



**OFFICE OF THE AUDITOR GENERAL
OF STATE FINANCES, RWANDA**

**PERFORMANCE AUDIT REPORT ON
MANAGEMENT OF SOLID AND LIQUID (SEWAGE)
WASTE IN CITY OF KIGALI**



May 2016

**PERFORMANCE AUDIT ON MANAGEMENT OF SOLID AND LIQUID (SEWAGE)
WASTE IN KIGALI CITY FROM MAY 2012 TO DECEMBER 2015**

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ACRONYMS AND ABBREVIATIONS

Abbreviation	Details
CoK	City of Kigali
MININFRA	Ministry of Infrastructure
MoH	Ministry of Health
OAG	Office of the Auditor General
PA	Performance Audit
REMA	Rwanda Environment Management Authority
RURA	Rwanda Utilities Regulatory Authority
SLW	Solid and Liquid Waste
MSLW	Management Solid and Liquid Waste
SW	Solid waste
WASAC	Water and Sanitation Corporation
WHO	World Health Organization

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GLOSSARY OF TERMS

Term	Definition
A waste	A product or a substance that is no longer suited for its intended use. The legal definition often includes fully usable substances, but defines them as waste if they are to be used in contexts other than their originally intended one
Solid waste	All putrescible and non putrescible solid and semisolid wastes, including garbage, trash, refuse, paper, rubbish, ashes
Liquid waste	Liquid waste can be defined as viscous mixture of by-products of human digestion (urine and faeces) stocked in toilets-Sewage
Leachate	Means any liquid and suspended materials it contains, which has percolated through or drained from the solid waste disposal facility. ¹
Waste management	Waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics.

¹ Practical Tools on Solid Waste Management of Imidugudu, Small Towns and Cities :Landfill and Composting Facilities published by REMA in 2010

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1. EXECUTIVE SUMMARY

The Government of Rwanda has made waste management one of the priority areas in achieving vision 2020.

During the EDPRS I period (2008-2012), the sector aimed at improving the environmental health and hygiene conditions of the population by promoting safer methods of waste disposal from community and health facilities. EDPRS II (2013-2018) stipulates that because of the rapid urbanization which will occur in Rwanda in the next five years, with 35% of the population envisaged to live in urban areas by 2020, it is likely to have huge economic and environmental impacts, through increased pressure on urban infrastructure, such as transport and solid and liquid waste (SLW) management systems.

In regard to waste management, CoK has the objectives of designing and constructing a sanitary landfill which will be complemented by efforts to recover the recoverable material from waste streams. From May 2012 up December 2015, CoK spent **Frw 1,314,338,294** mainly in the rental costs for heavy machines used during soil cover application and daily management of the landfill and finally **Frw 569,646,695** for expropriation costs.

With increase of the population in City of Kigali, there has been a rise in the amount of waste being generated on daily basis. Solid and liquid waste (SLW) are collected from households and transported to Nduba landfill to the tune of 300 tones par day and only 2% of solid waste is recycled. SLW is toxic and contains a greater variety of pathogenic micro-organisms.

Inevitable consequences of the practice of solid waste disposal in landfills are gas and leachate generation due primarily to microbial decomposition, climatic conditions, refuse characteristics and landfilling operations. The dispersion of gas and leachate to the landfill boundaries and their release into the surrounding environment present serious environmental concerns at both existing and new facilities. These concerns include fires and explosions, vegetation damage, unpleasant smell, ground water pollution, air pollution and global warming.

I therefore carried out a performance audit to assess whether CoK manages solid and liquid waste in a manner that is friendly to the environment.

Below I highlight the key findings noted and recommendations:

(i) Appreciation of achievements in the management of MSLW

- **High level enrollment of households in solid waste collection and transport:** There is a high level of enrollment of households in all Imirenge/ sector involved in collection and transportation of SLW. The District with the highest percentage is Nyarugenge where the level of enrollment is on average 97% followed by Kicukiro and Gasabo that have 88% and 84% respectively. This has made the collection of solid waste from area of generation to the landfill site to be excellent in CoK and the latter is ranked among the cleanest cities in

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Africa², This is a step ahead towards the appropriate solid waste management system. (See details in section 5.2.13).

- **Installing incinerator to handle hazardous and infectious waste:** The installation of the incinerator was completed with installed capacity of incinerating 100 kg per hour and can operate for 10 hours per day, making 1 ton per day. This is a step ahead towards appropriate solid waste management system. (See details in section 5.1.4).

The CoK reached the above achievements; however MSLW still present solid challenges as reported here below:

(ii) Status initiatives taken by CoK in the management of SLW

- **Failure to implement waste to energy project:** Procurement processes for installation and operation of a waste to energy plant had started in May 2015. However, the tender was cancelled and CoK decided to re-advertise. At the time of the audit (April 2016), the retendering process had not yet commenced. (See details in section 5.1.1).
- **Proposed composting facility at Nduba landfill:** The Company named Rwanda Compost Ltd (RCL) had secured a 25-year concession to build and operate a composting facility at Nduba. However, City of Kigali terminated the contract saying that the investor failed to comply with terms of the contract since it failed to provide a **business plan**. At the time of the audit (April 2016), CoK had not secured a new investor for the proposed composting facility. (See details in section 5.1.2).
- **Design for the new landfill and recycling centre:** The detailed design report was published on 20th June 2012, one month after the relocation to Nduba unsanitary landfill. However, at the time of the audit (April 2016), 4 years later, CoK had not yet constructed a modern sanitary landfill and recycling centre. (See details in section 5.1.3).

(iii) Compliance with existing guidelines for REMA and standards set by RURA

- **Failure to prepare a landfill plan:** No landfill plan has ever been prepared for Nduba landfill site. Waste is dumped on the site. In addition to this, there is no solid and liquid waste management plan. As long as the plan is not yet developed, the required improvements in solid and liquid waste management are not known. The current solid and liquid waste management in place exposes the city to environmental and health risks. (See details in sections 5.2.1 & 5.2.2).
- **No environmental impact assessment (EIA) conducted before opening of Nduba landfill site:** CoK did not conduct an EIA before establishment of Nduba unsanitary landfill. Had CoK conducted an EIA before operating Nduba unsanitary landfill, it would be informed

² <http://www.un.org/africarenewal/magazine/april-2016/kigali-sparkles-hills>

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about all health, social, economic and environmental risks affecting the site and hence enable it to establish mitigating factors accordingly. (See details in section 5.2.3).

- **Failure to manage leachate from unsanitary landfill:** CoK did not put in place an appropriate management system for leachate to protect ground and surface water. In addition to this, no water facility has been provided as planned and the population in Gatunga cell is still using the water from this contaminated source. This situation increases the risk of diseases due to unsafe water. (See details in section 5.2.4 & 5.2.5).
- **Inappropriate segregation of solid waste at Nduba site:** Solid waste were not segregated to separate biodegradable and non-biodegradable waste. The segregation of solid waste at Nduba landfill site is not done at all. All wastes are mixed. This led to the spray of many vermin and flies to the surrounding population which causes hygienic diseases. (See details in section 5.2.6).
- **Inappropriate solid and liquid waste disposal:** Solid waste disposed on the site are compacted and covered by soil at least once in two months instead of end of each working day. In two months, waste deposited at the site and left uncovered gets decomposed and attracts vermin and flies which eventually spread to the surrounding population. This also allows oxygen gas to penetrate in the solid waste and may cause combustion of the landfill as was the case in Nyanza dumping site. To reduce bad smell from the liquid waste, some chemicals are spread onto the liquid waste surface. The system of collection in pits does not give a fair and sustainable solution as many pits are required to accommodate that liquid waste. At the time of the audit (April 2016), 3 pits were already full and they were digging a fourth one. These pits are located on the top of the hill and if it rains heavily, they are likely to overflow and spread into the neighborhood and contaminate water and crops. This leads to spread of disease to the neighboring population. (See details in section 5.2.7).
- **Slow pace in expropriating neighboring residents:** Out of the 344 plots that were to be expropriated, only 138 representing 40% have been expropriated. In addition, there are 29 households on the gill in Rebero village, Gatunga Cell that are exposed to environmental and health threats of the landfill. They are also located within 400 meters of the landfill and when it rains, solid waste slides towards their residences. As of today (April 2016), there is no plan for expropriating them. (See details in section 5.2.8).
- **Inappropriate working conditions at landfill site:** Workers are not protected with overalls, working boots, gloves, dust masks, eyes protective glasses (goggles) and helmets and CoK does not monitor the working conditions. They are highly exposed to serious health risks. (See details in section 5.2.9).
- **The absence of an inspection area at the landfill site:** No inspection is done to verify the type and quantity before SW is entered into the landfill. Lack of appropriate inspection exposes the landfill to harmful waste which are dangerous to the environment and health. (See details in section 5.2.10).

