recycling of the metals which is part of the garbage.
- iv) Two NGOs were visited which have ever tried this project of composting and hence there is somewhere to learn from and refer to.
- v) Management of the environment is not something new; it is already a world wide trend.

**4.0 Threats:** The council is faced with a new threats and challenge; these include:

- i) changing people's attitudes/culture in regard to garbage disposal, where they are likely to find some resistance.
- ii) substitute/ competing product like cow dung from the abattoir which some of the prospective customers have been using, e.g. the tree nursery managers will be a threat to the marketing of this new product of compost manure. This will affect those people in the abattoir who have been selling the cow dung.
- iii) limiting economic factors – small incomes/ and/or poverty is a threat because there some people who actually need the compost manure like one nursery manager Mr. Makatu in Mbale Municipality who was one of the tree nursery managers visited, cannot afford it and actually his nursery is not doing that well compared to his neighbour Mr. Ejibu Samuel who applies manure.
- iv) low standard recyclables - the polythene bags cannot be sold to the proprietor who recycles them in Wakiso along Kampala Gayaza Road because he demands a certain standard of cleanliness that polythenes should have in order to qualify for recycling of which cleaning they wouldn't be cost effective. That is 1 kg of polythenes could be sold for 200/= after being cleaned. This is according to Mr. Semayobe Francis of Talent Calls Club – Development Promoters Initiative a Non Government Organization in Seeta which deals in decomposing garbage. They tried selling the polythene bags for recycling and couldn't succeed because of those hindrances. They resorted to heaping the polythenes and according to the National Environment Regulations, it is not allowed to burn them any how because of the toxic fumes that they emit which are hazardous to the environment.
- v) Limited quantities of compost manure and recyclable products to meet the requirements of the potential customers.
- vi) Inefficient technology of composting in terms of speed and quality of the output

## **2.0 DESCRIPTION OF THE ENVIRONMENTAL SETTING**

### **2.1 Geology, soils and vegetation**

The soils of Mbale town are largely of the formalistic gneiss that is in the last stages of tropical weathering. Their volcanic nature renders them fertile for support of plant life. The larger part of the municipality is developed such that it has presented a modified vegetation cover with limited traces of natural vegetation. The basement complex is firm and stable rendering it ideal for the development of housing to the high density settlement.

### **2.2 Climate**

The climate of Mbale is influenced by its proximity to the equator and its situation at the foot of Wanale ridge. The climate is warm and humid without extremes; with temperatures ranging from 23 – 25 °C. There is hardly any seasonal variation of temperature through out the year. Rain fall is fairly distributed ranging between 1250 and 1750mm per year.

Mbale receives relief rain fall. The town enjoys a double maximum of rain fall during the months of March to May and October to November. Rain fall amounts are sufficient to impart sustenance to growth of annual and perennial food crops within and without the municipality that support the urban population today.

### **2.3 Hydrology and drainage**

Hydrology deals with the occurrence and movement of water in various forms on and over the earth's surface.

The town is drained from East to West by three major rivers that have their sources on Wanale Ridge. The river Nashibiso and its tributary Napwoli drain the southern part of the town. These are bound by an extensive plain under Mbale forest plantation (Central Forest Reserve). River Nabiyonga and its major tributary Namatsio drain across the northern area of the town. Several primary and secondary drains have been developed to originate from within the town area and drain into these rivers. All the aforementioned rivers drain into R. Namatala that forms the North Western boundary of Mbale town.

### **2.4 Water resources**

Mbale Municipality is served by National Water and Sewerage Corporation (NWSC). Water supply from River Manafwa and Bungokho is 65 000cm<sup>3</sup> each thus 130 000 cm<sup>3</sup> per month. The river discharge drastically reduces during dry spells. Records of NWSC indicate that water quality of raw water on average is 1500no/100ml of total coli forms. This has moderate to heavy faecal contamination for all the three sources of Manafwa, Nauyo and Nabuyonga rivers. The quality of the final raw water is 0 no/100ml of total coli forms for final water in both water works as indicated below. However, the physico-chemical characteristics like colour and turbidity are always compliant. The corporation

has got two waste stabilization ponds at Doko and Namatala. NWSC records show that sewage quality (**Sewage ponds BODS mg/l faecal coliforms no/100mls;**) of five months average:

- Namatala raw sewage 43 1.4 x 10<sup>10</sup>
- Namatala final effluent 55 1.0 x 10<sup>4</sup>
- Doko raw sewage 538 1.4 x 10<sup>9</sup>
- Doko final effluent 46 1.6 x 10<sup>4</sup>

## **2.5 Wetlands resources**

An inventory carried out by Wetland Inspection Division (WID) in 1998 in the district found out that wetlands cover 356 km<sup>2</sup> or approximately 14.4 per cent of the old Mbale district. The conversion, pollution, and de-vegetation of wetlands have led to biodiversity loss. Wild game hunting is no longer practiced and wetland fishing is also limited. Breeding centres for birds have been cleared. There is thus deterioration in the biodiversity and habitats within the Municipality wetlands.

## **2.6 Overview of human environment**

Mbale municipality used to be the cleanest town in East Africa in the late 1970s but not any more. It is overcrowded due to population pressure. The population that was 23 544 in 1969 has steadily risen to 70 437 in 2002. Many of the buildings are old and some of the sewage systems have broken down due to wear and tear. Since jobs are not readily available, so many idlers crowd around restaurants "waiting to harvest money from where they have not sown" consequently increasing cases of theft. There has been an effort to plant trees and shrubs in the municipality but these have been vandalized by stray animals within the municipality.

## **2.7 Institutional Structure**

The Council is constituted by directly elected councils from each of the wards in the Municipality and women councilors from special interest electoral areas. The council is the supreme legislative body within the Municipality and is responsible for policy formulation and supervision of the implementation of policies and decisions it has made.

## **2.8 Administrative Units**

Mbale Municipal Council is comprised of three Divisions namely: Northern, Industrial and Wanale. These Divisions are substantive body corporate Local Government Councils under Part II, Sec. 4 subsection 4(b) of the Local Government Act 1997. The Divisions are subdivided into Wards and Cells (Table 2.1).

## **2.9 Population density**

According to the Uganda Population and Housing Census 2002, the population of Mbale Municipality is 70,437 with a sex ratio of 98.1 males per 100 females. Preliminary

studies have estimated the day population at 200,000. The land population density is 3,354 persons per sq. km.

**Table 2.1: Divisions, wards and cells in Mbale Municipality**

Division	Wards	Cells
1. Wanale	Boma	Masaba, Union, Elgon, Bungokho, Fairway, Bukwa, Nabigyo, Wanala
	Busamaga	Nabweya, Nampanganga, Butandiga, Bumboi
	Mooni	Isebele, Zesui, Mutoto, Nashibiso, Nagudi
2. Northern	Nabuyonga	Sebei, Buwalasi, Kichafu, Kisenyi, Mulembe, Magezi
	Nkoma	Busajja, hygiene, Buyonjo, Bujoloto, Gangaza, Senkulu, Wanambwa, Nambozo
	North Central	Hospital, Clock Tower, Duka, North Road, Byasala, Uhuru, Pesa, Nkokonjeru
	Namakwekwe	Nabigyo, Link Road, Bufumbo, Mission, Kachumbala, Gudio, Mugisu, Kiteso, Bulago, College, Mpumude
3. Industrial	University	Staff, Sheraton, Northern, Village
	South Central	St. Andrews, Wasike, Naboa, Republic Street, Foods, Lwakaka, Park, Police, Kale, Cathedral
	Masaba	Butalaje, Bumasisa, Pallisa, Malawa, Bugwere, Temuteo, Mukasa
	Maluku	Siroko, Busano, Majanga, Wanyera, Muti, Primary, Muyembe
	Namatala	Somero, Sisye, Nyanza, Wandawa, Doko, Mvule

**Table 2.2: Population profile of Mbale Municipality**

Division	Male	Female	Total
Industrial	15,492	15,437	<b>30,929</b>
Northern	14,612	14,792	<b>28,404</b>
Wanale	5,333	5,771	<b>11,104</b>
<b>Total</b>	<b>34,437</b>	<b>36,000</b>	<b>70,437</b>

## 2.10 Age composition and dependency

The population of Mbale Municipality is generally young. The medium age of the entire population is 6 years. This is an indication of high fertility. Mbale has a total fertility rate of 6.2 and a dependency ratio of 122 i.e. there are 122 persons in the dependency age category for every 1000 persons in the working age. The dependent ages are 0-14 and above 64 years.

The fertility rate and immigration behaviour from the neighbouring rural area and districts for employment in the Municipality during the census interval contributed to a growth rate of 6.1% between 1980 and 1991 and a rate of 3.6% between 1991 and 2002. This, if compared to the National average rate of 3.4% per year is relatively high.

## 2.11 Settlements

The settlements in Mbale Town are concentrated with patterns of orderly and planned settlements in the Central Business District and sub-standard settlements in the peripheral areas. This could largely be due to forces of urban growth.

## 2.12 Household size and occupancy levels

Household size for Mbale Municipality stands at 4.8 persons per household with a total of 14,674 households. According to the 2002 Uganda Population and Housing Census, approximately 51% or 35,922 of the residents of Mbale Municipality lived in an independent house or flat and the other 49% or 34,514 continued to share their accommodation.

## 2.13 Economic activities

The main socioeconomic activities in Mbale comprise of commercial activities in the Central Business District. The Municipality plays a role in this sector as far as the areas/location of operations, the quality of the premises and the licensing of the business units are concerned.

Generally job creation and employment in Mbale district is at a low level to the extent that most highly educated citizens are underemployed. Underemployment in the form of disguised employment, seasonal unemployment and outright absence of employment opportunities means many strong citizens are left with no alternatives but to harvest nature for survival thus leading to environmental degradation. Some job opportunities have been created by the increasing number of fuelling stations and industries based in Mbale Municipality (Table 2.3).

**Table 2.3: Industries located in Mbale**

Industry	Location	Product	Wastes
Bugisu Cooperative Union Ltd	Mbale industrial area	Coffee - green and roasted	Coffee husks
Mbale Exporters and Importers	Mbale industrial area	Coffee	Coffee husks
Kyagalanyi Coffee	Mbale industrial area	Coffee	Coffee husks
Masaba Cotton Company	Lukhonge	Lint cotton	Dust emissions
Bugema cotton Company	Bugema	Lint cotton	Dust emissions
Uganda Klere Industries Ltd	Industrial division	Perfume, plastic and drinking water	Inorganic Waste dumping beside factory
Uganda Trade and Industries Enterprises	Mbale industrial area	Edible oil	Effluent discharges
Shamlon (U) Ltd	Kumi road	Bread	Smoke emissions
Mbale importers and exporters	Mbale industrial area-Pallisa road	Wheat	Organic dust
Rice	Mbale industrial area	Rice	Rice husks

## 2.14 Household income and expenditure

The average household monthly expenditure in Mbale is Uganda Shillings 121 000/= compared to what obtained in 1997 (UBOS, 2002). The per capita expenditure is Uganda Shillings 24 300/= and it was observed that over 50 per cent monthly income is spent on food, drinks and tobacco as the first priority followed by rent, fuel and power and education. Most of the food consumed in urban areas is purchased. Household

income, the sum of income both in cash and in kind accrues from economic activities performed by household members on a regular basis. This income includes earnings from household enterprises, property income, remittances, wages and salaries.

### **2.15 Current Waste management practices**

A lot of waste is generated in the municipality this includes solid waste, liquid and gaseous waste. The solid waste is both organic and inorganic and is not sorted thus its management is quite difficult. The municipality does not have a gazetted land fill thus waste is dumped near Namatala wetlands. This poses a threat to rice and cocoyam farmers down stream who absorb the effluents directly. The cocoyams can take up heavy metals. The exposed waste is attracts vermin.

**Physical planning:** The municipality has got plans but unfortunately these are most often than not adhered to. Buildings and roads are not constructed as was designed. Many of the protected areas/ green belts have been leased out and this has impacted on the flow of stormy water resulting into floods in some areas. Some of the areas close to wetlands are used as car washing bays and some are used for *enguli* distillation sites.

### **2.16 Social infrastructure**

The social infrastructure is fairly strong and well distributed. These include schools, hospitals, health centres, churches, mosques, recreation centres and institutions. Religious institutions are numerous and fairly well distributed within town.

The learning institutions in Mbale district include both government aided and private primary and secondary schools; 1 primary teacher training college, 1 technical college and 2 universities. There are 316 primary and 51 secondary government and private aided.

### **2.17 Local initiatives**

SALEM Brotherhood an NGO in Nakaloke manages kaveera (polythene) by providing alternative packaging material and planting trees to improve the environment. In their fight against kaveera, they have stopped using drinking straws and are now using glasses. They have also sensitized the neighbouring communities to stop using the kaveera and resort to organic materials.

## **3.0 DESCRIPTION OF THE PROPOSED PROJECT SITE**

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### **3.1 Location**

Mbale Municipal Local Government is found in Mbale District in Eastern Uganda. It is located at 34° 10' East of the prime meridian and 1° 03' North of the Equator. It covers a geographical area of 2,435 hectares (24.35 km<sup>2</sup>). It is situated 45 kilometers north of Tororo Town, 56 kilometers southeast of Kumi Town, 57 kilometers east of Pallisa Town and 55 kilometers south west of Kapchorwa Town. Mbale is 256 kilometers and 220 kilometers via Tororo and Tirinyi respectively from Kampala.

### **3.2 Proposed Project site**

The proposed composting site lies along Mbale - Pallisa road (Tirinyi Road) about 2 Km from Mbale town. It is situated within Doko cell, Namatala ward (parish) in Mbale Municipality. It can be accessed by three (3) access roads that stretch off from Mbale to Pallisa Road opposite Bugisu Cooperative Union. It occupies the land that is between Mt. Elgon Millers and river Namatala. The size of the proposed site was estimated at 4.05 Ha (**Figure 3.1**) using GIS and Mapping technology although the actual area to be developed will be about 2.5 ha due to the sensitivity of the remaining section of land.

Records show that each month Mbale Municipality collects approximately 2,100 metric tones of municipal solid waste and of which approximately 50 metric tons are of acceptable organic wastes.

### **3.3 Area of influence of the proposed project**

According to the Mbale Municipality Urban Plan, much of the area was gazetted as a Green belt and an Industrial area (Light Industries). The northern section is surrounded by a conspicuous sugarcane garden, which camouflages the meandering River Namatala within it. Generally this portion is a wetland, draining into River Namatala, making this a sensitive feature as far as the proposed project is concerned.

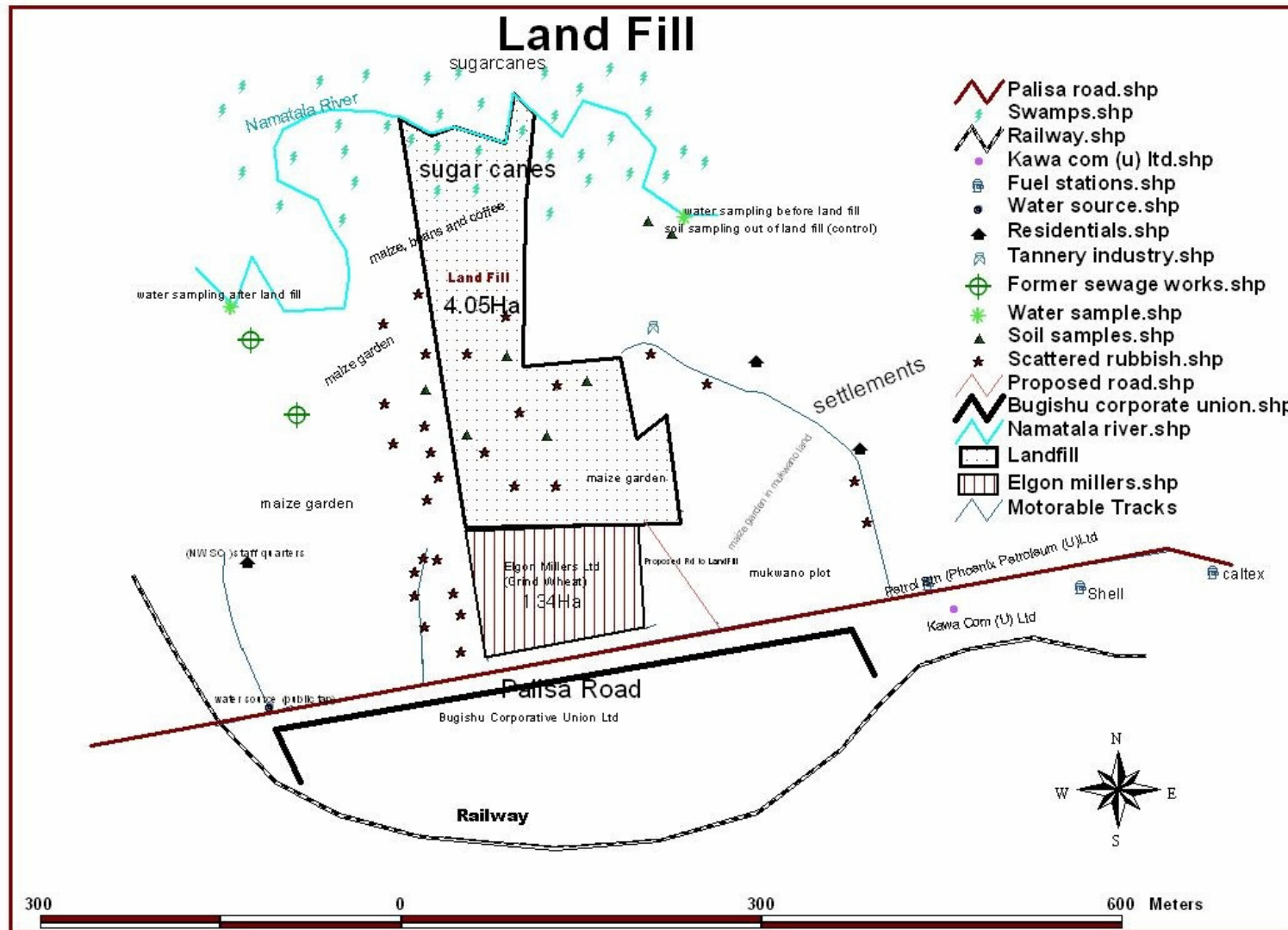
Subsistence farming activities are the main economic activities taking place within the 100m of the western and eastern ends of the dump site. The far eastern end (400 -500m) comprises light settlements, markets and petrol stations. The southern section within 100m of the dump site borders Mt. Elgon Millers Ltd (A wheat milling Factory (**Figure 3.1**)).

### **3.4 Inputs needed for making compost**

Vegetative materials, good top soil; Farm yard manure; Water; Dry elephant or spear grass and sticks; Air; Sewage sludge; Spades; Wheel burrows; Vehicles; Labour; Storage facilities; Barded wire or live fence; Well drained soils; Cool shade (composting shed); cement (concrete slab for material handling) aggregate, hard core; Trucks, and Packaging materials and Train staff.

The total project cost (including the proposed NEMA funding) is estimated at Uganda shillings 400,000,000 (Four hundred million shillings).

Figure 3.1: Site layout of Mbale Municipal Waste Landfill



### **3.5 Environmental and Social Evaluation**

Studies by Tom L. Richard et al, 1992; suggest that factors that require careful consideration when evaluating a potential compost facility site include:

- a buffer zone to protect neighbors from site activity impact;
- a level surface, preferable a 2-3 percent grade;
- a high soil percolation rate to avoid standing water;
- a central, accessible location with good traffic flow;
- a water source for wetting compost piles;
- a location where prevailing winds blow away from sensitive neighbors; and
- a low water table to prevent site flooding.

#### **3.5.1 Site Characteristics**

The total area of the proposed dump site is 4.05 hectares of which 2.5 ha will be developed for the composting project. The proposed site lies along Mbale - Tirinyi Road, about 2 Km from Mbale town. It is situated within Doko Cell, Namatala Ward in Mbale Municipality (**Fig 3.1**).

The available site in the Industrial Division may dictate Mbale Municipality's choice between composting methods. It occupies the land that is between Mt. Elgon Millers and River Namatala. There are no neighbouring settlements other than Mt. Elgon Millers; a wheat flour company, which is about 100m from the proposed site.

#### **3.5.2 Buffer from noise and dust**

The Doko site has river Namatala and associated wetlands on the lower side as a buffer zone between the proposed composting facility and community gardens.

Dust will be generated as a result of excavation and other site preparations- especially if the work is done during windy and dry weather. The noise from construction traffic is expected to be minimal. A landscaping plan will use a live fence (evergreen trees) to enhance the appearance of the facility and also absorb some dust and noises produced and visually screen the site.

#### **3.5.3 Slope**

The proposed site is a gentle slope of about 2- 4 %; this will aid storm runoff and avoid water stagnation and flooding. Excavation of the site to construct the compost facilities could create substantial changes in the slopes. If this happens; the designing of the slopes need to be checked to avoid water stagnating.

#### **3.5.4 Water table and quality**

The previous excavation of gravel from the former sewage pond 100 m from the proposed site shows that site has a low water table. The site has river Namatala

about 200m below; this will supply the necessary water for both for moistening the compost material and for fire protection.

Contamination can enter the river water through wash off and soil erosion from the proposed project site. The results in **Appendix 5** showed good physio-chemical quality and indicated there was an insignificant water quality change in the characteristics of river Namatala below and above the dump site. However, the biological results showed marginal levels of faecal coliforms usually associated with surface water.

These results give the baseline water quality data at the time of the EIA and will be a reference point for follow-on monitoring of river Namatala water quality.

### **3.5.5 Soil percolation rate**

Analyses were performed on two samples of soil (soil outside the site and soil at the site ); soil out of the site had 59% sand, 22% clay and 19% silt and the soil at the site had 66 % sand, 09% clay and 25 % silt (**Appendix 6**). The results indicating that the soils are sand with a higher percolation rate compared to clay soils.

The soil out had a pH of 7.5 and 9 at the site, indicating sodic soil at the site. Other elements, namely: Organic matter, N, P, Na, K, Pb, Cd, Cu, Zn and Fe were analysed for the two sites. The results indicate elements of lead and cadmium, however, their concentration were far below the concentration to indicate pollution.

### **3.5.6 Accessibility**

The site is located about 2km from Mbale town along Pallisa road which is a class 1 bitumen road. There is a short distance of existing 300m of gravel to be widened and improved upon. The impacts from dust and the maintenance cost of the gravel road will be minimal. The site is easily accessible by 2 access roads that stretch off from the Mbale - Tirinyi highway opposite Bugisu Cooperative Union (BCU) coffee factory. This location minimises the distance to be traveled by collection vehicles.

The area planned for the project is 2.5 ha, which is suitable and convenient for the composting of waste for a period of 20 years.

## **3.6 Waste management options**

### **3.6.1 No-action/ No composting Option**

The no-action, or no-composting alternative was considered and rejected. Allowing the status quo to continue would result in further pollution and continued environmental problems in town and at the existing Doko dumping site. The negative social and environmental impacts associated with dumping e.g. odour, leachate, scavenging and increased illegal dumping of garbage and littering within the Mbale municipality would increase.

### **3.6.2 Incineration Option**

Incineration of all or part of the waste stream by Mbale Municipal Council (MMC) was considered by the EIA Team. The option was rejected because of the high cost of incineration equipment. Additionally, incineration is only a solution for final disposal and a land fill would still be needed; given the wet nature of the organic materials available in Mbale, this option may could prove challenging. However, currently part of the medical waste is incinerated due to its infectious nature and the volume less compared to over 45 tons of mixed solid waste collected daily.

