COUNTY GOVERNMENT OF NAKURU

NAKURU MUNICIPALITY

DRAFT SOLID WASTE MANAGEMENT STRATEGY

MAY 2019

FOREWORD

Accumulated waste deposits are an indication of societal lifestyles, waste management practices and production technology. Some societies at the peak of their development have stagnated due to inadequate management of their waste leading to the proliferation of diseases, environmental degradation and ultimate impact on livelihoods. Improper management of waste poses a threat to Climate Change and eventually in the achievement of sustainable development. Waste is one of the contributors of greenhouse gases affects climate change and it is for this reason that as a country, we should develop sustainable waste management technologies and initiatives to curb this growing global challenge.

Through our commitment to sustainable development, Nakuru Municipality aims to balance the broader economic and social challenges of development and environmental protection. For this reason, the country subscribes to the vision of a prosperous and equitable society living in harmony with our natural resources. This is also reinforced in the Constitution under the fundamental right to a clean and healthy environment. Sound environmental management entails the use of waste reduction technologies in production, sustainable product design, resource efficiency, re-using products where possible and recovering value from products. Although elimination of waste entirely may not be feasible, systematic application of modern waste management systems should be explored and implemented.

The challenge of waste management affects every person and institutions in society. The measures set out in this strategy cannot be undertaken without a collective approach to waste challenges and the involvement of a broad range of stakeholders in their implementation. This Nakuru Municipal Solid Waste Management Strategy (NMSWMS) seeks to establish a common platform for action between stakeholders to improve systematically waste management in the Municipality. The Strategy lays the framework for improved waste management.

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PREFACE

Every person in Kenya is entitled to a clean and healthy environment, has the duty to safeguard and enhance the Environment. The Environment Management and Co-ordination Act _Ammendment_2015 and both the draft National and Nakuru County Waste Management Bills are guided with among others the following principles of public participation in the development of policies, plans and processes for the management of the environment, the principle of inter-generational and intra-generational equity, the polluter-pays principle and the precautionary principle.

It is in this context that Vision 2030 recognized that efficient and sustainable waste management systems are required as the country develops into a newly industrialized state by 2030. In this regard, Vision 2030 set flagship projects for the five cities namely; Mombasa, Kisumu, Eldoret, Nakuru and Thika to have fully functional and compliant waste management systems by developing strategies towards achieving sustainable waste management and enhancing a clean, healthy environment for all.

Although only the County Governments of these five municipalities were engaged in developing this Strategy, it was observed that waste challenges were similar in all other counties thus these systems can be replicated in other counties countrywide.

It is with this spirit that the County Government of Nakuru strived to develop this Nakuru Municipality Solid Waste Management Strategy, which will assist the public and institutions involved to adopt a **7R** oriented society, by **R**educing; **R**ethinking; **R**efusing; **R**eusing; **R**epairing; **R**efilling and **R**ecycling their waste.

All the efforts were driven towards compliance with the Environmental Management and Coordination Act of 1999 and the Environmental Management and Coordination (Waste Management) Regulations of 2006, Draft National Sustainable Waste Management Bill and policy and Draft Nakuru County Waste Management bill and Policy in order to ensure a clean and healthy environment for all, keeping in line with Article 42, of the Constitution of Kenya 2010.

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ABBREVIATIONS AND ACRONYMS

CBD	Central Business District
CBOs	Community Based Organizations
CGN	County Government of Nakuru
CSOs	Civil Society Organizations
CSR	Corporate Social Responsibility
EEEs	Electrical and Electronic Equipment
EMCA	Environment Management and Co-ordination Act
ENRED	Environment, Natural Resources, Energy, and Water Department
HDPE	High-Density Polyethylene
IDO	Industrial Diesel Oil
MB	Municipal Board
MEAs	Multilateral Environmental Agreements
NEMA	National Environment Management Authority
NGOs	Non-governmental Organizations
NMSWMS	Nakuru Municipal Solid Waste Management Strategy
OSHA	Occupational Safety and Health Act
PET	Polyethylene Terephthalate
POPs	Persistent Organic Pollutants
PPP	Public-Private Partnership
SWM	Strategic Waste Management

INTRODUCTION

All human activities generate waste, which requires to be properly managed to protect human health and the environment while enhancing aesthetics. This scenario is particularly evident in urban settlements, which generate large quantities of solid waste due to the high human population. Rapid urbanization has made solid waste management a serious problem today.

The impacts of poor solid waste management within the urban settlements, particularly cities and big municipalities can be disastrous. As such, there is a need for proper and efficient waste management.

Kenya Vision 2030 recognizes the need for efficient and sustainable waste management systems to be established as the country develops into a newly industrialized state by 2030. The perception of the people has always been that waste management is solely a responsibility of the County Governments. County Governments are constitutionally bound to keep their territories clean. For some time now, they have been experimenting with several innovative & participatory methods of Reduce, Reuse and Recycle

Purpose of the Strategy
The purpose of this Nakuru Municipal Solid Waste Management Strategy is to guide sustainable solid waste management in Kenya to ensure a healthy, safe and secure environment for all. The Strategy is a deliberate and visionary commitment for the Municipality in the management of solid waste.

The Nakuru Municipal Solid Waste Management Strategy is anchored on the premise that:

Solid Waste Management covers all activities pertaining to the control, transfer, transport, processing, and disposal of residual solid waste in accordance with best principles and practices of public health, economics, engineering, conservation and aesthetics. Its scope must include attendant administrative, financial, legal, planning and engineering functions.

The Strategy is guided by several key principles. They are:

The issue is much wider than SWM
The strategy acknowledges that solid waste management is no more a limited public health responsibility. It is a much wider task and, therefore, must be seen in the context of comprehensive planning and management of the total city environment.

Don't waste Waste
Waste is money. It does not make economic sense to waste the "useable waste". The residents should feel the need for effective community and household-based methods for urban solid waste management. They need not be ignorant of or averse to these methods, which call for greater household care and action. A considerable number of city residents must be whipped to support municipal SWM efforts to adopt a **7R** principle (**R**educing; **R**ethinking; **R**efusing; **R**eusing; **R**epairing; **R**efilling and **R**ecycling) and are seeking municipal guidance and follow-up.

Lack of financial resources is not the main issue

As in all other County Governments, in Kenya, Nakuru County also spends a considerable percentage of its annual budget of solid waste management. The amount spent daily is substantial. The reason for inadequate management is more a problem of strategy and administration than a lack of finances.

The disposal site is only the last resort

Currently, the city's solid waste management depends solely on collection and disposal method. There is increasing difficulty in finding suitable landfill sites. Obviously, the indiscriminate burying of recyclable material is a colossal waste of marketable resources. The strategy, therefore, treats waste as raw material and an income source for the Municipality. It will use the landfill technique only as of the last resort and, in its place, will promote alternative techniques to reduce, reuse and recycle the optimum possible quantum of waste at the point of generation. The strategy also proposes to use alternate methods to transform landfill sites into Eco-parks for public use and recreation.

Recognize the Informal sector as a vital partner

The urban informal sector is a critical part of the whole waste management system of the Municipality. This municipal strategy recognizes the presence of the informal sector in SWM and proposes municipal assistance and facilitation of its operations.

People need affordable solutions

The society seeks after easy solutions convenient, affordable to the individual, and family. Changing their attitude and habits is a formidable task. It can be done only by introducing innovative solutions that do not call them to go out of their way and routine. Home level composting appears to be an effective primary mode to meet this challenge. Home-based composting alone can prevent at least 60% of the household waste from being a municipal problem and an environmental hazard.

Peoples' participation

Social Mobilization for environmental care is an important element of this strategy. It recognizes public education as an important corollary in the context of current socio-economic pressures and complexities. It also envisages creating institutional methods to engage the city residents in municipal planning and decision-making. The strategy will mobilize School Environment clubs as partners in this regard. The strong public opposition against landfill sites in urban areas and garbage transportation through their localities must be positively addressed to convert such protests into a social movement for home-level waste reduction, reuse and composting.

Develop stakeholder partnerships

Nakuru Municipal is convinced that urban waste management will be easier and more effective only if the local authority can develop institutional mechanisms to promote sustainable partnerships with different stakeholders of the city such as the residents, civil society organizations and the private sector.

Administrative and institutional changes are vital

Several far-reaching administrative and institutional arrangements are suggested to implement the new strategy. In designing these arrangements, due caution and care have been taken in this

document to keep revisions to the minimum in order not to upset the existing administrative arrangements too much. The proposed arrangements emphasize:

(a) The use of alternative technological options to reduce, reuse and recycle domestic waste,
(b) The use of community structures to ensure local area management that can create waste-free environments,
(c) Institutionalization of the working group system at Municipal and ward levels to plan and review environment planning and implementation,
(d) The creation of an Enforcement and compliance Unit on Environment for policing the Municipality to nab the violators of environmental laws and also
(e) Annual submission of an Environmental Status Report for Municipal Board's debate, adoption, and necessary action.