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- **Failure to manage greenhouse gases emitted from the landfill:** Failure to monitor gases emitted from the landfill can lead to adverse impacts if not fixed. The decomposition of the organic matter in anaerobic conditions generates methane gas which is a global warming gas and can cause combustion if not eliminated or reduced. The liquid waste (sewage) generates ammonia gas whose emissions to the atmosphere are an environmental concern, contributes to bad smell, the eutrophication of surface water, and nitrate contamination of groundwater. Ammonia emissions also contribute to the formation of fine particulates, which have a negative impact on animal and human health. (See details in section 5.2.12).

(iv) National policy, strategic and operational framework regulating the MSLW

- **Lack of a national policy regarding LSWM:** CoK, the capital city of the country has a challenge in the management of SLW given that there is no specific policy regulating the management of waste. This exposes the city to environmental and health risks. (See details in section 5.3.1).
- **Inadequate planning for MSLW:** While it is a requirement by REMA, CoK did not carry out a proper assessment of waste being generated and reasons for the increase in the city and therefore does not have information on solid waste to enable proper planning and decision making. (See details in section 5.3.2).
- **Lack of Solid waste management sensitization:** CoK did not conduct sensitization to members of the public in matters of waste management such as segregation of waste according to their categories (organic and inorganic), efficient use of skips, waste recycling, waste minimization and adherence to waste management guidelines. Its actions and strategic plans did not take into consideration the solid waste management sensitization campaigns. (See details in section 5.3.3).
- **Lack of sustainable management system for solid and liquid waste:** As of June 2013, more than 300 tons of solid waste are collected every day and dumped to the unsanitary landfill located in Nduba Sector, Gasabo District. Nduba Landfill has not been developed to address the environmental and public health treats that caused the re-location from Nyanza dumpsite. The method of waste disposal at Nduba landfill is still the same as that used at Nyanza and hence poses the same health risks. For the liquid waste (sewage), there is no system to receive and treat the sewage emptied from septic tanks from different parts of the City. They are deposited into pits at Nduba site and as of today they have become like small lakes (ponds) of sewage. Disposal methods used at Nduba still expose CoK to environmental and health hazards. (See details in section 5.3.4).
- **Low rate of recycling for plastic and glass bottles:** Recycling is done at low level for plastic and glass bottles that are in large quantities at Nduba landfill to the extent that they have formed a heap. These bottles are mainly from breweries and companies that produce mineral water. The recycling is done at low pace for plastics by ECOPLASTIC Co while glass bottles are transported to Tanzania and Uganda where they are recycled. Failure to

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recycle the above waste has created a problem of space and storage because the above waste is increasing on a day to day basis. Recycling would reduce the pollution of the air and would allow companies that use the bottles to save their cost of importing and subsequently preserving raw materials. **(See details in section 5.3.6).**

OVERALL CONCLUSION

The collection of solid waste from areas of generation to the landfill site is excellent in CoK and the latter is ranked among the cleanest cities of Africa.

However, there is still a long way to go towards an environmental friendly and sustainable MSLW.

While Nyanza dumping site was considered to be a threat to the environment and public health and in 2011 the Prime Minister decided that the site be relocated to a temporary site which is Nduba, the latter has also become an environmental and health hazard to the city. There was no environmental impact assessment conducted before deciding to relocate. This would have informed decision makers about all health, social, economic and environmental risks that it entails and establish mitigating factors accordingly. There is no environmental management plan as well as liquid and solid management plan.

CoK changed waste disposal site but the method of disposal is still the same.

For sustainable MSLW, CoK had planned many projects that would solve the problem of MSLW. This includes:

- The transformation of waste into energy which not only would solve the problem of the waste but also generates energy.
- Establishment of a composting plant which would generate compost manure (fertilizer) from bio-degradable waste.
- Installing incinerator that would handle hazardous and infectious waste
- Design for the new landfill and recycling center which would provide the sustainable management of SLW and reducing the quantity of waste through recycling.

However, among the above 4 projects, only the one of establishing incinerator has been implemented.

As long as the above projects are not implemented, the problem of MSLW in CoK will persist and will lead to very serious environmental and health hazards.

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OVERALL RECOMMENDATION

CoK should speed up the implementation of the above 3 projects for a sustainable MSLW (transforming waste to energy, establishing a composting plant and establishing a modern landfill and recycling center).

To ensure the appropriate management of SLW, CoK should make sure that it is complying with guidelines developed by REMA and RURA standards which are mainly:

- The development of solid and liquid waste management plan,
- Development and implementation of an environmental management plan in order to address the environmental challenges that are being caused by the unsanitary landfill.
- CoK should apply the “polluter pays principle” by charging breweries and companies producing mineral water environmental protection fees to support CoK budget of environmental management.
- CoK should liaise with MINIRENA to establish a national policy encouraging the use of re-usable equipment especially for serving water. This can reduce significantly the quantity of plastic bottles deposited at Nduba landfill site.

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Kigali

..... **2016**

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2. INTRODUCTION

2.1. Terms of reference for the audit

In accordance with Article 165 of the Constitution of the Republic of Rwanda of 2003 revised in 2015, and Articles 6 and 14 of Law n° 79/2013 of 11/09/2013 determining the mission, organization and functioning of the Office of the Auditor General of State Finances (OAG), I carried out a Performance audit on solid and liquid waste management in the City of Kigali for the period of May 2012 to December 2015.

2.2. Background

The Government of Rwanda has made waste management one of the priority areas in achieving vision 2020. This is because by 2020, the rural and urban areas are to have sufficient sewerage and disposal systems. Each town is to be endowed with an adequate unit for treating solid wastes. Households will have mastered and be practicing measures of hygiene and waste disposal.

During the EDPRS I period (2008-2012), the sector aims to improve the environmental health and hygiene conditions of the population by promoting safer methods of waste disposal at community and health facilities and finally EDPRS II (2013-2018) stipulates that because the rapid urbanization which will occur in Rwanda in the next five years, with 35% of the population envisaged to live in urban areas by 2020. This is likely to have huge economic and environmental impacts, through increased pressure on urban infrastructure, such as transport and solid and liquid waste management systems.

2.3. Historical background of solid and liquid waste

Kigali City started in 1907 as a small colonial outpost initially it was supposed to be inhabited by at least 300,000 people. Currently Kigali is inhabited by 1,132,686³ citizens. Kigali City has never had any clear Master plan to reorganize the planning and resettlement. Since the colonial era, in spite of the rapid and ever increasing numbers of inhabitants. This has exerted strenuous pressure on the infrastructure which has resulted in many complex problems regarding settlement notably solid and liquid waste management. Sanitation and solid and liquid waste management in Kigali Municipality is a colossal challenge that is manifested.

Waste management involves solid, liquid, and gaseous substances, with different methods and fields of expertise for each. Waste management practices differ for rural, small town, urban or industrial producers.

Thus, waste stream is a good starting point when searching for defects in the waste management system to establish an audit. There are 7 stages through which waste passes in the waste stream: Prevention/ generation/ Recycle, Reuse and Recover/ collection/ transport and export/ treatment

³ Fourth population and housing census, Rwanda, 2012

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and disposal/ contaminated sites and finally illegal dumping. In fact, waste policy and management system include all the stages in the waste stream.

During the **prevention** (stage 1), the motivation behind is the sustainable use of resources. The objective of preventing waste generation is often included in a country's national policy. The second stage is the **generation** of waste. The government could influence the amount of waste generated through economic incentives, where efficient use of resources and a limited generation of waste are rewarded. Some principles may be applied such as polluter-pays principle and the method of substituting hazardous chemicals with less harmful ones.

The Third stage is **Recycle, Reuse and Recover**. To make this happen, different materials must be sorted and treated separately.

The fourth stage is the **collection** of waste which is usually regulated to some extent by local or national authorities and are handled by private actors. Waste are collected and deposited into landfill and the later must be well designed and managed. If not well managed, some adverse environmental impacts are raised up such as wind-blown litter, attraction of vermin, and generation of liquid leachate. Another common byproduct of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobically. This gas can cause respiratory diseases, damage surface vegetation, and is a greenhouse gas. Design characteristics of a modern landfill include methods to contain leachate such as clay lining material. Deposited waste is normally compacted to increase its density and stability, and covered to prevent attracting vermin (such as mice or rats).

The fifth stage is the **transport and export** of waste. The operators may be either public or private and this requires some official requirements. The transport of hazardous chemicals requires firm regulations to avoid possible accidents and requires a special request from REMA. The sixth stage is the **treatment and disposal** of waste which is most often subject to regulations from the authorities.

The possibility of **illegal dumping**, stage seven, must be acknowledged, and necessary measures must be taken to deal with this problem. There exist a number of instruments that can be used to implement these measures, such as monitoring and inspections, but their use must be based on a solid statutory basis. Both the permission to conduct inspections and appropriate sanctions must be in place. Waste that is not properly handled ends up in contaminated sites. These may be the result of poor management in bygone years, which needs to be addressed today. The polluter-pays principle may be applied, but with old damages it may no longer be possible to hold the original polluter responsible.

There are 3 principal kinds of waste, solid, hazardous and radioactive waste. Solid waste is often called non-hazardous waste. Waste in the form of powders, liquids, and gases is considered

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hazardous regardless of its toxic properties because it needs special handling to avoid unwanted dispersal. Thus, all waste that is not included under the classification of hazardous may be labelled solid. Although not considered hazardous, solid waste can cause considerable harm and damage, and may lead to diseases and air pollution and the poisoning of water sources for people and animals.