### **3.6.3 Composting Option**

Improvement on the existing dump site at Doko to accommodate a composting facility was evaluated for the environmental and technical suitability. It was concluded that the present site will be zoned to handle a composting facility and the rest used for dumping and/or landfill. The present dumping site is suitable because of its location (2km from the town centre), easy access, relatively minor environmental problems, and near a source of water (river Namatala) needed for composting.

Selection of the site at Doko was aided by a check list of technical, environmental and social factors with surface water contamination considerations judged as a critical factor. The sites selected minimize groundwater contamination, maximize isolation from view and easily accessed. Given the benefits of composting and the availability of land in an area not settled by communities. Composting (**details in Section 3.7**) is viable and the most suitable option compared to dumping and incineration. Furthermore, composting shall be integrated with other waste management options.

### **3.6.4 Competing products and substitutes to compost**

**Plant mulches** are used to protect the soil against the impacts of raindrops, improve rain water percolation, protect the soil against the full impact of sunrays and hence conserve soil moisture by reducing evaporation, enrich soils with nutrients when they decompose, improve soil structure, enhance activity of micro-organisms in the soil and reduce weed growth.

**Green manure plants:** These are plants grown specifically for fertilizing the soil. They are usually ploughed into the ground just before they flower and on rotting improve soil fertility. All plants that add organic matter to the soil can be called green manure plants, but the most effective are those belonging to the legume family e.g. *Calliandra*, *Sesbania*, *Mucuna* bean and *Tephrosia*.

Green manure improves the soil fertility by producing large quantities of vegetable matter which on rotting improves soil structure. The root system which breaks up clods of soil and promotes porosity; legume plants take up atmospheric nitrogen and fix it using symbiotic bacterial in their root nodes. Nitrogen is added to the soil when the plant rots. Deep rooting plants extract soil nutrients like nitrogen and phosphorous and on rotting these are released to the top soil layers becoming available to shallow rooting crops which can extract them.

**Farm Yard Manure:** All animal excrement, liquids and solids, can be used as fertilizer. Animal manures include; cow dung, droppings (from goats, pigs, sheep, rabbits and poultry) and slurry from biogas digesters. Efficient collection of dung and droppings

requires that animals are kept in enclosures for sometime. This calls for structures such as stables or kraals and/or housing. The manure collected from these structures can be applied directly to crop fields or used in composting. When applied directly to crop fields, they may burn the crops as they rot. It is therefore necessary that they are applied before crops are planted or away from crop roots. All fresh animal excrement should always be handled carefully to avoid diseases and parasite infection. Human excrement can also serve as manure but it requires careful handling and treatment before incorporation into the soil due to the high risk of disease transmission. The best-treated human excrement can be obtained from sewerage plants and biogas digesters that are managed by professionals.

**Inorganic manure:** These are usually manufactured in factories and it contains no organic matter. These are readily available in shops around town. Commercial fertilizers are always composed of a high concentration of mineral salts that are easily soluble in water. Because of this, they have immediate effect on plant growth as they are immediately available to plants. They are also less labour intensive to transport and apply as they are less bulky compared to organic fertilizers. However, the high solubility of some of them means that they are easily leached out of the soil by rain and may pollute underground water sources. If washed away by surface water, fertilizers pollute surrounding watercourses such as rivers and lakes. They require technical know-how in terms of what to apply, amounts to applicable for each crop, how to apply and timing of the application. They are expensive and may not be available in the required quantities and quality specifications.

Organic manures have a diversity of soil fertility constituents while inorganic fertilizer are made to specifications and contain few specified nutrients,

### **3.7 Technical information on Composting**

#### **3.7.1 Introduction**

Compost is the finished product resulting from a decomposed mixture of organic wastes and is valuable for use in soil improvement (Charles Rusoke et al, 2000). Compost helps in the creation of good conditions for soil organisms, including supply of organic matter, improving the soil's moisture holding capacity, and preventing conditions which lead to creation of extreme alkalinity or acidity.

In Uganda farmers have varying experiences in composting agricultural wastes. However, when considering a Municipal Solid Waste (MSW) composting, there are a number of challenges unique to MSW which need to be addressed (Tom L Richard, 1992). MSW contains materials which vary widely in size, moisture, and nutrient content, and the organic fractions can be mixed with varying degrees of non-compostable wastes and possibly hazardous constituents.

The composition of Municipal Solid Waste generated in Mbale Municipality, comprises of three main categories of wastes that is organic waste; polythene and plastic and metals & glasses. The organic waste includes leaves, food remains, grass, paper; and cow dung. Others include visible materials such as plastic and glass, and chemical contaminants (hazardous), such as batteries. The physical and chemical

contaminants can have a negative impact on the marketability of the finished product, and their removal will form part of the expense of the composting program.

Manufacturing a marketable compost product from this material requires a range of physical and biological processes detailed in section 3.7.2

The present system of collection of waste in most of the towns in Uganda is from common collection points. The wastes are a mixture of many materials including soil, food waste, other organic materials, paper, plastic, tyres, metal, cloth etc. But it is assessed that organics constitute from 70-90 % of the waste.

The composting plant should have facility to accept mixed municipal solid waste and convert the organics into compost. The composted materials can be processed to remove the unwanted material before being sold to the farmers as soil conditioner. The materials which cannot be sold would be sent for land fill. Below is the recommended design for setting up a composting facility for handling 70 tons per day of municipal solid waste as feedstock.

### **3.7.2 Aerobic Composting basics**

Composting is a controlled aerobic bio-oxidative process that converts fresh organic matter and leads to production of carbon dioxide, water, minerals and stabilized organic matter.

Composting is the process of degradation of organic matter that converts the fresh organic matter into compost. Compost is the product of the composting process that is suitable for use in agriculture and horticulture.

In aerobic composting the organics are converted into compost by microorganisms, which require the oxygen in air for their survival and growth. During this process of conversion heat is released. There are ideal limits for different parameters within which these microorganisms survive. Adequate moisture is required for the microorganisms to survive and composting to take place. If these conditions are ensured, the compost quality and time of composting can be controlled. In batch conditions the composting process continues at progressively reducing rate as the oxygen becomes a limiting factor or organics get consumed. To ensure the survival of these organisms the availability of oxygen in the waste being composted has to be ensured through provision of air. For economic reasons the time of composting is restricted till the major conversion is done and subsequently compost maturing is taken up till the compost is safe for application to plants. The organics typically have high moisture and in the compost process this is removed. There are different possible configurations of holding waste and providing air for aerobic composting. The selection of this is based on economics and competence in handling technology.

The various parameters, which affect the composting process and the compost quality, are enumerated as follows:

#### **3.7.2.1 Organisms**

Microorganism facilitates the process of decomposition. Bacteria, fungi, actinomycetes are the major organisms supporting the process. These organisms thrive in waste but there has to be a minimum start up population for quick degradation. Initial start up cultures can be obtained from cow dung slurry or special bacterial cultures. This has to be provided, till threshold concentrations are available in the waste.

### **3.7.2.2 Carbon/Nitrogen (C:N) Ratio**

Carbon and Nitrogen are two important elements in composting process. Carbon provides the food and nitrogen provides the raw material for building up bacterial mass. The proper proportions of these are important for the composting process to go on smoothly. The ratio of carbon/Nitrogen availability is an important parameter dictating successful composting. Typically no adjustment needs to be made in municipal waste for this.

### **3.7.2.3 Temperature**

Most microorganisms have an ideal or optimum temperature for growth. The composting process is exothermic and the windrow temperature rises due to the process. The desired maximum temperature is about 70°C. When the oxygen availability comes down and the aerobic activity reduces, the temperature comes down. When air is supplied the microbial activity improves and the temperature rises again but the extent keeps coming down as organics get consumed. When the maximum temperature comes down to between 40-45°C typically the initial phase of composting is stopped. The changes in temperature are a good indicator of the activity and needs to be monitored for assessing the composting process.

### **3.7.2.4 Aeration**

Aerobic microorganisms do composting. It is necessary to ensure that oxygen is supplied throughout the mass and aerobic activity is maintained. During the decomposition, the oxygen gets depleted and has to be continuously replenished. This is achieved by different strategies based on the composting method adopted. Blowing air in the waste or turning of waste are two of the common strategies adopted.

### **3.7.2.5 Moisture**

Moisture tends to occupy free air space between the particles. Hence when moisture is high, anaerobic condition sets in. However composting mass should have certain minimum moisture content in it for the organisms to survive. The optimum moisture content is known to be 40% to 60%. Typically the initial moisture in the organics should be adequate for the whole composting process. In case the initial moisture is low or mixed wastes are being composted additional water may be required. The water should be sprinkled in such way that adequate moisture level is maintained.

The above-mentioned controlling parameters need to be monitored in the industrial scale plant. In large composting operations it is necessary to monitor the wastewater, which comes out of the organic waste, called leachate. The

production of this leachate has to be minimised and whatever leachate is generated has to be collected and reused for maintaining the moisture content of the heap and as an inoculum.

### **3.7.3 Design Basis**

A simple composting system is proposed for Uganda. The basis for the design of the compost plant has been detailed in the sub sections. These include the basic composting process proposed, the design waste quantity, the detailed process flow and the materials balance used in the design.

#### **3.7.3.1 The composting process overview**

Aerobic composting would be done for the incoming waste without any pre sorting. The aerobic composting would be by windrow method. The Windrow area would be fully covered. Windrow turning would be by tractor front-end loaders. The waste would be matured prior to segregation of compost from other materials in the waste or disposal into the landfill.

#### **3.7.3.2 Sizing of plant**

The compost plant design has been done based on the following:

- i. The design is based on waste generation and collection of 70 tons per day.
- ii. No facility for processing to segregate the compost is proposed. To begin with this would be done manually using sieves. As the demand for the compost increase mechanisation would be introduced.

#### **3.7.3.3 The process flow**

The step-by-step process operations are given below. The various aspects, which come into play at each of the steps, are also given:

**Step 1:** The waste is received at the gate in trucks or other transport equipment. This waste is weighed at the weighbridge (this is dependant on availability of funds to procure a weigh bridge). A detailed record on incoming wastes is maintained at the gate. A time record of the staff and visitors is also done at the gate.

**Step 2:** The incoming vehicle directly goes and unloads the waste at the composting yard as per the plan. As soon as the waste is unloaded the large inorganic wastes like tyres, which cannot be screened, would be manually removed. Then the tractor front-end loader is used to make the waste into a windrow. The windrow is then sprayed with cow dung or bio culture slurry. The cow dung or bio culture slurry is made in mixing tank provided at an elevation. It is then sprayed.

**Step 3:** The windrow is maintained for 7 days. The temperature is monitored to ensure that the composting process is ongoing. The leachate from the windrow comes out and is collected in the drain. The drain is connected to the leachate tank. The leachate from leachate tank is used for making the inoculums slurry.

**Step 4:** At 7 days from start, the first windrow is dismantled and the waste is transferred to the second windrow using the tractor front-end loader. The waste volume would have reduced by about 30 % compared to start with moisture reduction and degradation. The place where the waste is dismantled would receive the fresh waste for forming the first windrow. While forming the second windrow addition of inoculums slurry and water to maintain the moisture is done using the trailer mounted slurry tank. The temperature profile in the second windrow is monitored. The leachate from the windrow may come out and is collected in the drain.

**Step 5:** At 14 days from start the second windrow is dismantled using the front end loader. The waste volume would have reduced by about 25 % compared to start of windrow 2 with moisture reduction and degradation. The waste is reformed into the third windrow. Addition of water is undertaken if required. The temperature profile in the third windrow is monitored. No leachate is expected from now on.

**Step 6:** At 21 days from start the third windrow is dismantled using the front-end loader. The waste volume would have reduced by about 20 % compared to start of windrow 3. The wastes are reformed into the fourth windrow. Addition of water is undertaken if required. The temperature profile in the fourth windrow is monitored.

**Step 7:** At 28 days from start the fourth windrow is dismantled using the front-end loader. The waste volume would have reduced by about 10 % compared to start of windrow 4. The wastes are reformed into the fifth windrow. Addition of water is undertaken if required. The temperature profile in the fifth windrow is monitored. This is the maturing stage of the compost.

**Step 8:** At 35 days from start the fifth windrow is dismantled using a tractor linked front-end loader. The waste is now transferred to the processing unit into the initial hopper. The waste volume would have reduced by about 10 % compared to start of windrow 5.

**Step 9:** The waste is sieved in a 6 mm sieve to the extent that the compost separated can be sold.

**Step 10:** Materials recovery from the rejects is undertaken and the recyclables are stored in the recyclables shed.

**Step 11:** The reject are taken out for disposal in landfill at least once every 3 days. The recyclables are sold when adequate quantity is available for transport. The compost is sold as per demand. The matter which cannot be sold is sent for landfill.

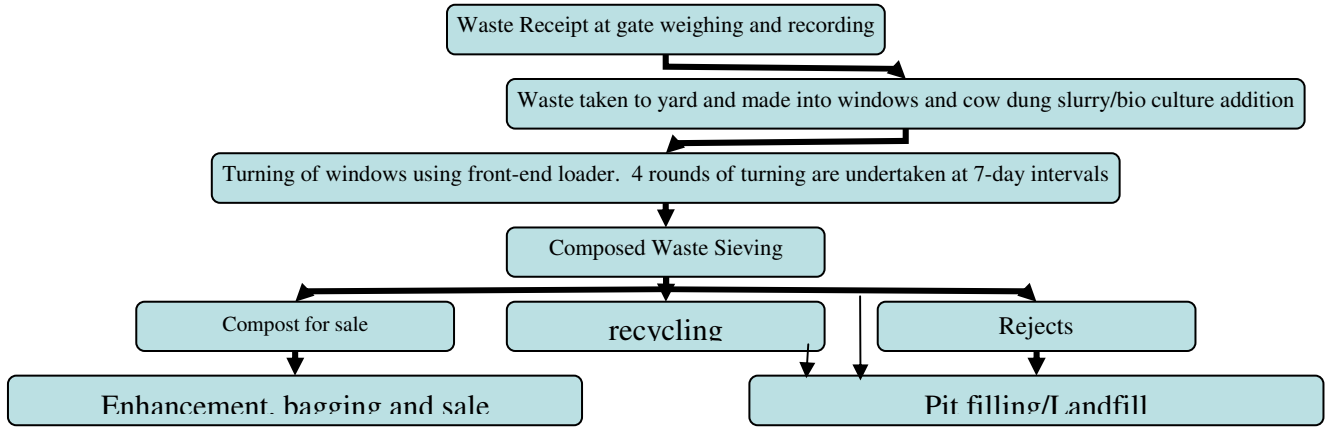
#### **3.7.3.4 Process flow chart**

The process flow chart is given in **Chart 1**. The process flow chart traces the movement of the waste from the time it enters the composting plant till it is disposed off out of the plant. It includes the composting, processing and the rejects handling.

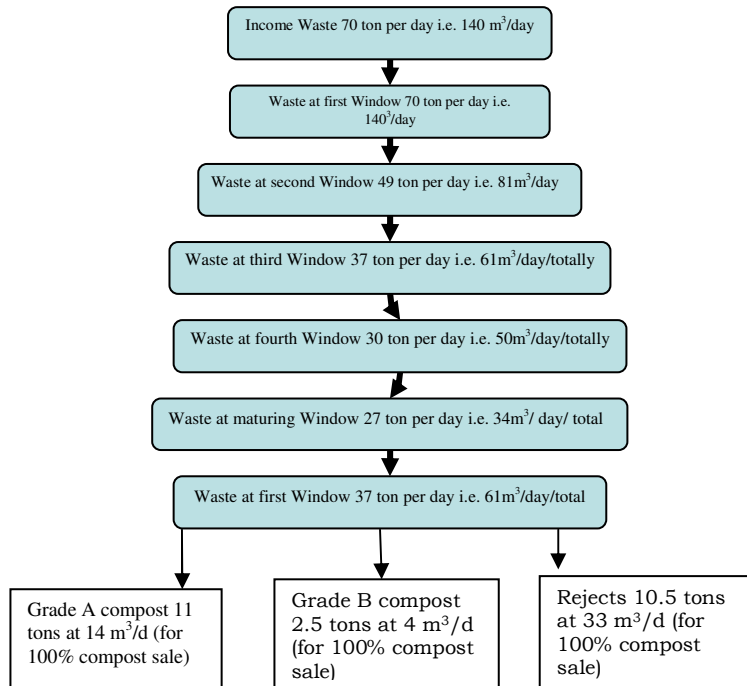
#### **3.7.3.5 Materials Balance**

The materials balance **Chart 2** gives the quality of materials flowing through the plant at different processing points both in terms of weight in ton and the volume in m<sup>3</sup>. The data presented is based on design capacity of the windrow fixed at 7 days of windrow timing plus 3 days of additional capacity to accommodate days when the quantity of waste is higher or it may not be able to process waste.

**Chart 1: Process Flow chart**



**Chart 2: Materials balance**



### 3.7.4. Compost Plant Design

The process flow and the materials balance were given in the previous section. These data have been used to size the various components. Based on the sizing of the various components, the detailing can be undertaken and the detailed drawing of the various components done.

#### 3.7.4.1 Project Layout

The Layout of the project is based on the actual layout of the plant. The access to the site has to be provided. Provision for green belt and provision for increase in compost yard needs to be made. A major cost of the compost plant is the civil works costs. The sizing, design parameters and detailing is presented in this section. The location of the facilities would depend on the topography of the site.

##### 3.7.4.1.1 Site Leveling and lowering

This is required as per the topographic profile of the site.

##### 3.7.4.1.2 Aerobic Compost Yard

The central core of the composting plant is the aerobic composting yard where incoming municipal solid waste is made into windrows, treated, turned and made into compost. The leachate from the waste is generated in the composting yard. This makes it one of the most expensive components of the compost plant. The size of the compost yard is fixed based on the layout of the waste. The incoming waste is made in to windrows and turned; and the ideal layout of the windrows is one, which occupies minimum area and is convenient for shifting of waste. The **Box 1** gives the assumptions and area and dimensions of the different stages of windrows. Based on this data the ideal compost yard layout is presented in **Drawing 1**. The size required of the compost yard is a semicircle of 88 m diameter with a 5 meter extension towards the base, a total area of 3480 m<sup>2</sup>. It is proposed that the no flooring is done for the compost yard. Simple drains are provided for draining of the leachate. It is proposed that the whole composting yard be covered. The framed support structure, roof truss and the roof are designed for live and dead loads including wind loads.

#### Box 1: Windrow Sizing

A	BASIC DESIGN	UNITS	
1.	<b>Design capacity</b>	ton	70
2.	Waste for vermin compost would be picked after first two rounds of aerobic windrowing		
3.	Density of waste under windrow formation (in t/cum)	t/m <sup>3</sup>	0.5
4.	Density of waste under windrow nos. 2,3,4 (in t/cum)	t/m <sup>3</sup>	0.6
5.	Density of waste at 5 <sup>th</sup> windrow (in t/cum)	t/m <sup>3</sup>	0.8
<b>B</b>	<b>MOVEMENT SPACE TO BE PROVIDED</b>		
1	Movement space required on periphery: (Along length and breadth (minimum)	<b>3m</b>	
2	Movement space required between W/R: (Along length and breadth of windrow (typical)	<b>3m</b>	

### C DESIGN WITH 10-DAY WINDROW OPERATION

	No of days considered per windrow	Day	7				
	DETAILS	Unit	W/R No.1	W/R No.2	W/R No.3	W/R No.4	W/R No.5
1	Quantity of waste	Tons	70	49	37	30	27
2	Volume	M <sup>3</sup>	140	82	62	50	34
3	Top width	M	3	2.5	2.5	2.5	2.5
4	Bottom Width	M	5	4	4	4	4
5	Height	M	2.5	2.5	2.5	2.5	2.5
6	Cross-section area	M <sup>2</sup>	10	8.125	8.125	8.125	8.125
7	Length of windrow per day	M	14	11	8	7	5
8	Total length required	M	98	77	56	49	35

#### Box 2: Volume of Storage for compost and rejects

##### Volume of Compost storage required (100% compost segregation):

Number of days of compost storage: 60 days

Volume of Grade A and B Compost per day: 18m<sup>3</sup>

Volume of storage for 60 days: 1080 m<sup>3</sup>.

It is preferred to store compost without bagging as bagging can lead to caking of compost; it is proposed that heaps of compost can be stored. At an average height of 4 m storage, the area required would be about 270 m<sup>2</sup>.

##### Volume of Rejects storage required (100 % compost segregation):

Total rejects volume 33m<sup>3</sup> per day.

Storage days 3 days

Volume 99 m<sup>3</sup>

At average height of 4 meters to enable removal of recycling materials is assumed. The area required would be 25 m<sup>2</sup>.

##### Volume of Rejects storage required (No compost segregation):

Total rejects volume 51m<sup>3</sup> per day.

Storage days 3 days

Volume 153 m<sup>3</sup>

At average height of 4 meters to enable removal of recycling materials is assumed. The area required would be 40 m<sup>2</sup>.

#### 3.7.4.1.3 Covered waste processing shed

The processing shed houses the various equipments, which are required for processing the waste. This shed has to be covered. At present as processing is not envisaged this shed is not required.

#### 3.7.4.1.4 Recyclables and compost storage space

The compost plant would encourage segregation of compost from the segregated wastes and other recyclables. There is a potential for recycling plastics, metals, tires and miscellaneous items. It is proposed that any body interested be allowed to scan through the reject materials to recover whatever can be sold. To assist them to collect and store the materials a closed recyclable storage space is proposed. This is to be provided as and when required.

#### **3.7.4.1.5 Security building**

A security building to house the security, (weigh bridge system when funds are available), vehicle monitoring and staff time monitoring system is proposed at the gate. The total area proposed is 3m x 3m.

#### **3.7.4.1.6 Office Block with parking**

An office block is proposed which would include the office space, space for laboratory and wash facilities separately for gents and ladies. Parking for vehicles, is provided along with the office block. The total dimension of the office block would be 5 m x 6 m of total area 30 m<sup>2</sup>. The parking to accommodate one tractor front end loader, one trailer and 10 cycles is required. The vehicle shed has diesel storage tank.

#### **3.7.4.1.7 Internal roads in the compost plant**

The internal roads in the compost plant would be of 3.75 m width of soil and murrum. The road connects the main gate to the compost yard, the recyclables and compost storage and the office block.

#### **3.7.4.1.8 Drains in and around the yard**

A drain is provided all round the compost yard to collect the leachate and direct it to the leachate collection tank. The drain is 150 mm x 150 mm in the compost yard area and 200 mm x 200mm on the periphery.

#### **3.7.4.1.9 Water storage tank, leachate tank and slurry tank.**

There are three tanks required for the plant operation: the fresh water storage tank, the leachate tank and the slurry tank (left out from this design). The capacity calculation for each of the tanks is given in **Box 2**. The water storage tank would be of 10 m<sup>3</sup>, leachate storage of 5-m<sup>3</sup> and slurry tank would have been 2-m<sup>3</sup> capacity. The water and leachate storage tanks are RCC tanks while the slurry tank is a HDPE tank. The slurry tank was to be placed on the office block.

### **3.7.5 Compost facility components, technical specifications and performance standards**

The detailed design for the compost facility of each of the proposed sizes will be done by the engineers and included as an addendum.

#### **3.7.5.1 Compost facility components**

The components of the compost facility are listed and described in the **Table 3.7**. The design provides for a gate and a boundary fence, a small building at site, concrete pad with roof, access road to the concrete pad, a drain around the pad, tank to hold the leachate, water supply facility, the front end loader with necessary attachments and the processing equipment.

