



SUSTAINABLE SOLID WASTE MANAGEMENT IN URBAN AREAS A COMPARATIVE STUDY OF NAIROBI IN KENYA AND KIGALI IN RWANDA

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1.0 INTRODUCTION

Disposing of solid waste in towns and cities has proved to be one big challenge for city councils and town municipalities despite having tried different solid and liquid waste disposal approaches. The production of the solid waste depends on various factors such as the ability to manage the waste, the demographic size, the geographical location and financial capability thus active participation is fundamental.

Accumulation of garbage is a sign of way of living, managing of waste and advancement in technology. As a result of some developing countries inability to manage the waste disposal, there has been an emergence of ailments, our surroundings degrade and the consequences are dire on the lives. Inappropriate garbage handling affects the climate change and development sustainability. Greenhouse effect which is a result of poor handling of refuse lead to a change in the environment and therefore, the technology that can sustainably handle the litter and ways to fight this world menace. Some strategies that we can apply are such as techniques to minimize the refuse, product designs which are sustainable, management of resources, recycling and reuse of goods. It should be noted that eliminating of all refuse may not be

realized 100% but with proper technology to manage waste, we can achieve the dream of cleaning cities and towns.

Over the decades Kenya's demographic size has been shooting and many Kenyans have resorted to reside in the towns and cities. The rural, urban migration has contributed to the rise of garbage generated and disposing of it has become a complicated affair. The trend has been made even worse by the number of growing industries in Kenya's economy. Although there exist laws and guidelines, implementing them and improper practices could have contributed to the municipalities and councils unable to handle waste resulting to poor health and polluted surroundings.

For a long time, handling of refuse has been left on the arms of the local authority. Nevertheless, the authorities did not consider it as a priority to enact appropriate systems for handling refuse. Therefore, they set aside insignificant resources for handling it. Technical management lacked in dealing with the refuse, and therefore many challenges have been experienced in the process of waste disposal.

1.2 What problem is this project trying to address?

Households should take it as their responsibilities to sort, minimize, recycle and reutilize solid refuse. The authority should, however, propagate this to achieve efficient waste collection and disposal. When the recycle and reutilize of the garbage disposal is realized, it creates employment opportunities. Therefore, individuals and families are economically lifted. In most cases, the composite sites present ugly scenes thus, their density will be reduced, but utilization will be maximized. When this is done, sanitation will be improved, and chances of dumpsite related ailments will be eradicated.

1.3 Proposed solution

It is not possible for homes to live without producing waste. Hence, this research is going to give counties with substitute remedies of handling the causation alongside garbage gathering and disposing of it in the composite sites. In this case, the public will be guided on how they can sort the wastes before dumping. Well labeled dustbins will be used to gather a different kind of refuse. The containers can be gotten from the manufactures of the consumables for instance factories and supermarkets. Sensitization to investing in a "necessary waste only" is of value as it will widely minimize the end garbage products disposed of in the composite sites. It also enables authority to handle it whether biodegradable or not.

1.4 Impact of the project

Appropriate refuse handling has been guided by 3Rs which stands for (Reduce, Reuse, and Recycle) for efficiency. This research is aiming at supporting the process with the objective of the effectiveness of the 3Rs. Reduce strategy is to educate the homesteads on means of minimizing refuse but at manageable costs and thus maintain constant or lower cost expenses. Reutilization, on the other hand, will educate them on another usage of the otherwise what could be treated as refuse. Finally, recycle is to equip the households on adding the value of their waste and therefore, earning revenue from it. An excellent sensitization of 3Rs minimizes the production of refuse, and eventually, little cost is registered by all individuals involved, clean surroundings and sustainable economy are achieved.

1.5 Stake holders in solid waste management

In the Kenyan situation, there are commendable efforts by the Ministry of Environment, Water and Natural Resources: the municipalities and city councils and various NGOs are also involved in sustaining a clean surrounding. However, no initiative exists in equipping the public with the information that can help them adapt an environmentally sound decision on how to manage their refuse. The existing situation is to enable households to dispose of their refuse without value addition. In this case, a lot more costs are incurred as much more waste is produced as demographic rise.

2.0 Current waste management practices

2.1 Waste Segregation

Most of the refuse production is done at homesteads, in markets, cities and towns' organizations and industries. In this case a few homesteads will sort out the rubbish at their homes with most refuse not separated at the CBD areas, Industry, Institution and town level. However there is considerable segregation of biomedical waste and items that can be recycled such as plastic, papers, rubbers, glasses, and metals which is done by uninformed people.

2.2 Collection and Transportation

Refuse in CBDs is left for the county governments whereas in estates and areas of residence is done by the private vendors who charge a fee. In Slums, refuse gathering is done by coordinated groups and Community Based Organizations (CBOs). Those who collect the garbage are licensed by the county Governments from areas of designation.