According to the origin of the solid waste, we have SW which is the garbage that are produced by people in their homes and where they work. Usually, SW refers to what we throw away each day in our cities and towns such as old appliances, household garbage and just about anything you can think of that people throw away at home, schools, and businesses.

CoK being the source of the solid and liquid waste collected and transported and deposited to Nduba landfill, is also an overpopulated city compared to other cities of the county. This shows there is significant quantity of solid and liquid waste produced because of that increasing population and businesses.

City of Kigali (CoK) is in charge of the management of SLW, of course collaborating with contracted private firms that collect solid and liquid waste and transport them at Nduba Landfill. These companies are COPED, COCEN, KPC General Services, CESCO Masaka, ROYAL Company Ltd, AGRUNI, Real Environmental Protection, UBUMWE Cleaning Services Ltd, INZIRA NZIZA CO Ltd, NEW LIFE NT& MV Ltd, BA HEZA General Services, ISUKU KINYINYA, UMURIMO MWIZA Ltd, KIGALI SEPTIC Services Ltd, INDATWA Gitega Cooperative, KANGUKA Business Company Ltd and HAKIZIMANA Babu.

Regulations and guidelines made by MINIRENA-REMA, RURA, CoK and MININFRA govern waste management and are followed while complying with the environmental laws.

CoK has to monitor and follow all processes regarding the MSLW.

2.4. Necessity (reasons) for the audit

The landfilling and disposal of domestic solid waste and liquid waste are a great environmental and health hazard. Solid and liquid waste is toxic and contains a greater variety of pathogenic microorganisms. Of all the procedures for solid and liquid waste disposal, landfills have serious public health problems of land and water pollution.

Modernization and progress has had its share of disadvantages and one of the main aspects of concern is the pollution it is causing to the earth – be it land, air, and water. With increase of the population in City of Kigali, there has been a rise in the amount of waste being generated daily by each household (0.6 Kg per day per household and cumulating to 300 tons per day in total)⁴.

This waste is collected and thrown into the landfill at Nduba site. However, it was noted that not all of this waste gets collected and transported to the final landfill. Those collected, only 2 %

⁴ Project proposal for sustainable waste management in City of Kigali, June 2013.

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were recycled. If at this stage the management and disposal is improperly done, it can cause serious impacts on health and problems to the surrounding environment.

Waste that is not properly managed, especially sewage sludge and solid waste from households and the community, are a serious environmental and health hazards and lead to the spread of infectious diseases.

Unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease. The wet waste decomposes and releases a bad smell. This leads to unhygienic conditions and thereby to a rise in the health problems. Thus, residents nearby the landfill (Nduba) are vulnerable of those effects but mostly the landfill's workers are mostly affected if not well protected. Workers at Nduba dumping site don't use equipments that would at least mitigate the risk of getting affected due to their exposure to the waste.

Inevitable consequences of the practice of solid waste disposal in landfills are gas and leachate generation due primarily to microbial decomposition, climatic conditions, refuse characteristics, and landfilling operations.

The dispersion of gas and leachate away from the landfill boundaries and their release into the surrounding environment present serious environmental concerns at both existing and new facilities.

These concerns include fires and explosions, vegetation damage, unpleasant smell, ground water pollution, air pollution and global warming.

The audit will be conducted in order to provide recommendation on how MSLW can be managed to minimize these impacts.

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3. AUDIT DESIGN

The audit was conducted in accordance with the International Organization of Supreme Audit Institutions Auditing Standards and guidelines in the Office of the Auditor General's Performance Audit manual. The standards require that the audit is planned in a manner which ensures that an audit of high quality is carried out in an economic, efficient and effective way and in a timely manner.

3.1. Scope

The main study focused on the management of Solid and liquid (sewage) waste. The study covered the period from May 2012⁵ to December 2015.

Audit object: The audit focused on all activities undertaken by City of Kigali in relation to the management of solid and liquid waste.

Geographical coverage: The audit was carried out in the City of Kigali.

Period covered: The team evaluated the processes involved in the management of Solid and liquid (sewage) Waste over a period from 01st May 2012 (establishment of Nduba Landfill) to December 2015.

Objective of the audit

The overall objective of the audit is "To assess whether CoK manages solid and liquid waste in a manner that is friendly to the environment".

3.2. Key audit questions

The Performance audit answered the following questions:

- Is there a policy, strategic and operational framework for solid and liquid waste management and is it adequate?
- To what extent is CoK compliant with guidelines on solid and liquid waste management provided by REMA and RURA?
- Does CoK monitor the implementation of the contract with the private firms related to collection, transport and disposal of solid and liquid waste?

⁵ May 2012 was taken as the starting of the auditable period because it is where Nduba was opened

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3.3. Audit methodology (sources of information and methods of data collection)

The following methods were used to collect data:

3.3.1. Interviews:

Primary data was collected through interviews carried out with the following.

- Private firms that signed contracts with CoK to collect and transport of solid waste to Nduba landfill
- Private firm that contracted to manage the day to day operations of the landfill - New Life Company
- The Director of Health and Environment
- Solid and liquid waste management officer
- The community that live near Nduba landfill and the village leader

3.3.2. Documentary review

Secondary data was mainly collected through review of various documents including strategic and action plans, monthly reports and contracts between private firms and CoK. Details about key documents reviewed are in **Appendix 1**.

3.3.4. Physical verification:

Field visit to Nduba was conducted to evaluate the compliance with REMA and RURA guidelines in regards to the management of Nduba Landfill. Photographs were taken to provide to the reader the real situation at the landfill.

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4. SYSTEMS AND PROCESS DESCRIPTION

4.1. Introduction

Waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, and the environment. Waste management is also carried out to recover resources from it. Waste management involves solid, liquid, and gaseous substances, with different methods and fields of expertise for each. Waste management practices differ for rural, small town, urban or industrial producers.

4.1.1. Management of solid wastes in the year 2012 and back

The system used was an open dump site. The waste was transported to Nyanza dumpsite where it was dumped and covered with soil using bulldozers. The site was receiving a lot of waste was full to brim. Given the extent of high threat to resident's health that were caused by Nyanza landfill, the Prime Minister gave an ultimatum to close the Nyanza based dumping site.

Relocation of Nyanza landfill to Nduba site

Since 01th May 2012, the Kicukiro-based dumping site was relocated to Nduba Hill, Muremure cell. The landfill has already become both a health hazard and a source of livelihood for the residents living near it.

4.1.2. How solid and liquid waste are managed?

Waste reduction methods: An important method of waste management is the prevention of waste material being created, also known as waste reduction. Methods of avoidance include reuse of second-hand products and repairing broken items instead of buying new.

Recycling: Items that are usually composed of a single type of material are relatively easy to recycle into new products i.e. paper and plastics. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required.

Composting: Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. The resulting organic material is then recycled as mulch or compost for agricultural.

Landfill: Disposing of waste in a landfill involves burying the waste. A properly-designed and well-managed landfill is a hygienic and relatively inexpensive method of disposing of waste materials. However, poorly-designed or poorly-managed landfills can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate. Another common byproduct of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobically.

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This gas can cause respiratory diseases, damage surface vegetation, and is a greenhouse gas. Design characteristics of a modern landfill include methods to contain leachate such as clay lining material. Deposited waste is normally compacted to increase its density and stability, and covered to prevent attracting vermin (such as mice or rats). Many landfills also have landfill gas extraction systems installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity.

Incineration: Incineration is a disposal method that involves combustion of waste material. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam, and ash. Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants.

Waste handling and transport: Domestic solid and liquid waste collection services are often provided by private companies that contracted with CoK and they are operating in different sectors. In addition, MSW from big institutions and other business houses are collected and transported by the stated companies.

Liquid waste management

Liquid waste are collected and transported to Nduba by specialized companies with special vehicles upon the request of people. They are deposited in a pond where the company in charge of Nduba management deposit chemicals to avoid bad smell. Currently, Pivot Company started to treat liquid waste and make briquettes from them but the project is still at startup phase.

4.2. Mission and responsibility of CoK with regard to solid and liquid waste

4.2.1. CoK vision

The vision for the City of Kigali in relation to the solid and liquid waste management is a creation of clean and safe environment that supports doing business, investment, tourism and living in the City.

4.2.2. CoK mission

This mission of the Authority is to regulate public utilities by building an environment which is clean.

4.2.3. Key responsibilities

CoK has the following responsibilities in regards to MSLW:

- Establishing an institution/specialized unit to take care of waste management services.
- Build capacity for waste management and recycling techniques.
- Improve solid and liquid waste management.

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4.2.4. CoK objective in regard to solid and liquid waste

- Design and construct of a sanitary landfill which will be complemented by efforts to recover the recoverable material from the waste streams.
- Establishment of a specialized department, under the direct supervision of the City Authority, with some minimum equipment and skilled personnel to be in charge of City waste management plans and programmes.