#### **Table 3.7: Compost facility components**

Serial	Component	Details
1	Gate and Boundary Fence	A proper entrance to site has to be defined. The area of the proposed site needs to be secured. A barbed wire fence with concrete poles may be provided. Alternatively a live fence can also be proposed.
2	Site Building	A 10 m <sup>2</sup> building is proposed and provision for 2 (two) twin pit pour flush latrines one each for men and women with water facility. Basic furniture and a solar light to be provided where power connection is not sought
3	Concrete Pad with roof	A concrete pad designed for 30 tons/ m <sup>2</sup> loading of required dimensions with a roof to be provided. The dimensions of the concrete pad are specific for each size. The Layout on the ground to be adapted for the location.
4	Drain around the Pad	A masonry drain is provided on one side of the pad and the water is led to the leachate tank.
5	Access Road	An access road will be provided from the nearest motorable road to the site and then on to the concrete pad area. To keep the costs low, mud road to the site and water bound macadam road inside the campus is proposed.
6	Leachate tank	A leachate tank of appropriate size to be provided
7	Power and water supply facility	The water supply and power as required to be obtained for the site.
8	Tractor front end loader with different attachments	It is proposed that for the 40 tons per day and 70 tons per day facility a 60HP tractor with front end loader for turning of wastes, a 4 m <sup>3</sup> tipping trailer and a trailer with tank and pumping attachment shall be provided.
9	Processing equipment	The processing equipment would consist of: <ul style="list-style-type: none"> <li>- Back hoe tractor</li> <li>- Sieving wing screen</li> <li>- Skips</li> <li>- Water pumps, waste lifting forks, protective gear</li> </ul>

### **3.7.5.2 Technical Specifications**

The standard technical specifications for the each of the individual components of the civil works and the weigh bridge are to be adopted. The detailed specification for the tractor front end loader will be provided by the design engineers.

### **3.7.5.3 Performance standards**

There are two performance standards which would be applicable in the compost facility: the 'performance standards during the set up of the facility and the performance standards during the operation of the facility:

- The performance standards during the set up of the facility would be on quality, costs and time management. The performance monitoring sheets may be prepared prior to construction and used for the same.

- The performance monitoring during operation would include monitoring of the receipts of the waste, the process parameters and sending out of the composted wastes, compost and recyclables. In addition monitoring the fuel use, manpower and other costs need to be undertaken. The quality of compost also needs to be monitored to ensure the required level of degradation is achieved. A standard performance measure for each of this can be established to assess the performance and variance.

#### **3.7.5.4 Documentation**

The performance standards are directly linked to proper documentation at the site which can then be used for monitoring. A set of standard books need to be used at the site. In addition a set of monitoring forms also need to be prepared for monitoring the performance. This documentation would be of daily, monthly, quarterly and annual duration.

#### **3.7.6 Potential for sourcing equipment for compost plants within Uganda**

The compost plant design has been undertaken so as to simplify the whole process. The major components of the compost plant are civil works for providing the concrete pad, roof over the pad and other facilities. There is adequate capacity within Uganda to undertake these construction works. There are existing procedure to call for contracts for civil works and monitoring their execution.

The Equipment proposed for the compost plant is a front end loader which is either 60 HP tractor mounted or a conventional 72 HP integral machine with pneumatic tires. Both these equipments are not manufactured in Uganda but importing them would be possible.

### **3.8 Vermi composting**

The time and quality of composting depends on the type of technology used in composting. The NGOs consulted who were using the traditional method of "hot bed" composting which involves heaping of organic materials in windrows and periodically turning it over to enhance decomposition, say this method is slow and needs a committed manual labour, eventually they couldn't handle the order which was a disappointment to their customers. However, Uganda Environmental Protection Forum wanted to try an alternative method which is faster and more environmentally friendly that is, vermi composting (composting of garbage by earthworm). It requires a particular type of earth worms which are more efficient and easier to breed. However, it is costly to raise the earth worms and you have to compost until the heat reduces, and then you introduce the earthworms. They tried to import earth worms from India but could not meet the requirements of the law and regulations and abandoned the idea.

Vermi composting is a potential method for back yard composting, which is gaining popularity in the country. Currently, Makerere University Faculty of Agriculture is promoting it.

### **3.9 Quantity of waste to be handled**

According to the available facilities only 41.4 tons of waste is collected per day, making it 1242 tons per month (**Table 3**). This is so because of insufficient funding to facilitate routine transportation and timely payment to contractors.

A lot of waste is therefore not collected. However, under adequate facilitation, it is estimated that 60 - 70 tons of waste should be collected per day. Hence about 1860 tons of waste will be generated per month.

### **3.10 Need for a second Municipal Waste site**

Under the current population growth rate of 3.4% it is estimated that total waste collected per day will have reached 2198.4 tons per month by 2011. In ten years time, it is estimated to be 2600 tons per month. This is therefore; to recommend that Mbale Municipal Local Government buy and gazettes another site for Municipal Waste Management.

## **4.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK**

### **4.1 Policy Framework**

The policies and regulations below are directly related to the proposed project and are intended to ensure that its development and operation fulfill the wider objectives of environmental conservation.

#### **4.1.1 The National Environment Management Policy, 1994**

The overall goal of National Environment Management Policy, 1994 is to promote intergenerational equity and sustainable development that maintains and enhances environmental quality and resources periodically to meet human needs of the present generation without compromising ability of future generations meeting their own.

#### **4.1.2 The Uganda Forestry Policy, 2001**

The Uganda Forestry Policy aims at developing an integrated forest sector. It is hoped that this will help achieve sustainable increases in the economic, social and environmental benefits from forestry by Ugandans, most especially the poor and the vulnerable. It provides for the development of the forestry sector that safeguards the nation's forest biodiversity and environmental services through effective conservation strategies. One of the policy statements deals with conservation of forest biodiversity and management in support of local and national social-economic development and international obligations.

#### **4.1.3 National Policy for the Conservation and Management of Wetland Resources**

Wetlands, other natural resources and the environment are inter-related. There is a need to take into account other aspects of the environment including the ample use of wetland resources in view of the requirement to conserve the natural environment and minimize any adverse effects.

### **4.2 Legal Framework**

#### **4.2.1 Constitution of the Republic Of Uganda, 1995**

Article XIII (Protection of natural resources) of the constitution entrusts Government with the responsibility of protecting important natural resources on behalf of the people of Uganda. Article XXVII (The Environment) recognizes the need for sustainable management of air, water and land resources, and utilization of natural resources to meet development and environment needs and conservation of natural resources.

#### **4.2.2 The National Environment Act, Cap 153**

In 1995, the National Environment Statute was enacted as an umbrella law on environment management in Uganda. The statute was later changed into an Act in 2000. Under Section 19(1), a developer of a project described in the Third Schedule

is required to submit a project brief to the lead agency. The format and the information required are prescribed in the National EIA guidelines prepared by NEMA (NEMA, 1997) has been followed in preparing this Environmental Impact Statement.

#### **4.2.3 The National Forestry and Tree Planting Act, 2003**

The National Forestry and Tree Planting Act, 2003 provides for the conservation, sustainable management and development of forests for the benefit of the people of Uganda. It prohibits certain activities. Section 14 prohibits cutting, disturbing, damaging, burning or destroying any forest produce or removing, receiving any forest produce except in accordance with regulations or guidelines or in the course of management of the forest reserve by the responsible body. Section 38 requires that any person intending to undertake any project or activity, which is likely to have significant impact on a forest, shall undertake an EIA. This project respects this requirement.

#### **4.2.4 The Land Act, 1998**

Section 44 of the land act require that the government or local government shall hold in trust for the people and protect among others wetlands, forest reserves and national parks and any other land reserved for ecological and tourism purposes for the common good of Ugandans. The project will respect this provision.

#### **4.2.5 The Water Act Cap 152**

The Water Act Cap 152 provides for the management of water in Uganda. Under section 107, the water regulations 1998 and Sewerage regulations 1997 were formulated and are aimed at minimizing pollution of public waters by developers and others users. This provision will be respected.

#### **4.2.6 The Public Health Act 1964**

Section 105 of the Public health Act 1964 imposes a duty on the local authority to take measures to prevent any pollution dangerous to the health of any water supply, which the public has a right to use for drinking or domestic purposes. It establishes rules for drainage and sanitation, which specifically mention technical aspects of water disposal.

#### **4.2.7 The Wetlands, River Banks and Lake Shores Management Regulations, 2000**

Sections 30 (1) and (3) of The National Environment (Wetlands, River Banks And Lake Shores Management Regulations, 2000) require a protected zone of 100 meters from the bank of some rivers within which no activity shall be undertaken without written authority of NEMA. This project will respect this regulation.

#### **4.2.8 The Environmental Impact Assessment Regulation, 1998**

The environmental impact assessment (EIA) regulations, 1998 (Statutory instruments 1998 No. 13, Republic of Uganda), section 13 subsection 1 where the executive director has, under sub-regulation (1) of regulation 9 determined that an environmental impact study be made under these regulations, the developer shall make an environmental impact statement on completing the study.

Section 13 subsections 2 in making an environmental impact statement, the developer shall pay attention to the issues laid down in the First Schedule to these regulations.

#### **4.2.9 Standards for discharge of effluent into Water or on land regulations, 1999**

Section 6 (2) of The National Environment (Standards For Discharge of effluent into Water or on Land) Regulations, 1999 details maximum permissible limits for 54 regulated contaminants, which must not be exceeded before effluent is discharged into water or on land. These regulations would directly affect the management and disposal of sewage generated by the facilities during operation phase.

#### **4.2.10 The National Environment (Noise Standards and Control Regulations), 2003**

Section 6(1) of these regulations requires that the maximum noise levels from a facility in the general environment specified in Part 1 of the First Schedule as "mixed residential (with some commercial and entertainment)", shall not exceed 55 dBA and 45 dBA during day and nighttime respectively. This regulation has a direct influence on daytime or nighttime noise levels generated at the proposed facility both during construction and operation phases.

#### **4.2.11 The Water (Waste Discharge) Regulations, S.I. No. 32/1998**

Section 4 (1) No person shall discharge effluent or waste on land or into the aquatic environment contrary to the discharge established under regulations 3 unless he or she has a permit in the format specified in the First Schedule issued by the Director. Section 4 (2) A person granted a permit under sub-regulation (1) shall (a) ensure that the effluent or waste discharged conforms to the maximum permissible limits established under regulation 3; (b) be subject to such other conditions as the Director may specify. This provision will be respected while implementing the proposed project.

### **4.3 Institutional Framework**

The National Environment Policy, 1994 led to the formation of the National Environment Statute, 1995 and the establishment of NEMA as a regulatory authority responsible for coordinating, monitoring and supervision of environmental protection activities in Uganda. NEMA also enforces regulatory compliance during and after construction.

## **5.0 ANALYSIS OF BIOPHYSICAL AND SOCIOECONOMIC IMPACTS**

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### **5.1 Introduction**

Waste composting is the aerobic processing of biologically degradable organic wastes, such as garden waste, to produce an end-product (compost) which can be applied to land to improve soil structure and enrich the nutrient content of the soil. Composting is currently carried out at individual household level and by private flower and nursery operators. Composting can offer benefits such as removal of organic waste from final landfill so reducing methane emissions and the threat of groundwater pollution. The end product can also be used as a substitute for manure. Composting does, however, have environmental consequences.

Mbale Municipal Waste composting operations will include collection, separation, composting, curing and storage, which shall take place at the proposed Doko site after the approval of the National Environment Management Authority. These activities can adversely impact the existing ecological environment.

The proposed site is within a 200 m of river Namatala and associated wetlands; within 100m from Mt. Elgon wheat Millers and offices.

### **5.2 Long-term Positive impacts**

**Social benefits:** The major social benefit will be an increase in general cleanliness of the Mbale Town which will provide a more pleasant and healthier environment for residents and visitors. The improvement of sanitary conditions of the existing dump site at Doko will reduce odour to the residents downwind from the site and control vermin and pest problems. Reduction of road-side waste and elimination of dumps in town will have a broad social benefit for town residents and visitors.

**Improved waste Management:** The heaps of garbage within Mbale Municipality will finally be turned into an income generating activity. The negative impacts caused by solid wastes in the Municipality will be eliminated and garbage will be confined in one place where it will be well managed by composting.

**Reduced Scavenging:** The garbage within the municipality and at the present dumping site was target for scavengers such as children that can endanger their lives and health. The removal of garbage from town will eliminate these dangers to people in town. Since the composting operations will be fenced and guarded; scavengers will have no access to the site.

**Improved aesthetics:** Mbale Municipality is currently littered with garbage, vultures, cattle egrets and vermin such as rats are common site near garbage heaps. The removal of these heaps will greatly improve the aesthetics of the town and minimize the impacts of leachate and odour from rotting garbage heaps.

**Reduction in illegal dumping:** Bulky waste, which is frequently dumped along roadsides, will be collected and deposited at the dump site and the organic component sorted and composted. This will be assisted by stronger enforcement of the laws and regulations.

**Income generation:** The project will in the long run generate income after recovering investments costs and this will certainly enhance revenue of Mbale Municipal Council.

**Recycling:** The idea of materials recovery from the rejects will be encouraged and promoted; the recyclables will be stored in the recyclables shed. The recyclables will be sold when adequate quantity is available for transport; the matter which cannot be sold is sent for landfill. However, care will be taken to ensure that such recyclables are not contaminated with hazardous materials.

**Employment:** During project implementation, it will be necessary to employ supervisors of the skips at every spot to enforce proper disposal of garbage inside skips. Proper sorting of waste by generators will minimize the cost of sorting which would otherwise make compost manure expensive for customers who actually need it. The project will also provide employment opportunities for people that will be involved in selling compost. Customers that will buy the compost will realize higher crop yield, which will also be reflected in improved quality of life.

### **5.3 Short Term Negative Impacts**

These will likely arise during construction of the proposed compost facility, these include:

**-Erosion and siltation:** Construction activities will loosen soil particles which could in turn accelerate erosion of the loosen materials and increase siltation of the drainage down stream.

**-Flooding:** The proposed construction activities could have an impact on existing drainage pattern with substantial increase in the amount of runoff resulting into flooding. This could be as a result of leaving the soil bare. It is however expected that the project site will be vegetated and therefore chances of flooding minimised.

**-Dust and Nuisance:** Dust will be generated as a result of excavation and other site preparations-especially if the work is done during windy and dry weather. The noise from construction traffic is expected to be minimal.

**-Slope stability:** Excavation of site up to 5 m depth or so could create substantial changes in the slopes. The designing of the slopes need to be checked to avoid accidents from collapsing slopes.

**-Cost of composting:** The project has financial implications in that composting will require sorting the garbage which means increasing the number of skips from one to three to handle the bio-degradable, plastics and glass and metals at every disposing site around the Municipality.

### **5.4 Long-term Negative impacts**

#### **5.4.1 Heavy metals**

Chemical contaminants, which include heavy metals (cadmium, lead and mercury); may expose compost workers to potential risks during waste processing; some may also be of concern in finished composts. Metals appear in the municipal solid waste stream from a variety of sources. Batteries, consumer electronics, ceramics, light bulbs, house dust and paint chips, lead foils such as wine bottle caps, used motor oils, plastics, and some inks and glass can all introduce metal contaminants into the solid waste stream. Composts made from the organic material in solid waste will inevitably contain traces of these elements:

Plants take up only a small proportion of the lead from most soils, and long-term field studies (Tom L Richard, et al, 1992) suggest that very little increase in the lead content of crops will occur even with substantial additions of MSW compost. Studies further state that MSW composts can actually decrease the uptake of lead by crops, presumably because the organic matter in the compost binds the lead and decreases its availability to plants.

#### **5.4.2 Trace elements**

Trace elements (e.g., arsenic, chromium, copper and Nickel) are of concern primarily because of their potential to harm soil organisms and animals and humans who may eat contaminated plants or soil. The impact of metals on plants grown in compost amended soils depends not only on the concentration of metals, but also on soil properties such as pH, organic content and cation exchange capacity. Different types of plants also react very differently to metals which may be present. Studies by Tom L Richard et al, 1992 suggest that arsenic, chromium, copper, nickel and zinc are unlikely to cause problems for plant, animal, or human health, primarily because they are not found in high concentrations in MSW compost and/or are not readily taken up by plants:

##### **5.4.2.1 Effects on Water Quality**

In addition to affecting plant and animal health, trace elements contained in MSW composts may be leached (carried by water) from the soil and enter either ground or surface water. As with plant uptake, soil pH, organic matter content, and other soil characteristics affect the amount of leaching.

##### **5.4.2.2 Effects on Soil Organisms**

Little is known about the effect of trace elements in MSW composts on soil organisms such as invertebrates (e.g., earthworms) and microorganisms (e.g., nitrogen-fixing bacteria). Studies from elsewhere indicate that when sewage sludge is applied to land, the concentration of some trace metals (e.g., cadmium) in earthworms is increased, but this increase does not pose a significant risk to the worms or to wildlife that consumes them.

##### **5.4.2.3 Long-term Concerns**

As organic matter decomposes the concentration of metals in compost and thus, in the soil to which it has been applied may increase. Studies by Cornell University USA, suggest that if large amounts of MSW composts are applied to agricultural soils, half

of the organic matter may decompose within one or two decades. Metal concentrations in soil are unlikely to exceed the concentration present in the original compost, unless very large amounts of compost high in organic matter are applied. Over time, metals generally become less available to plants and other organisms unless soil pH decreases greatly or the soil is flooded for a long period of time.

#### **5.4.2.4 Increased soil nutrients and characteristics**

Studies by Tom L Richard et al, 1992 indicate that there are potential beneficial effects of trace elements for agriculture and horticulture. Soils that have been cropped for many years may be deficient in nutrients such as boron, zinc and copper, and MSW compost could mitigate such deficiencies.

Other benefits include improved soil physical characteristics such as increased water-holding capacity, improved chemical characteristics such as nutrient retention capacity, and stimulation of microbial activity that can improve plant growth and decrease the leaching of pollutants into water supplies. MSW compost may also limit harm to plants by tying up trace pollutants and toxic organic compounds.

#### **5.5 Poor waste disposal**

The current state of the dump site is that it has no specific boundaries under which waste must be dumped. This has expanded unnecessarily the size of the dump site from where it should be up, to Pallisa road. Waste has been scattered beyond where it should be and if this trend continues in the new waste disposal and composting project, it could result into epidemics and aesthetic impacts.

#### **5.6 Contamination of R. Namatala**

Both solid and liquid waste (Leachate) from the compost site and dump site might contaminate river Namatala. The EIA study indicated that under heavy rains, there is a possibility of leachate reaching the near by river. Solid waste could also find its way into the river in absence of an adequate barrier.

#### **5.7 Offensive odours from the dump site**

Although there are no major settlements around the dump site, it could be a source of offensive smells to the surroundings especially under heavy winds if no measures are taken to minimise this effect.

#### **5.8 Poor quality composting materials**

Sorted organic waste could be mixed with polythene & plastics at the dump site if there are no proper mechanisms of waste separation at the dump site. This will reduce the quality of compost manure produced and probably fail the composting project.

Much as waste from the town to the dump site will be inspected and re-sorted to fully isolate only organic waste for composting and polythene for burning, this exercise should not be encouraged to continue at the dump site. All waste

categories must be sorted from homes and at the skips/collection centres in town. Sorting of waste at the dump site is tedious, ineffective and expensive. If this is allowed to continue, the composting project could fail due to the poor quality of compost manure that will be produced and lack of funds to sustain it.

### **5.9 Limited composting materials**

It is anticipated that if the project of composting organic matter into compost manure becomes successful, small private composting plants might be established all around the municipality, which might reduce the supply of waste at the landfill.

**Dumping of hot ash and burning of waste in skips:** In some instances, residents have attempted to burn the waste in skips. Some pour hot ash into skips, which ends up setting the waste on fire. Burning waste in skips destroys the skip material and makes waste handling difficult especially due to fires and high temperatures.

**Scattering of waste at residences and in transit to the skips:** Residents have a tendency of establishing home-based rubbish pits that they later fail to manage. Also, residents commonly spill waste on roads while delivering it to collection skips. This usually happens at night. Such acts which are a threat to health of people and also sustainability of the composting project should be discouraged.

**Collection of waste in spoilt/weak skips:** Several skips observed in the divisions are no longer fit for waste collection. A majority of them lack handles are rusty, and perforated. Such skips if left at collection centres will increase costs of waste collection, since waste will always have to be transferred into normal skips. All spoilt skips must not be left at collection centres. All spoilt skips must be repaired or sold off to steel rolling mills for recycling. Only strong skips must be fabricated.

### **5.10 Limited capacity of the landfill**

Landfill is the controlled deposit of waste to land. It normally involves the filling of voids created by mineral extraction or other hollow land. It can also involve the deposit of waste above the ground in a process known as land raising. Landfill can cause significant environmental impacts and is seen as a "last resort". Sites produce landfill gas which is made up of 55% methane and 45% CO<sub>2</sub> and can be used for energy. The associated impacts that a landfill could have on the environment are:

- waste of valuable resources;
- contribution to climate change and greenhouse effect;
- threat of water pollution through contamination of land;
- noise and visual pollution created by heavy traffic, smoke and dust.

The actual area that will be gazetted as landfill will be approximately 2.9 hectares. At a daily arrival of 41 tones of waste per day from the town, it's logical to predict that the carrying capacity of the landfill would be exceeded at a certain time if there are no mechanisms to have the waste recycled.

### **5.11 Conflicts**

Several gardens of maize, beans, sugarcane, coffee and several other crops surround the proposed landfill. The area gazetted as landfill itself is also covered by such gardens. Although EIA findings showed that the majority of these are squatters, proper methods of evicting them should be used so as to reduce damage on both sides.

**Scavengers:** More than 150 women depend on dumped waste (rice husks) for their survival. These people re-sieve the rice husks dumped at the site to obtain some rice remains that they later collect and sold for a living. Unless an alternative source of livelihood is created for these people, displacing them would deprive them of their source of income.

### **5.12 Insufficient labour force in waste collection**

The current labour force employed in waste collection is small which explains the huge heaps of waste piled at several collection centres in town. If the new waste disposal and composting project is to be feasible, it must employ the right number of people to have all the waste collected on time.

### **5.13 Uncoordinated waste management system**

Due to the fact that Divisions are semi-autonomous units, waste management and coordination among them and Mbale Municipal is poor. There is no overall officer in charge of waste management for the municipality. And this has hampered effective waste collection in Divisions especially those that are financially incapacitated. Waste management must be centrally planned with collective efforts if the new project is to be effectively implemented by all the divisions of Mbale Municipality.

### **5.14 Poor and costly transport vehicles**

Vehicles currently used in waste collection in all three divisions are old and need comprehensive repairs if they are to function on a routine basis. Most of the vehicles especially those for Northern and Wanale divisions are completely broken down. Without adequate vehicles for waste transportation, efficiency of the composting project would be impaired.

**Usage of FUSO or Jifang trucks for waste collection:** There have been attempts by both Northern and Wanale Divisions of Mbale Municipal Council to use 'Fuso' and 'Jifang' trucks in substitute of the faulty Municipal Skip Lorries. Although these are fuel efficient, they are not ergonomic and user-friendly to workers involved in waste loading. They are high, hence tedious and difficult to load waste into them. Continuous use of these vehicles will eliminate usage of skips and encourage haphazard waste dumping at collection centers. This is likely to fail the process of waste sorting and the project eventually

**Transport trucks:** There will be need to increase the number of trucks in the Municipality that transport garbage to its final destination for processing. This would empty all the filled skips in time during waste collection.

### **5.15.1 Occupational hazards**

Depending on the operations, design and quality control program, MSW composting workers may be exposed to a number of pathogens, toxic substances, and other physical and chemical hazards. In addition, the composting process uses equipment and machinery that can have hazards.

**Protective gear:** Most of the workers currently employed in waste management do not have protective gears. A majority of them lack protective gloves, boots and overalls. The tools used in waste collection are not adequate and forks, rakes, spades, pangas etc should be provided to the workers in appropriate numbers.