Free services are less sustainable
The Municipal can no more provide waste collection services free of charge. In addition to being financially unsustainable, free services permit careless and unrestrained anti-social behavior, which is also a moral hazard. Moreover, free waste collection and disposal is also a discriminatory practice because the bulk producers of waste are treated in the same manner as those who generate less. The proposed strategy is based on the premise that generators of waste must share the costs of waste management according to the volume they generate.

Documentation is important
The municipal record-keeping methods are weak. They do not provide vital information required by the administrators and planners to understand the ward-specific, street-specific quality and quantity of generated waste. It does not even provide leading information to plan the cadre and vehicle deployment effectively. However, information exists that can indicate the types and volumes of different waste that can help planners determine the different recycling modes and processes that can be used.

The aim of this strategy is to communicate clearly;

- **Where we are now,**
- **Where we want to go, and**
- **What we believe needs to be done (How we get there).**

The Six Strategic Elements
The proposed strategy is not a monolithic collection & disposal system. Instead, it proposes to employ a multi-pronged approach that revolves around the '7R' participatory principle of **R**educing; **R**ethinking; **R**efusing; **R**eusing; **R**epairing; **R**efilling and **R**ecycling. The strategy employs six main elements. They are:

1. Engaging an affordable mix of appropriate technical options to **R**educing; **R**ethinking; **R**efusing; **R**eusing; **R**epairing; **R**efilling and **R**ecycling.
2. Involving all major stakeholders in the implementation
3. Promoting Private-Municipal Partnerships
4. Strengthening institutional SWM capacity of Nakuru Municipal
5. Influencing national and County level policies & program support

6. Enforcing laws and policy

Waste Management

Legal Framework relevant to Solid Waste Management in Kenya

The legal frameworks highlighted below are relevant to solid waste management in Kenya;

Constitution of Kenya:

In the Constitution of Kenya, Article 42 on the Environment provides that-

"Every person has the right to a clean and healthy environment, which includes the right

(a) To have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and
(b) To have obligations relating to the environment fulfilled under Article 70"

Article 69 on Obligations to the Environment, the Constitution provides that –

(1) The State shall—

(e) Encourage public participation in the management, protection, and conservation of the environment;
(f) Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
(g) Eliminate processes and activities that are likely to endanger the environment; and
(h) Utilize the environment and natural resources for the benefit of the people of Kenya.

(2) Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources. ***Part 2 of the Fourth Schedule in the Constitution of Kenya*** also explicitly provides that the County Governments shall be responsible for; refuse removal, refuse dumps and solid waste disposal.

Vision 2030

In Vision 2030, one of the flagship projects is the Solid waste management initiative which calls for the relocation of the Dandora dumpsite and the development of solid waste management systems in five (5) leading municipalities (Nakuru, Mombasa, Kisumu, Thika, and Eldoret) and in the economic zones planned under vision 2030.

The Environmental Management and Coordination Act (EMCA), 1999 and the Amended 2015

Section 3 of EMCA, 1999 stipulates that - "Every person in Kenya is entitled to a clean and healthy environment and has a duty to safeguard and enhance the environment."

Section 9 of EMCA, 1999 further states that –

"(1) The object and purpose for which the Authority is established are to exercise general supervision and coordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment.

(2) Without prejudice to the generality of the foregoing, the Authority shall –

(a) co-ordinate the various environmental management activities being undertaken by the lead agencies and promote the integration of environmental considerations into development policies, plans, programs and projects with a view to ensuring the proper management and rational utilization of environmental resources on a sustainable yield basis for the improvement of the quality of human life in Kenya;"

Section 86 of EMCA, 1999 provides that – "The Standards and Enforcement Review Committee shall, in consultation with the relevant lead agencies, recommend to the Authority measures necessary to:-

(2) Prescribe standards for waste, their classification, and analysis, and formulate and advise on standards of disposal methods and means for such wastes; or

(3) Issue regulations for the handling, storage, transportation, segregation and destruction of any waste."

Section 87 of EMCA 1999 states that – "(1) No person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such manner as to cause pollution to the environment or ill health to any person.

(2) No person shall transport any waste other than –

(a) In accordance with a valid license to transport wastes issued by the Authority; and

(b)To a wastes disposal site established in accordance with a license issued by the Authority.

(4) No person shall operate a wastes disposal site or plant without a license issued by the Authority.

(5) Every person whose activities generate wastes shall employ measures essential to minimize wastes through treatment, reclamation, and recycling.

Environmental Management and Coordination (Waste Management) Regulations of 2006

In the Responsibility of the Generator, Regulation 2 states that – "Any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed of such waste in the manner provided for under these Regulations."

Regulation 5 on the Segregation of waste by a generator states that – "(1) Any person whose activities generate waste, shall segregate such waste by separating hazardous waste from nonhazardous waste and shall dispose of such wastes in such facility as is provided for by the relevant Local Authority."

There are also clear provisions in the Regulations, which govern the Responsibilities of a Transporter, to own or operate treatment facilities and disposal sites and/or facilities.

The Occupational Safety and Health Act, 2007

The Occupational Safety And Health Act (OSHA), 2007 Part IX, Chemical Safety, Section 83 Subsection IV states that:- "at every workplace where chemicals or other toxic substances are manipulated, the employer shall develop a suitable system for the safe collection, recycling and disposal of chemical wastes, obsolete chemicals and empty containers of chemicals to avoid the risks to safety, health of employees and to the environment."

The Public Health Act, 2012

The Public Health Act Revised Edition 2012, **Part 126. Rules under Part,** The Minister, on the advice of the board, may make rules and may confer powers and impose duties in connection with the carrying out and enforcement thereof on local authorities, magistrates, owners and others as to—(d) the drainage of land, streets or premises, the disposal of offensive liquids and the removal and disposal of rubbish, refuse, manure and waste matters.

Part—(c) any street, road or any part thereof, any stream, pool, ditch, gutter, watercourse, sink, water tank, cistern, water-closet, earth-closet, privy, urinal, cesspool, soak-away pit, septic tank, cesspit, soil-pipe, waste-pipe, drain, sewer, garbage receptacle, dust-bin, dung pit, refuse-pit, slop-tank, ash-pit or manure heap so foul or in such a state or so situated or constructed as in the opinion of the medical officer of health to be offensive or to be injurious or dangerous to health.

Part (e) states that any noxious matter, or wastewater, flowing or discharged from any premises, wherever situated, into any public street, or into the gutter or side channel of any street, or into any or watercourse, irrigation channel or bed thereof not approved for the reception of such discharge constitutes to be a nuisance.

The County Governments Act, 2012

Section 120, Tariffs and pricing of public services, subsection (3) A tariff policy adopted under subsection (1) shall reflect following guidelines — **part (h)** promotion of the economic, efficient, effective and sustainable use of resources, the recycling of waste, and other appropriate environmental objectives.

The Urban Areas and Cities_ Amendment_ Act 2019

Functions of a Board

Section 20(1) part q. Promote a safe and healthy environment.

The Environmental Management and Co-ordination (Water Quality) Regulations, 2006.

Part III – Water for Industrial Use and Effluent Discharge,

Subsection 11. No person shall discharge or apply any poison, toxic, noxious or obstructing matter, radioactive waste or other pollutants or permit any person to dump or discharge such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards set out in the Third Schedule to these Regulations.

The Environmental (Impact Assessment and Audit) Regulations, 2003

This regulation defines "waste" includes any matter prescribed to waste and any matter whether liquid, solid, gaseous or radioactive, which is discharged, emitted or deposited in the environment in such volume composition or manner likely to cause an alteration of the environment.

Part II - The Project Report, 7. (1) A proponent shall prepare a project report stating –

(a) The materials to be used, products and by-products, including waste to be generated by the project and the methods of their disposal.
(b) The products, by-products, and waste generated the project.

Part IV - The Environmental Impact Assessment Study Report, 18. (1)A proponent shall submit to the Authority, environmental content of impact assessment study report incorporating but not limited to the environmental following information - (f) the products, byproducts, and waste generated by the project;

Part V - Environmental Audit and Monitoring 36, (2) an environmental audit report compiled under these Regulations shall contain - (b) an indication of the various materials, including non-manufactured materials, the final products, and by-products, and waste generated.

International obligations – Multilateral Environmental Agreements (MEAs)

The evolving system of international conventions, agreements and treaties have provided an important framework for waste management policies across the globe.

The current global environmental governance is to a large extent a result of the Rio Earth Summit of 1992 and Agenda 21, which amongst others advocates for four major waste-related programs:

- Minimizing waste
- Maximizing environmentally sound waste disposal and treatment
- Promoting environmentally sound waste disposal and treatment
- Extending waste service coverage

The summit set in motion a series of multilateral environmental agreements (MEAs) dealing with land-based sources of marine pollution, water quality, regional trans-boundary movement of hazardous waste, the management of toxic chemicals, and the trans-boundary movement of radioactive waste, among others.

In relation to hazardous substances and waste, five principal conventions apply:

The **Basel Convention** was ratified and entered into force in Kenya in the year 2000. This convention addresses the need to control the trans-boundary movement of hazardous wastes and their disposal, setting out the categorization of hazardous waste and the policies between member countries.