4.3. Roles and responsibilities of key players

Key players in the solid and liquid waste management are RURA, REMA, MINIRENA, 3 districts of CoK, MININFRA, private companies that collect and transport solid and liquid waste to Nduba and WASAC. The details are provided in **appendix 2**.

4.4. CoK organizational structure

CoK is headed by Kigali City Council and directed by the Mayor who is seconded by 2 Vice Mayors and the Executive Secretary. The above are further supported by 4 Director Generals who are seconded by 8 Director. The Solid and liquid waste management is under the responsibilities of the vice Mayor in charge of social affairs, Director General of Social development and the Director of Public health and environment Unit.

CoK organizational setup has been designed as presented under the **appendix 3**.

4.5. Funding of CoK (budget allocated to solid and liquid waste including Nduba landfill)

Since it started operating in May 2012, CoK spent an amount of Frw 1,883,984,989 mainly in the rental costs for heavy machines used during soil cover application, maintenance costs and daily management of the landfill and finally expropriation costs. The table below summarizes funding used for Nduba landfill.

Table no 1: Funding for MSLW

Year	Description	Amount used in Frw
2013/2014	Maintenance of landfill	659,909,397
2014/2015	Maintenance of landfill	654,428,897
2013/2015	Expropriation fees	569,646,695
Total		1,883,984,989

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4.6. Systems and process descriptions

4.6.1. Contract to collect and transport solid and liquid waste to Nduba

The City of Kigali has signed contracts with private companies to collect from households and transport domestic waste to Nduba.

Bio-degradable solid wastes are expected to be transported to Nduba separately from non-biodegradable. Appropriate cars are used to transport solid waste. Any company found violating the guideline is punished with Frw 50,000.

Each month the contractor deposit to bank a sum of money from which Frw 5,000 and Frw 3,000 for a car of 3 and 5 tons respectively will be deducted every time his/her car deposits solid waste at Nduba.

4.6.2. Generation

The process of waste generation involves the production of solid and liquid waste from different economic activities and households. Even if the country cannot avoid the generation of waste because it cannot stop its economic growth but some minimization of produced waste can be applicable through economic incentives, where efficient use of resources and a limited generation of waste are rewarded.

Waste generated in the City of Kigali are from 3 districts namely Gasabo, Kicukiro and Nyarugenge. The quantity of waste transported to Nduba Landfill per day is approximately estimated to 300 tons.

4.6.3. Segregation

The process of waste segregation is about sorting waste into biodegradable and non-biodegradable. Thus, biodegradable waste is put aside and can be used to produce fertilizers and non-biodegradable can be recycled or reused anyhow. Waste reaches the landfill being well sorted. In addition to this, Nduba landfill is not allowed to hold industrial waste.

4.6.4. Packaging

Solid waste is packaged at the production level, homes, and while the private company comes to pick it up, it is removed from their sacs and thrown in a car.

4.6.5. Collection

Solid and liquid waste collection is done by contracted private companies. They collect domestic solid and liquid waste from households and deposit them at Nduba landfill. However, at their arrival at Nduba, waste is deposited being mixed and they are separated by another company in charge of sorting after they have been deposited.

Although, solid waste from public institutions are collected by cleaning companies and the later contract with transport companies which are used to channel solid waste to Nduba.

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4.6.6. Transportation

The transportation of waste to Nduba is done by contracted private firms. As waste collected are from 3 districts, many private firms are involved for each district monitors itself the transportation and the City of Kigali acts as the supervisor of the whole process.

In addition the access time of the waste at the dumping site is scheduled between 6:00 a.m. to 6:00 p.m. as indicated in the guidelines given by REMA and appropriate cars are used in the transportation.

4.6.7. Treatment (papers, Plastic waste, pharmaceutical waste, tins in metal)

Non- biodegradable waste is subjected to treatment and this method can be recycling or reusing depending on the nature of the solid. Actually papers from public entities are collected at the generation level (offices) and transported to the treatment plant located at BUGESERA and they are transformed into hygienic toilet papers and other papers from other places are also driven at the landfill.

Plastics are transported to MAGERAGERE to be recycled. However, some bottles are not yet at the level of being locally recycled and they are transferred to Uganda, Kenya and Tanzania.

Moreover, pharmaceutical waste and other hazardous waste are incinerated using the incinerator with the capacity of 100kg/hour and not exceeding 10hrs/day. This method is not a sustainable solution because of the pollutant gases which are released in the atmosphere.

4.6.8. Disposal

Waste after being selected it is disposed of in the landfill and covered with the soil. This type of waste disposal focuses on burying wastes in land. Waste which is disposed of in landfill such as plastics and pharmaceuticals are treated using recycling and incineration as explained above and some plastic bottles are not recycled and remain not disposed of.

4.6.9. Liquid waste (sewage) and its disposal

Liquid waste (Sludge) are generated by public and private institutions, households, Hotels, restaurants and bars.

The latter are collected and transported to Nduba Landfill where they are deposited in 4 big pits. The fact that these big pits are located on the mountain, the liquid waste sinks in the soil and affects the downward regional groundwater.

Domestic Liquid waste is not usually an extreme environmental hazard unless discharged in a manner where it can impact surface water or shallow groundwater. With proper application, domestic liquid waste can be a resource (fertilizer, source of moisture) rather than becoming a pollutant.

Domestic liquid waste should be disposed of properly following the appropriate standards for effluent disposal. Any liquid waste, especially from hospitals, dispensaries and clinics, industries and any other dangerous liquid waste, shall be collected, treated and changed in a manner that does not degrade the environment in order to prevent, eliminate or reduce their adverse effects on

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human health, natural resources, flora and fauna and on the nature of the environment. In fact, liquid waste is very harmful if not well managed for its composition. It may contains heavy metals and other harmful substances dissolved which may contaminate groundwater.

To mitigate risks that can be caused by the liquid waste (sludge) disposed of at Nduba landfill, Cok planned the septic sludge treatment stabilization pits and these pits naturally treat liquid waste without application of chemicals apart from calcium carbonate (lime) that are applied to eliminate bad smell and act as a disinfectant. Furthermore, there is a company called PIVOT which is at the pilot phase of treating sludge sewage to make renewable fuel “BRIQUETTE” from it.

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5. FINDINGS

5.1. STATUS INITIATIVES TAKEN BY CoK IN THE MANAGEMENT OF SLW

For the sustainable management of SLW, CoK had planned many projects (from 2013 to 2018) that would solve the problem of SLW. This includes:

- The transformation of waste into energy which not only would solve the problem of the waste but also generates energy.
- Establishment of a composting plant which would generate compost manure (fertilizer) from bio-degradable waste.
- Installing incinerator that would handle hazardous and infectious waste
- Design for the new landfill and recycling center which would provide the sustainable management of SLW and reducing the quantity of waste through recycling.

However, among the above 4 projects, only the one of establishing incinerator has been implemented.

5.1.1. Failure to implement waste to energy project

CoK supported by the Government of the Republic of Rwanda has identified the investment in solid waste transformation into energy as an alternative and thereby a priority for an integrated waste management.

The total investment was supposed to be covered by the investor and in return the government will ensure availability of raw materials (waste) and purchase the product (power generated) at a rate agreed upon by investor and Government of Rwanda. Terms of reference for the waste to energy project has been published on 27th May 2015, bidding and technical evaluation took place and there was one successful bidder.

Financial negotiations took place but the proposed unit price for power purchase and the investment costs were very high compared to power generated by Rwanda Energy Group and consequently the tender was cancelled.

At the time of the audit (April 2016), the retendering process had not yet commenced. Failure to implement solid and liquid waste related projects increases the environmental and health hazards.

Recommendations

CoK should take appropriate measures in order to speed up all projects aiming at improving solid and liquid waste management

Management comment

Observation is noted and recommendation will be implemented

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5.1.2. Proposed composting facility at Nduba landfill

Composting is the method of transforming organic matter into compost manure which is used as soil fertilizer. According to integrated waste management hierarchy, composting is the 3rd preferred method of solid waste management after reduction and reuse. *See appendix 4 for details.*

Nduba unsanitary landfill site accommodates bio-degradable and non-biodegradable waste. Non-biodegradable solid waste can be recycled or reused and bio-degradable may be transformed into compost or energy. As provided in the development plan issued by the City of Kigali, the composting plant was supposed to be established in 2014/2015. In this line, the Rwanda Compost Ltd (RCL) was created. This company aimed at composting manure that would be used as a fertilizer.

The company had secured a 25-year concession to build and operate a composting facility at the landfill site. However, City of Kigali terminated the contract saying that the investor failed to comply with terms of the contract (which was not provided for audit purpose) since it failed to provide a **business plan**. At the time of the audit (April 2016), no new contract for composting was initiated.

Failure to implement solid and liquid waste related project increases the environmental and health hazards. This limited CoK from having compost manure that would be used in agriculture and the problem of solid waste generated and dumped is still persistent.