### **5.15.2 Limited funding for waste management**

The EIA findings show that waste management in all the divisions is under-funded. This explains waste accumulation at several collection centres, some to unbearable amounts. The consistency in failing to repair municipal vehicles for both Northern and Wanale divisions is a sign of financial stress. Financial budgets for waste management for all the divisions are too low to handle the proposed project. Without an external source of income for waste disposal and composting project, local revenue collections cannot sufficiently handle this project. The project should sustain itself in the long run.

### **5.15.3 Social – cultural factors**

Marketing decisions are strongly affected by developments in the political and legal environment. Society shapes our beliefs, values, and norms. Traditionally in Uganda, many towns have not had planned and proper centralised waste management systems. So introduction of a new culture of garbage management involving sorting and composting will definitely affect their lifestyle. This is likely to pose a political challenge to the Municipality given that people's lifestyles can take time to change. However, since garbage management is a secondary value it can be changed with time.

## **5.16 Marketing compost**

### **5.16.1 Introduction**

Since compost is a new product in a new market, personal selling is ideal because it would involve answering some questions like how different is compost manure from the prospective customer's other types of organic manure they have been using, for instance cow dung. And also the difference it has got compared to inorganic manure (like artificial fertilizers). In the long-run as the quantity of production increases the promotional strategy can change to advertising through the medium of radio (the one which potential customers listen to) and sales promotion through Farmers' Associations.

The idea of preserving the environment through proper garbage management can be packaged and promoted by using the most efficient communication channel, which is in this case opinion leadership. Anything that involves change of someone's

culture is normally a challenge. The two NGOs contacted had the same challenge of getting the communities change their culture of disposing garbage and begin sorting it, it is reported that they had not yet succeeded in changing their attitude towards it.

#### 5.16.2 Critical success factors (CSF)

- i) **Managing garbage:** Sorting of the garbage; adequate land for composting; change of attitude towards garbage disposal; incentives and ordinances and by laws. The sorting of garbage will require provision of more skips at the dumping site in the Municipality i.e. one skip will be for the bio-degradable, the second one for plastics and a third one for metals which will certainly have a financial implication in terms of cost.
- ii) **Managing the environment:** Government policies and bye-laws; Attitude of the people in the municipality towards environmental management; and Sensitization through training and other appropriate methods
- iii) **Managing the health condition in the Municipality:** Development and enforcement of the appropriate bye-laws in regard to garbage disposal; Sensitization through training; and Incentives
- iv) **Restoring the image of the municipality:** Cleaning the municipality
- v) **Composting facility:** The facility should include an enclosed area to protect recyclables, workers, and equipment from weather. The facility will be designed for loading and unloading organic waste and compost. A concrete slab reduces dust and mud. The site will be fenced to contain litter and provide security.

#### 5.16.3 Market segments/Potential users of compost

- **Property owners** (e.g. hotels, residential houses) which manage flower gardens and compounds. Backfill for trees and shrubs. Backfill is loose soil or substrate used to fill gaps around the root ball, or root network of a tree, or shrub in a landscaped setting. Roots need a firmly packed growing medium capable of retaining moisture to properly supply the rest of the plant with nutrients and water as they grow. Compost is effective at promoting these conditions and can be used as an amendment mixed with backfill materials. Nursery stock, house plants, and most types of flowers require certain blends of growing medium to grow well and stay healthy.
- **Nursery beds.** The nursery attendants mix compost with soil in nursery beds that are used to produce ornamental plants and tree seedlings. Using compost as a component of nursery bed media can improve conditions for plant growth. Tree nursery managers in and around Mbale town; and in the long run even the peasants in the villages where there is limited land for cultivation of which the soils have been degraded due to over utilization and hence need replenishing to be able to produce high yields of crops.

- **Farmers and erosion Controllers.** Studies have shown that compost is an effective medium for minimizing soil loss and erosion in areas where surface soils have been disturbed. Erosion control applications include compost. Landscaping, construction, and road work are examples of settings in which compost might be useful as an erosion control product. Road contractors, Farmers associations around the Mbale town for their demonstration plots including Uganda National Farmer's Association (UNFA).

Local residents especially those in the North Division who grow vegetables and manage their compounds/flower gardens;

#### **5.16.4 Promotion**

Mbale Municipality will first come up with a compost and logo which will serve as a focal point. Many marketing programs use;

- local radios
- newspaper columns
- television and video shows commercials
- trade Shows
- newsletters
- billboards
- Mbale Municipal Web Site
- word of Mouth

#### **5.17.1 Strategies for marketing the compost**

##### **5.17.1 Diversification**

A new product of compost manure and other recyclable products are going to be developed and sold to a new market. There are mainly two products to be marketed to the community of Mbale Municipality. These are:

- the idea of preserving the environment through garbage management which is the intangible product, and ;
- the compost manure and other by-products for instance the recyclables which are tangible products.

The quantity of the compost manure and other by-products should be viable to support the market needs, and the speed at which the compost is made is critical in meeting the demand of the customers.

##### **5.17.2 Packaging**

Packaging is an important way to get the advertising message across. The compost manure should be packaged in appropriate packs depending on the need of the customer. The manure can be availed in packs of 100 kgs (bag) or in tons per truck and byproducts and recyclables in kilograms.

##### **5.17.3 Competent and dedicated staffing**

Getting a composting program off the ground requires planning; coordination and a well-trained staff. The composting program team should include individuals with operations management experience; and other unskilled labour (people who could be members of the community), will be guided by trained staff. There will be need for workers to take care of the skips and ensure that each type of garbage goes to the right skip.

#### **5.17.4 Marketing channels**

The marketing channel most suitable for compost manure would be the direct one (which is producer to customer) that is without intermediaries. For a beginning because of the size of output, no intermediaries will be required. Direct marketing is one of the fastest growing avenues for serving customers and can be used to build a long-term relationship with the customer (typically known as Customer Relationship Management).

#### **5.17.5 Sales and/or distribution**

One of the most important functions of the market research will be to identify target markets for the compost product. Within the sales and distribution program, strategies which include pricing policies will be developed for the target markets to be approached. These markets typically include those with the greatest potential as far as volume and value, and those which are the easiest to penetrate over a short period of time. Continued market research should identify and develop programs for new niche markets as well as methods to increase the value of the compost.

#### **5.17.6 Product Value**

Talent Call Development Promoters Initiative an NGO in Seeta – Kampala that was one of those visited, priced their compost manure at 100/= per Kg and packed their product in 100 Kg bags which was sold at 10,000 per bag. One of their key customers was Makerere University Kampala which used to take it to Kabanyoro farm according to the Assistant Programme Coordinator Mr. Semayobe Francis. However, the individual peasants found it expensive. In the introductory stage of the production of compost manure there should be price skimming to target only those few customers who can afford (e.g. Mbale Resort Hotel) to be able to meet the demand of the market since there won't be much compost manure at the beginning. Then as the production increases the pricing can be switched to penetration (affordable price) to target the rest of the market.

Selling at lower prices may be a time-honored way of dealing with competitors, though it presents problems cost recovery.

#### **5.17.7 Market information System**

There will be need for an establishment of a Marketing Information System which will provide a feedback for control and monitoring purposes.

### 5.17.8 Positioning

There are many ways for a business to be unique, from small pricing, packaging, and service differences to significant feature and benefit contrasts with the competition. Correct positioning will have to solve the marketing mix problems of the "Four Ps of Marketing" – product, price, promotion or advertising and place (distribution)

Positioning is ordinarily a very important factor in creating effective **advertising and promotion**. In fact, the less money spent on advertising and promotion, the more important correct and consistent positioning becomes. Mbale Municipal Council shall:

- Work at consciously identifying brand features and benefits that are unique to differentiate the company and its products from the competition.
- Communicate and test which differences are most important to buyers and consumers in deciding to purchase the compost rather than other fertilizers.
- Work at communicating the most unique and important differences to buyers and consumers to create "branded value" and a "brand personality."

While promoting the compost manure and the preservation of the environment a position statement can be used to help in positioning the products in the mind of the customer as such. "Using compost manure to manage your soil fertility while preserving the environment"

### 5.18 Strategies to attract steady supply of organic wastes

There is lot of garbage generated (approximately 16 skips per day which is an equivalent of 35.2 cubic meters is collected per day, Industrial Division collects 10 skips per day under normal circumstances can even collect 15 skips, North Division 5 skips per day but under normal circumstances can go to 10 skips, Wanale Division collects 5 skips per month) to start with.

The organic wastes generated in Mbale Municipality already meet up to more than 70 percent of the demand for starting materials for composting. However, the challenge is sorting and collecting them at a central area for composting.

All the players must work closely together-Municipal Authorities, Factory owners; Mbale main market, Residents in Indian and Senior quarters, Petty food vendors along the streets, and Companies cleaning the green areas within town.

To increase the supply of organic raw materials, however, the Municipality will use a number of methods, but also a capable coordinator to mobilize the suppliers:

- Market research should identify and develop programs for suppliers of waste.
- Rewards to residents who supply sorted wastes
- Provision of 12 hour transport to collect the wastes from dump of points.

Awareness, sensitisation and adverts through: local radios, newspaper columns, television and video shows commercials, billboards, Mbale Municipal Web Site and word of Mouth

## **6.0 MITIGATION OF ADVERSE IMPACTS**

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Preventive and mitigative measures have been proposed in response to the potential direct, indirect and secondary impacts and marketing strategies identified in Chapter 5. Some measures are associated with sorting at household level and others with composting of the organic wastes. Most impacts associated with waste handling are moderate to minor and short-term. If good municipal waste management practices are employed, impacts will be in-significant.

All organic waste generated at the collection centres /skips and in factories will be transported to the composting site according to the waste management plan.

The composting activities will not have detrimental significant social impacts through diverting of a significant portion of the waste generated from zero grazers who buy banana peelings, cabbage leaves and potato vines. The EIA process found out that there is lot of garbage generated as shown in section 5.18.

All the players will work closely together in implementing the composting project. Municipal Authorities will involve factory owners; Mbale main market, residents in Indian and Senior quarters, petty food vendors along the streets, hotel owners, restaurant owners and companies cleaning the green areas within town.

To offset the diversion of a significant portion of organic raw materials, Mbale Municipal Local Authorities will use a number of methods, but also a capable coordinator to mobilize the suppliers:

- Market research shall identify and develop programs for suppliers of waste.
- Income, rewards and recognition of residents who supply organic wastes
- Provision of 24 hour transport to collect the wastes from dump of points.
- Awareness, sensitisation and adverts through: local radios, newspaper columns, television and video shows commercials, billboards, Mbale Municipal Web Site and word of Mouth

### **Mitigation of Direct Impacts**

#### **6.1 Public information and education**

A baseline survey will first be conducted to obtain training needs of the residents as far as the development, suitability and sustainability of the waste disposal and composting project is concerned. Then waste management-training manuals will be produced and systematically circulated within all the cells. Residents will be sensitised and educated at cell-level with emphasis on the need for waste sorting by composition. The new waste handling and management system will be articulated to the residents before its implementation.

The success of a composting program will depend on early community involvement, followed by continuing educational efforts. This will start by determining residents' interest in composting and their concerns about how the composting program will work. Their input will be taken seriously and their concerns answered.

This program will be introduced in schools within the municipality and through participation and cooperation with environmental NGOs in Mbale. When children

learn about recycling at school, they serve as composting ambassadors, sharing what they have learned with their families and others in the community.

The resident communities involved in the waste management will be sensitized together with the district councils, local leaders.

To enhance **public information** it is proposed that a popular version of leaflets presenting the project, its objectives, its impacts and the proposed mitigation measures be distributed to the affected Local Councils and Cell communities before starting the composting project.

## **6.2 Worker Health & Safety**

In Uganda commercial waste composting is limited and lacks evaluative data offering a foundation on which to base scientific assessments. Thus serious, immediate and wide-spread threats to the environment and consumers presented by MSW composts may not be evident. Most of the concerns focus on long-term, chronic exposures. Despite uncertainties, Mbale Municipal Local Authorities will act to safeguard public health and the environment.

Workers will be provided with protective gears, which shall include gloves, leather boots, appropriate working clothes and all the necessary tools and implements. Workers involved in waste sorting, loading and off loading shall be given an opportunity to wash or shower after work before they return home. Landfill development will provide for wash water source and a shower room on the site.

**Carcasses** of dead animals will be disposed of by either incineration or burying. Similarly condemned carcasses from slaughterhouses will be incinerated or buried.

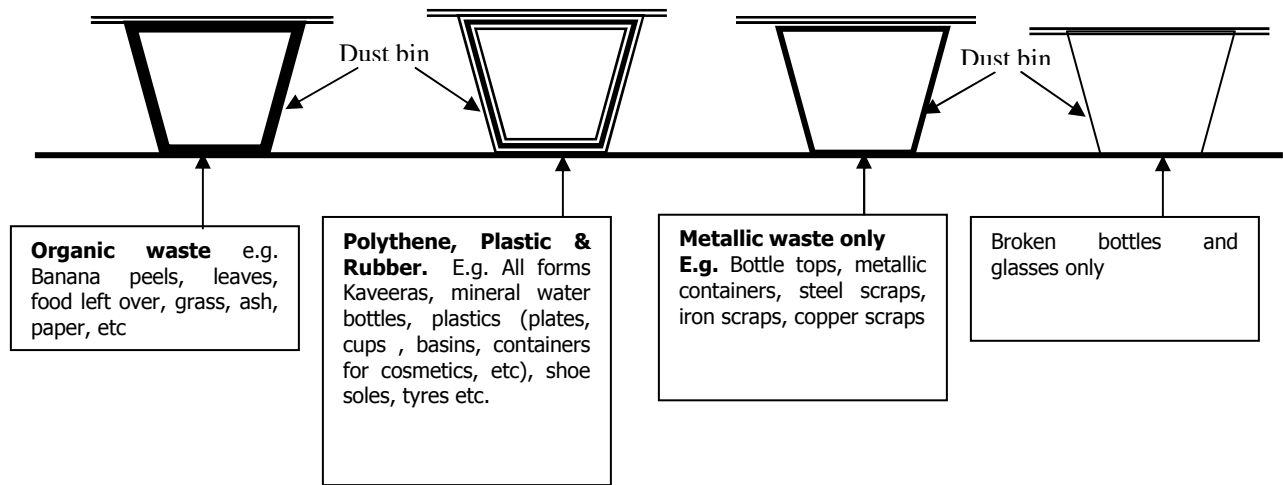
**Heavy metal contaminants:** Elements such as cadmium, lead, and mercury can be harmful to animals and humans at relatively low concentrations and thus, will receive close scrutiny and eliminated from the compost materials:

**Management of Fuel and Lubricants:** Vehicles and equipment shall be properly maintained, serviced and refueled at services stations outside the project site, so to avoid soil and water pollution by fuel and lubricants, oil contamination, seepage and spread into compost.

## **6.3 Sorting of waste at its origin**

As a new policy of the municipality, it shall be clear and mandatory to every home, hotel, hospital, shops, markets, clinics, hospitals and all units of waste generation to sort their waste before taking it to the central collection points (skips). Liquid waste and water will not be mixed with solid waste. Every unit generating waste shall have 4 dust bins each collecting waste of different composition. The dustbins shall comprise waste of the following categories - waste sorting procedure at homes, hotels, markets, shops, industries etc.

**Figure 6.1**



#### **6.4 Regular inspections**

Every waste collection point will have a waste inspector to ensure that all the waste brought is well sorted as per the illustration above and also to ensure that it is dumped in the right skip. A waste inspector shall be well trained to know his/her job.

#### **6.5 Sorting at the collection points**

Just as waste is sorted at home, the same procedure will be followed at the skips. The illustration for sorting waste at home above will be used for sorting waste at the collection centres/skips. Every collection centre will have 4 skips each handling specific as shown above. There shall be a separate skip for organic waste, polythene & plastics waste, metallic waste and bottles. The municipality shall employ a team to start the initial process of sorting waste at the dump site. This team will also direct the process of dumping different waste types on the arrival of skips or waste from the factory. Unsorted waste from the factory will not be accepted at the composting facility, but will be directed to the landfill.

#### **6.6 Establishment of bylaws and punitive measures to lawbreakers**

The implementation of the waste disposal and composting project will not be successful if there are no clear and stringent guidelines, policies and bye-laws to restrain non-compliance. Adequate and protracted sensitization will be undertaken in project communities to stimulate behavioral change. Punitive measures will be put instituted for people who fail to sort waste or who attempts to mix waste of different composition at collection centres. These new guidelines shall be brought to the attention of the residents before the project commencement. Dumping of concrete debris from construction sites into skips will be prohibited.

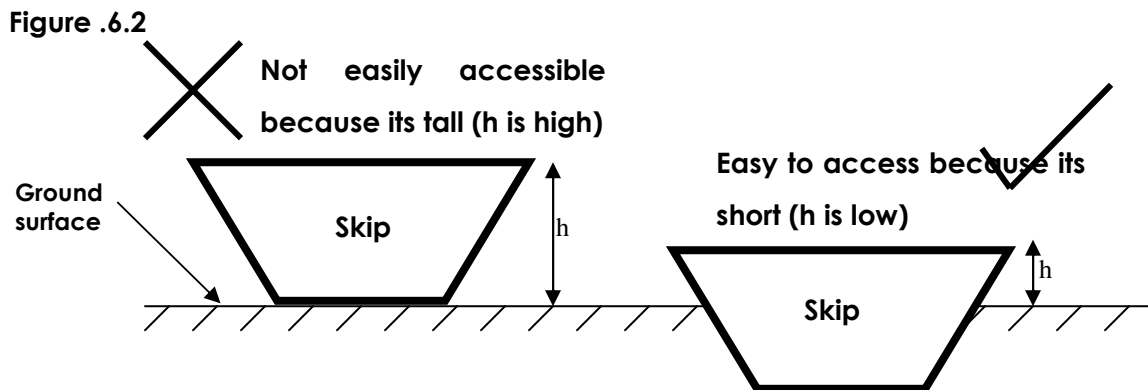
#### **6.7 Penalties for infringements of environmental laws**

The specific requirements of the relevant legislation are cited in this EIS and standards shall be respected and adhered to, with regard to site selection, composting program design, and implementation; and decommissioning. Any infringements of the regulations cited herein and other existing by the developer,

composting site manager and/or their workers will attract a penalty. Increased enforcement of the existing litter law will deter would-be dumpers.

### 6.8 Lowering the vertical height of the skips

The EIA study indicated that some people fail to dump waste into skips because of height limitations relative to the skips. Therefore, Mbale Municipal Council will make sure that all the skips are lowered by partially submerging them in the ground. Every skip will be fixed in a pit so that its content can be clearly visible to the waste dumpers; **figure 6.2**.



### 6.9 Timely emptying of skips

Skips will be emptied as soon as they fill up and not be left to overflow and spill to the ground. Waste inspectors at the skips shall report promptly to concerned authorities to have filled-up skips taken to the landfill immediately.

### 6.10 Faecal waste management

Mbale Municipal Council shall ensure that all toilets in the municipality are connected to the main sewer line of National Water & Sewerage Corporation (NWSC). Every homestead using toilets will confirm to municipal authorities with certified evidence that they are legally and properly connected to the main sewer line. Municipal Council will work with NWSC to ensure that this is effectively done. Pit latrines shall be properly constructed and located relative to the homestead and its surrounding features. No homestead will be located in a wetland. All latrines in the divisions shall be inspected and certified by Division Health Officers and Environmental Officers of Mbale District.

### 6.11 Proper road net work at the composting facility

A proper road network within the composting facility will be maintained by the Divisions' Health Inspectors of Mbale Municipal Council. The roads will clearly connect to the different compartments of the landfill and inspected regularly.

## **6.12 Fencing the landfill**

The current situation is that people don't know the boundaries of the landfill and waste is littered everywhere even up the road. The area that has been gazetted as a landfill shall be surrounded with a chain link fence to ensure orderly dumping and also to avoid scattering solid waste to river Namatala by either waste collectors or wind. The northern boundary of the landfill will end at the red line and not at the riverbank as had originally been proposed by MMC. A buffer distance of 100 meters shall be left between the actual northern boundary/fence (redline) of the landfill and the riverbank.

## **Mitigation of indirect Impacts**

### **6.13 Protection of river Namatala from possible contamination by leachate**

Zone C will be planted with wetland plants especially papyrus so as to absorb any toxic flow from the landfill (**Figure 6.3**). The papyrus will be cut regularly to ensure regrowth and sustain effectiveness of plants to continuously absorb possible toxins. Zone B will be planted with elephant grass to intercept and control any possible flow of leachate and erosion from the landfill. Zone A will be planted with an assortment of trees such as Terminalia Ivorensis (Umbrella tree), Pinus patula (pines) and Grevelia robusta (Grevelia). The trees will prevent any possible movement of bad air from the composting site besides beautifying the area and camouflaging the existence of a composting facility and dump site.

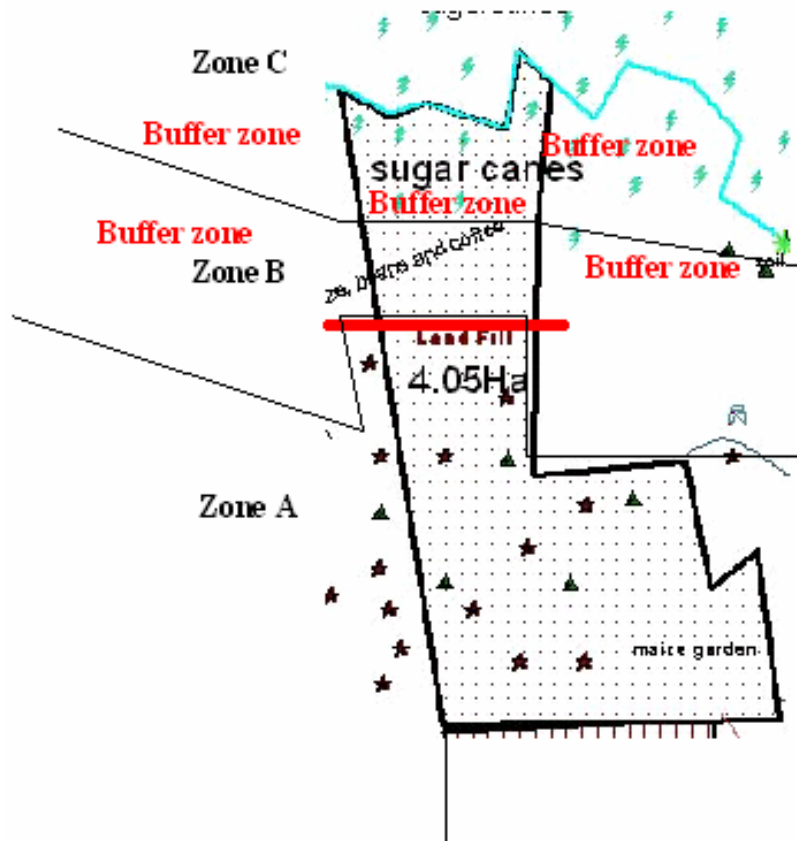
### **6.14 Scavengers - displacement of women who winnow rice husks near landfill site**

About 150 women are involved in winnowing rice husks at the dump site and depend on this as the only source of livelihood. This signifies high levels of unemployment in Mbale Municipality. EIA findings show that activities of these women would not affect performance of the composting project. It is therefore recommended that they do not get displaced but left to continue operating at their current location. It is also recommended that they will be incorporated into the composting project activities within the town and at the site such as waste sorting and spreading which will be a consistent, reliable and more paying job.

### **6.15 Removal of scattered waste outside the gazetted area**

All scattered waste outside the gazetted area will be removed and dumped in the gazetted and fenced dump site. This will be implemented before the composting project starts. It will be effectively done with a grader to clear such areas of waste and avoid outbreak of diseases. The area between Mt Elgon Millers and NWSC land, opposite Pallisa road will be considered first. This area neighbours a water source and will be cleared of waste immediately.