Kenya became a signatory to the **Stockholm convention** on persistent organic pollutants (POPs) in 2001 and ratified it in 2004. This treaty seeks to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts

on human health or on the environment. Member countries are required to phase out pops and prevent their import or export.

The **Rotterdam Convention** that Kenya ratified in 2005 sets out the procedure for Prior Informed Consent in the International Trade of hazardous chemicals and Pesticides. The convention promotes transparency in enforcing open exchange of information and calls on exporters of hazardous chemicals to use proper labeling, include directions on safe handling, and inform purchasers of any known restrictions or bans.

The **Montreal Protocol**, to which Kenya became a signatory in 1987 and ratified the subsequent amendments provides for the phase-out of the production and consumption of ozone-depleting substances in order to reduce their abundance in the atmosphere and thereby protect the earth's fragile ozone Layer.

Kenya is also a signatory to the **Bamako Convention** since 2003. This is an African nations treaty that prohibits the import of any hazardous (including radioactive) waste into Africa. The convention is a response to Article 11 of the Basel convention, which encourages parties to enter into bilateral, multilateral and regional agreements on Hazardous Waste to help achieve the objectives of the convention.

Scope of the Strategy

Solid waste management remains a major challenge in all the 47 counties and more so in their urban centers in Kenya. Over the years, most local authorities did not prioritize the establishment of proper waste management systems and hence the County Governments have inherited this state of affairs. This has led to the current poor waste management situation across the country. Under the Urban areas and Cities Act, Municipalities are expected to plan and manage their wastes. This sustainable solid waste management strategy shall be applied to Nakuru Municipality.

In an effort to address poor solid waste management, NEMA developed some minimum requirements as a baseline for implementation by the Counties. These included designation, securing and manning of the disposal sites, promotion of efficient collection and transportation of waste. The basic requirements were expected to ensure the continuous promotion of efficient solid waste management. This Strategy will, therefore, build on these on-going waste management efforts towards the attainment of full compliance and ensuring a clean and healthy environment.

It is proposed that this Strategy will cover a period of eleven (11) years within the Vision 2030framework and be reviewed every five (5) years in accordance with the medium-term plans.

With the full implementation of the Strategy, it is expected that Nakuru Municipal will have embraced environmentally sound waste management technologies and best practices

Minimum requirements for Solid Waste Management in Kenya

The County Governments and their Urban areas and Cities are expected to implement the minimum requirements across the waste management cycle;

Waste collection

1. Ensure that the waste collection areas are zoned;
2. Ensure timely and regular collection of all solid wastes either through the door-to-door collection or from centralized collection points;
3. Ensure waste collection facilities such as skips, bulk containers, and waste cubicles are regularly emptied and do not become eye-sores;

Waste transportation

4. Ensure that all the collected waste is transported using NEMA licensed vehicles to designated disposal sites.

Waste disposal site

5. Ensure there is a designated site(s) for waste disposal
6. Ensure that the disposal site is secured with a fence and a gate manned by a county government official to control dumping and spread of waste outside the disposal site.
7. Ensure all incoming waste is weighed or estimated and the quantities recorded in tonnes
8. Develop and maintain motorable roads inside the site to ensure ease of access during disposal;
9. Ensure the waste is spread, covered and compacted at regular intervals
10. Put in place appropriate control measures for the management of dumpsite fires
11. Enhance security and control of the disposal sites so that illegal activities are contained.

Requirement for licensing

12. Obtain licenses to operate waste disposal sites.
13. Ensure that all waste services providers in the County are licensed by the County Government of Nakuru for waste tracking and management

The County Governments and their urban areas and cities will strive to ensure continuous improvement of collection methods, transportation, and disposal facilities. Effective waste management systems will deliver a clean and healthy environment for all as granted by the Constitution of Kenya, 2010.

Overview of the current status of waste management

Kenya has a growing human population and an increase in urbanization. The urban centers have attracted a large population of informal settlements dwellers and the middle class. This urbanization and increased affluence have led to increased waste generation and the complexity of the waste streams. This trend is compounded by the growing industrialization of the Kenyan economy. Despite the existence of laws and policies guiding waste management, weak implementation and poor practices have led to towns and cities being overwhelmed by their own waste, consequently affecting public health and the environment. Over the years, waste management has been the mandate of the local Authorities. However, most urban authorities did not prioritize the establishment of proper waste management systems and hence allocated meager resources for its management. Further, the councils lacked technical and institutional capacities to manage waste. This has led to the current poor state of waste management, which includes indiscriminate dumping, uncollected waste and lack of waste segregation across the country.

Waste Management Services
Feasibility was studied by Mott MacDonald done in 2017 for Nakuru County on Integrated Solid Waste Management Plan by enhancing solid waste reduction, reuse, and recycling in the urban areas of the county. The aim was to develop a financially and technically sound public-private partnership (PPP) solution to improve waste management in the County. The following were the findings of the study:

Waste Collection and Cleaning
Household waste collection is undertaken across 40 separate zones; with a different private contractor responsible for each of 31 of these and the remainder collected by the CGN. Outsourcing to the public sector commenced in approximately 2007. All collection service contracts have recently been retendered and were procured simultaneously commencing on 1 October 2016 and covering a three-year period.

The CGN provides commercial waste collection services through the Environment, Natural Resources, Energy, and Water Department (ENRED). Nakuru town is served by two tipper trucks. Commercial waste is deposited in piles from where it is collected with its tipper trucks and staff. The deposited piles result in odors, litter and visual impacts on the commercial establishments and the local population. The collection operation's key issues include traffic delays and lack of space for vehicle maneuvering during collection and lack of mechanization.

Private contractors undertake litter picking in the areas where they provide services. ENRED provides street cleansing at public spaces (squares, streets, parks, and gardens) in Nakuru, Naivasha and Molo. The cleanliness levels and the bin loading levels and condition in Nakuru town areas were observed during our visit and they were found to vary significantly from location to location.

Disposal Sites and Recycling
Gioto landfill is the main disposal site for the county, it has no gate, no weighbridge, and no checkpoint. On-site data collection is lacking: without effective data management, waste disposal estimates are unreliable. The CGN has stated that the landfill receives approximately 200 tonnes of waste per day (around 80 to 100 vehicles per day).

Multiple other sites receive waste from various sources throughout Nakuru, these all have no engineering and are open land dumpsites. The largest sites are Naivasha, Gilgil, Molo, and Mai Mahiu. In general, these operate with little to no planning or control. Vehicles are allowed on-site to dump their waste and leave, and the waste is typically picked by scavengers.

No facilities treating or recycling wastes are operating in the County. CGN is considering segregation at source, with household and commercial wastes being collected in two streams, organic and inorganic. In addition to the informal recycling market, there are 400 people picking waste including their families living around Kiamunyi (Gioto) landfill. (Mott MacDonald |Nakuru Integrated Solid Waste Management PPP Project **2** Feasibility Study Report and PPP Implementation Plan 3 November 2017)

Waste Composition Study and Conclusions

A total of 6,230 kg of waste was analyzed. Samples were collected from 15 zones, over an 8-day period (17th January 2017 to 25th January 2017). The sampling areas were intended to cover a variety of income levels and to cover both residential districts and commercial areas. The study was undertaken during the dry season in January when the daytime temperatures were on an average 30ºC.

A total of 7 samples were analyzed from the residential areas and 8 samples were analyzed from the commercial areas of Nakuru Municipality. The results are only a snapshot in time and it was recommended that similar studies are undertaken at 3-monthly intervals to obtain an understanding of the impact of seasonal variation.

Residential Waste

Waste samples collected from residential areas were nearly 80% biodegradable materials, which is a combination of organic food, paper, cardboard, textiles, and fines. The remaining 20% of non-biodegradable materials comprised plastics, glass, ferrous, non-ferrous, hazardous waste, and miscellaneous combustibles.

In the residential waste stream, organic food waste is the main category at 57%. It was observed that rural and high-income areas to have less food waste in the residual waste stream when compared with middle-income areas. The Lead Consultant was informed by CGN that the affordability of domestic help within high-income families results in lower organic food waste as any excess food is consumed by house staff such as cleaners, cooks, and gardeners.

Textiles/rags were observed to be present in predominately-low income and rural areas. The consortium was informed by local contractors that there is a culture within Kenyan families to hand over used clothing to those in need within and outside the family. Waste from high-income areas comprised of more packaging (paper, cardboard, non-ferrous drink cans, glass, and polyethylene terephthalate (PET)).