Recommendation

CoK should take appropriate measures in order to speed up all projects aiming at improving solid and liquid waste management

Management comment

The observation is noted and recommendation will be implemented

5.1.3. Design for the new landfill and recycling centre

In order to manage MSLW, CoK commissioned “*Wat Ingenieuresellschaft mbH*” to conduct a service of designing and supervising a new landfill and a recycling centre.

Activities were carried out under “consolidated waste management project in Rwanda” supported by UNDP. The objective of the project was to establish and operate smoothly the new facilities which would help to cater for solid waste management and address environmental and public health hazards.

The detailed design report was published on 20th June 2012 one month after the relocation to Nduba unsanitary landfill. However, at the time of audit (April 2016), 4 years later, CoK had not yet constructed a modern sanitary landfill and recycling centre. Failure to implement solid and liquid waste related project increases the environmental and health hazards.

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Recommendation

CoK should take appropriate measures in order to speed up all projects aiming at improving solid and liquid waste management

Management comment

The observation is noted and recommendation will be implemented

5.1.4. Installed incinerator to handle hazardous and infectious waste

In order to dispose of appropriately toxic and infectious waste, the incineration method is used. The incinerator reduces the mass of the waste by 95 to 96% depending on the recovery degree and composition material.

The installation of the incinerator was completed with installed capacity of incinerating 100 kg per hour and can operate for 10 hours per day, making 1 ton per day.

This is a step ahead towards the appropriate solid waste management system. *See photo below:*



Photo no 1 taken on 25/02/2016, showing the front side the incinerator used at Nduba landfill with a capacity of incinerating 100kg per hour

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Photo no 2 taken on 25 Feb 2016, showing the incinerator used at Nduba landfill with a capacity of incinerating 100kg per hour

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5.2. COMPLIANCE WITH EXISTING GUIDELINES FOR REMA AND STANDARDS BY RURA

5.2.1 Inappropriate landfill plan

Before the implementation of the landfill site, a landfill plan should be established to put into consideration all requirements. A disposal plan should be used to guide the operation of the site. The landfill plan should provide a detailed explanation of what will be done by who, when and resources required⁶. However, no landfill plan was prepared for Nduba, waste is just dumped on the site. This exposes CoK and its environs to the environmental and health risks.

Recommendation

The CoK should prepare a plan for Nduba landfill and implement it for sustainable environmental management.

Management comment

Observations are noted and recommendations will be implemented

5.2.2 Lack of solid and liquid waste management plan

Solid and Liquid waste management plan is a document that is supposed to outline how waste can be reduced, managed, and disposed of. It can assist and guide the development and implementation of solid and liquid waste management program by establishing what actions need to be undertaken.

The document assists in taking into consideration all factors when managing solid and liquid waste. It

- Defines current waste management practices from generation to disposal
- Identifies problems and deficiencies with the current system
- Identifies opportunities for improvement in the current system
- Sets priorities for action to address problems and affect improvement
- Measures progress toward implementing actions
- Identifies the resources needed and develop budgets and schedules⁷

During the audit, I noted that the CoK did not develop the SLW management plan and is still in the process where only terms of reference (undated) for solid waste management plan have been prepared and submitted for approval by the donor who agreed to fund the activities.

For liquid waste management, no plan at all and the current practices are very harmful to the environment.

⁶ Practical Tools on Solid Waste Management of Imidugudu, Small Towns and Cities: Landfill and Composting Facilities by REMA (2010)

⁷ Terms of reference prepared by CoK for the study on solid waste management plan

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As long as the plan is not yet developed, the required improvements in solid and liquid waste management are not known. The current solid and liquid waste management in place exposes the city and its environs to environmental and health risks.

Recommendation

CoK should collaborate with all stakeholders in the management of SLW and accelerate the process of developing the SLW management plan which will help the City to manage SLW in a manner that is friendly to environment.

Management comment

The City of Kigali has already started the process of developing Solid Waste Management Plan after which the Liquid Waste Management Plan will be developed as well.

5.2.3 No environmental impact assessment (EIA) conducted before opening Nduba site

The environmental impact assessment is an evaluation which identifies effects that may be caused by human planned activities or a project⁸. The guidelines of REMA stipulate that every activity or project should always be subjected to an environmental impact assessment to cater for all possible health, social, economic and environmental hazards⁹.

However, I noted that CoK did not conduct an EIA before establishment of Nduba unsanitary landfill. Had CoK conducted an EIA before operating Nduba unsanitary landfill, it would be informed about all health, social, economic and environmental risks that affecting the site and hence enable it to establish mitigating factors accordingly.

Recommendation

CoK should develop and implement environmental management plan in order to cater for environmental challenges that are being caused by the unsanitary landfill.

Management comment

Measures like waste compaction and soil coverage is done every 2 months. These are among other mitigation measures being used to minimize and control the environmental and health risks. This will continue to be done and we will increase the frequency of compacting and covering waste by soil at least once a month.

5.2.4 Failure to manage leachate from unsanitary landfill

When leachate is not properly managed, it contaminates ground and surface water. Contaminated water is not only harmful to people's life but also to crops in which water sink.

According to REMA guidelines, no private or public drinking, irrigation, or water supply wells within 500 meters down gradient of the landfill boundaries should be used. The same guidelines provide how the leachate should be managed to protect ground and surface water.

⁸ Standards on the management of waste disposal site (landfill) set by RURA

⁹ General guidelines and procedures for environmental impact assessment

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Contrary to the above, CoK did not put in place an appropriate management system for leachate to protect ground and surface water and this may cause threat to the neighboring population.

Refer to photo below:



Photo no 3 taken on 25/01/2016, showing leachate generated by solid waste at Nduba site

Recommendations

CoK should put in place measures of managing leachate and prevent contamination of the ground and surface water.

Management comments

The observation is noted and recommendation will be implemented. The City of Kigali is in the process of establishing a new plant that will be used in leachate treatment.

5.2.5 Failure to protect water source or provide safe water to residents near the landfill

During rainy season, leachate with various types of toxins from the landfill flows down the valley and contaminate water source located in the village of Rebero, Gatunga cell. There are 992 households with 3,339 people¹⁰ from Gatunga Cell using water source affected which expose them to health risks.

From the above concerns raised by local population, a plan has been designed to provide clean water to the population neighboring Nduba landfill in Gatunga cell. The cost was estimated at **Frw 48,458,856**. However, this was not done.

¹⁰ Interview with Gatunga Cell's officer

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During the field visit, I noted that no water facility has been provided as planned and the population in Gatunga cell is still using the water from contaminated source, hence increasing the risk of diseases due to unsafe water. *See photos below:*



Photo no 4 taken on 25/01/2016, showing where leachate flows with rain water, from landfill towards residence and water source



Photo no 4 taken on 01/03/2016, showing water source where residents from Gatunga Cell get water downside the landfill

Recommendation

CoK in partnership with WASAC should avail safe water to the residents of Gatunga Cell.

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Management comment

The observation is noted and recommendation will be implemented

5.2.6 Inappropriate segregation of solid waste at Nduba landfill site

Appropriate MSWM requires waste to be segregated from generation¹¹. Biodegradable and non-biodegradable have to be put in different containers, transported separately and they have to be put in different locations. This allows the process of landfilling and prevent vermin to be generated. In addition to this, the guidelines established by KCC in the article 6 stipulate that the private companies should only collect and transport segregated waste. This means that solid waste not segregated should not be collected and transported to the landfill.

However, the physical verification done at the site showed that there is no segregation done at all, all waste are mixed. This led to the spray of many vermin and flies to the surrounding population which causes hygienic diseases. *For more details, see photos below:*



Photo no 6 taken on 25/01/2016, showing unsegregated waste deposited at Nduba landfill

Failure to segregate waste will render the recently installed incinerator useless, as it is intended to be used for toxic and infectious waste. The latter cannot be obtained without an appropriate segregation from generation point.

¹¹ Practical tools on solid waste management of Imidugudu, small towns and cities: Landfill and composting facilities

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Photo no 7 taken on 25/01/2016, showing unsegregated waste deposited at Nduba landfill

In addition to mixing all solid waste, they have been dumping solid waste in pits accommodating sewage. *See photos below.*



Photo no 8 taken on 25/01/2016, indicating solid waste deposited in the sludge sewage

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Photo no 9 taken on 25/01/2016, indicating solid waste deposited in the sludge sewage

Recommendation

- CoK should take appropriate measures in order to properly segregate solid waste
- CoK should manage appropriately pits reserved for liquid waste disposal to ensure that no solid or other substances are thrown into pits.

Management comment

- *The observation is noted and recommendations will be implemented. Monitoring of waste pits will be strengthened to ensure they are protected*
- *Awareness campaigns will continue to encourage the households to segregate waste.*

5.2.7 Inappropriate solid and liquid waste disposal

A. Solid waste

Following the standards provided by REMA, Compacted waste should be covered with up to 10 cm of soil or similar material at the end of each working day. This measure reduces the infestation of waste by flies and other insects¹².

However, following the interview conducted with CoK staff, I was informed that solid waste disposed of on the site are compacted and covered by soil at least once in two months instead of end of each working day.