## **Figure 6.3 Zoning of the landfill**



### 6.16 Handling of factory waste

Sorting, transportation and disposal of factory waste into the dump site shall be entirely the work of factory owners/managers. All managers of factory (table 6.1) in Mbale will be fully incorporated in the new waste management and composting project. Every factory will embrace the new waste sorting system. Waste shall be sorted into four categories just as homesteads have been advised to do it. Every factory shall have 4 waste bins for separate collection of organic waste, plastics, metallic waste and glass.

**Table 6.1 factories operating in Mbale town**

Name	Product	Plot	Street
Uganda Klere Industries (sleeping baby)	Cosmetics & Juice	1/3	Maluku drive
Chinese Industry	Chalk and shoe polish		Majanga
Mbale soap works	Soap	13/25	Karamoja lane
Mbale soap works	Soap & Cooking oil	66/68	Pallisa Road
Ntake Bakery	Bread	74/76	Pallisa Road
African Textile Mill (ATM)	Clothes		Pallisa Road
Uganda Trade Industry	Soap & Cooking oil	68/80	Temuteo Mukasa
Elgon Millers Safy	Rice		Pallisa Road
Bugisu Cooperative Union (BCU)	Coffee hauling		Pallisa Road
Bugisu Coffee Factory	Coffee hauling		Pamba Road
Abattoir	Meat & cow dung		Freight Road
All Rice and Maize millers	Rice & maize hauling		Bugwere Road
All maize mills in Northern division			Mwanyi Road
			Bunyoli Road

			Freight Road
			Pamba Road

### 6.17 Land conflicts around the dump site

The proposed mitigation measures of planting papyrus plants, elephant grass and trees around the landfill could cause land use conflicts between Municipal Council and the legitimate landlords around it. National Water and Sewerage Corporation (NWSC) Mbale branch is a key player in this as they neighbour the proposed project site. However, if Mbale Municipal Council negotiates with NWSC, such conflicts will not arise.

### 6.18 Farming in and around the dump site

All farmers within and around the landfill site will be stopped from cultivating and notified to leave the area. No further cultivation of any kind will be permitted. They will be given time to harvest all that they have planted and given a deadline of 3 months to quit this area. All banana and coffee gardens will not be tolerated after the deadline.

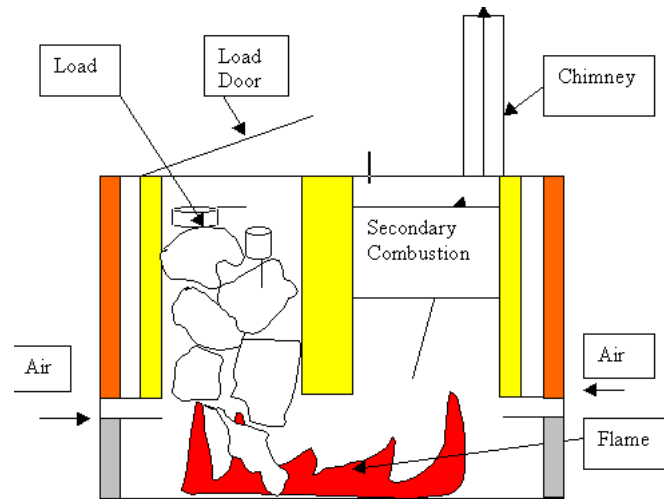
### 6.19 Metallic and medical waste management

**Metallic waste** will not be transported to the landfill. It is easily recycled and metallic waste is on high demand by steel rolling industries. Mbale Municipal council shall assemble all forms of metallic waste from the various skips and factories at a common point after which it will be sold off or given away to steel rolling mills for recycling.

As good practice, every hospital, medical centre and clinic shall have a medical needle cutter, waste incinerator or (pit) to handle medical waste.

**Medical waste** from hospitals and other medical centres are managed through incineration; based on the architectural drawings incinerators may be constructed. A firebrick core is built with fire door tunnel and air inlets. The chimney, loading door, ash hole and trays may be made of rolled steel fitting. Ordinary mortar is used for the brickworks (see diagram of sample Morfort Incinerator **Figure 6.4**). The incinerator can be built on a two square meter square concrete platform, with a layer of firebricks beneath the incinerator body. The materials needed are Fire bricks, Cement, Steel sheet for doors, hinges, water.

**Figure 6.4: A cross section of a sample Morfort incinerator**



Source: Morfort University Incinerator

**Incinerator Operation:** The incinerator is loaded with sorted waste and lit with paper and/or wood at the bottom of the primary chamber as shown in the diagram above. Once lit, the combustion chamber is fed with waste at regular intervals to keep the chamber as full as possible. The incinerator does not have a temperature gauge and so adequate operating temperatures have to be judged by the operator based on training and experience. Some waste materials such as ampoules and glass bottles containing liquid vaccines and medicines may explode during incineration causing glass and other waste materials to be blown into the atmosphere. The operator ensures that eye protection and a face mask is worn when opening the loading door or when visually checking the combustion process through the air inlet or when removing the ash door while the incinerator is in use.

**Medical waste handling:** The operator always has to wear heavy-duty gloves and apron while handling medical waste. A rod or scraper is used to pull the solids out through the ash door and into a dustpan or box. The ash or other waste materials are removed when they have cooled down. This takes about five hours. If the incinerator is in operation on a daily basis then the ashes and other waste material can be removed the following day as part of the preparation for operation.

The operator has to judge when to place which type of waste into the incinerator at any particular time. The ash and other waste materials that are not burnt are carefully removed and disposed of in a lined disposal pit in a designated place within the medical facility.

## 6.20 Environmental protection strategy

### 6.20.1 Scavengers

Scavenging will not be permitted at the composting facility. Recycling will be assigned to project workers. A fence will be constructed to enclose the site to control dogs, people dumping mixed wastes.

### 6.20.2 Odour, noise, pest and litter control

The organic part of the waste stream will be composted and others; the inorganic parts that are not recycled will be dumped and covered. This will drastically reduce odor. The composting facility will operate twenty four hours (24 hrs), however, noise from trucks and machinery will be minimized and the buffer zone of a live fence will diminish the sound from the composting facility. Incoming vehicles will be covered with nets to avoid littering in route and at the composting facility. Site maintenance will include removal of litter that has blown from the working area. The vermin will diminish through the composting of organic garbage which attracts them.

### 6.20.3 Surface water and erosion control

A concrete slab will be constructed and used for raw material handling; runoff from the site during heavy rains will be directed away from the composting site into the channels and spread out into the compound. The proposed project site has a gentle slope, so accelerated erosion at the compost site will only be a minor problem. Surface water runoff will be diverted around the perimeter of the site via water diversion channels, and runoff will be deflected away from active waste handling areas.

### 6.20.4 Training

Improper waste composting operations and marketing procedures constitute a potential health risk to the workers and residents.

To assure that the composting will operate in an environmentally sound manner, the staff will be trained and equipped to perform their functions. Training in fire control and prevention, operation of composting equipment, leachate sampling and monitoring will be conducted. There shall be modules with both practical hands-on and classroom sessions. The personnel will be trained to be competent in their responsibilities; some of the areas to emphasise during training is outlined under table 6.2.

**Table 6.2 Areas for practical hands-on and classroom training**

Topic	Content
<b>A. Classroom sessions.</b>	
i) The Composting Process <b>(Refer to Section 3.7 on Technical Information on Composting)</b>	This module will introduce the theory of composting and practical issues concerned with ensuring that the composting facility can fulfil roles in producing quality compost from organic wastes collected from households and markets.
ii) Meeting the legislation	This will cover What legislation applies and how to achieve compliance.
iii) Compost site management	This module will cover the basic overall operation of the plant and discuss in more detail the individual processes involved.
iv) Plant Equipment	An overview of the specialist composting equipment, what it does and how it fits into the process.
v) Compost plant Maintenance	A full account of the preventative maintenance programme including the required record keeping.
vi) Health and Safety	All aspects of Health and Safety requirements for both operating staff and visitors to the site.
vii) Public Relations Issues	How to keep good relations with neighbours and to manage the public perception of waste composting.

<b>B. Practical hands-on on-site training includes</b>	
<b>Pre-treatment Area:</b>	In-depth training of pre-treatment of the fresh waste.
<b>Composting windrows</b>	Training on the care and use of the windrows and the equipment associated with them.
<b>Maturation Area:</b>	Training on the management of the maturation windrows to ensure the highest yield of the best quality product.
<b>Compost business and marketing:</b>	Pricing, composting costs and business management.
<b>Documentation:</b>	All trainees will be given a hardcopy of the training notes.

## **Mitigation of Secondary Impacts**

### **6.20.5 Environmental health education and awareness**

This component aims to educate, inform and increase the awareness of the general public in waste generation, storage and collection schedules and procedures, litter, illegal dumping, bulky waste handling, backyard composting. The activities to be carried out include: (i) public education through media campaigns, printed material and seminars; (ii) technical assistance at the community level for backyard composting; (iii) community clean-up programs; and (iv) environmental education in schools.

### **6.20.6 Site restoration strategy**

**Removal of the concrete slab:** At the end of the project, Mbale Municipal Council Authorities will determine whether to use the area for other planned activities or remove the concrete slab and any other unwanted structures and dispose them off in a gazetted area.

**Back filling the pits:** The pits created by the removal of concrete will be filled with murrum and the surfaced leveled and used for the intended activities – house construction etc.

**Controlling soil erosion:** To minimise soil erosion from project site; grass and ornamental plants may be planted to form some green as a nature conservation strategy, however, this will depend on the intended use of the site.

**Penalties for infringements:** The specific requirements of the relevant legislation cited in this report and standards shall be respected and adhered to, with regard to site restoration. Any infringements of the regulations cited herein will attract a penalty.

### **Contamination with heavy metals**

The soil at the composting site will be sampled and analyzed for heavy metal (Lead, Cadmium, and Mercury) and trace element (Chromium, Copper, Nickel, etc) contaminants. The analyses will be conducted at the Government Central laboratories or any other laboratory for soil contamination.

A natural process called **bioremediation** could be used as an alternative cleanup remedy for heavy metal contaminated soils. Bioremediation boosts the activity of naturally occurring microorganisms to degrade hazardous substances in soil or sediment into nontoxic materials (Tom I. Richard et al, 1992).

**Composting:** Composting uses naturally occurring microorganisms to degrade organic wastes. Increased temperatures from heat produced by microorganisms speed their metabolism and degradation of the organic materials in the waste. Studies by Tom .L. Richard indicate that Municipal Solid Waste composts can actually decrease the uptake of lead by crops, presumably because the organic matter in the compost binds the lead and decreases its availability to plants. The application of MSW composts will, however, increase the lead content of uncontaminated soils. This may pose a risk to animals or children in the area who ingest the composted soil directly.

Because of the modest equipment and monitoring requirements, windrow composting is a cost-effective technology, with a **high degree of treatment effectiveness** for heavy metal contaminated soils at a **low process cost**.

**Bio-slurry:** In case the compost site requires greater process control and more complete degradation; **soil slurry, bio-treatment** or "bio-slurry" is a bioremediation option. The contaminated (soils) materials are mixed into slurry to allow contact between the microorganisms and the contaminants. The treated slurry is suitable for direct land application, similar to finished compost.

**Table 6.1 Environment Management Plan**

Impact	Proposed Mitigation	5% of project cost will meet the cost of mitigation	Responsible party	Impacted area component	Monitoring indicators	Timing
1. Worker Health & Safety	<p>-Despite uncertainties, Mbale Municipal Local Authorities will act to safeguard public health and the environment.</p> <p>-Personal Protective Equipment e.g. gloves, goggles, face masks, guards will be given to the workers and encouraged to use them.</p> <p>-Training awareness on the use and dangers of poor waste management will be provided to all the workers free of charge.</p>		<p>Medical Officer</p> <p>District Health Officer /Inspector</p>	Workers	<p>Presence of First Aid kits</p> <p>Presence and use of Personal Protective Gear</p>	<p>On-going</p> <p>At long times</p>
2. Water pollution	<p>-River buffer zoning of 30 metres</p> <p>-Develop a water quality monitoring system</p> <p>-Papyrus and other wet land plants will be planted at to absorb leachate. The papyrus will be cut regularly.</p>		<p>District Water Officer</p> <p>NWSC</p> <p>DEO</p> <p>DWD</p> <p>Municipal Waste Mgt. officer</p>	River water, Local community	<p>Polluted water</p> <p>Solid waste in river Namatala</p> <p>Available planted wetland plants and trees at the site</p>	On-going
3. Establishment of bylaws and punitive measures to law breakers	<p>-Mbale Municipal Council will enforce and where necessary develop ordinances; waste management guidelines, and measures to restrain non-compliant residents.</p> <p>-Residents will be sensitized on the waste management guidelines before the project kicks off.</p>		<p>MMC</p> <p>District Local Council</p>	Public	<p>Waste management guidelines and by laws instituted.</p> <p>Degree of compliance in waste sorting</p>	1 <sup>st</sup> year; on-going

4. Human excrete	Residents using pit latrines will be regularly inspected and certified by division health officers and environmental officers of Mbale district.		DEO MMC	Environment	Human waste in composting materials	Monthly
5. Proper road net work at the waste management site	Access roads will be maintained by the divisions' Health Inspectors. These roads must be opened and inspected regularly.		Town Engineer	Physical environment	-Pot holed access roads -blocked roads	On-going
6. Medical wastes	As good practice, medical wastes will be disposed will be incinerator or deposited in a technically designed pit.		District Medical Officer	Public and physical environment	Medical mixed in MSW	On-going
7. Welfare and protection of workers	Workers involved in waste management will be paid regularly. And provided with protective gear and a convenient shower room at the composting site.		Health Inspector	Workers and MMC	Disgruntled workers  Workers without PPE	On-going
8. Dead animals and/or carcasses	Carcasses of dead animals will be disposed by burying at the landfill and any other condemned parts of the slaughter will be incinerated or buried deeply;		Health Inspector District Vet Officer	Public and workers	Absence of dead animals in compost making materials	On-going - whenever necessary
9. Land conflicts around the landfill	-MMC will negotiate with the all stakeholders and address any issues that may lead to conflicts.  -Organic wastes from the collection skips will be transported to the composting site; and the non-compostable wastes will be dumped at the landfill.		MMC NWSC	Land users and owners near the waste management sites	Pending cases reported to LCs, Police	
10. Farming in and around the landfill	All farmers within and around the landfill will be stopped from cultivating and notified to leave the area after harvesting their crops.		MMC	Subsistence farmers and MMC	Gardens near and with waste management sites	1 <sup>st</sup> quarter
11. Waste dump scavengers - rice	The 150 women scavengers at the land fill will be incorporated into the composting project activities with in the town and at the site such as waste sorting and spreading which will be a consistent,		Scavengers Health Inspectors	Waste scavengers	Disgruntled waste scavengers	1 <sup>st</sup> quarter

	reliable and more paying job.					
12. Handling of factory waste	Sorting, transportation and deposing of factory waste to the landfill will be done by the factory owners/managers. The waste will be sorted into organics, polythene, metals and glass and deposited into different bins/skips.		Factory owners	Factory owners and MMC	Factory wastes mixed with MSW	On-going
13. Metallic waste Management	Metallic waste will be recycled and sold off or given a way to steel rolling mills for recycling.		MMC - workers	Workers and waste generators	Metals wastes mixed in the compost wastes	On-going
14. Sorting and collection	Waste will be sorted and there will be Skip for organic waste, a skip for polythene & plastics waste, a skip for metallic waste and a skip for glass.		MMC - workers	Workers and residents	Unsorted waste streams at composting facility	On-going
15. Waste inspection and sorting at the collection centres/skips	Waste collection points will have a waste inspector to ensure that all the waste brought is sorted as per the guidelines and dumped in the right skip.		Waste Inspector	Health Inspectors	Inspection records	Monthly
13. Removal of scattered waste outside the gazetted area	All waste outside the gazetted area will be collected and dumped in the gazetted areas. This will be done before the commencement of the composting program.		MMC Divisions MMC- workers	MMC workers	Wastes dumped outside gazetted areas	Regularly On-going
16. Sensitization and education of residents at cell level	-Training needs assessment will be done - Residents will be sensitized and educated on the need for proper waste management - waste sorting, composting and disposal.		MMC Residents LCs Health Inspector	MMC and workers	Workers and residents not aware of the waste management procedures and practices	On- going
17. Timely emptying of skips	Skips will be emptied as soon as they fill up to avoid overflow to the ground.		MMC - workers	Workers and MMC	Over flowing waste bins	On-going
18. Fencing the land fill	The landfill will fenced to ensure orderly dumping. A distance of 100 meters left between the actual the landfill and the riverbank.		MMC – workers Physical Planner	MMC workers -	Fence around waste facility	1 <sup>st</sup> quarter

## **7.0 ENVIRONMENTAL AND SOCIAL IMPACT MONITORING**

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### **7.1 Monitoring process**

Mbale Municipal Council (MMC) will monitor actual environmental impact of the waste management project to ensure that mitigation measures are implemented. To be able to fulfill this requirement, it will be necessary to work with indicators of environmental change outlined in the Table 6.1. The indicators will be monitored on a quarterly, annually and at project completion. Capacity to conduct monitoring will be built through training. The major objectives of the monitoring plan outlined in Table 6.1 are to:

- Assess compliance with the National Environment Management Authority (NEMA) EIA approval certificate condition;
- Measure and improve the effectiveness of Mbale Municipal Solid Waste Management Plans (MSWPs);
- Assess the chemical, physical, and biological impacts of receiving wetland and rivers waters;

The Monitoring Plan, developed to address these objectives, has several elements: core monitoring, which includes waste management process (collection, sorting, size reduction, composting, recycling, and land filling/dumping). Project impact monitoring (water and soil sampling, worker health and welfare, compost marketing) and the Best Management Practice (BMP) effectiveness.

A monitoring program will check on progress of the project and the resulting impact on the environment. It will also include regular reviews of the impacts that could not be adequately assessed before the project started, or which may arise unexpectedly. In such cases, appropriate new actions to mitigate any adverse effects will be undertaken.

### **7.2 Nuisance Control Plan**

The waste management and/or waste composting site operations will be monitored on a regular basis, according to the approved waste management program. Any situation contrary to what is planned will be addressed immediately on a case-by-case basis:

**Odour:** Obnoxious odours may be associated with anaerobic conditions. Excessive temperatures, excessive water, will be monitored and addressed to minimize the occurrence of any odour causing conditions.

**Stagnant water:** Drainage at the composting site will be improved by constructing a concrete slab base which will help eliminate the potential of stagnating water. Additionally, the windrows will run parallel to the slope allowing for proper drainage and prevent standing water or ponding. Any standing water observed on site will be subjected to immediate corrective actions. These actions may include; adding fill material, re-grading the area or modifying drainage patterns.

Through the elimination of standing water, the regular turning of windrows and heat

generated by the compost process breeding of vermin and insects is inhibited. Regular monitoring of the compost and mulch windrows will also be accomplished.

**Noise:** Noise from operating equipment will not present a significant problem considering that the site is located in the industrial division and its neighborhood not inhabited.

**Dust:** Dust generated by access roads or by turning the windrow and/or processing machinery will be suppressed by use of water sprays if necessary.

**Safety and well being of employees:** Mbale Municipality will operate the compost site in a professional manner. The safety and well-being of its employees, the public and the environment are of the utmost concern. The operations will be monitored daily and any safety hazards or public complaints will be rectified immediately.

### **7.3 Social and environmental impact monitoring**

Monitoring of impacts is essential in order to determine actual impacts and check compliance with required environmental standards. It also helps determine whether the recommended mitigation measures have been implemented. The monitoring team will ensure that the respective bodies implement the mitigation measures recommended in this report and will undertake to monitor the following:

- The management of the wastes streams and the composting processes;
- During implementation of the project, the team has to ascertain that mitigation measures are put in place at every stage of the project;
- Regular inspection of the landfill and composting facility by the district environment officer and NEMA checking on waste management and composting in accordance to the suggested monitoring indicators;
- Health, safety and welfare of the workers;
- Regular environmental audits of the waste management program will be carried out at least once every year and reports submitted to the National Environment Management Authority;

This environmental monitoring program is to ensure implementation of measures proposed to improve project performance and ensure that the project operates in a way that will not cause injury to the environment.

### **7.4 Monitoring Team**

While Mbale Municipal Council will do its own internal monitoring, a monitoring team headed by the District Environment Officer and composed of the local environmental authorities, representatives from Divisions and Local Environment Committees, NEMA and any other lead agencies may also carry out the monitoring process.

## **8.0 CONCLUSION AND RECOMMENDATION**

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### **8.1 Conclusions**

According to the assessment carried out, the compost manure can be marketed to people around the Municipality i.e. the Hotels Managers, Tree Nursery Managers, households who want to manage their compounds and flower gardens. This will be happening in the short-term. In the long-run, as the amount of garbage collection increases and hence more compost output, the market will be extended to rural setting to help peasants improve degraded soils. There will be need to train people in the composting of the manure, sorting, marketing and selling of the compost manure. Sales people will have to be trained to be able to promote the compost and other recyclable products.

And as a result of the project, the health condition and agricultural production in the area will improve and the whole environment at large.

While Landfills as dumping sites for waste management have been used for many years world over, composting of waste is not as old. In Mbale municipality like any other urban centres in Uganda these have been existent, but have only served as an “emergence get rid of filth from immediate eye site”. Little or no care has been given to the environmentally associated impacts from stage of waste collection, on to disposal. NEMA Initiative to setup disposal sites with a commercial element that would work as an incentive to partnership building for waste management with the waste generators comes with optimism for better waste management for sustainable development. However with all the advantages that this may bring, anticipated project negative impacts must be kept in focus. These among others include conflicts relating to the new (compost manure) resource use and partnerships formation, disposal methods from sources storage, transportation, and final disposal, traditional socio and cultural attitudes, among others. Overall the proposed project will have wider positive socio economic advantages both onsite and offsite as sited in the sections above. Going by the views expressed by the community and other stakeholders they anxious, optimistic and supportive of the proposed project.

### **8.2 Recommendations**

Opinion leaders should be identified in the three Municipality Divisions who can be targeted for training in environmental management through proper garbage management. Scientific methods should be used to identify opinion leaders to ensure best results. (care should be taken not to choose opinion leaders by a matter of looking around for the person who is most educated; the most favoured, or attends most of the meetings etc.). A simple survey using a questionnaire would be most appropriate. The objective of the training should be changing people's culture in regard to garbage disposal especially introducing the new tradition of sorting garbage before disposing it. These opinion leaders should be motivated in terms of being given an incentive to be able to promote the project.

The market price for compost manure (what other projects were using) should be followed for the customers to have a reference point. The initial price can be 10,000/= for 1 bag which is an equivalent of 100 kgs. For the other recyclables still the market price can be followed.

Some members of the community will be involved directly by employing them to supervise the skips at the dumping sites in the Municipality, to ensure that the different types of garbage go to right skips. And as such each dumping site will have three skips, i.e. one for biodegradable, another for plastics and polythenes and yet another for metals.

Under the current population growth rate of 3.4% it is estimated that total waste collected per day will have reached 2198.4 tons per month by 2011. In ten years time, it is estimated to be 2600 tons per month. This is therefore; to recommend that Mbale Municipal Local Government buy and gazettes another site for Municipal Waste Management.

Regarding the technology of composting the garbage, windrow composting is so far the most effective and efficient method given the nature of the garbage in Mbale Municipality. However, with time vermi composting method could be integrated.

### **8.3 Application recommendations**

Farmers can improve soil fertility by composting. The nutritive value of compost depends up on the amount and nutrient content, the age of the compost and the method of storage. Application rates should not exceed crop requirements. It is often recommended that 25 tones per hectare can be applied on loams and 38t/ha on sandy loams. In the case of row crops, these amounts could be reduced significantly by restricting the application of the compost to the planting row, or to each pit with trees and bushy plants.