Table 1: Residential waste composition

Waste Category:	***kg:***	**Percentage:**	**Mean:**	**High:**	**Low:**
Paper	*179.6*	7.1%	7.3%	9.9%	3.9%
Cardboard	*45.5*	1.8%	1.7%	2.5%	0.0%
HDPE	*27.5*	1.1%	1.2%	3.4%	0.0%
PET	*44.0*	1.7%	1.7%	4.2%	0.0%
Other Plastics	*263.6*	10.4%	10.3%	12.9%	4.1%
Glass	*97.5*	3.9%	3.9%	12.1%	0.0%
Textiles	*72.0*	2.8%	3.3%	10.7%	0.0%
Organic Food	*1439.4*	56.9%	56.6%	82.4%	39.1%
Organic Garden	*0.0*	0.0%	0.0%	0.0%	0.0%
Ferrous	*31.2*	1.2%	1.2%	1.6%	0.6%
Non-ferrous	*10.5*	0.4%	0.4%	1.1%	0.0%
Hazardous	*3.0*	0.1%	0.1%	0.6%	0.0%
WEEE	*0.0*	0.0%	0.0%	0.0%	0.0%
Hard Plastics	*29.5*	1.2%	0.9%	5.6%	0.0%

Misc. Combustibles	*27.0*	1.1%	1.1%	3.2%	0.0%
Nappies	*46.0*	1.8%	1.7%	4.7%	0.0%
Fines	*212.5*	8.4%	8.7%	12.4%	3.2%
Total:	2528.7	100.0%			

Commercial Waste

The waste stream from the commercial areas of Nakuru was distinct from the residential waste and represents the growth of the hospitality and leisure sector of a town which is expanding at a fast pace.

The wholesale market waste produces predominately fruit and vegetable waste (>97%). The remaining waste is made up of paper, cardboard, textiles, and plastics. The textiles were worn out hessian bags used to transport fruits and vegetables.

Waste from the wholesale market is collected 6 days a week and has little contamination (<4%) making it ideal for organic waste treatment. The waste from the remaining commercial areas represents the hospitality and leisure sector with packaging (paper, card, high-density polyethylene (HDPE), PET, other plastics, glass, ferrous and non-ferrous) contributing 46% and organic food 39%.

Table 2: Commercial waste collection by private contractors

Waste Category:	**kg:**	**Percentage:**	**Mean:**	**High:**	**Low:**
Paper	283.5	12.0%	14.1%	37.8%	6.6%
Card	168.5	7.1%	7.4%	12.4%	0.9%
HDPE	8.5	0.4%	0.4%	0.7%	0.0%
PET	66.0	2.8%	2.7%	4.4%	0.8%
Other Plastics	321.0	13.6%	13.9%	18.7%	9.7%
Glass	159.0	6.7%	5.8%	13.0%	0.0%
Textiles	77.0	3.3%	2.9%	6.1%	0.5%
Organic Food	917.8	38.9%	37.5%	57.1%	21.4%
Organic Garden	0.0	0.0%	0.0%	0.0%	0.0%
Ferrous	36.2	1.5%	1.5%	1.9%	1.0%
Non-Ferrous	39.5	1.7%	1.8%	5.6%	0.0%
Hazardous	0.0	0.0%	0.0%	0.0%	0.0%
WEEE	0.0	0.0%	0.0%	0.0%	0.0%
Hard Plastics	0.0	0.0%	0.0%	0.0%	0.0%
Misc. Combustibles	26.5	1.1%	1.3%	2.4%	0.0%
Nappies	1.0	0.0%	0.0%	0.2%	0.0%
Fines	257.5	10.9%	10.6%	12.5%	7.7%
Total	2362.0	100%			

Most towns and cities have inefficient waste collection and disposal systems. For instance, a study done for Nairobi indicates that about 30-40% of the waste generated is not collected and less than 50% of the population is served. In Nakuru, it's estimated that 45% of the waste generated is collected and disposed at Gioto Dumpsite, 18% is recovered and the rest accumulates in the environmental (National Waste Management Strategy, 2015). The Mott and Macdonald study did

in 2017 estimated that 55% of the waste generated is disposed at Gioto dumpsite. It also pointed out to an increased waste recovery rate

Waste transportation is largely rudimentary using open trucks and tractors trailers. These transportation modes, sometimes lead to littering during transportation, making waste an eyesore, particularly plastics in the environment. However, Nakuru County has adopted some appropriate transportation trucks as stipulated by the Waste Management Regulations. In addition, Nakuru County Government has privatized waste transportation through Private Public Partnership arrangements.

Disposal of waste in the country remains a major challenge as most of the counties lack proper and adequate disposal sites. Nakuru Town has a designated site (Gioto) which practices open dumping of mixed waste due to lack of appropriate technologies and disposal facilities. However, in the recent past, much formal/informal waste recovery efforts have increased both outsides and inside the disposal site, therefore, reducing the waste volume in the dumpsite significantly.

Types of waste streams and their management

There are various waste streams generated in Kenya, that can be categorized as domestic, municipal, industrial and hazardous wastes. Other emerging waste streams, such as e-waste, and waste tires are as a result of growing industrialization and growth of ICT. The composition of general waste varies considerably between households, businesses, and industries.

Domestic waste:

Domestic waste is also referred to as garbage, refuse or trash. It consists mainly of biodegradable waste, which is food, and kitchen waste, green waste paper and non-biodegradable such as plastics, glass bottles, cans, metals and wrapping materials. The composition of the domestic waste streams is a function of income, consumption patterns and recycling opportunities. Nationally domestic waste is not adequately managed and is disposed of at our disposal sites with minimal sorting/segregation.

Waste Tyres:

Waste tires are an emerging waste stream that has reached their end of life due to wear or damage and cannot be recycled or reused. There are no established formal systems for collection and recycling of tires with the exception of retreading. As such the bulk of the tires are informally collected and often illegally burnt in the open to recover steel for recycling. This emits harmful gases causing air pollution and soil contamination arising from the residues. Currently, only two facilities in the country are using waste tires as fuel and for producing industrial diesel oil (IDO). To address the management of waste tires, NEMA has developed relevant regulations.

Construction and demolition waste:

This is waste that is generated as a result of new construction works, remodeling or demolition.

Construction waste comprises debris, steel, timber, iron sheets, tiles and ceramics among others. Although construction and demolition waste is not classified as hazardous, a mixed waste source requires separation into component parts for the purposes of recycling. These wastes currently end up in the disposal sites or are used for backfilling in our road networks.

Asbestos Waste

Demolition wastes may include asbestos, which is hazardous and can present a significant health risk when improperly disposed or reused. NEMA has developed guidelines on safe management and disposal of Asbestos.

Industrial waste:

Industrial waste is the waste produced by industrial activity, which includes any material that is rendered useless during the manufacturing process. Industries produce both hazardous and nonhazardous waste. These wastes include chemical solvents, paints, sandpaper, and paper products, industrial by-products, metals, municipal solid waste, and radioactive waste.

Currently, most of the hazardous industrial waste is not pretreated before reuse, recycling or disposal. This poses health risks to the handlers and causing damage to the environment. Disposal of hazardous industrial waste illegally occurs at the municipal dumpsites. However, some industries have embraced best practices in disposing of the industrial waste by seeking guidance from NEMA on appropriate disposal methods.

Biomedical Waste

Biomedical waste also referred to as medical waste refers to waste generated in health facilities, research institutions or during immunization of human beings and animals. It's classified into; Infectious waste, sharps, pharmaceutical wastes, chemical waste, and pathological waste. Biomedical wastes pose risks to human health due to its pathogenic characteristics and hence require prior treatment before disposal.

Currently, segregation is fully embraced in most hospitals and clinics based on the guidelines issued by the Ministry of Health. Although the biomedical waste is expected to be disposed of through incineration, some find its way to the municipal dumpsites while some are handled through rudimentary facilities such as kilns. While big hospitals have embraced proper biomedical waste management, the major challenge remains the small clinics, which practice illegal disposal of these wastes.

So far, NEMA has licensed 15 incinerators countrywide in both government institutions and private, which have complied with the provisions of the Third Schedule of the Waste Management Regulations of 2006. Although the licensed incinerators are few they are not operating at optimal capacity and hence other medical facilities are encouraged to share. In Nakuru Level 5 Hospital, there is an Integrated Autoclave with Shredder – a cost-effective and environmentally friendlier way of managing biomedical waste

E-waste:

E-waste is an emerging waste stream arising from Electrical and Electronic Equipment (EEEs) becoming obsolete at the end of life. Kenya has experienced a rapid increase of e-waste due to the adoption of ICT across all sectors and an influx of low-quality EEEs. E-waste comprises of heavy metal components and materials used in the manufacture of electronic goods. Some of these include mercury, brominated flame retardants, and cadmium which are considered hazardous if not well handled during dismantling or recycling can become harmful to human health and the environment.

As a county, limited infrastructure has been put in place to deal with e-waste. NEMA has developed E-waste Regulations which will assist the country in regulating e-waste by registering producers, licensing of recyclers and preventing the entry of sub-standard EEEs. In addition, the Regulation has extended responsibility to producers to the bare cost of recycling of the products commonly known as *extended producer responsibility*. Currently, there are two licensed facilities in the Country, which are undertaking e-waste management.

Batteries:

Batteries can either be alkaline (dry cells) or acid based which support domestic and industrial applications. The acid based (rechargeable and silver oxide) batteries contain heavy metals such as mercury and cadmium, which are classified as hazardous substances. This hazardous material if not properly handled and disposed of presents a risk the human health and the environment.