¹² Practical Tools on Solid Waste Management of Imidugudu, Small Towns and Cities: Landfill and Composting Facilities by REMA (2010),page 21

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In two months, waste deposited at the site and left uncovered gets decomposed and attracts vermin and flies which eventually spread to the surrounding population. This also allows oxygen gas to penetrate in the solid waste and may cause the combustion of the landfill.

B. Liquid waste (sewage)

Liquid waste is collected from households and other big estates with septic tanks. After collection, it is transported to Nduba. During the field visit, I noted the following:

- Liquid waste are deposited into pits. And as of today, they have become like small lakes.
- To diminish bad smell from the liquid waste, some chemicals are spread onto the liquid waste surface
- PIVOT Company is on pilot phase of treating liquid waste to make briquettes. However, its capacity is still low.

The system of collection in pits does not give a fair and sustainable solution as many pits are required to accommodate that liquid waste. At the time of the audit (April 2016), 3 pits were already full and they were digging a fourth one. These pits are located on the top of the hill and if it rains heavily, they are likely to overflow and spread in the neighborhood and contaminate water and crops. This leads to spread of disease to the neighboring population. *See photos below:*



Photo no 10 taken on 25/01/2016, showing briquettes fabrication from liquid waste

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Photo no 11 taken on 25/01/2016, showing old pond for liquid waste



Photo no12 taken on 25/01/2016, showing the current pond for liquid waste

Recommendations

CoK should comply with the standards and guidelines of REMA to prevent the unpredicted combustion of solid waste.

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CoK should have an appropriate way of liquid waste disposal to minimize environmental and health hazards

Going forward, CoK should enforce the construction code which requires constructions to have septic tanks.

Management comments

For solid waste, the City of Kigali has been compacting waste and do soil coverage basing on the quantity of waste on the site. Waste compaction and soil coverage is going to continue to be done but since it is practically not possible to be done during rainy season it's only done during dry season or when there is no heavy rain. It is done once every two months.

For liquid waste, the City of Kigali is in the process of establishing centralized sewerage system plant and also establishment of decentralized plant to manage the sewage

5.2.8 Slow pace in expropriating neighboring residents

According to REMA guidelines, the landfill should be located 400 meters far away from residential area. This means that people living within the 400 meters radius should be expropriated and relocated.

In Nduba neighborhood, plots that were supposed to be expropriated before the installation of landfill were 344 from Taba Village, Muremure cell and among them 138 representing 40% have been expropriated. This means that the remaining 60% is still exposed to environmental and health risks.

In addition, there are 29 households on the hill in Rebero village, Gatunga Cell that are exposed to environmental and health threats of the landfill. They are also located within 400 meters of the landfill and when it rains, solid waste slides towards their residences. As of today (April 2016), there is no plan for expropriating them.

Recommendation

CoK should take appropriate measures and speed up expropriation process to save lives of the population near the landfill.

Management comment

The City of Kigali has expropriated some properties and is continuing to expropriate the remaining ones. By end of this year 2016, all properties within 400 meters will have been expropriated.

5.2.9 Inappropriate working conditions at landfill site

The guidelines regarding the SWM state that workers involved in collection, transportation and disposal of solid waste should be provided with protective clothing which includes overalls, working boots, gloves, dust masks, eyes protective glasses (goggles) and helmets¹³.

In addition to this, CoK is required (per contract) to monitor the working condition of staff operating at Nduba site.

¹³ Practical tools on solid waste management by REMA, page 26

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During field visit, I noted that workers are not protected and CoK does not monitor the working conditions. Inappropriate protective clothing exposes the above workers to health risks. *See photo below.*



Photo no 13 taken on 25/01/2016 showing staff not protected at Nduba landfill

Recommendation

CoK should urgently inspect the working conditions of the contracted companies to ensure the safety of the personnel involved in the management of solid and liquid waste at Nduba landfill.

Management comment

The observation is noted. The City of Kigali will make sure all workers wear the protective clothes

5.2.10 The absence of an inspection area at the landfill site

Waste that is disposed of should be inspected to check for weight (quantity) and the type of waste as appears in the standards issued by RURA. This helps to have an idea on the quantity of waste received at any time and to ensure that no illegal kind of waste is brought at the landfill. This helps also to ensure that prohibited waste such as hazardous wastes, automobiles parts, white goods, large metallic objects, tires and biomedical waste are not dumped to the site.

During the interview conducted with CoK staff officer, I noted that there is no inspection done to verify the type and quantity before SW is entered into the landfill.

This was also confirmed during the field visit. Lack of appropriate inspection exposes the landfill to harmful waste which are dangerous to the environment and health.

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Recommendation

CoK should establish appropriate measures in order to conduct inspection for quantity and type for all waste entering the site.

Management comment

The observation is noted and recommendations will be implemented

5.2.11 Inappropriate access controls of Nduba landfill

According to standard set by RURA¹⁴, each landfill should be adequately fenced or otherwise secured to prevent unauthorized entry. The field visit conducted revealed that the site is fenced in the front only and someone can easily enter into the landfill from backside. This also causes a danger to the neighboring citizens because solid waste slide from unfenced side. In addition to this, unauthorized solid waste can be thrown to the site. *See photo below:*



Photo no 14 taken on 25th January 2016, showing solid waste scattered in the unfenced side of the landfill

Recommendation

CoK should urgently make sure that the landfill is well fenced for all sides to protect against unauthorized access and the scattering of solid waste.

Management comment

¹⁴ Standards on the management of waste disposal site (landfill),page 10

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The landfill has been partially fenced and now the fence is going to be completed after the expropriation of all properties.

5.2.12 Failure to manage greenhouse gases emitted from the landfill

According to REMA guidelines, pipes have to be installed on landfill site to capture methane and carbon dioxide gases generated from the landfill¹⁵. The decomposition of the organic matter in anaerobic conditions generates methane gas which is global warming gas and can cause combustion if not eliminated or reduced.

According to the report of WHO¹⁶, methane and carbon dioxide do not only produce a strong global warming effect but also contribute significantly to more than 7 million premature deaths annually linked to air pollution.

According to the research published by the book of *Cesare Marchetti* and *Jesse H. Ausubel*¹⁷, methane gas can cause the flight accident as it can mislead indications that the flights instruments would provide.

In addition, the liquid waste (sewage) generate ammonia whose emissions to the atmosphere are an environmental concern because they can contribute to bad smell, the eutrophication of surface water, and nitrate contamination of groundwater. Ammonia emissions also contribute to the formation of fine particulates, which have long run negative impact on animal and human health¹⁸.

During the audit, I reviewed the available documentations regarding guidelines on how gases can be treated and noted that guidelines issued by REMA provide all measures regarding the treatment of gases and the main concern is that they are not applied by the CoK. This will lead to the adverse impacts if not fixed.

Recommendation

- CoK should exploit SLW by transforming them into compost and as biomass to reduce the quantity of gases emitted in the atmosphere.
- CoK should put in place appropriate measures that cater for all long term effects of the inappropriate management of solid and liquid waste for the sustainable environmental protection.

Management comment

CoK minimize the release of gases into the atmosphere through waste compaction and soil coverage but also will put in place mechanisms to ensure waste are transformed into compost or other products that do not produce pollutant gases

¹⁵ Practical tools on solid waste management of imidugudu, small towns and cities : Landfill and composting facilities

¹⁶ New report identifies four ways to reduce health risks from climate pollutants (October 2015)

¹⁷ Methane: The linchpin in the AF447 tragedy, 23 June 2009, page 5

¹⁸ Air emissions of ammonia and methane from livestock operations: Valuation and policy options by Jih-Shyangshish et al., page 8

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5.2.13 High level enrollment of households in solid waste collection and transport

The guidelines established by KCC in the article 8 states that every household must pay the fees for waste collection and transport. Those fees are established by RURA. Transporting companies enter into agreements with sectors and households for collection and transportation of MSW from household to the landfill site.

During the review of progress reports, I noted that there is a high level of enrollment of households in every sector involved in collection and transportation of solid waste. The District with the highest percentage is Nyarugenge where the level of enrollment is on average 97% followed by Kicukiro and Gasabo that have 88% and 84% respectively. This has made the collection of solid waste from area of generation to the landfill site to be excellent in CoK and the latter is ranked among the cleanest cities in Africa¹⁹. This is a step ahead towards the appropriate solid waste management system.

Recommendation

CoK should continue to work with districts and sectors officials in order to sensitize citizens and keep the number increasing

¹⁹ <http://www.un.org/africarenewal/magazine/april-2016/kigali-sparkles-hills>

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5.3. NATIONAL POLICY, STRATEGIC AND OPERATIONAL FRAMEWORK REGULATING MSLW

5.3.1. Lack of a national policy regarding MSLW

Putting in place policies governing the solid and liquid waste management is under the responsibility of the government through its different agencies and ministries.

CoK, the capital city of the country has a challenge in the management of solid and liquid waste and there is no specific policy regulating the management of waste in particular which exposes the city to environmental and health risks.

Not having a policy regulating MSLW limited CoK from having general guidance, specific guidance toward implementing strategies and mechanism to control the set targets in MSLW system.