2.3 Waste Treatment

New technologies for treating refuse have not been widely in use in the country, but there are measures which are taking place to boost treating of waste. There are however some industries which collect recovered materials like papers, polythenes, plastics, glasses, scrap metals, used oil, e-waste and tires that can be recycled. This is however limited due to little public awareness of the particular industries with many of them not having gained full operations. There are also very few composite sites majority of which are located at horticultural farms. Incinerators and Cement Kilns that use heat treatment are predominantly used, but most of them don't comply with the requirements of the Kenyan regulations stipulated in the Third Schedule of the refuse treatment regulations act of 2006.

2.4 Waste Disposal

Open composite sites are common for some household and municipalities of discarding the produced trash but not a recommendable practice. Incinerations and rudimentary kilns are common in disposing of biomedical refuse, expired goods, and damaged goods. People working in these incinerators have limited knowledge and managerial skills.

3.0 Challenges in Waste Management

For quite sometimes the managing of refuse in Kenya has been a hurdle due to various reasons. These problems are related to poor trash management, lack of skills and expertise, politics, technical and finances

Lack of awareness and knowledge: Public may be not aware and knowledgeable of the essence of uncontaminated and healthy surroundings. Therefore, the ignorance has made public to manage refuse which has led to contaminated environment poorly. The ignorance has also contributed to the improper management of trash at the homestead level which includes lack of separation, utilization, minimization, and recycling. Dropping of litter, dumping illegally and open burning are also caused by ignorance.

Political influence and lack of good will: The government not prioritizing refuse management has led to misappropriation of funds and misplacement of funds.

Disposal sites: Availability, sitting and management

It is the responsibility of County Governments to provide waste deposit sites in their governing areas. I might not be realized though because the public land for the disposing

refuse is a hurdle. Also, in areas where the land for dumpsite is available, the surrounding communities oppose the idea of the dumpsite erected in their field. Consequently finding alternatives in vulnerable sectors such as riverbanks, marshy and forests areas.

Lack of segregation: The public doesn't separate refuse at household, industry, organization and market levels. Therefore all the litter is put in one container which makes the sorting out at dumping site impossible. Consequently hindering material recovery, utilization and value addition processes.

Limited technical competencies: The country and county government have limited or lack competent handlers of refuse causing inappropriate handling of waste managing equipment and resulting in their inability to achieve the maximum capacity for operations.

Slow adoption of modern technological options: There is a sabotage or lack of interest to use new technologies in managing waste. It could be facilitated by misplacement of funds, corruption, no tax waiving for those importing such equipment, technophobia, ignorance, land menace and slow enforcement of the law.

3.1 The preferred state of waste management in the country

The overall aim of solid waste management is the protection of human health and the environment in a manner that is affordable, environmentally friendly and socially acceptable. Achieving the over waste management, there is need to adopt the principle of integrated solid waste management. In the current dispensation, county governments are charged with the management of waste in their jurisdictions.

3.2 Integrated Solid Waste Management

The solid waste management hierarchy is an integrated approach to protecting and conserving the environment through implementation of various approaches to sustainable waste management. It establishes the preferred order of solid waste management alternatives as follows: waste reduction, reuse, recycling, resource recovery, incineration, and landfilling.

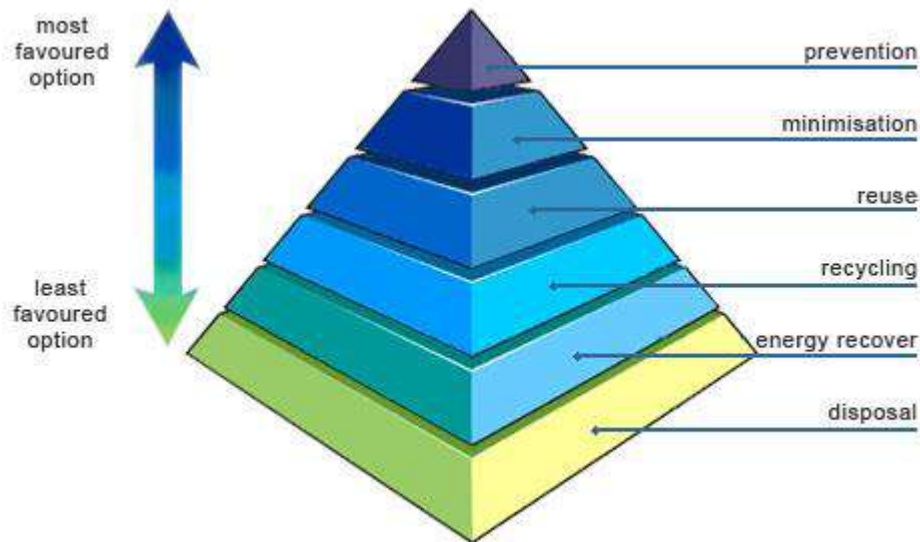


Figure 3: The Solid Waste Management Hierarchy.

3.3 How solid and liquid waste is managed

In Kenya, there are various ways of handling solid and liquid refuse which include the following.

Preventing of the trash being created by for instance reusing of old products and repair of damaged objects rather than buying new.