Currently, there are no recycling or disposal facilities for alkaline, rechargeable and silver oxide batteries. As such the batteries are disposed in the open dumpsites alongside domestic waste. On the other hand, lead-acid batteries, which are also considered hazardous waste, are recyclable and by February 2015 NEMA had licensed two facilities for their recycling.

Fluorescent Lamps:

Fluorescent lamps are used for illumination and contain a small amount of mercury. The mercury is a neurotoxin and can be harmful even in small quantities. Fluorescent lamps can be successfully recycled and the mercury recovered. However, if poorly handled at any stage this releases the mercury, which is hazardous. Increasingly people are adopting florescent lamps as energy saving devices across the country, which is likely to compound the challenge of their disposal. So far, NEMA has licensed one facility for recycling fluorescent lamps.

Pesticide Waste:

Pesticides are chemicals used to control pests. Pesticide waste consists of expired and contaminated pesticides as well as the used containers. Due to their toxicity, potential to pollute and threat to human health, pesticide wastes are extremely hazardous and must be transported, treated and disposed of accordingly. These pesticides can contain persistent organic pollutants (POPs), which can accumulate in the food chain if not well managed. Large-scale generators of pesticides waste incinerate or export the waste to developed countries for treatment or disposal. However small scale generators dispose of in their farms.

Used Oil and Sludge:

Used Oil and Sludge arises from the use of petroleum products. This contains potentially hazardous compounds such as poly-aromatic hydrocarbons that have carcinogenic and mutagenic properties. Used oil and sludge have a slow rate of decomposition and hence any spillage can accumulate in the environment causing soil and water pollution. This waste is currently recycled to produce lubricants and industrial oil used in furnaces and boilers. Though illegal, used oil is also largely applied in the treatment of timber and dust suppression.

NEMA has developed guidelines for the management of used oil and sludge and has licensed a few used oil and sludge handlers.

Sewage Sludge:

Sewage sludge is a sediment material that accumulates over time in the sewage treatment plants and ponds. The widespread disposal of industrial effluent via sewage treatment works results in contamination of sewage sludge with hazardous chemicals, thereby posing particular challenges for its disposal. The sewage sludge that is contaminated by heavy metals from industrial effluent can severely contaminate agricultural land to which it is applied. However, a high proportion of the contaminated sewage sludge continues to be disposed of in dumpsites. In this regard, there is need to pre-treat contaminated sewage sludge before disposal. Uncontaminated sewage sludge has a variety of commercial uses and can be recycled.

Current Waste Management Practices

Waste Segregation

- Most of the waste is generated at household, market places, cities, towns, institutions, and industrial zones
- Very few households segregate waste at the household level
- There is minimal waste segregation at source within the CBD areas, industries, institutions in most towns/cities
- There is considerable segregation of biomedical waste
- Recovery of recyclable items like plastics, papers, glass, and metals is done by Nakuru Solid Waste Management Association, Nakuru Waste Reclaimers Association and an increasing number of informal groups
- There is increasing waste segregation at Gioto dumpsite by both the formal and informal groups
- Composting is on the increase with various formal and informal organizations being involved

Waste Collection and Transportation

- Waste in the CBDs is largely collected by the County Government of Nakuru while private operators contracted by the County Government dominate collection in residential areas at a fee
- Waste collectors obtain permits from the County Governments to collect waste from designated areas
- NEMA issues annual licenses to waste transporters in accordance with the provisions of the waste management regulations of 2006. However, some waste transportation vehicles operate illegally as they do not meet NEMA requirements.

Waste Treatment

- Waste treatment technologies have not been fully embraced in Nakuru County. However, there are on-going efforts to enhance waste treatment practices through the World Bank funded Nakuru County Integrated Waste Management PPP Project, which is under feasibility study.
- Recyclable materials comprise 50 – 80% of the general waste stream;
- Several industries exist that receive recovered materials such as paper, polythene, plastics, glass, scrap metals, used oil, e-waste and waste tires for recycling. There is low public awareness of these facilities and hence majority have not achieved optimal operations;

- A few composting facilities exist especially in horticultural farms;
- Thermal treatment of waste by use of incinerators is increasingly being adopted. However, most incinerators do not comply with the requirements of the Third Schedule of the waste management regulations of 2006.

Waste Disposal

- Most of the municipal and domestic waste generated is disposed of in open dumpsite (Gioto). Although this is not a recommended practice it is the most common practice
- Biomedical waste is largely disposed of through incineration and rudimentary kilns; however recently at the Nakuru Level 5 Hospital, there is an Integrated Autoclave with Shredder – a cost-effective and environmentally friendlier way of managing medical waste
- Condemned, damaged or expired goods are disposed of through incineration or in the cement kilns.
- The existing incineration facilities have been largely burners and kilns and do not meet the requirements stipulated the Third schedule of the waste management regulations of2006.
- Most of the workforce operating these disposal sites have minimal or no training on how to manage these facilities.

Challenges in Waste Management

Waste management in Kenya has remained a major challenge due to diverse factors. This range from problems associated with waste management systems, limited knowledge, attitude and practices, political will, technical and financial resources.

The Absence of a Municipal-level SWM Strategy: Nakuru Municipality does not have a solid waste management strategy of its own. As a result, SWM is largely viewed solely as an engineering responsibility for collection and disposal. Solid waste management is no more a technical issue. It needs social, fiscal and administrative solutions as well. However, since the enactment of the Urban Areas and Cities-Amendment-Act 2019, the County Government of Nakuru administration has begun to take a more comprehensive look at the problem. The new Nakuru Municipal Solid Waste Management strategy is a result of that new view.

Lack of awareness and knowledge: There are limited awareness and knowledge on the importance of a clean and healthy environment. This has led to poor practices by the Public towards waste management, which has led to environmental pollution. As such there is poor handling of waste at the household level including lack of segregation, reuse, reduce and recycling. In addition, negative attitude towards waste management and failure to take individual responsibility has contributed to poor practices such as littering, illegal dumping, and open burning. ‘We dump – They collect’ is the general attitude among the residents by over a long period. Solid Waste Management and adoption of 7Rs approach is not their concern.

Negative public perception: The average resident views SWM as a Municipal responsibility. The general public carries a negative perception of the role played by the local body mainly because of the conspicuous quantities of waste lying uncollected on the town’s open spaces and stormwater drains for days. At the same time, there is widespread resistance to the call for separation of waste

at the household level. It is viewed as a move by the Municipality to shy away from one of its customary responsibilities and hand over the same as the responsibility of the households. This lack of civic awareness and public cooperation has always plagued the municipal efforts to keep the city clean.

Political influence and lack of good will: Political goodwill is key to the ultimate success of proper waste management in the country. Unfortunately, the waste management agenda has not been prioritized, leading to poor investments and funding.

Disposal sites: Availability, siting and management.

The county governments are expected to designate waste disposal sites/facilities within their areas of jurisdiction. However, the availability of public land for the purpose of a disposal site remains a challenge. In situations where the land is available, the neighboring communities are opposed to it being in their backyard. This is as a result of poor management of the existing sites. This has culminated in dumpsites being sited on environmentally sensitive areas such as riverbanks, forests, and wetlands.

Funding: Lack of prioritization for waste management in the counties has led to inadequate budgetary allocation. As a result, management of the entire waste management cycle (collection, transportation, and disposal) is hampered. Low funding has also affected investment in waste management facilities and equipment.

High poverty levels: High poverty level, especially in informal and low-income settlements, has compromised the ability to pay for waste management services. This has led to a lack of collection leading to illegal waste dumping in undesignated areas sites, streams, rivers, and highways. The situation is further compounded by lack of access and waste management infrastructure.

Lack of segregation: There is a lack of waste segregation at source leading to mixed wastes which are collectively disposed of in the dumpsites. Where sorting is done, the problem is compounded by the lack of compartmentalized vehicles for transportation of the sorted waste leading to the remixing. This hampers material recovery, reuse, and recycling. The sorting has largely been relegated to the lowly in society such as the waste pickers and street urchins.

Limited Institutional Capacity: The Municipality it lacks financial & human resources to address solid waste issues effectively. While this claim needs careful study and analysis, there is undoubtedly a human resource issue that is affecting the efficiency and effectiveness of the SWM team. None of the team members have any comprehensive training in SWM. Under the circumstances, they have had very little opportunity to expand their knowledge horizons and enhance technical expertise. They need exposure to modern SWM applications.

Slow adoption of modern technological options: Although there are many waste management technologies in the country, there has been low adoption of the same by the relevant practitioners. This as a result of diverse factors including inadequate financial resources to purchase the equipment, lack of incentives including tax waivers, resistance to change, lack awareness, unavailability of land and weak enforcement.

Lack of Partnerships: The County Government of Nakuru has engaged the services of a private waste service providers to assist it in solid waste collection and disposal as an income generating venture. It appears to be working well. Nevertheless, for better results, more partnerships must be built.

Lack of database and record keeping: The Municipal does not have a functional record keeping method to assess the volumes of waste handled i.e. collected and safely disposed of. There is no weighbridge to weigh the volume of waste that gets into the dumpsite per day. There is a need to know the volumes of waste generated per day both from residential and commercial areas. What is stressed here is that without adequate record keeping and realistic databases it is difficult to improve the quality of planning and delivery of waste services in the Municipality.