Recommendation

CoK should liaise with MINIRENA to establish policy regarding solid and liquid waste management to improve the sustainability of the environment.

Management comment

The observation is noted. The City of Kigali will implement the recommendation in partnership with stakeholders

5.3.2. Inadequate planning for MSLW

Following the requirements from REMA, a landfill should have a gatehouse and office in which a gate keeper records the details of each load including the type of waste, its source (location) and an approximation of the quantity of waste being carried²⁰.

In addition to the above records, City of Kigali should collect data about the increase of waste in the city, analyze the factors contributing to the increase of waste such as population and changing consumption habits of residents. Accurate and complete records and data about increase of waste will provide accurate inputs and used by CoK in planning and take appropriate strategies in regards to MSLW.

During the audit, I noted that no records detailing each load including the type of waste, its source (location) and the quantity of waste received. CoK did not carry out a proper assessment of waste being generated and reasons for the increase in the city and therefore does not have information on solid waste to enable planning and decision making.

Planning was not based on proper assessment of solid waste generated and this resulted in failure of CoK to adequately address the challenges of solid waste management in the City of Kigali.

²⁰ Practical Tools on Solid Waste Management of Imidugudu, Small Towns and Cities: Landfill and Composting Facilities. Page 22

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Recommendation

CoK should make sure that a recording system for waste received at Nduba Landfill is working before being deposited. The record should specify the type of waste, its source (location) and the quantity. Those records will be used for effective planning and in taking appropriate strategies in regard to MSLW.

CoK should collect data about the increase of waste in the city and analyze the factors contributing to the increase of waste

Management comment

The City of Kigali has been recording the number of trucks arriving at the landfill which are used to estimate the amount of waste generated. The recommendation is noted and the City of Kigali is going to set up all the necessary measures so as to implement it.

5.3.3. Lack of solid waste management sensitization

According to Practical Tools on Solid Waste Management²¹, Education and sensitization in the area of waste and waste management is important. This means that members of the public are supposed to be educated in matters of waste management such as segregation of waste according to their categories (organic and inorganic), efficient use of skips, waste recycling, waste minimization and adherence to waste management guidelines.

CoK did not conduct sensitization campaigns to its inhabitants. This was further raised by solid waste collectors in an interview, where they disclosed that the level of solid waste management understanding of people in CoK is at low level.

Furthermore, when reviewing action and strategic plans, the awareness of solid waste management was not taken into consideration.

Lack of solid waste management awareness campaigns has led to inappropriate solid waste management practices. This has a negative impact on the environment.

Recommendation

City of Kigali should conduct sensitization to increase public understanding about solid waste management such as segregation, proper disposal practices, waste minimization and policing against solid waste malpractice.

Management comment

Observations are noted and recommendations will be implemented

²¹ Practical tools on solid waste management of Imidugudu, small towns and Cities: Landfill and Composting facilities by REMA (2010),

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5.3.4. Lack of sustainable management system for solid and liquid waste

For more than 30 years all the collected waste had been dumped to Nyanza in Kigarama Sector, Kicukiro District which was just an open dumpsite. It was not structured to meet the standards of a sanitary landfill. The site constituted a threat to the environment and public health. Following the visit of the Prime Minister dated 23 December 2011, it was decided to relocate it to a temporary site which was Nduba. Nduba Landfill was selected to be developed and serve as a transitional landfill for the CoK while waiting for the completion of a modern landfill.

As of June 2013, more than 300 tons of solid waste are collected every day and dumped to a new unsanitary landfill located in Nduba Sector, Gasabo District.

During the field visit, it was observed that Nduba Landfill has not been developed to address the environmental and public health treats that caused the re-location from Nyanza dumpsite. The method of waste disposal at Nduba landfill is still the same as that used at Nyanza and hence causes the same health risks.

For the liquid waste (sewage), there is no system to receive and treat the sewage emptied septic tanks from different parts of the City. They are deposited into pits at Nduba site and as of today they have become like lakes (pits) of sewage.

Disposal methods used at Nduba still expose CoK to environmental and health hazards.

Recommendation

City of Kigali should construct the sanitary landfill in order to ensure that solid and liquid waste are well managed and do not portray environmental and health risks.

Management comment

The City of Kigali is planning to establish and operate a sludge and leachate treatment plants

5.3.5. Low rate of recycling – plastic and glass bottles

Rapid growth, urbanization and industrial growth have led CoK to generate more waste in plastic and glass. Among the way of reducing those generated plastic and glass waste, there is recycling which is the process of converting waste materials into reusable objects to prevent waste of potentially raw materials. This has an advantage of reducing the consumption of fresh raw materials and energy usage, mitigating air pollution (from incineration) and water pollution (from landfilling) and lowering greenhouse gases emissions.

During the field visit, I found important quantity of used plastic and broken glass bottles to the extent that they have formed a heap. These bottles are mainly from breweries and companies that produce mineral water. The recycling is done at low pace for plastics by ECOPLASTIC Co while glass bottles are transported to Tanzania and Uganda where they are recycled.

Failure to recycle the above waste has created a problem of space and storage because the above waste is increasing on a day to day basis.

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Recycling would reduce the pollution of the air and would allow companies that use the bottles to save their cost of importing and subsequently preserving raw materials. *For more details refer to the photo below:*



Photo no 15 taken on 25/01/2016, showing used plastic bottles stocked at Nduba



Sac
s

A
heap

Used
plasti



Sacs of

Photo no 16 taken on 25/01/2016, showing broken glass bottles at Nduba

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Recommendation

- CoK should help the existing recycling company to increase its capacity and attract new companies to invest in that activity.
- CoK should apply the “**polluter pays principle**” in charging the breweries and companies producing mineral water environmental protection fees to support CoK budget of environmental management.
- CoK should liaise with MINIRENA to establish policy encouraging the use of **re-usable** consumables especially for serving water. This can reduce significantly the quantity of plastic bottles deposited to Nduba.

Management comment

The observation is noted and recommendation will be implemented

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6. CONCLUSION

The mission of CoK with regards to environmental protection is to regulate public utilities by building an environment which is clean.

CoK responsibilities include establishing a specialized unit that will take care of waste management services - build capacity for waste management and recycling techniques and - improve the management of solid and liquid waste.

The audit was conducted with the objective of assess whether CoK manages solid and liquid waste in a manner that is friendly to the environment”.

The results of the audit made me concluding the following:

There is a well-established system of solid and liquid waste collection from area of generation to the landfill site and this has made the city to be ranked among the cleanest cities of

Though the CoK has the above achievement in MSLW, it still has a lot to do. The current final destination of SLW (Nduba landfill) is a serious threats to the environment and public health. These threats emanate from a number of weaknesses including:

(i) CoK failed to implement its initiatives towards sustainable MSLW

For the sustainable MSLW, CoK had planned many projects that would solve the problem of MSLW. This includes:

- The transformation of waste into energy which not only would solve the problem of the waste but also generates energy.
- Establishment of a composting plant which would generate compost manure (fertilizer) from bio-degradable waste.
- Installing incinerator that would handle hazardous and infectious waste
- Design for the new landfill and recycling center which would provide the sustainable management of MSLW and reducing the quantity of waste through recycling.

However, among the above 4 projects, only the one of establishing incinerator has been implemented.

As longer as the above projects will not be implemented, the problem of MSLW in CoK will persist and will increasingly lead to very serious environmental and health hazards.

(ii) Noncompliance with existing guidelines for REMA and standards set by RURA

REMA and RURA have put in place respectively guidelines and standards related to MSLW, however they have not been complying with them, such as:

- Preparation a landfill plan that provides detailed explanation of what will be done by who, when and resources required.

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- Conducting environmental impact assessment that would inform CoK on all health, social, economic and environmental risks that the landfill entails and establish mitigating factors.
- Development of SLW management plan based on what the EIA proposed to cater for all possible health, social, economic and environmental hazards that would include leachate management plan as well as gases.
- Covering waste with soil on daily basis which in contrary is done once in two months, leading to spraying many vermin and flies to the surrounding population.

As long as CoK is complying with guidelines and standards set for MSLM, the problem of MSLW in CoK will persist and will increasingly lead to very serious environmental and health hazards.

(iii) National policy, strategic and operational framework regulating MSLW

There is no specific policy addressing the issue of SLW management in particular those which exposes the city to environmental and health risks.

In absence of a policy that can guide the management of SLW, the problem will persist and will increasingly lead to very serious environmental and health hazards.