### **8.4 Record Keeping and documentation**

#### **Record keeping**

**Why keep records:** Good recordkeeping saves time and effort at closing of books of accounts; the records will assist the auditors in quickly and accurately completing the auditing. Records may also prevent one from having to pay additional taxes and penalties for unsubstantiated items. In addition to proof of payment, the project will need to keep these records:

- Bank statements
- Canceled checks or other proof of payment
- Deposit slips
- List of account numbers
- Invoices
- Accountabilities
- Purchase price, sales price
- Dated and signed receipts showing the amount and description of the transaction
- Check pay stubs as proof of payment
- Sales receipts and other written documentation that spells out exactly what was paid for.
- Accidents recorded at the composting site

- Tonnage of the waste for composting and compost sold
- Vehicle mileage logs
- Employment records (Advertisements, applications, interview results, disciplinary records etc)

## **Documentation**

The Mbale Municipal Council and in particular the Medical Officer of Health shall document the method, weight and/or volume, amount, expenses and sales and income received for the materials recycled or the composted wastes. Names and location of persons involved in the composting and those using compost. In addition to documents kept in a safe deposit box (costly or hard-to-replace items such as checks, vehicle logbooks, property agreements and/or titles, etc.), many important records need to be filed systematically and conveniently at office. An Excel spreadsheet is a great way to track this information, but even a handwritten schedule can do (Carolyn McKinney PhD, 2001).

The accountabilities and other records will have to be kept for five years from the date the transaction took place or the closure of the project.

## 9.0 APPENDICES

### Appendix 1: Environmental Impact assessment Team

List of key EIA members involved in the preparation of the Environmental Impact Assessment Study of the proposed waste management project in Mbale Municipality, Mbale District

Names	Profile and Relevant qualifications
<b>Mr. Musamali Paul Buyerah</b>	Mr. Buyerah an Environmental Management Specialist and Team Leader. Is an environmental management professional with training in environment science; he has an MSc. degree in environment, a BSc. in environment studies, a diploma in education from Makerere University Kampala, Uganda and a Certificate in Integrated Environment & Water Management from Institute of Water and Environment, Denmark. He in addition, holds a Diploma in environment management from Galilee College, Tivon Israel. Has over fifteen years experience in environment conservation and management. He is a member of the Uganda Association for Impact Assessment. <b>Registered and Certified Environmental Impact Assessor.</b>
<b>ENG. LAMMECK KAJUBI</b>	Mr. Kajubi an Environmental Engineer, holds a Master of Science degree in Environmental Engineering of the University of Queensland- Australia and a BSc Eng (First Class Honors) degree in agricultural engineering specializing in Soil & Water Engineering. His MSc Eng (Environmental) focused on Wastewater, Solid waste, Air pollution, Sustainable development, Cleaner production, Environmental Economics and law. Currently CEO, AWE Limited, Lammeck has had experience and increasing responsibilities in environmental consulting. He has contributed solutions in Cleaner Production, Wastewater systems design, Solid waste management, environmental impact studies, environmental auditing and air pollution control for several consulting projects. Lammeck has been involved in over numerous environmental consulting assignments including EIAs, Environmental policy studies, Environmental audits and Pollution control systems design in Uganda. <b>Registered and Certified EIA Practitioner.</b>
<b>Dr. Charles Koojo</b>	Mr. Charles Koojo is a graduate scientist with post graduate degrees for more than 12 years of professional experience. Starting as a Research Assistant and Physical Planner, Mr. Koojo has over these years developed into an environmental expert and senior physical planner. These experiences were gained through working for the government ministry, consultancy, university teaching and various adhoc assignments with international bodies and organisations. His PhD Thesis was "Implementation of physical plans with reference to wetland land use in Kampala City-Uganda".
<b>Mr. MUHUMUZA MOSES</b>	<b>Sociologist;</b> Mr. Muhumuza has five years of professional working experience; Moses has executed and aided consultancy work in over fifty projects in diverse disciplines throughout the country and beyond. These were under environ –impact and management consults; Water, environment and Geo Services (WEGs) Consultants; Plan international Uganda. He has participated in the private sector environment, energy and natural Resources Management initiatives programme in the neighbouring south Eastern republic of Rwanda as head of the water, environment, (We Consult) team. He is partner in Green Impact and Development Services (GIDS) consults, and is <b>Registered and Certified EIA Practitioner</b>
<b>OTHER EIA TEAM MEMBERS</b>	
<b>MS. LEAH N. BAGABO</b>	Mrs. Nantale Bagabo is a marketing professional with over 5 years work experience in both the private and public sector. She holds a degree in marketing and a diploma in business education. Specialized in designing marketing strategies, new product development, designing & implementing communication strategies, drawing up business plans, marketing research, customer relationship management, product segmentation, targeting and positioning. In this assignment she will be of crucial importance in conducting market analysis and making sure it is realigned with Mbale Municipal Council waste management strategy.
<b>MR. ALFRED TUMUSIIME</b>	Mr. Tumusiime is a Forester, Holds a B Sc Forestry (Hons) from Makerere University Kampala (MUK) and a certificate in harvesting and utilization of Forestry products from Nyabeya Forestry College and project propose and scientific writing from MUK. He is currently an Associate Research Assistant with the National Forestry Authority, Kampala.

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### **Appendix 3: List of People Consulted**

## Appendix 4: Records and minutes of Public Consultation

### Meeting 1: Held with the Health Educator of Mbale Municipal Council (Industrial Division)

Meeting with:	Name	Designation
	Mr. Wanzusi Masurubu	Health educator, Industrial Division
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> /July/2006, Mbale Municipal council, Industrial Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Mr. Wanzusi Masurubu, Health Educator MMC, Industrial Division	
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	About the proposed project	Not yet conversant with the proposed activities at the site but is aware the land fill is to be re-developed and a composting project is to be undertaken
2	On the quantity and mode of waste collection in Industrial division:	The division has a total of 38 skips positioned at strategic locations although 12 are not in good condition. Some have lost handles and others are too old, rusty with holes. The division has one vehicle that is involved in collection and emptying of skips. Waste from different zones of the division is collected into skips after which the skips are emptied at the landfill. Markets are the largest contributors of waste. Hotels are no longer contributing much because the banana peels and food remains are collected and fed to animals by the residents. On average, the division collects 12 skips per day and each skip is 2.2 m <sup>3</sup>
3	Staff and organization of labour involved in waste collection:	A company known as Keep Mbale Clean was contracted to collect and manage all the waste from the division. Headed by Mr. Mukiibi Kamadi Katende, the company has a staff of 11 people with 8 workers on the ground, 1 supervisor and a driver.
4	Facilitation, Welfare and personal hygiene of staff:	Workers are facilitated with all the necessary tools such as rakes, forks, spades, brooms and other implements to do the work with ease. Protective gears such as gloves and gumboots were provided although most workers could have sold them because they don't possess them these days.
5	About sorting of waste into biodegradable and non-biodegradable	There is no form of treatment given to the waste. We don't sort waste except medical waste. Although medical waste is sorted at residences (clinics), it finally finds its way at the landfill. The division has 2 hospitals (Mbale and Cure Hospitals), a town dispensary, 2 health centres run by the division and 10-15 small clinics.
6	About occurrence of sanitation related diseases	Have had cholera cases but can't be attributed to the current state of the landfill or poor waste management within the division. Cholera came from out and affected the residents although we no longer get such cases.
7	About the landfill, leachate, NWSC and river Namatala	We are aware the leachate flows to the river in serious rains but we believe the grass in between filters it. No steps have been taken to stop the leachate. However, effluent from National Water and Sewerage Corporation (NWSC) also gets its way into R. Namatala.
8	About social economic advantages of the land fill	So far we have not had any complaints from the near by residents arising from the current state of the land fill except that it has turned out to be a source of income especially to the women who follow the rice husks to sieve out some rice remains. Some boys are also ever in the landfill trying to pick out metallic wastes to sell to steel rolling mills. These people have earned income through this means.
9	About cultural sites of significance	There are no cultural sites of significance at and around the proposed landfill. As a matter of fact, history has it that the gazetted as a landfill is not in Bugisu land.
10	Problems faced in waste management as a division.	-Have one vehicle to collect waste and when it breaks down, the waste may stay for some time, which can be a health hazard. This usually raises complaints from the communities about irregularities in collection. - Insufficient funding for waste collection. The scrapping off of Boda boda

		fee, Graduated tax and market dues reduced the budget tremendously. About 60.8million was budgeted for waste collection yet not even a quarter of it collected from local revenue annually.
11	About donor funding	Have not had any funding not even from local entrepreneurs. Usually some donors come, make their studies and do not show up to fund such projects of waste collection. A project had been started to recycle the refuse by Chelsea and Kensington from UK but did not respond after that.
12	Any future plans a division for the dumping site?	We don't have any future plans for the dumping site because planning is done at the municipal level although we were planning to put there some access roads.

**Meeting 2: Held with the Senior Assistant Town Clerk of Mbale Municipal Council MMC (Northern Division)**

Meeting with:	Name	Designation
	Mr. Mabonga David	Senior Assistant Town Clerk, MMC (Northern Division)
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> /July/2006, Mbale Municipal council, Northern Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Mr. Mabonga David Senior Assistant Town Clerk, MMC, Northern Division	
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	On quantity and the mode of waste collection in the division	We have skips and have put up collection centres in conjunction with the local councils (Cells). Skips were provided by the LGDP (Local Government Development Project) and the beneficially dump their rubbish. We have about 10 collection centres (functional skips) as follows; Nkoma stage, Soroti Market, Kumi road, 2 in Namakwekwe estate, Gangama, Mbale regional hospital, behind post office (Jambula) and at Bilal primary school. On average, about 5 skips are collected per day depending on the availability of fuel and the condition of the truck after which waste is taken and dumped at the land fill. There has been a decline in the quantity of rubbish collected because the truck is very old and keeps breaking down
2	Staff and organisation of labour involved in waste collection:	Previously we had a contractor but failed to raise funds and now we have casual labourers whom we pay from our local collection. These labourers have a supervisor in the names Nashesho Michael with a team leader also known as Abdu. Originally we had a casual staff of 20 members but have declined to about 14 and these are the ones responsible for waste collection in Northern Division which has 5 parishes and 36 cells (Villages).
3	Facilitation, Welfare and personal hygiene of staff:	Other than providing them with the basic implements such as forks, spades and rakes, workers have no protective gears due to lack of funds although we are supposed to have them get the gears.
4	About sanitation and infrastructure:	Had cholera out break in 2005 and a total of 11 people died in all the divisions. The division has 2 health centres; one in Namakwekwe and another on Pallisa road plus other several clinics. The biggest part of the division is peri-urban with both piped water and protected wells as water sources. Unlike the Industrial division, the Northern division has no factories except 3 bakeries. The biggest contributors of waste are markets, hotels and restaurants.
5	About sorting of waste	The biggest part of the division is peri-urban with many farmers. Once waste is sorted into organic and inorganic, people can come from even far to collect the compost manure especially if it's well explained to the people.
6	Problems faced in waste collection	-The biggest problem is separation of waste into biodegradable and non-biodegradable. Sorting it is difficult. Once it's mixed with polythene, it's very hard to separate the polythene from the organic waste. -People who use the skips are insensitive dumping any where outside the

	<p>skip which is a health threat and a laborious exercise.</p> <p>-Lack of funds to collect the waste. The truck is very old. Has worked over 30 years and is always breaking down. Local revenue has reduced due to the scraping off of boda boda fee, market dues and graduated tax. Compensation on Graduated tax is not adequate. Some of the skips are breaking and others are stolen by thugs.</p>
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**Meeting 3: Held with the Health Assistant of Namakwekwe Health Centre, MMC (Northern Division)**

Meeting with:	Name	Designation
	Ms. Nandudu Dinah	Health Assistant
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> /July/2006, Namakwekwe Health Centre, Northern Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Ms Nandudu Dinah, Health Assistant MMC, Northern Division	
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	On forms of medical waste	Medical waste is usually in form of syringes, needles, cotton wool, wasted papers, bottles, placentas, and plastic bottles for polio drugs and food remains.
2	On disposal of medical waste from the Health Centre	Hospital refuse is not mixed with municipal refuse. Syringes, cotton wool and bottles are sorted and each placed in its separate container (waste bin) after which they are burnt in a near by collection point and the ash dumped in a medical pit behind the health centre. Placentas are also dumped in the same pit where they are burnt after mixing them with chemicals. The metallic part of the needle is cut using a needle cutter and the plastic part mixed with syringes, which is later burnt. The metallic part is later dumped in the medical pit. Food residues and non-medical waste have their separate rubbish pit where they are collected and burnt regularly.

**Meeting 4: Held with the Health Assistant of Mbale Municipal Council MMC (Northern Division)**

Meeting with:	Name	Designation
	Mr. Mukhwana Jenifer	Health Assistant , Northern Division
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> /July/2006, Namakwekwe Health Centre, Northern Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Mrs., Mukhwana Jennifer Health Assistant , Northern Division, MMC	
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	On the quantity and mode waste collection in Northern division	The Northern division has 21 collection centres and only 6 people are involved in waste collection for all the 21 centres. However only 8 skips are functional. The division has one truck, which is too old hence collection is not frequently done. The division tried to borrow a truck from the Centre but because its high (different make), the workers could not manage to load the waste easily and was later refused and taken back. On average, 5 skips are collected per day if the vehicle is in good condition. Much of the refuse collected is domestic. Out of the solid waste generated in the division, 52% is collected and the rest either is composted or rots.
2	On Sanitation conditions	Toilets are connected to the main sewer and treated by National Water and Sewerage Corporation (NWSC). Had 32 cases of cholera with one death. There are usually no typhoid cases except in the main hospitals. Had cases of dysentery and a survey conducted attributed this to lack of pit latrines by the victims.

		People along Nabuyonga stream were badly affected by cholera because they have persisted to use water from the stream for domestic use despite the immense health education that has been conducted to deter them. The division has 3 wells (springs), 4 bore holes and tap water.
3	About composting the waste	There was a seminar organised by National Environment Management Authority (NEMA) and they have been educating people to burn the buveera and compost organic matter. People with space are doing it. A research was carried out in peri urban areas and 54 % have compost pits. Most people have the idea of having compost pits but the sorting out of polythene is still a problem.
4	On problems associated with waste management	<ul style="list-style-type: none"> <li>- The truck is very old and breaks down every time.</li> <li>- Insufficient funds. Labourers are not paid on time and are not paid well. There have been strikes over time by the labourers.</li> <li>- Labourers don't have protective gears which threatens their lives.</li> <li>- People miss-use the skips by dumping the rubbish out side the skips. People often say what will council do to me? We adults give rubbish to children, who can not manage to dump the rubbish into the skips.</li> <li>- People don't know what to put in the skips. Others put in hot ash, which ends up burning the waste in the skips. This destroys the skips and their half-lives.</li> <li>- Private clinics don't have medical pits to cater for medical wastes hence dump medical waste into the skips. This so common with clinics in town.</li> </ul>
5	Any way forward to improve waste management	The division has put it a priority on this year's budget to get more skips and the issue of the vehicle is to be handled by the centre. The budget has also been increased on fuel, labourers and wages.

#### Meeting 5: Held with the Chairman LCIII, Northern Division of MMC

Meeting with:	Name	Designation
	Mr. Wambede Habib	Chairman LCIII, Northern Division
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> /July/2006, Mbale Municipal council, Northern Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Mr. Wambede Habib Chairman, Northern Division of MMC.	
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	About the proposed project	Am aware of the proposed composting project at the landfill although am a new person in the office.
2	Plan for waste management in the division	<p>Am doing all it takes to ensure that all waste generated is collected on time because the residents want to see the garbage removed. I was thinking of getting a loader but I found that it's very expensive. Am also trying to get some incentives for the labourers so that they can come to love their job.</p> <p>The tipper is old and we want it disposed off so that we can get a new one in place although not in this years financial budget because it was not catered for but hopefully in next years'.</p>
3	About sorting the waste	We want to start educating cell by on the advantages of sorting waste and after we shall put some bylaws and who ever does not comply will be fined.
4	About financing waste management	Financing this exercise is not adequate from market dues that have just been introduced. We discovered that this could spark off epidemics yet markets are the largest contributors of waste. We decided that each vendor pays 100 shillings for garbage collection per day although this is still not enough.
5	About problems faced during	"Money is the problem" We have no funds to runs these activities adequately. No more money from markets as it was before; No money

waste management.	from boda boda; No money from Graduated tax although government promised to compensate, they can not fill that gap.
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**Meeting 6: Held with the Chairman, Keep Mbale Clean, a company that took the Tender of waste collection for Industrial Division of MMC**

<b>Meeting with:</b>	<b>Name</b>	<b>Designation</b>
	Mr. Kamadi Katende Mukiibi	Chairman, Keep Mbale Clean
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> / July / 2006, Mbale Municipal council, Industrial Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Mr. Kamadi Katende Mukiibi, Chairman, Keep Mbale Clean	

**Responses to issues raised by consultant (quoted verbatim)**

1	On waste collection and staffing involved in Industrial division:	On average, 14-15 skips are collected per day depending on the turn up of workers although in some days we can take even up to 20 skips. We have only one vehicle involved in this kind of work.  I have total staff of 18 in garbage collection and 79 in cleaning, slashing, sweeping streets & central lanes and those digging and picking polythene.
2	<b>Key observations during waste collection and management in Industrial division</b>	
A	Burning of waste in skips	People burn waste in skips especially in dry season. This damages the skips. The skip rusts and gets destroyed quickly during wet seasons. The material used to make skips is not hard. Skips wear out quickly.
B	Accessibility of the land fill	During wet seasons, the landfill becomes inaccessible due to poor road net work at the dumping site. People who take waste directly to the landfill especially from the factory dump their waste in landfill roads. They don't know where do dump what. Liquid waste from cosmetics, cooking oil, and soap factories is dumped any where at the land fill which makes the landfill roads impassable.
C	Hygiene and well fair of staff	Although most of the workers were provided with protective gear such as gloves, and gum boots, most of them don't use them. A study has shown that gum boots are not fit for the job because they generate a lot of heat bearing in mind that most of the decomposing waste is also hot. This creates a burning effect and makes gum boots unfit for this work.  Some of the staff eat the food in the skips because they are not well paid and some of their salaries delay. For every skip, the division pays the contractor 15,000/= (Fifteen thousand Shillings only). This money caters for collection, loading and transportation, which is not enough. This money was decided upon when fuel prices were at 800/= (Eight hundred shillings) yet the prices have more than doubled.
D	Hospital waste	Private clinics and some hospitals dump their waste into skips, which is a key issue of concern from us. Needles and fetuses are sometimes found in the skips. These are not a good scene and sometimes needles pierce my staff. How ever for cases of fetuses, dead children, dead animals such as dogs and cats, we don't take them to the landfill. We honour such things by burying them in convenient places.
D	Concrete waste and bricks	Those who break their houses also dump this type of waste into the containers (skips). This damages the skips especially heavy concrete and bricks.
E	Quality of waste	70 -90% Of the waste generated can be composted as it is organic in nature e.g. grass, maize cobs (in maize season), watermelon, cabbages and banana leaves and peelings. This is usually so in wet seasons however in the dry season, polythene usually dominates.
F	Smelling of the waste	Garbage from the upper zones of the town does not smell like that from the market. Garbage from the market smells badly because it contains fish intestines, dogs, cats and market waste. In fact when its not removed,

		market dwellers always complain bitterly compared to that of the upper zones of the town,
G	Collection of waste in the town.	Originally, the skips were in lanes and people could take advantage of this and dump rubbish in the lanes. They were then transferred into strategic points in town where rubbish can be easily dumped. The industrial part of the town has 3 collection points each with more than one skip. However a group of workers' are employed to mop up waste remains from the lanes with wheel burrows everyday.
H	Management of the landfill	The three divisions of Mbale Municipal council i.e. Industrial, Wanale and Northern are supposed to have a standby worker to open up land fill roads, scatter waste to dry, burn waste, and direct waste dumping at the land fill. However, it's only Industrial division that has complied with this cause. In most cases, there is no one at the landfill hence waste is dumped haphazardly.
G	Sorting of waste	We don't sort waste.
F	Smelling of the land fill	In most cases, the landfill does not smell except in rainy seasons when the waste is hyped in one place. We try to spread the waste and burn it before it smells.

#### Meeting 7: Held with the Chairman, Industrial Division of Mbale Municipal Council

Meeting with:	Name	Designation
	Haji. Masa Musa	Chairman, Industrial Division
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> / July/2006, Mbale Municipal council, Industrial Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Haji. Masa Musa, Chairman Industrial Division of MMC,	
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	About the proposed development	I have heard that the Centre is planning develop the land fill but am not aware of the actual plan they have for it.
2	About opening up of the land fill roads	Refuse site has not been accessible because of its road network. We are now opening up roads to the refuse site. Work is actually going on.
3	About sorting of waste	Rubbish is not sorted and its collection is not orderly hence the refuse fails to decompose. Hence at a later time, the refuse is going to be small.
4	Waste sorting sensitisation	We have not tried to sensitise people on rubbish sorting yet.
6	Waste management funding/donors	<p>Have not approached donors for funding yet but a twinning programme with other divisions internally and externally. We are twinning with a UK company called Chelsea and Kensington. Although this has not helped much because we end at sharing experiences and knowledge but no financial donations have been made.</p> <p>A number of NGOs are approaching us and are introducing sorting of refuse. If NGOs can come up and sensitise the communities, this can be great contribution to waste management.</p>

#### Meeting 8: Held with the Health Inspector, Wanale Division of Mbale Municipal Council

Meeting with:	Name	Designation
	Mr. P.W Wamboga	Health Inspector Division
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	25 <sup>th</sup> / July/2006, Mbale Municipal council, Wanale Division	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	

		Mr. P.W Wamboga Health Inspector, Wanale Division of MMC,
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	On waste management in the division.	The division has 7 collection points, which may not be skips. We have 5 skips that are operational. These are situated as follows; Busamaga market, Mbale resort hotel, Government lodge, Sunrise hotel, Elgon Hotel and Moonie. These are the major collection points. However if there was funding, the division would need 15 skips for effective waste collection.
2	On staffing and waste collection	We should be collecting 3 trips (skips) a day but ideally, it can take even a week with out collecting any waste because the vehicle broke down. Each skip is estimated at 1.8 metric tons.  We used to hire a firm for collecting rubbish but because of failure to pay them on time, they abandoned us. So when we get funds, we borrow trucks from the neighbouring divisions pay part time labourers and clear the residue.  We wanted to get a self loading tractor from the boda boda money but this move failed after the fund was scrapped.
3	Sorting and Composting of waste:	The division is residential and most of the waste is put into compost pits although the buveeras (Polythene) persist. Refuse in the peri-urban is manageable because it's purely organic except the high class people who bring buveera (polythene). In most cases, waste collected, does not contain banana peeling and cooked food because its taken away by cattle and pig keepers respectively from both the markets, hotels and restaurants  For Wanale division, over 60% of the waste is not collected Therefore it's either composted, burnt or recycled. This survey was conducted in Busamaga and Moonie wards (Parishes). These are peri-urban and with sensitisation, sorting can be possible. Medical waste is separated from municipal waste.
4	Infrastructure and sanitation:	The division is purely residential. We don't have any factories in the division. We have 2 health centres i.e. Busamaga health centre and St. Jude Health centre. We have no clinics. There was an outbreak of cholera in Moonie ward but was later contained.
5	About complaints from residents:	We have had very many complaints from the residents especially Moonie ward (parish). People go as far as radio stations to present their cause especially when rubbish piles and blocks the roads.
6	Management of the land fill:	We used to contribute towards the opening up of roads at the landfill. We had somebody to work at the landfill but could not support him because of low funding.
7	Financing of waste management:	Wanale division is the most disadvantaged. Being purely residential, we have little sources of revenue. For financial 2005-2006, only 1.2 million was allocated for waste collection yet to carry one skip, you need 6litres of fuel and labour. The total annual health budget for financial year 2005-2006 was 3.5 million and it has even been reduced to 3.4million for the 2006-2007 financial year. Surprisingly only 50% of the estimated budget was released because 28% of the money was collected. We used to raise 1million shillings from boda boda fees every month which could much but this is no longer coming.