Absence of participatory mechanisms: The city administration does not have adequate institutional mechanisms to engage the residents, public organizations, Civil Society Organizations (CSOs) and other stakeholders on a regular basis to assist in indecision making and solid waste program implementation. The role that these stakeholders can play in educating the masses and mobilizing their communities has not been adequately recognized. Any future strategy to streamline solid waste management in the Municipality will be effective only if it can directly address these drawbacks. The strategy proposed here is an attempt in that direction.

Conclusion

The above problems and drawbacks inform the formulation of this forward-looking zero waste strategy for the Nakuru Municipality. For decades, solid waste management has been considered primarily as an engineering function; collection and disposal. Time has come now for the municipality to adopt a new guiding principle and strategy for solid waste management.

The Waste Management Cycle and the ideal approaches:

The waste management cycle comprises;

- Waste generation
- Waste collection
- Waste transportation
- Waste treatment
- Waste disposal

Waste Generation

Most of the waste is generated at household, market places, cities, towns, institutions and industrial zones. Ideally, the waste generator should endeavor to minimize waste by reducing, reusing, refusing, returning waste or by adopting cleaner production technologies;

All waste generated should be segregated at source;

The County Governments and the licensed service providers should provide color-coded bags or bins as per the NEMA guidance for the segregated waste;

Waste Collection
Waste collection is the main point of interface between the public and waste service providers who are either the Government or the private sector.

Collection centers/transfer stations should be established at strategic areas within a town.They should be fully equipped with waste receptacles, which should either be color coded or labeled with the specific waste stream to promote waste segregation.

All waste collection centers should be zoned/ designated by the County Governments.

These collection areas should be properly managed and maintained with frequent and timely collection of waste to avoid scattering into undesignated areas.

Adequate measures should be put in place to manage any leachate from the waste receptacles and collection areas;

The County Governments should embrace Public-Private-Partnerships with organized groups to enhance waste collection within the informal settlements and low-income areas.

Waste Transportation
The County Governments should provide adequate transport for the various segregated waste streams;

The waste transportation trucks should be closed and suitable for the transportation of the various waste streams to the waste treatment facilities and landfills;

The trucks waste trucks should be regularly serviced and maintained to avoid littering of waste;

All waste transportation vehicles should be licensed to operate by NEMA.

Waste Treatment
The following waste treatments technologies are highly recommended to enable the Country to achieve a reduction of waste directed to landfills and other disposal facilities.

Material recovery technologies
Recycling
Recycling is the processing of waste material into a new product of similar chemical composition.

Recycling prevents wastage of potentially useful materials, reduces the consumption of fresh raw materials and energy usage in addition to reducing pollution.

Kenyans should embrace full recycling of all recyclable materials to reduce the amount of waste being disposed at the landfill.

Composting
Composting is the biological decomposition of biodegradable solid waste under controlled aerobic conditions to produce compost

Compost is used as an organic fertilizer in agricultural production. Kenyans should strive to compost all their organic wastes to reduce organic waste ending at the landfill.

Waste to energy/ Energy recovery technologies

Thermal treatment of waste:

Thermal treatment is the combustion of waste at specific temperatures with or with no air supply as part of the process and includes waste incineration, gasification, and pyrolysis. The un-reusable and unrecyclable wastes can be subjected to thermal treatment, which is an environmentally sound technology that reduces the volume of waste and inserts any hazardous components. At the same time, energy can be recovered as an end product.

Waste Incineration:

Incineration is controlled the burning of solids, liquids, and gaseous waste.

The technology is applicable in the management of both hazardous waste streams as well as municipal solid waste.

Incineration should be undertaken in facilities that meet the requirements in the Third Schedule of the Environmental Management and Coordination (Waste management)Regulations of 2006.

Gasification:

Gasification is a process of reacting waste at high temperatures greater than (>700 °C), without combustion, with a controlled amount of oxygen and/or steam to generate useful products such as electricity, chemicals, fertilizers, and natural gas. This could be an important option in landfills.

Pyrolysis:

A pyrolysis is a form of treatment that chemically decomposes organic materials by heating the absence of oxygen. Pyrolysis typically occurs under pressure and at operating temperatures above 400-500 degrees Celsius. The National Solid Waste Management Strategy highly recommends thermal treatment of waste as it leads to the generation of useful products besides waste treatment.

Biological treatment of waste:

This is a natural process that occurs where plant and animal materials (biomass) are broken down in the presence of microorganisms. Biological treatment of waste can either be anaerobic or aerobic. In anaerobic treatment, waste is broken down in the presence of microorganisms and in the absence of air while in the aerobic treatment, biological degradation of organic waste takes place in the presence of oxygen. Useful products are derived from these two processes mainly biogas which produces electricity and organic fertilizer. This National Solid Waste Management Strategy highly recommends the biological treatment of organic waste which is an environmentally sound technology and leads to the generation of useful products.

Waste Disposal

Disposal refers to the depositing or burial of waste on land.

The Sanitary landfills should be lined with systems to collect leachate and methane gas.

There should be frequent spreading, compacting and covering of waste with soil or any other appropriate covering material to avoid environmental pollution and scavenging birds.

This National Solid Waste Management Strategy highly recommends minimal disposal of waste and the establishment of properly engineered Sanitary landfills with systems to collect leachate and methane gas.

THE WASTE MANAGEMENT STRATEGY

This Nakuru Municipal Waste Management Strategy has been formulated with the aim of gearing the Municipality towards achieving sustainable solid waste management with Zero Waste status.

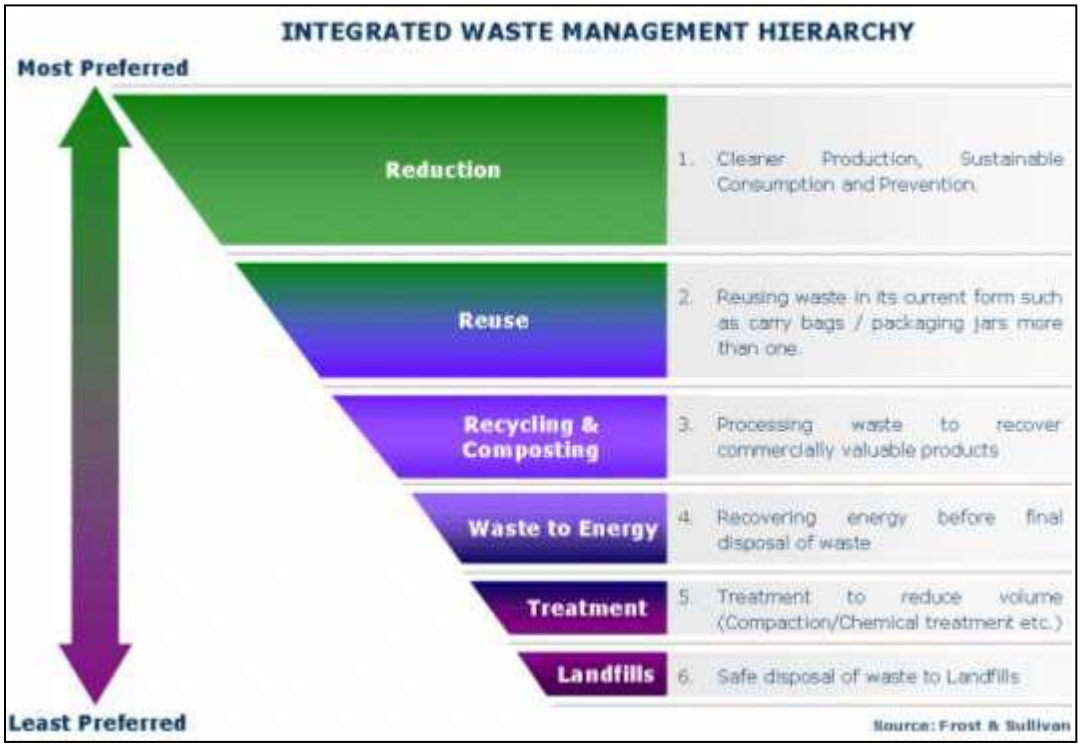

Figure 1: Hierarchy demonstrating the integrated waste management

The Strategy has been developed to enable the Municipality to meet the goals for solid waste management as summarized below:

Table 3: Summary of goals for solid waste management

Overall strategy goals	i. Protection of public health ii. Reduction of poverty iii. Reduction of waste management costs iv. Protection of environment
Guiding principles	Zero Waste Principle (Waste is a resource that can be harnessed to create wealth, employment and reduce pollution of the environment)
Long-term goals	Achieve approximately 80% waste recovery (recycling, composting and waste to energy) and 20% landfilling in a Sanitary landfill (inert material) by 2030
Mid-term goals	Achieve 50% waste recovery (recycling, composting and waste to energy) and 50% semi-landfilling by 2025

Short-term goals	Achieve 30% waste recovery (recycling, composting) and 70% controlled dumping (tipping, compacting and covering) in key urban areas by 2020
Key Priority areas	• Preparation of Municipal based waste management action plans that are consistent with County and national solid waste management strategy and other relevant policies. • Capacity building at all levels of planning and decision making (national and the county government levels) to promote transformative leadership • Enactment of county laws to regulate waste recovery and disposal to serve as a regulatory regime for the use of waste as a resource
Instruments	Specific action/programs
Legal instruments	Solid waste recovery and disposal laws (emphasis for SWM should be on reuse and recycling), enactment/enforcement of regulatory and supervisory statutes
Financial instruments	Levying taxes as disincentives for landfilling to encourage source reduction, provide incentives for waste recyclers, preferential use of recovered materials over virgin materials.
Communication instruments	Advocacy for behavioral change through media campaigns, communication, and technology, dissemination of waste management information
Institutional instruments	Decentralized SWM, public-private partnerships (e.g. voluntary agreements), strengthened entrepreneurial activities (e.g. for SMEs) training of SWM managers, demonstrations, promotion of research and development in SWM.