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7. RECOMMENDATIONS

In view of the above highlighted shortcomings in the management of solid and waste which causes environmental and health risks, it is recommended that;

(i) Status initiatives taken by CoK in the management of SLW

The fact that CoK undertaken 4 projects for the sustainable MSLW and only the one of establishing incinerator has been implemented. It is recommended that:

- CoK should take appropriate measures in order to speed up all projects aiming at improving solid and liquid waste management

(ii) Compliance with existing guidelines for REMA and standards by RURA

- The CoK should prepare a plan for Nduba landfill and implement it for sustainable environmental management.
- CoK should collaborate with all stakeholders in MSLW and accelerate the process of developing the MSLW plan which will help the City to manage SLW in a manner that is friendly to environment.
- CoK should develop and implement environmental management plan in order to cater for environmental challenges that are being caused by the unsanitary landfill.
- CoK should put in place measures of managing leachate and prevent contamination of the ground and surface water.
- CoK in partnership with WASAC should avail safe water to the residents of Gatunga Cell.
- CoK should take appropriate measures in order to properly segregate solid waste
- CoK should manage appropriately pits reserved for liquid waste disposal to ensure that no solid or other substances are thrown into pits.
- CoK should comply with the standards and guidelines of REMA to prevent the unpredicted combustion of solid waste.
- CoK should have an appropriate way of liquid waste disposal to minimize environmental and health hazards
- Going forward, CoK should enforce the construction code which requires constructions to have septic tanks.
- CoK should take appropriate measures and speed up expropriation process to save lives of the population near the landfill.
- CoK should urgently inspect the working conditions of the contracted companies to ensure the safety of the personnel involved in the management of solid and liquid waste at Nduba landfill.

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- CoK should establish appropriate measures in order to conduct inspection for quantity and type for all waste entering the site.
- CoK should urgently make sure that the landfill is well fenced for all sides to protect against unauthorized access and the scattering of solid waste.
- CoK should exploit SLW by transforming them into compost and as biomass to reduce the quantity of gases emitted in the atmosphere.
- CoK should put in place appropriate measures that cater for all long term effects of the inappropriate management of solid and liquid waste for the sustainable environmental protection.

(iii) On national policy, strategic and operational framework regulating MSLW

- CoK should liaise with MINIRENA to establish policy regarding solid and liquid waste management to improve the sustainability of the environment.
- CoK should make sure that a recording system for waste received at Nduba Landfill is working before being deposited. The record should specify the type of waste, its source (location) and the quantity. Those records will be used for effective planning and in taking appropriate strategies in regard to MSLW.
- CoK should collect data about the increase of waste in the city and analyses the factors contributing to the increase of waste
- City of Kigali should conduct sensitization to increase public understanding about solid waste management such as segregation, proper disposal practices, waste minimization and policing against solid waste malpractice.
- City of Kigali should construct the sanitary landfill in order to ensure that solid and liquid waste are well managed and do not portray environmental and health risks.
- CoK should help the existing recycling company to increase its capacity and attract new companies to invest in that activity.
- CoK should apply the “**polluter pays principle**” in charging the breweries and companies producing mineral water environmental protection fees to support CoK budget of environmental management.
- CoK should liaise with MINIRENA to establish policy encouraging the use of **re-usable** consumables especially for serving water. This can reduce significantly the quantity of plastic bottles deposited to Nduba.

APPENDICES

PERFORMANCE AUDIT ON MANAGEMENT OF SOLID AND LIQUID (SEWAGE) WASTE IN KIGALI CITY FROM MAY 2012 TO DECEMBER 2015

Appendix 1: List of reviewed documents

No	Document name
1	INTOSAI guidelines about Municipal Solid Waste Management, 2001
2	Supervision reports for Nduba Landfill management for the period 2012-2015
3	Practical Tools on Solid Waste Management of Imidugudu, Small Towns and Cities: Landfill and Composting Facilities, Published by REMA in 2010
4	Standards on the management of waste disposal site (landfill). By RURA in 2009
5	CoK development plan 2013-2018
6	Action plans for 2012/2013, 2013/2014, 2014/2015 and 2015/2016
7	ToRs for solid and liquid management plan (draft undated)
8	Relocation of Nyanza dumpsite progress report dated 13/01/2012
9	Contracts signed between CoK and private companies (to collect and transport SW)
10	Detailed Landfill design report dated 20 June 2012
11	Terms of reference for the tender relating to collection and transport of solid waste (undated)
12	Project proposal for sustainable waste management in the CoK dated 13rd June 2013.
13	Action points of the Prime Minister's Work visit at Nyanza landfill and central business district dated 29 Dec 2011
14	Training report for companies that collect, transport and day today management of solid waste dated 08/06/2011
15	Training report for representatives of companies and cooperatives that collect and transport of solid and liquid waste and those in charge of cleaning roads and gardens in City of Kigali dated 18/12/2014
16	Inspection report on Hygiene campaign 2015 dated 23/03/2015

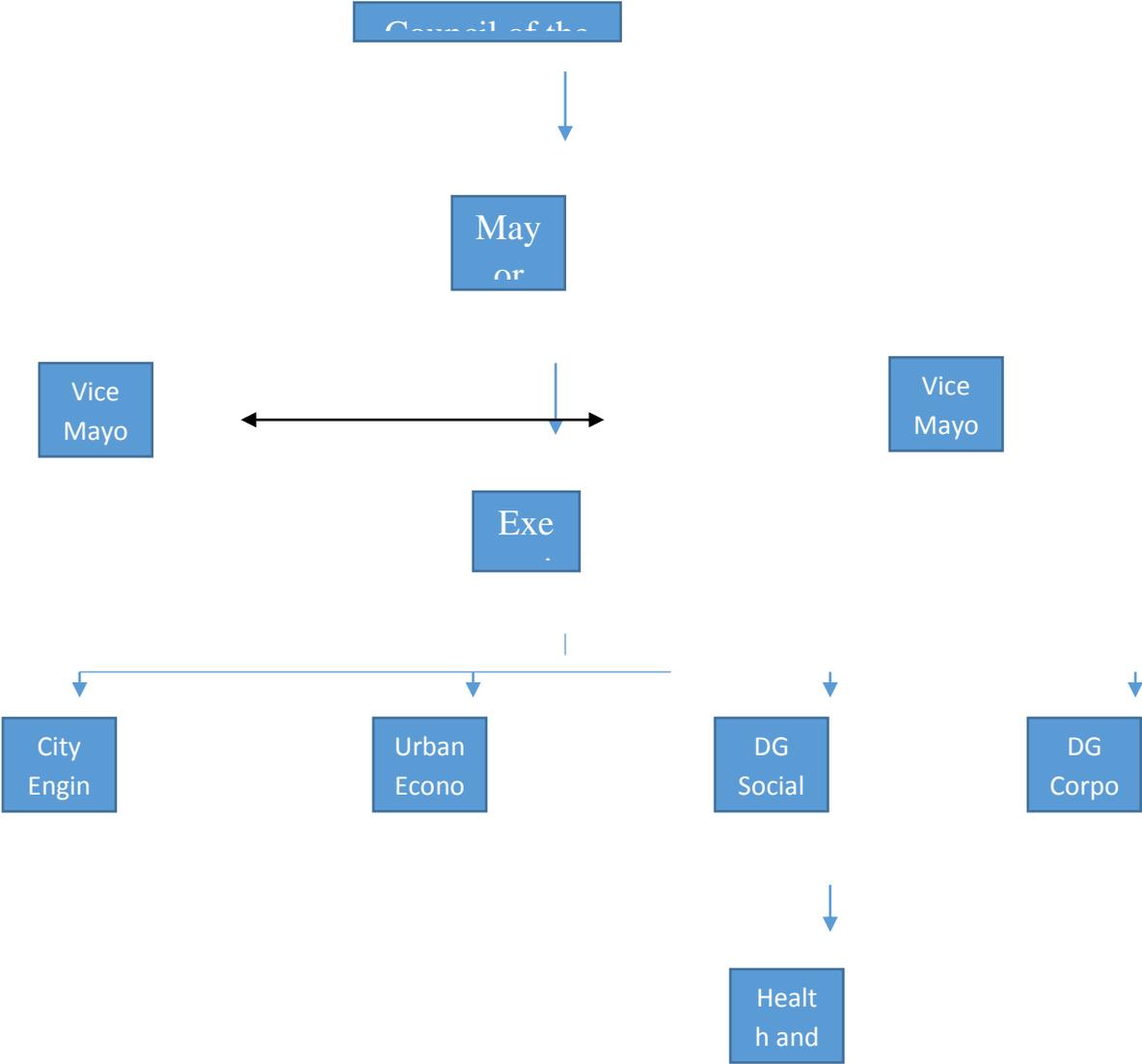
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Appendix 2: Roles and responsibilities of key players in the MSLW

No	Institution	Responsibilities
1	Ministry of environment and natural resources	Responsible for making policy for management of waste including solid waste
2	Rwanda Environment Management Authority (REMA)	Prepare guidelines related to management of waste including solid waste
3	Rwanda Utilities Regulatory Agency (RURA)	Regulate the management of waste including solid waste
4	Districts of Nyarugenge, Gasabo and Kicukiro	Ensure that solid waste are collected and dumped at Nduba site
5	MININFRA (Ministry of infrastructure)	Provides guidelines through its department in charge of water and sanitation, by providing guidance on how to improve sanitation.
6	WASAC (Water and Sanitation Corporation)	Provides some guidance on how to improve sanitation by effectively manage waste and it has crosscutting responsibilities with the CoK in the waste management.
7	Private firms	Execute the contract of management of solid and liquid waste

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Appendix 3: Organisational structure



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Appendix 4: Integrated waste management hierarchy