#### Meeting 8: Held with the Chairman, Wanale Division of Mbale Municipal Council

Meeting with:	Name	Designation
	Dr. Netuwa Emmanuel	Chairman, Wanale Division
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the	

		composting project of Mbale Municipal Council (MMC)
<b>Date held &amp; Place:</b>		25 <sup>th</sup> /July/2006, Mbale Municipal council, His Private Clinic
<b>Present:</b>		Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)
		Dr. Netuwa Emmanuel Chairman, Wanale Division of MMC,
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	About the proposed project.	Am not aware of the location of the site. I am also not a ware of the proposed activities but had had of the proposed idea to develop it. I also hear part of the dumping site was sold off to Elgon Millers. I don't know what is going to be done because there is no money. However the issue of developing the landfill and improving waste management is good and must be developed.
2	About Finance	Wanale is a disadvantaged division. It's just a residential area with little revenue collection but that does not stop us from service delivery.
3	About Polythene and waste management	Now that the waste is not like that of long ago because it contains polythene, it may accumulate and fill the dumping site. <b>If the government could phase out buveera and bring paper bags, then there would be no problems with waste.</b> We don't have a lot of rubbish. For areas like Busamaga and Moonie, people are encouraged to burn the buveera and give the peelings to their cattle except for areas like Mbale resort, Elgon hotels and markets which need to have their waste into skips.

#### Meeting 9: Held with the District Environment Officer (DEO), Mbale district

<b>Meeting with:</b>	<b>Name</b>	<b>Designation</b>
	Mrs. Nakayenzi Anna	<b>DEO, Mbale district</b>
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	31 <sup>st</sup> /July/2006, Mbale district headquarters.	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
	Mr. Musaka Fred, Consultant (OPEP Consult Ltd)	
	Mrs. Nakayenzi Anna DEO, Mbale district.	
<b>Responses to issues raised by consultant (quoted verbatim)</b>		
1	About project design:	I need to look at the design of the proposed project The Road network in the site needs to be organised.
2	On R. Namatala:	A 100 metre buffer zone should be left between the landfill and R. Namatala. The vegetation in between should be sufficient enough to protect the river. Wetland species like papyrus could be planted and cut regularly to absorb the toxic waste from the landfill.
3	On waste management:	As a municipal, they don't have a clear waste management system. They need to clearly define and assign responsibilities in regard to this. The duties of the municipal health officers need to be clear. They don't have a fully-fledged person responsible for waste collection.
4	On waste sorting	Much as they claim that they want to sort the waste at the land fill, they should start with the LCs. The municipal has not gone out to sensitise the communities.
5	On sewage.	Quality of sewage has deteriorated because of more developments in Mbale town hence more water is being received at National Water and Sewerage Corporation (NWSC) ponds and the settlement period reduced. Sewage should be given an opportunity to meander and filter well in the ponds.
6	On community concerns about the landfill	There haven't been any community concerns regarding the location of the landfill. They are more concerned with sewage ponds.

#### Meeting 10: Held with the communities surrounding the landfill (see attendance list)

<b>Meeting with:</b>		<b>Name</b>	<b>Designation</b>
		Community members	<b>Local leaders, stakeholders &amp; farmers</b>
<b>Purpose of meeting:</b>		To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>		31 <sup>st</sup> /July/2006, At the Landfill.	
<b>Present:</b>		Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd) Mr. Musaka Fred, Consultant (OPEP Consult Ltd) <b>Local leaders, stakeholders &amp; farmers (see attendance list attached)</b>	
<b>Responses to issues raised by consultant (quoted verbatim)</b>			
1	On Rice winnowing in the landfill:	We request that once the proposed project is implemented, they leave for us some space where we can continue winnowing rice husks because this is the only source of our livelihood. We are very many who depend on this.	
2	On leachate:	When it rains, the water from the landfill flows up to the river. This contaminates the river.	
3	On job opportunities:	Developments come and people don't get jobs. For example people who are currently opening the road in the landfill have been imported from somewhere else. We request that when the composting project starts, they should involve us. The chairman assured them of jobs but have to accept the payment rates	
4	On landownership around the landfill:	Much of the land is for MMC except Mr. Kigenyi (owns plot on the eastern side of the landfill) and Mukwano. The plots in the western side belong to NWSC.	
5	On Farming activities in and around the landfill:	We know that the land is for MMC but we just come to cultivate. People cultivating include; Mr. Alumansi Ntambi who owns sugarcanes, Mr. Kawuka David who has sugarcanes, maize and beans, Mr. Makwa Isaac who owns coffee and bananas, Mr. Hakim Bugembe, Ssesanga Muhammad and Sula Mabanja who cultivate sugarcanes plus Jane Kakai who cultivates sweet potatoes. We should not be chased away immediately because we have our crops there.	
6	On road reserves	When they were opening the new road to the landfill, they destroyed our crops. Council should clearly mark the road reserves such that we don't construct or cultivate in road reserves.	
7	Location of skips	Skips for waste disposal are near roads and when they delay to empty them, waste blocks roads. Council should get better locations for skips. Also need some body to monitor waste disposal at skips so that people don't just dump anywhere.	
8	On sewage	Sewage to the Doko ponds overflows to peoples' land sometimes and this is a health hazard. NWSC should look into this issue.	
9	On smell of the land fill	Sometimes waste comes with dead dogs, fetuses and other things that smell especially when there are strong winds blowing from the landfill.	

#### Meeting 11: Held with District Water Officer

<b>Meeting with:</b>		<b>Name</b>	<b>Designation</b>
		Ddeme Fred M	<b>District Water Officer</b>
<b>Purpose of meeting:</b>		To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>		31 <sup>st</sup> /July/2006, at Directorate of Water Development (DWD) head office.	
<b>Present:</b>		Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd) Mr. Musaka Fred, Consultant (OPEP Consult Ltd) <b>Ddeme Fred M, District Water Officer</b>	
<b>Responses to issues raised by consultant (quoted verbatim)</b>			
1	On water management	We basically explore groundwater for example boreholes, springs and the like. We deal with communities at the subcounty level hence municipal council and surface water are outside our jurisdiction. Am also not conversant with municipal activities. I hope NWSC would advise well.	

**Meeting 11: Held with Medical Officer of Health**

Meeting with:		Name	Designation
		Dr. Kalyebi S.W	<b>Medical Officer of Health</b>
<b>Purpose of meeting:</b>		To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>		1 <sup>st</sup> /August/2006, at Mbale Municipal Council, Central office.	
<b>Present:</b>		Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
		<b>Dr. Kalyebi S.W, Medical Officer of Health</b>	
<b>Responses to issues raised by consultant (quoted verbatim)</b>			
1	On financing waste management	Financing waste disposal is entirely the work of the division. We only do supervisory work and the municipal Engineer has to ensure all the vehicles are working all the time.  We have two Tata lorries, a benz truck and a tractor although one lorry and the tractor are not functioning. We usually lend the truck to Northern division for waste collection because they don't have a vehicle for waste collection at the moment. However its make is not conducive for waste loaders because it's high. This truck was received as a donation from KCC.	
2	On Planning the financing the composting project	We haven't sat down to plan for this project because we don't know how much we shall receive. NEMA has been at the forefront of this project. We are expecting 300,000-600,000 dollars from NEMA. Once we have got the money, then we shall start to plan. However NEMA advised us to plan well such that the project is sustainable at a later stage of its implementation.	
3	About farming in the landfill.	Some people have made this a habit especially after cultivating in a plot for 3 years; they start to claim the land. Municipal land is going like that.	
4	On NWSC	When Eli nine came, the sewage treatment ponds of Doko flooded and waste was washed a way to peoples land. National water should have a way of preventing this occurrence.	

**Meeting 12: Held with the Senior Assistant Town Clerk, Wanale Division of MMC**

Meeting with:		Name	Designation
		Mrs. Makita Rosemary M	<b>Senior Assistant Town</b>
<b>Purpose of meeting:</b>		To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>		1 <sup>st</sup> /August/2006, Mbale Municipal council, Central Offices	
<b>Present:</b>		Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd)	
		Mrs. Makita Rosemary M, Wanale Division of MMC,	
<b>Responses to issues raised by consultant (quoted verbatim)</b>			
1	On waste management in the division:	We have two major dumping sites in Wanale division although there are some others. Formerly, we were hiring a Tata lorry from Northern division for waste collection but because drastic rate in revenue and lack of funds, we can not afford to higher it now. The division Tata lorry for waste collection broke down and besides; it consumes a lot of fuel. We were planning to repair it but due to lack of funds, this has not been possible. We are basically relying of the jifang truck for waste collection and should it break down, then we are in trouble.	
2	Staffing in waste collection.	What we have decided is that once waste has accumulated, we higher a jifang truck from the Center get people to load and take the waste. Getting these people is also a problem and once the chance comes, they demand a lot of money and others prefer to shy a way from the job.	
3	On composting	Before the skips were introduced, the peri- urban residents used to compost. Infact residents were requesting that they resort to their local composting methods because when the skips fill up, they delay to empty	

	them and the waste becomes a menace.
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**Meeting 13: Held with the Area manager, NWSC Mbale head offices**

<b>Meeting with:</b>	<b>Name</b>	<b>Designation</b> Area Manager NSWC Mbale Branch
	Mr. David Opoka	<b>Area Manager,</b>
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	1 <sup>st</sup> August/2006, NWSC Mbale Branch	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd) Mr. Musaka Fred, Consultant (OPEP Consult Ltd) Mr. David Opoka Area Manager	
<b>Responses to questions given to the NWSC Area Manager Mbale</b>		
<b>Issues</b>	<b>Response</b>	
1. Mbale Municipal Council is proposing to establish a waste disposal and composting project at the land fill. Have you been informed about it?	1. National Water and Sewerage Corporation has not been informed officially about the establishment of the waste decomposing project.	
2. Are there any issues related to the management of river Namatala that have come up to your attention in regard to the location of the proposed land fill?	2. The issues related to the location of the proposed land fill; National Water & Sewerage Corporation Management was not consulted and the clear boundary for the land fill site and National Water & Sewerage Corporation land has not been brought to light.	
3. Our consultations have shown that there have been many developments in Mbale Town and the Quantity of liquid waste (sewage) received at your treatment ponds is more than expected. Therefore sewage is not given enough time to meander so as to receive enough treatment through biological processes.	3. As per your consultation there have been many developments in Mbale town, the Quantity of liquid waste (sewage) received at the Namatala Waste Stabilization ponds is still half of the installed design influent capacity.	
4. What are some of the problems/challenges that you have faced in the management and treatment of sewage and water in Mbale District (Municipality)?	4. The population equivalent of the effluent is mainly low and sewage received is of domestic nature. All the parameter effluent looked at in Namatala ponds is below the National Standards hence treatment is effective (B.O.D <sub>7</sub> ). Some of the problems and challenges in treatment of sewage in Mbale District (Municipality): <ul style="list-style-type: none"> <li>o Encroachment by the locals on the wetland Area (Areas reserve for effluent filtration, people have dug all the supposedly wetland and planted yams, rice and grazing of cows.</li> <li>o The theft/vandalism of the infrastructures e.g. slabs, sign post, V-notches and level gauges.</li> <li>o Lack of serious education by the Local Council.</li> <li>o Lack of knowledge on the dangers of waster water.</li> </ul>	

<p>5. How best would you work with Mbale Municipal Council so as to make the waste disposal and composting project a success?</p>	<p>5. National Water &amp; Sewerage Corporation can best work with Mbale Municipal Council so as to make the waste disposal and composting projects a success through good corporate relationship, understanding the role of each Organization, educating the masses on the importance of proper waste management disposal:</p> <ul style="list-style-type: none"> <li>- Getting the benefit of waste</li> <li>- Knowledge on how waste matter affects the community economically and socially.</li> </ul>
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**Meeting 14: Held with the Production Manager, Uganda Klere Industries (UKI) (U) Ltd (Sleeping baby cosmetic Industry)**

<b>Meeting with:</b>	<b>Name</b>	<b>Designation</b>
	Mr. P. Shah	<b>Production Manager, UKI (U) Ltd</b>
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	1 <sup>st</sup> /August/2006, UKI (U) Ltd factory premises, Mbale.	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd) Mr. Musaka Fred, Consultant (OPEP Consult Ltd) Mr. P. Shah, Production Manager, UKI (U) Ltd Mr. Esitu Simon, Production manager, F&B Mr. Mwaura David, Factory Chemist	

**Responses to issues raised by consultant (quoted verbatim)**

1	On factory waste	We have little liquid waste because we deal with jerry and oil. Only produce liquid waste when we are washing tanks, containers and machines, which we don't do every time. The little liquid waste produced is passed through our drainage channels that are connected to the main sewer line of NWSC. Much of the waste is solid and comprises back paper (paper where factory label are attached) and polythene bags that come along with wax, a raw material for making jerry. We have a rubbish pit in the factory where we pile solid waste and later loaded and transported to the landfill every Saturday. We use plastic to make cosmetic containers and any plastic waste produced is recycled. <b>N.B Consultants were taken around the factory to witness and confirm some of these statements.</b>
2	On environmental audits	Have not conducted any environmental audits yet but an Environmental Inspection was conducted by a tem from NEMA
3	On products produced	We produce sleeping baby petroleum Jerry, Lotions and Creams. The lotions are either water in oil emulsion or oil in water emulsions. Our brand names (products) include Tonie, Chic & Sleeping baby.

**Meeting 15: Held with the Production Manager, Mbale Soap Works Ltd**

<b>Meeting with:</b>	<b>Name</b>	<b>Designation Mbale Soap Works Ltd</b>
	A.V.C Reddy	<b>Production Manager,</b>
<b>Purpose of meeting:</b>	To obtain technical input regarding the proposed landfill and the composting project of Mbale Municipal Council (MMC)	
<b>Date held &amp; Place:</b>	1 <sup>st</sup> August/2006, Mbale Soap Works factory, Mbale.	
<b>Present:</b>	Mr. Tumusiime Alfred, Consultant (OPEP Consult Ltd) Mr. Musaka Fred, Consultant (OPEP Consult Ltd) A.V.C Reddy, Production Manager	

**Responses to issues raised by consultant (quoted verbatim)**

1	On waste management	Much of the waste produced is solid we have no liquid waste except when we are washing the tanks. The water produced during soap manufacturing is recycled back to the tank as it contains some soap.
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		Much of our solid waste is wood ash, and plastic bags that come along with raw materials such as stone powder. Little remains of dirty /incomplete soap from factory flows is also conspicuous at the factory rubbish pit. At a later time when this waste piles at the factory, it's then carried to the landfill. <b>N.B Consultants were taken around the factory to witness and confirm some of these statements.</b>
2	On soap manufacture	We use edible oil, caustic soda, soap stone powder and sodium silicate as the main raw materials.

#### Meeting 16: Record of Stakeholders' Involvement

Meeting with:	Name	Designation
	1. Stakeholders in the Industrial Division 2. 2. Mr. Lawrence G. Kinyua 3. 3. Mr. Wafula Ogola 4. 4. Mr. Wanzusi Masurubu 5. M/s Mukwana Jennifer 6. M/s Akello Scholastic 7. Mr. Ejibu Samuel 8. Mr. Makatu 9. Mr. Moko Geofrey 10. Mr. Semayobe Francis 11. Mr. Kintu Sula 12. 12. Mr. Nkwiine Charles	General Manager General Manager Health Inspector Health Assistant Health Assistant Tree Nursery Manager Tree Nursery Manager Nursery Attendant Assistant Programme Coordinator Project Officer Soil Biologist & Ecologist
<b>Purpose of meeting:</b>	<ol style="list-style-type: none"> <li>To find out their feelings or responses about the project.</li> <li>To find out whether they would be interested in buying the compost manure.</li> <li>To find out whether they would be interested in buying the compost manure.</li> <li>To get information in regard to garbage disposal in the Industrial Division.</li> <li>To get information in regard to garbage disposal in North Division.</li> <li>To get information in regard to garbage disposal in Wanale Division.</li> <li>To find out where he gets the manure for his nursery.</li> <li>To find out where he gets the manure for his nursery.</li> <li>To find out where they get their manure for their nursery.</li> <li>To find out how they were composting and marketing their compost manure.</li> <li>To find out how they were composting and marketing their compost manure.</li> <li>To find out about vermi composting and vermi culture</li> </ol>	
<b>Date and Place:</b>	<ol style="list-style-type: none"> <li>31/7/06 - At the dumping site</li> <li>31/7/06 - Mbale Resort Hotel</li> <li>31/7/06 - Mt. Elgon Hotel</li> <li>31/7/06 - Industrial Division Office Mbale</li> <li>31/7/06 - Industrial Division Office Mbale</li> <li>31/7/06 - Industrial Division Office Mbale</li> <li>31/7/06 - Along Tororo Road in Mbale</li> <li>31/7/06 - Along Tororo Road in Mbale</li> <li>31/7/06 - NFA – FORRI/NARO in Mbale</li> <li>04/8/06 - Seeta Jinja Road (Kampala)</li> <li>04/8/06 – Mitchell Courts (Kampala)</li> <li>12. 07/8/06 – Makerere University – Faculty of Agriculture Dept of soil science.</li> </ol>	
<b>Present:</b>	Mr. Fred Musaka and M/s Bagabo Nantale. A	
<b>Responses to issues raised by the consultant (quoted verbatim):</b>		
<b>Issue:</b> The General Manager of Mbale Resort Hotel raised the issue of pricing.	<b>Response:</b> They would be told as soon as the product would be available and that it would be affordable.	

## **Appendix 5: Water Quality Sampling Report**

## **Appendix 6: Soil Analysis Results**

## **Appendix 7: Check list for solid waste management**

### **1.0 Project Inputs**

#### **1.1 Inputs to construction:**

- Land-take
- Construction materials
- Heavy plant and machinery?
- Skilled and unskilled labour force?

#### **1.2 Inputs to operation:**

- Waste treatment and disposal facilities and equipment
- Trained management team and labour-force
- Heavy machinery (e.g. refuse trucks, bulldozers)

### **2.0 Waste streams**

- Municipal (paper, putrescible, inerts) ?
- Commercial?
- Industrial/non-hazardous?
- Hazardous?
- Clinical?
- Construction?

### **3.0 Project Activities:**

- Site selection
- Construction (e.g. access roads, landfill cells, incinerators)
- Waste collection and transfer (e.g. truck, tractor, pushcart)
- Waste treatment and disposal (e.g. chemical, biological, physical treatment)
- Maintenance of operations

### **4.0 Project Outputs**

- Construction wastes (soil, silt, oil/fuel spills, other materials)
- Treatment wastes (pre-treated) e.g. compost, incinerated material, gases, leachate
- Non-treated wastes e.g. gases, odour, leachate
- Noise (e.g. refuse trucks)

### **5.0 Receptors of Impacts**

#### **5.1 Human Environment**

- Human settlements in proximity to the project
- Existing land uses to be displaced/converted (e.g. agricultural land, recreational areas)
- Sensitivity of the local population
- Local labour market?
- Security of livelihoods/cash income generation?
- Traditional livelihoods (e.g. tribal peoples)?
- Public health?
- Introduction of squatters?

## **5.2 Natural Environment**

- Protected areas (local, national and international)
- Areas supporting significant biodiversity or critical habitats
- Environments already significantly degraded
- Sites of significant cultural or historical importance
- Terrestrial or aquatic flora and fauna, including:
  - Rare species (e.g. CITES endangered species)?
  - Ecologically important species (e.g. soil micro-organisms, pollinating insect natural pest predators)?
  - Commercially or domestically important species (e.g. fish or locally hunted wildlife)?
- Air Quality (e.g. odour, particulate concentration, toxic gases)
- Soil (e.g. soil stability)
- Water quality - groundwater and surface water (e.g. rivers, lakes);
- Local hydrology (e.g. storm flow volumes, dry season flow)

## **6.0 Environmental Impacts**

### **6.1 Impacts of Site Selection**

- Land use conflicts, reduction in surrounding land values
- Loss of tourism if disposal site visibly degrades the environment
- Loss of amenity

### **6.2 Impacts from Construction**

#### **6.2.1 Impacts on Human Health:**

- Ground and surface water contamination by oil, grease and fuel spills
- Creation of stagnant water bodies in borrow pits and spoil tips which act as habitats for disease vectors
- Environmental and social disruption by construction workers
- Safety of construction workers
- Noise, dust and traffic

#### **6.2.2 Impacts on Soil:**

- Soil erosion due to earth movement, rain action on exposed surfaces, increased runoff due to soil compaction
- Land slips and land slides from poor embankment grading
- Differential settlement due to poor restoration

#### **6.2.3 Impacts on Local Hydrology:**

- Interruption of subsoil and overland drainage
- Increased runoff
- Flood hazard

#### **6.2.4 Impacts on Aquatic Ecosystems:**

- Impacts on aquatic ecosystems from increased stream turbidity
- Temporary or permanent covering of benthic organisms and riverbed flora
- Increased Biological Oxygen Demand (BOD) placing fish and aquatic flora under oxygen stress
- Sediments of high nutrient content carried to still water bodies causing high BOD (e.g. wetlands, rivers)

## 6.3 Impacts from Waste Collection, Transfer, Treatment and Disposal Operations

### 6.3.1 Socio-Economic Impacts:

#### Positive socio-economic impacts

- Improved public health?
- Employment and income generated by municipal waste collection and disposal schemes and local recycling schemes?
- Improved living and working conditions?

#### Negative socio-economic impacts

- worker accidents and hazards when dealing with hazardous components
- perceived risks from gas and leachate (water contamination)

### 6.4.2 Pollution Impacts:

- Dust and litter creation
  - *During filling and unloading of stationary communal containers?*
  - *During transport to disposal sites?*
  - *During unloading at disposal sites?*
- Refuse spilled from stationary communal containers, and scattered by animals
- Dust from unloading and spreading/grading operations at land disposal sites
- Smoke from open burning of refuse at land disposal sites
- Contamination of air from insufficiently incineration or resource recovery facilities
- Odours from landfill disposal sites and composting systems
- Water contamination by leachate from land disposal systems
- Explosion of toxic response from accumulated landfill gas in buildings
- Potential risk of fires and explosives from mixing of incompatible chemical
- Emission of potentially toxic volatile organisms from land disposal sites
- Acute poisoning from accidental contact with or exposure to hazardous wastes of labour force or local population
- Damage to health of labour force or local population through chronic long term exposure to hazardous wastes via contaminated water supplies and/or polluted air

### 6.5 Operational Impacts on Natural Environments:

- Contamination of ground and/or surface water by leachate from land disposal systems
- Loss of deep-rooted vegetation from toxic landfill gas
- Direct poisoning from toxic wastes of flora and fauna
- Sterilisation of land use due to poor operational and restoration practices
- Damage to local agricultural production by toxic effects on crops/produce/livestock from contamination of soil (e.g. by compost or sludge application)
- Possible adverse effects from marine disposal
  - *on marine life, fish and shellfish culture, seaweed harvesting and culture?*
  - *on amenity and bathing areas (e.g. deterioration in water quality, floating objects, odour)?*
  - *on other uses of the sea (e.g. deterioration of water quality for industrial use, underwater corrosion of structures)?*

#### 6.5.1 Significance of Impacts

The significance of certain environmental impacts can be assessed by contrasting the predicted magnitude of impact (e.g. location, volume, concentration) against a relevant environmental quality standard. Impact significance should also be assessed by taking due regard of those environmental priorities and preferences held by society but for which there are no quantifiable objectives. Particular attention needs to be focused upon the environmental preferences and concerns of those likely to be directly affected by the project.