Objectives of the Strategy

This strategy is to be implemented through seven (7) key objectives.

1. To formulate policies, legislation and economic instruments to reduce waste quantities.
2. To inculcate responsible public behavior on waste management.
3. To promote waste as an income generating venture.
4. To promote waste segregation at source.
5. To promote resource recovery for materials.
6. To promote resource recovery through energy generation.
7. To establish environmentally sound infrastructure and systems for waste management.

Table 4: Log frame on the national solid waste management strategy objectives

Overall goal: Sustainable solid waste management with Zero Waste in Nakuru by the year 2030			
Objectives	**Key result areas**	**Outcomes**	**Activities**
To formulate policies, legislation and economic instruments to reduce waste quantities	Policies and economic instruments on waste management	Sustainable management of solid waste	Develop and harmonize county legislation on waste management Develop policies on economic instruments

	Uptake of efficient technologies Compliance and enforcement of waste management legislation		Implement policies and economic instruments Benchmark on appropriate technologies Enforcement of waste management standards and legislation
To inculcate responsible public behavior on waste management	Capacity building in waste management Informed public on waste management	Public behavior changed on waste management	Sensitize the public on responsible waste management Create awareness of suitable waste management options Educate the public on integrated waste management Undertake monthly clean-ups Develop sensitization materials
To promote waste as an income generating venture	The market for the recovered and recycled products More entrepreneurship in waste management activities Increased uptake of modern technology	Enhanced income from waste management activities	Explore market opportunities for the recovered and recycling materials Promote the use of recycled and recovered materials Promote modern technologies on recovery and recycling Promote Public-Private Partnership in waste management
To promote waste segregation at source	Improvement in Knowledge, Attitude and Practice towards	Segregated wastes	Intensified waste segregation campaigns

	SWM Segregated waste services		Pilot waste segregation Provision of equipment for waste segregation Provision of segregated waste transport systems Promote Public-Private Partnership in waste management
To promote resource recovery for materials	Recycling and composting facilities Market availability for recovered materials Acceptance of recovered materials Collaborations in recycling	Enhanced materials recovery and use	Enhance modern technologies for recycling and composting of waste Explore market opportunities for recovered materials Develop promotion programs for the use of recovered materials Enhance collaboration with stakeholders on recycling
To promote resource recovery through energy generation	Waste to energy generation plants Energy generated Collaboration in waste to energy recovery initiatives		Promote energy recovery plants Enhance waste to energy resources Enhance collaboration with stakeholders on energy recovery
To establish environmentally sound infrastructure	Improvement on existing waste management facilities, collection	Existence of environmentally sound waste management	Improve existing waste management facilities,

and systems for waste management	and transportation systems, transfer stations, treatment, and disposal facilities	collection, transportation, transfer stations, treatment and disposal facilities	Provision of adequate and appropriate collection facilities and services Provision of adequate and appropriate transport systems for segregated waste Build and operate transfer stations Develop standard incinerators with energy recovery facilities Establish composting facilities Establish recycling facilities Develop sanitary landfills

Objectives Key Result Areas Outcomes Activities

Key approaches to implementing the strategy

Depending on the situational analysis of the waste management practices in a county, the strategy will be implemented using the following approaches;

i. Strategic alignment and recognition of partners through a public-private partnership
ii. Introduction of incentives in the waste management cycle (generation, segregation, collection, transportation, treatment, and disposal)
iii. Introduction of extended producer responsibility and public awareness campaigns and education;
iv. Establishment of efficiency and value addition in the waste management cycle
v. Compliment the input from CBO's and other private-public activities.
vi. Phase out waste burning
vii. Establish waste operational zones
viii. Upscale the activities of the informal sector to link up with the existing formal recycling industries.
ix. Establishment of infrastructure and systems for residual waste through a stepwise phasing out of illegal dumpsites to establishment of sanitary landfills

Roles of Collaborating Agencies:

Successful implementation of this strategy requires the involvement of several actors whose roles are outlined below;

Ministry of Environment, Water and Natural Resources:

a) Give policy direction on solid waste management initiatives countrywide;
b) Channel funding to NEMA, for benchmarking and for capacity building and technology transfer.

NEMA:

a) Formulate policies, legislation and economic instruments relevant to achieving sustainable waste management;
b) Develop and disseminate public information on the regulatory requirements for waste management in Kenya;
c) Undertake to benchmark regionally and internationally on appropriate waste management technologies;
d) Enhance the capacity of the county governments on waste management systems and approaches applicable in their respective counties;
e) Employ social media to attract wider stakeholder participation and change attitudes towards waste management at a national level;
f) Hold public awareness sessions (for example, school workshops, public consultation exhibitions, and public events) on waste management initiatives;
g) Support the dissemination of waste management research and development findings
h) Involve mass media dissemination techniques, such as the publication of news articles and press releases, in addition, to ensure coverage in both print and media outlets.

County Governments:

a) Undertake enforcement activities of the laws developed on solid waste management and surveillance exercises on illegal waste-related activities. Monitoring and evaluation of the strategy.
b) Formulate County policies, legislation and economic instruments relevant to achieving sustainable waste management in the county
c) Allocate funds to Municipalities to run the waste management function and capacity building
d) Responsible for drawing up action plans for implementation of applicable solid waste management systems within their counties;
e) Source adequate funding for the development of sustainable waste management initiatives in the entire cycle;
f) Put in place measures for enhanced Public-Private-Partnerships (PPP);
g) Benchmark on best practices of appropriate technologies;
h) Undertake periodic clean-up activities within their counties;
i) Provision of equipment for waste segregation and transport systems;
j) Zone the waste operational areas;
k) Continuous management of activities/facilities to ensure all the waste is transported to the designated waste disposal sites in a timely manner;
l) Monitoring and evaluation of the strategy

m) Ensure wide coverage and no littering of waste through improved collection methods and facilities;
n) Progressively improve the designated official county disposal site towards a sanitary landfill.

Municipalities:

a) Formulation and implementation of Municipal Waste Management Strategy
b) Continuous management of activities/facilities to ensure all the waste is collected, sorted and transported to the designated waste disposal sites in a timely manner
c) Undertake periodic clean-up activities within their Municipalities
d) Ensure timely enforcement of waste management laws and regulations
e) Monitoring and evaluation of the strategy

The National Treasury:

a) Channel funding to the respective government agencies and institutions for the development of waste management initiatives and facilities.

Civil Society Organizations (CSOs) and NGOs:

a) Promote and /or undertake income-generating ventures in waste management initiatives;
b) Represent the public's interest in the solid waste management agenda, nationwide and in support in identification of illegal waste-related activities.
c) Advocate for change in the public's knowledge, attitude and practice towards sustainable waste management.

Private Sector

a) Through PPP, Involvement in the development of effective and efficient solid waste management facilities;
b) Prioritize on corporate social responsibility (CSR) on waste management
c) Empower communities and other stakeholders in understanding waste management related issues and in finding solutions for the same.

The Citizens/Public

a) Change in attitude and practice to embrace the concept of a waste generator's responsibility by ensuring waste is appropriately managed at source and/or in all phases of the waste management cycle;
b) Adopt the 7R (Reuse, Recycle, Reduce, Rethink, Refuse, Refill, Repairing) and/or an integrated solid waste management approach in the management of all waste streams;
c) Collaborate with other government entities, CSOs, NGOs and other informal groups in waste management through the PPP approach.