#### **6.5.2 Environmental Standards:**

- Water quality standards
- Emissions and air quality
- National and local planning regulations:
  - *legislation concerning change in landuse?*
  - *regional/local waste management plans?*
  - *strategic watershed plans?*
- National legislation to protect certain areas (national)
  - *Wetlands?*
  - *forest reserves?*
  - *river banks?*

#### **6.5.3 Environmental Priorities and Preferences:**

- Government policies for environmental protection (including, where appropriate, incorporation of objectives from Country Environmental Studies/Environmental Action Plans
- Environmental priorities of international, national and/or local Non-Governmental Organisations
- Participation of affected people in project planning to determine priorities for environmental protection, including:
  - *public health/*
  - *protect revered areas, flora and fauna (e.g. cultural value, visual landscape)?*
  - *surface and ground waters, i.e. because utilised by local people for drinking water or bathing?*
  - *surface water-bodies supporting hunted fish?*
- Conflicts of interest between current and future users of those human resources affected by the project, e.g. land (developed agricultural land, urban land, recreational areas), housing, water supplies, waste absorbing capacities of surface water-bodies, local skilled labour, credit availability etc.)

### **7.0 Mitigation Measures**

In order to protect the environment from the adverse effects of solid waste management projects there are a number of mitigation and management options that can be implemented. Some key options are given below. These may be undertaken individually or combined into an action plan. To achieve the best results, mitigation options should be determined through the close participation of those for whom the project is intended and those likely to be adversely affected.

#### **7.1 Effective Planning Measures**

- National and local integrated waste management strategies

- Plan location of site facilities to fit existing and planned land use
- Do not locate incineration facilities in enclosed airsheds or in areas with already degraded air quality
- Provide buffer zones to minimize land and water resource impacts, aesthetic impacts, human health risks
- Screen site facilities by judicious tree planting

## **7.2 Construction Measures**

### **7.2.1 Mitigation of Impacts on Human Health:**

- Establish precautions to avoid accidental spills
- Assessment of disease vector ecology in work areas and employment of disease preventative measures, e.g. filling or drainage to avoid creating vector habitats
- Collection and recycling of lubricants

### **7.2.2 Mitigation of Impacts on Soil:**

- Limit earth movement and soil exposure to the dry season
- Balance cut with fill such that there is minimum earth movement
- Resurface and revegetate exposed surfaces
- Protect vulnerable surfaces with mulch
- Provide sedimentation basins
- Line receiving surfaces with stones or concrete (not landfill sites)

### **7.2.3 Mitigation of impacts on Local Hydrology:**

- Limit earth movement and soil exposure to the dry season
- Minimise soil compaction
- Minimise period that soil surfaces are exposed

### **7.2.4 Mitigation of Impacts on Aquatic Ecosystems:**

- Minimise soil erosion from construction sites
- Construction of bunds and containments to prevent spills from poisoning water courses and their fauna

## **7.3 Measures for Solid Waste Collection, Transfer, Treatment and Disposal**

### **7.3.1 General Measures:**

- Minimise handling and maximise containment
- Provide enclosed refuse collection vehicles or tarpaulin covers for open vehicles
- Provide enclosure to loading and unloading areas, as well as ventilation and dust suppression
- Assess nature and quantity of hazardous wastes and provide separate collection and disposal systems
- Regulate transport of toxic material
- Pave access roads
- Water-spray working areas to suppress dust with collection of run-off
- Prohibit toxic waste transportation through ecologically valued areas

### **7.3.2 Incineration and Other Treatment:**

- Spread and compact incoming refuse, cover daily with soil
- Maintain aerobic conditions during composting
- Provide effective air pollution control for incineration facilities

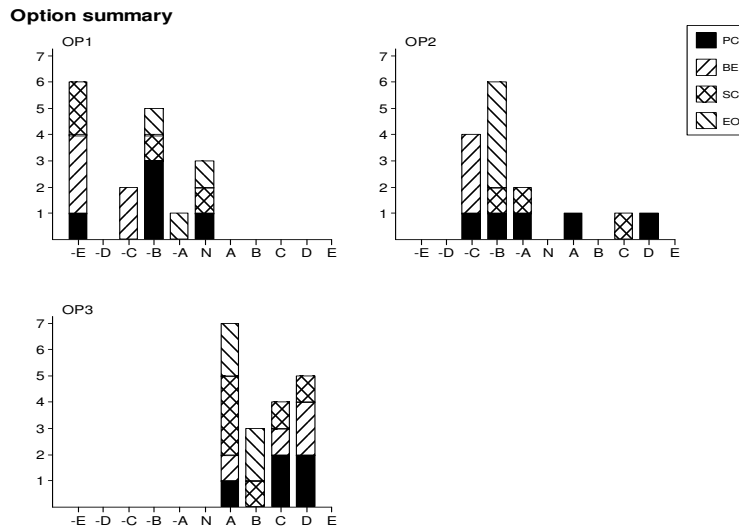
## Appendix 8: Technical Explanation of Alternatives Impact Weighting

### 8.1 Discussion of the Rapid Impact Assessment Matrix Analysis

A computer software known as Rapid Impact Assessment Matrix was used to analyse and evaluate the impacts of the three options (zero option, incineration and composting project).

The results of the RIAM analysis are presented in Table 8.1 – 8.3 and visualized in Figure 8.1 AND 8.3.1 – 8.3.3 show that more negative impact are associated with zero option and incineration options for all the parameters due to the negative impacts associated with poor waste management and the high cost of an incinerator for Municipal Solid Waste incineration.

**Figure 8.1 Summary of no action (OP1), incineration (OP2) and composting (OP3)**



The composting option has many beneficial attributes and impacts for all the biophysical and socio-economic components. The positive ecological impact is reduced risk of surface and ground water pollution. Additionally, there will be many social benefits as detailed in chapters 5 and 6 of this report. The income from the sell of the compost, employment and revenue to Mbale Municipal Council offsets the negative impacts.

## 8.2 Range values from the Rapid Impact Assessment Matrix (RIAM) Analysis

**Table 8.1 NO ACTION - ZERO OPTION**

### Physical and chemical components (PC)

Components		ES	RB	A1	A2	B1	B2	B3
PC2	Health risks	0	N	2	0	3	2	3
PC3	Solid wastes along roads	-14	-B	2	-1	2	2	3
PC4	Skips over flowing with mixed wastes	-18	-B	1	-3	1	2	3
PC5	Increased vermin at disposal/skips	-16	-B	1	-2	3	2	3
PC6	Bulky waste	-72	-E	3	-3	3	2	3

### Biological and ecological components (BE)

Components		ES	RB	A1	A2	B1	B2	B3
BE1	Scattered wastes around along roads	-72	-E	3	-3	3	2	3
BE2	Increased vermin at skips	-24	-C	1	-3	3	2	3
BE3	Dirty and health town	-72	-E	3	-3	3	2	3
BE4	Increased mixed wastes	-24	-C	1	-3	3	2	3
BE5	Ground water pollution from leachate	-72	-E	3	-3	3	2	3

### Sociological and cultural components (SC)

Components		ES	RB	A1	A2	B1	B2	B3
SC1	Inadequate safety measures	-14	-B	1	-2	3	2	2
SC3	Community not involved in waste management	0	N	0	0	3	2	3
SC4	Poor sanitation	-72	-E	3	-3	3	2	3
SC6	Diseases and sick Community members	-72	-E	3	-3	3	2	3

### Economical and operational components (EO)

Components		ES	RB	A1	A2	B1	B2	B3
EO1	Poor flower and vegetation yields	-6	-A	1	-1	3	2	1
EO2	Loss of valuable raw materials	-16	-B	2	-1	3	2	3
EO3	Unemployed would be workers	0	N	3	0	2	2	3

### Summary of scores

Range	-108	-71	-35	-18	-9	0	1	10	19	36	72
	-72	-36	-19	-10	-1	0	9	18	35	71	108
Class	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	1	0	0	3	0	1	0	0	0	0	0
BE	3	0	2	0	0	0	0	0	0	0	0
SC	2	0	0	1	0	1	0	0	0	0	0
EO	0	0	0	1	1	1	0	0	0	0	0
Total	6	0	2	5	1	3	0	0	0	0	0

**Table 8.2 INCINERATION OF MSW**

### Physical and chemical components (PC)

Components		ES	RB	A1	A2	B1	B2	B3
PC1	Air pollution and odour	-27	-C	3	-1	3	3	3
PC2	Wet wastes do not burn	7	A	1	1	2	2	3
PC3	Bulky wastes need shredding	-6	-A	1	-1	1	2	3
PC4	Land to construct an incinerator	-10	-B	2	-1	1	2	2

PC5 Clean town	63	D	3	3	2	2	3
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#### Biological and ecological components (BE)

Components		ES	RB	A1	A2	B1	B2	B3
BE1	Air and water pollution by fly ash	-27	-C	3	-1	3	3	3
BE2	Bulky and wet wastes not burnt	-21	-C	3	-1	2	2	3
BE3	Need for a landfill to dispose of fly ash	-24	-C	2	-2	2	2	2

#### Sociological and cultural components (SC)

Components		ES	RB	A1	A2	B1	B2	B3
SC1	Improved sanitation	21	C	1	3	2	2	3
SC2	Limited involvement of community members	-6	-A	1	-1	2	2	2
SC3	Need highly skilled staff	-12	-B	1	-2	2	2	2

#### Economical and operational components (EO)

Components		ES	RB	A1	A2	B1	B2	B3
EO1	High of procuring and incinerator for MSW	-16	-B	1	-2	2	3	3
EO2	Cost for land outside town	-10	-B	1	-2	1	2	2
EO3	Increased maintenance costs	-14	-B	1	-2	2	2	3
EO4	High Cost of scrubbers	-14	-B	1	-2	2	2	3

#### Summary of scores

Range	-108	-71	-35	-18	-9	0	1	10	19	36	72
	-72	-36	-19	-10	-1	0	9	18	35	71	108
Class	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	0	0	1	1	1	0	1	0	0	1	0
BE	0	0	3	0	0	0	0	0	0	0	0
SC	0	0	0	1	1	0	0	0	1	0	0
EO	0	0	0	4	0	0	0	0	0	0	0
Total	0	0	4	6	2	0	1	0	1	1	0

**Table 8.3 COMPOSTING PROJECT**

**Physical and chemical components (PC)**

Components		ES	RB	A1	A2	B1	B2	B3
PC1	Reduced wastes along roadsides	42	D	3	2	2	2	3
PC2	Reduced ground water pollution	56	D	4	2	2	2	3
PC3	Improved aesthetics	21	C	1	3	2	2	3
PC4	Improved sanitation	21	C	1	3	2	2	3
PC5	Reduced vermin	6	A	1	1	2	2	2

**Biological and ecological components (BE)**

Components		ES	RB	A1	A2	B1	B2	B3
BE1	Improved sanitation	21	C	1	3	2	2	3
BE2	Reduced pollution from leachate	36	D	3	2	2	2	2
BE3	Improved plant - flower gardens	6	A	1	1	2	2	2
BE4	Reduced contamination of surface water	54	D	3	3	2	2	2

**Sociological and cultural components (SC)**

Components		ES	RB	A1	A2	B1	B2	B3
SC1	Clean community settlements	6	A	1	1	2	2	2
SC2	Increased involvement of community members	28	C	2	2	2	2	3
SC3	Employment opportunities	14	B	1	2	2	2	3
SC4	Income to compost sellers	7	A	1	1	2	2	3
SC5	Improved vegetable and crop yields for compost users	6	A	1	1	2	2	2
SC6	Reduced health risks	36	D	3	2	2	2	2

**Economical and operational components (EO)**

Components		ES	RB	A1	A2	B1	B2	B3
EO1	Cost of composting equipment	8	A	1	1	3	2	3
EO2	Income from compost	7	A	1	1	2	2	3
EO3	Longer life for dumping site	14	B	1	2	2	2	3
EO4	Reduced cost of transporting wastes to dump site	16	B	1	2	3	2	3

**Summary of scores**

Range	-108	-71	-35	-18	-9	0	1	10	19	36	72
	-72	-36	-19	-10	-1	0	9	18	35	71	108
Class	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	0	0	0	0	0	0	1	0	2	2	0
BE	0	0	0	0	0	0	1	0	1	2	0
SC	0	0	0	0	0	0	3	1	1	1	0
EO	0	0	0	0	0	0	2	2	0	0	0
Total	0	0	0	0	0	0	7	3	4	5	0

### 8.3 Graphs showing visualization of the Impacts of waste management project

Figure 8.3.1 Zero Option

#### NO ACTION - ZERO OPTION

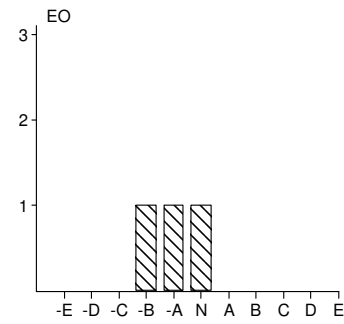
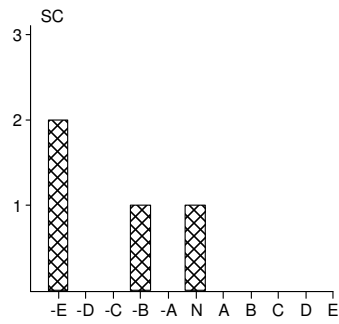
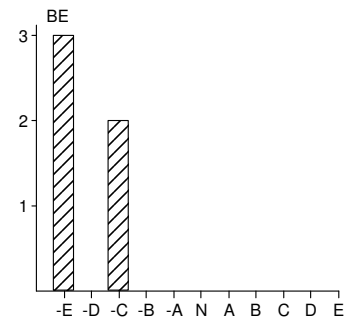
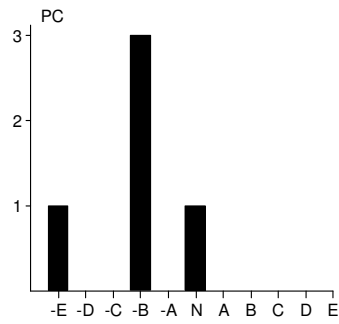
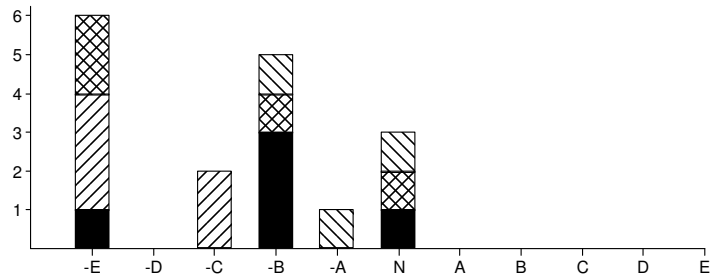


Figure 8.3.2 Incineration option

INCINERATION OF MSW

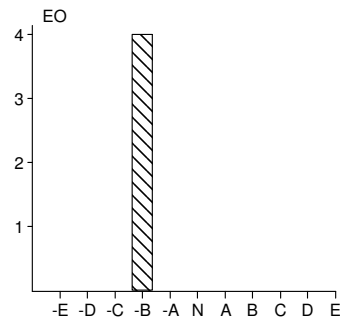
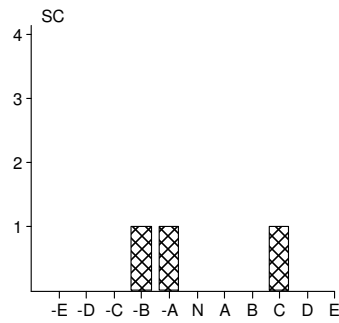
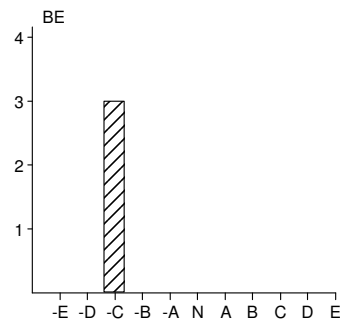
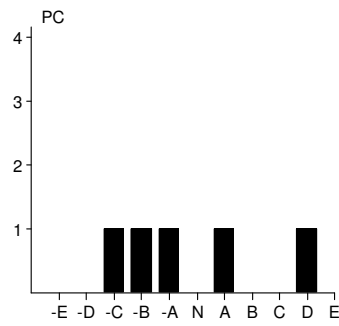
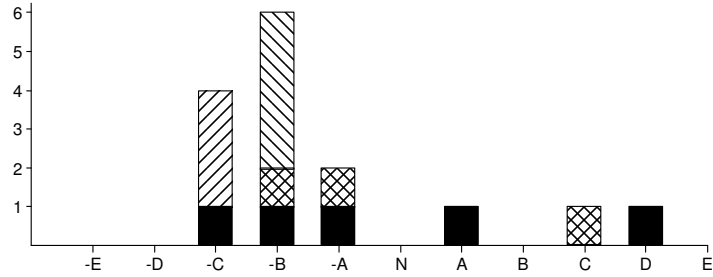
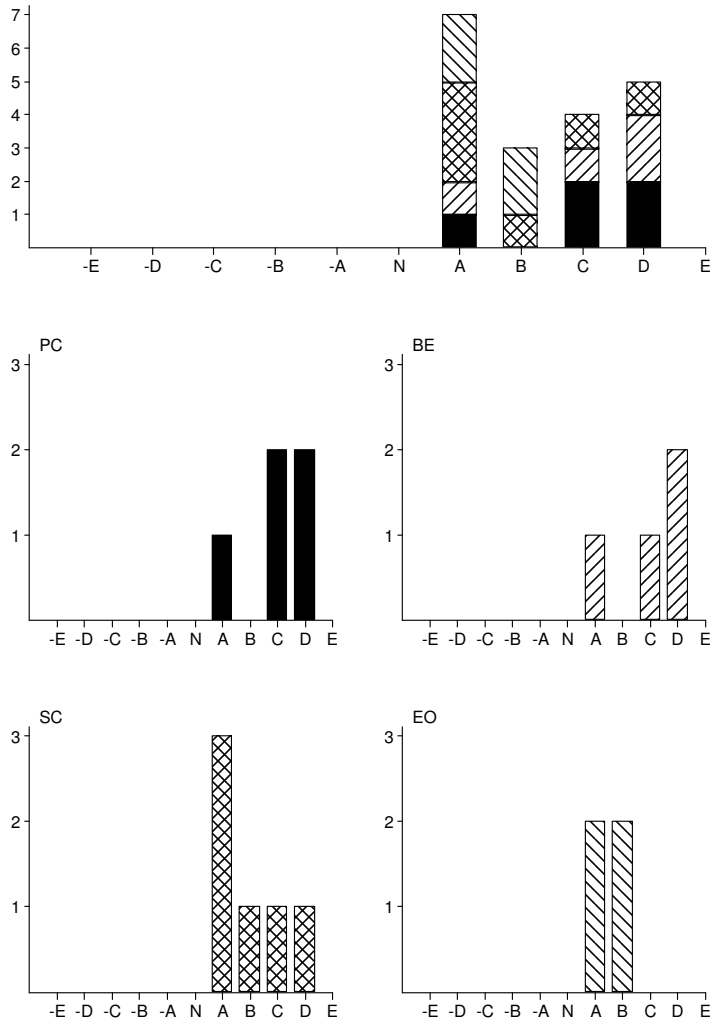


Figure 8.3.3 Composting option

COMPOSTING PROJECT



## Appendix 9: Terms of Reference for the EIA Study

### TERMS OF REFERENCE FOR AN ENVIRONMENTAL IMPACT ASSESMENT OF MBALE MUNICIPAL WASTE COMPOSTING PROJECT

#### 1.0 Scope of the activities to be carried out in the composting project

The project to be executed will include the following elements:

- (i) Evaluation of identified sites for the composting operations: these could be the sites currently in use or new suitable sites identified,
- (ii) Development and preparation of the composting sites, including building the slab for the solid waste compositing and putting in place other necessary infrastructure;
- (iii) Procuring and installation of hardware and equipment required for implementation of the compositing operations,
- (iv) Undertaking the procurement and delivery of other goods, works and services necessary for the implementation of the Project,
- (v) Processing biodegradable solid waste into manure and recovery of other resources from the waste; and
- (vi) Trading, under CDM, of the GHG emission reductions, and sell of manure and other by-products.

#### 2.0 Scope and Terms of Reference for the EIA

The Environmental Impact Assessment to be carried out will cover the following key areas that will be integral to the waste composting process:

- (i) Evaluation of the status and suitability of the identified **waste disposal sites** to be used for final disposal and composting of the wastes, including assessment of:
  - general site suitability with respect to social issues (e.g.; relative nearness of settlements) and possible impacts to fragile/sensitive ecosystems;
  - pollution potential,
  - haulage distance in relation to long-term operational/ transportation costs.
- (ii) Identification of potential impacts and mitigation measures to control direct, indirect and other secondary environmental impacts that could arise out of the **composting operations** specifically:
  - addressing the potential social impacts of composting
  - determining whether the composting activity will not have detrimental social impacts through diverting of a significant portion, of the waste generated, from current informal users (if any) of the resource. Where such impacts may occur, the EIA should identify appropriate mitigation mechanisms.
- (iii) Identification of possible involvement of other stakeholders and partners especially the private sector and Civil Society Organisations (CSOs) to ensure sustainability,

- (iv) Evaluation of compositing site management requirements, to ensure availability of sound environmental management capacity and effective operation of the composting project,
- (v) Identification, in close collaboration with the Municipal authorities, of direct project impacts to the community including;
  - Identification of specified communities for the specific short term and long term benefits from the project
  - Identification of specified communities who could be disadvantaged by the project activities, and proposing mitigation measures (if any)
- (vi) Identification of existing and potential market opportunities for the compost manure and any other by-products from the project (immediate and long-term market prospects).
- (vii) Elaboration of an Environment Monitoring and Management Plan (EMP) for ensuring compliance to the national environment laws and to the recommended environmental management and mitigation measures;
- (viii) Assessment of the training and capacity building needs necessary to meet the human resources management needs of the project,

### **3.0 Required expertise for the EIA**

In order to carry out the EIA, the following expertise will be required:

- i. An EIA expert and Team leader,
- ii. Solid Waste Management expert,
- iii. An Economist.
- iv. A sociologist/Physical planner.

### **4.0 Duration of the study**

It is expected that EIA will last a period of 10 man days as follows:

- 4 days for initial consultations and field studies,
- days for draft report preparation and discussions with key stakeholders
- days for finalization of the report and consultations

### **5.0 OUTPUTS**

The Consultant shall produce the following outputs:

- (i) An Environmental Impact Statement indicating the following:
  - clear recommendations on the suitability of the identified sites for the composting operations,
  - a strategy for regular and sufficient supply of solid waste for purposes of the Project;
  - A clear indication of the social impacts due to the composting activity and where adverse impacts have been identified appropriate mitigation mechanisms should be clearly indicated.
  - Mitigation and management measures for environmentally sound execution of the project,

- Proposals and recommendations for the necessary training under the Project;
- An Environment Monitoring and Management Plan (EMP) for ensuring compliance to the recommended environmental management and mitigation measures;
- A strategy for ensuring that the Compositing site operations and associated activities are compliant with environmental laws and management measures as per the identified environment monitoring and management plan;
- A recommended strategy for marketing the compost and other byproducts
- Recommendations for site restoration and remediation when this becomes necessary,
- Recommendations for record keeping and documentation of project deliverables and implementation progress.

## **6.0 Reporting**

The Consultant shall submit the Final Environmental Impact Statement to Mbale Municipal Council Town Clerk.