IMPLEMENTATION MATRIX

To formulate policies, legislation and economic instruments to reduce waste quantities

Table 5: Strategic Objective 1

Activity		**Key performance targets**	**Key performance indicators**	**Time frame (years)**					**Outcomes**	**Actors**	**Budget – Kshs (M)**
				1st	**2nd**	**3rd**	**4th**	**5th**			
Policies and economic instruments on waste reduction	Develop and harmonize policies and economic instruments	Harmonized policies and economic instrument	Policies and economic instruments						Reduced quantities	CGN, Municipal Board& other relevant lead agencies	10M
	Implement policies and economic instruments	Implementation of policies and economic instruments	Policies and economic instruments implemented								
Uptake of efficient technologies	Undertake to benchmark on best practices of appropriate technologies	Best practices of appropriate technologies benchmarks	Appropriate technologies adopted							CGN, Municipal Board	10M
Compliance and enforcement of waste management	Compliance and enforcement of waste management standards and legislation	Compliance and enforcement to set standards	Level of compliance and enforcement							CGN, Municipal Board with other relevant lead agencies	10M

To inculcate responsible public behavior on waste management

Table 6: Strategic Objective 2

Activity		**Key performance targets**	**Key performance indicators**	**Time frame (years)**					**Outcomes**	**Actors**	**Budget – Kshs (M)**
				1st	**2nd**	**3rd**	**4th**	**5th**			
Capacity building in waste management	Sensitize the public on responsible waste management	A sensitized public on responsible waste management	Number of people sensitized						Public behavior changed on waste management	CGN, Municipal Board, Media& other relevant lead agencies	25M
Informed public on waste management	Create awareness of suitable waste management options	Awareness created on suitable waste management options	Number of campaigns							CGN, Municipal Board, Media& other relevant institutions, CSOs, NGOs, the public/citizenry	
	Educate the public on integrated waste management	Educated public on integrated waste management	Number of clean-ups							CGN, Media houses & other relevant institutions, CSOs, NGOs, the public/citizenry	25M
	Develop sensitization materials	Sensitization materials developed	Number of sensitization materials developed							CGN, MB	5M

To promote waste as an income generating activity

Table 7: Strategic Objective 3

Activity		Key performance targets	Key performance indicators	Time frame (years)					Outcomes	Actors	Budget – Kshs (M)
				1st	2nd	3rd	4th	5th			
The market for the recovered and recycled products	Explore market Opportunities for the recovered and recycled materials	Market opportunities for the recovered and recycled materials explored	No. of market opportunities sourced/explored for the recovered and recycled materials						Enhanced income from waste management activities	CGN, MB& other relevant lead agencies	50M
More entrepreneurship in waste management	Promote the use of recycled and recovered materials	Recycled and recovered materials in use	Percentage of recycled and recovered materials in use in the Municipality							CGN, MB, public/ citizenry	
	Promote modern technologies on recovery and recycling	Modern technologies in use for recovery and recycling	Modern technologies in use for recovery and recycling							CGN, MB, public/ citizenry	
	Promote Public-Private Partnership in waste management	Public-Private Partnerships enhanced on various aspects of waste management	No. of Public-Private Partnerships in existence in the Municipality							CGN, MB &other relevant lead agencies, CSOs, NGOs, the public/citizenry	

To promote waste segregation at source

Table 8: Strategic Objective 4

Activity		**Key performance targets**	**Key performance indicators**	**Time frame (years)**					**Outcomes**	**Actors**	**Budget – Kshs (M)**
				1st	**2nd**	**3rd**	**4th**	**5th**			
Segregated waste services	Provision of equipment for waste segregation	Equipment for waste segregation provided	No of equipment provided						Segregated wastes	CGN, MB	50M
	Provision of segregated waste transport systems	Segregated waste transport systems provided	No of transport system provided							CGN, MB	100M
	Intensified waste segregation campaigns	Campaigns on segregation undertaken	Number of campaigns							CGN, CSOs, NGOs, the public/ citizenry	20M
	Initiate pilot waste segregation	Waste segregation pilot schemes	No of pilot schemes initiated							CGN, MB&other relevant lead agencies, CSOs, NGOs, the public/citizenry	50M

To promote resource recovery for materials

Table 9: Strategic Objective 5

Activity		**Key performance targets**	**Key performance indicators**	**Time frame (years)**					**Outcomes**	**Actors**	**Budget – Kshs (M)**
				1st	**2nd**	**3rd**	**4th**	**5th**			
Recycling and composting facilities	Enhance modern technologies for recycling and composting of waste	Enhanced recycling and composting of waste	Percentage of recycled and composted materials						Enhance materials recovery and use	Local and international investors, CGN, MB Relevant Government agencies, NGOs, CBOs. Etc.	(Dependent on investor potential as well as the type of facility)
Market availability of recovered materials	Explore market opportunities for recovered materials	Market opportunities for recovered materials explored	No. of market opportunities sourced/ explored for the recycled and composted materials								50M
Acceptance of recovered materials	Develop promotion programs for the use of recovered materials	Promotion programs for the use of recovered materials developed	No. of promotion programs undertaken countrywide to enhance or promote the use of recovered materials								
Collaboration in recycling	Enhance collaboration with stakeholders on recycling	Mechanisms of collaborations with stakeholders	No. of collaborations								

		on recycling enhanced								

To establish environmentally sound infrastructure and systems for waste management

Table 10: Strategic objective 6

Activity		Key performance targets	Key performance indicators	Time frame (years)					Outcomes	Actors	Budget – Kshs (M)
				1st	2nd	3rd	4th	5th			
Improvement of existing waste management facilities	Upgrade existing waste management facilities	Upgraded waste management facilities	No. of upgraded waste management facilities						Existence of environmentally sound waste management collection, transportation, transfer station, treatment and disposal facilities	CGN with support from various funding bodies	100M
Waste collection and transportation systems	Provision of adequate and appropriate collection facilities and services	Adequate and appropriate collection facilities provided	No of appropriate facilities provided							Local and international investors, CGN, MB with support from various funding bodies	100M
	Provision of Adequate and Appropriate transport systems for segregated waste	Appropriate transport systems provided	No of appropriate transport systems provided							CGN, MB with support from various funding bodies	
Waste transfer stations	Build and operate transfer stations	Transfer stations built and operational	No. of transfer station built and operational							Local and international investor, CGN, MB with support from various funding bodies	100M

Waste treatment facilities	Establish recycling facilities	Recycling facilities established	No. of recycling facilities established							Local and international investors	Dependent on investor potential
	Establish composting facilities	Composting facilities established	No. of composting facilities established								
Waste disposal facilities	Develop sanitary landfills	Sanitary landfills developed	No. of sanitary landfills developed							CGN with support from various funding bodies	1 Billion
	Develop standard incinerators	Standard incinerators	No. of standard incinerators with energy recovery facilities developed							Local and international investors, CGN with support from various funding bodies	

FUNDING MECHANISM

The implementation of the NMWMS will result in a number of clear socio-economic benefits, saving the Municipality considerable resources in terms of public health and environmental degradation. The NMWMS has to address the issue of the sheer volume of wastes produced by our society, at the same time ensuring that waste management measures targeting the increasingly complex waste flows are environmentally sustainable and protect the health and well-being of the people. Accordingly, the NMWMS seeks to integrate the objectives of environmental sustainability and achievement of the waste hierarchy with the broader transformation and development objectives of improved public health outcomes, economic development, poverty alleviation and improved access for all.

The sources of funding for the implementation plan will be from the Government of Kenya, Public-Private Partnerships, waste generators, and the development partners. The funding must be self-sustaining in the long run and strategically integrated into all facets of the waste management system. These facets include initiatives to minimize generation of waste at source, improve collection and transportation systems as well as managing the disposal of waste that cannot be recycled or reused (residual)

MONITORING AND EVALUATION

Environmental monitoring will be a key component of this strategy. This is because poor solid waste management has direct and indirect effects on the public health and the environment and must be monitored. There are essential parameters to monitor the quality of the environment and does provide basic information on the levels of deviation on the set standards of environmental quality.

DOCUMENTATION

There is a need for regular collection of information of waste generation and disposal rates in each municipality. This information will then be linked to the population trends, economic growth, and other social monitoring parameters. This undertaking will provide a basis for planning of future waste management needs, for example, the need for additional landfills, material recovery facilities, and different recycling modes or processes. The information will also inform on the effectiveness of strategies earlier put in place e.g. public awareness and education programs

CONCLUSION

There is a need to introduce service charge to the residents for solid waste collection for all waste generation firms, Institutions, and individuals in order to offer commensurate service provision. It is proposed that a well-designed charging system can have a positive effect in reducing waste generation by producers through offering incentives for those who minimize waste by lowering their chargeable tariff. This initiative requires intensive social marketing and public goodwill. Other premises e.g. supermarkets would be encouraged to buy back valuable used items such as bottles hence enabling greater recovery.

Other than the government's annual budgetary allocation, partial funding from various partners can also be explored for the infrastructural components of the strategy. The main aspect of such an arrangement would be the extent to which the government and private sector share the cost. The

development of the NMWMS is an important milestone in the process of implementing the strategy and establishing an integrated approach to waste management across the Municipality.

As stated in the introduction to the NMWMS, there are many challenges in relation to waste management that require a coordinated effort by government and stakeholders. Addressing these challenges will not be easy, given the capacity and resource constraints we face as an in the County with large income inequalities and competing for development priorities. Nevertheless, the implementation of the waste hierarchy and achievement of the objectives outlined in this strategy is integral to achieving the vision of a zero waste Municipality, and establishing a sustainable future and a better life for all the residents. The NMWMS provides the framework within which the actions of different stakeholders are located. This strategy is addressed to stakeholders in all spheres of government, industry, community-based and non-governmental organizations, development partners and the public at large. It sets out the different roles and responsibilities that need to be taken up by each stakeholder and level of government.

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