Recycling too has been in use in Kenya of simple materials, but complex materials like electronics are still not possible due to its additional costs of dismantling.

Biodegradable materials such as plants are put in composite sites to form organic manure and mulch for agricultural processes.

The landfill is another method used in the management of garbage. The waste is buried in a properly-designed and in a hygienic way and not a very expensive method of refuse disposal. However, if wrongly done there can be hazardous effects such as wind blowing the litter, parasites growing in it among others.

Another way Kenyans use to dispose of garbage is through Incineration which is a process of burning waste. It is done in an enclosed system which uses high thermal heat. The process turns waste into gas, water or steam.

4.0 Solid waste management in Kigali (Rwanda)

4.1 Stages of waste management stream

Rwanda is known for stringent measures in waste management an initiative has ranked Rwanda among the cleanest city not only in the region but also globally.

In her management of the refuse, Rwanda has adopted seven stages which are preventing, generating, recycling, reusing, and recovering, collecting, transporting and exporting, treating and finally disposing of.

The first stage which is prevention which is motivated by the supportable utility of resources actually Prevention of refuse generation is one of the national policies in Rwanda.

Generating refuse is the second waste management process. The Rwandan government influences the waste generation by giving economic incentives to those who efficiently utilize the resources and who generate less refuse. Some of the methods used include polluters pay principle and substitution of dangerous chemicals with less hazardous ones.

Another stage and third stage is the use of recycling, reusing and recovering. To ease the process at this stage, materials are sorted and subjected to treatment differently.

Fourthly, it is refuse collection which is highly controlled by the local and national government, but handling is done by private operators. At this stage the collected refuse is disposed of in the landfills waiting for management at a later date. There are dire consequences that are associated with wrong designing and managing of landfills; litter can be blown by the wind, the attraction of dangerous vermin and a liquid by the name Leachate can be produced. Secondly, landfills can breed gas (a combination of CO₂ and Methane) which when it breaks anaerobically can cause respiratory ailment, damaging the vegetation and it is a greenhouse gas. Nevertheless the landfills can be coated by leachate such as lining made of clay. Disposed materials can always be compacted to make it more dense and stable and can be covered to keep away vermin such as rats and mice.

Transporting and exporting of garbage is the 5th stage. The government or private operators are involved but they have to be licensed by REMA. Transportation of dangerous substances is done in accordance to the regulatory guidelines to prevent accidents which may happen. In this case, the involved party in transportation must seek a permit from Rwanda Environment Management Authority (REMA).

Treating and disposing of garbage is highly regulated by the authority and which is the sixth stage.

The government of Rwanda is aware that dumping can be done illegally and for this reason, it has vigilant measures taken against the offenders. The authority has been applying means such monitoring, inspecting and this are founded on stringent statutory standards. Permits for investigating and sanctioning should be well executed. Poor handling of refuse results into contaminating of sites. Those that pollute the environment are fined.

5.0 Lessons Kenya can learn from Rwanda garbage treatment

Prevention is one measure the government Rwanda has been able to achieve though not 100% but at manageable levels. All entry point of Rwanda is manned by people prevent nylon papers don't sneak in the country. Everything wrapped in polythene bags is unwrapped, and they are people at the border who sell biodegradable papers to substitute the nylon ones. Packaging in many Rwandan retails, wholesales, supermarkets, and markets are done using biodegradable papers. This rule has contributed to the cleanliness of Rwanda as a whole. A lesson that Kenyan governments (both county and national) can borrow from their youngest economy neighbor Rwanda.

Secondly, the Rwandan government is strict on the generation of the solid and liquid refuse. Though it is not easy to prevent economic activities from happening, it is easy to apply the rule of minimization. Rwanda has achieved the generation control of minimization through giving rewards regarding financial incentives to those who would efficiently use their resources. It also rewards those who generate little refuse from their industries, another lesson that Kenyans take home from Rwanda. People can be motivated to minimize the generation of trash in the environment.

Another valuable refuse management lesson that Kenyans can learn from Rwanda is segregation. In isolation garbage management in Rwanda, the households, companies, institutions, businesses, and industries are provided with various containers for different waste. The refuse is sorted at household levels before it is collected to be taken to Rwanda main landfill called Nduba. Garbage is sorted into biodegradable and non-degradable. Therefore, artificial manure is produced from biodegradable materials while non-biodegradable materials are recycled and reused. Moreover, industrial refuse does not get its way to Nduba landfill; an important lesson for Kenyan NEMA.

The packaging of the solid waste is done at the household level where the private operators with REMA permit collect it. The garbage is emptied in the Lorries, and the collecting bags are given back to the owners. In fact, this has made the Rwandans responsible in matters of garbage disposal. They don't pick it on themselves to dispose of it anywhere; a takeaway lesson for Kenyan authority to sensitize its citizens on the responsible waste disposal.

In Rwanda, there are no cartels involved in garbage collection. Some private operators are contracted by the government to do so. These operators collect the garbage from the household level and dump it at Nduba landfill. Solid waste from public operators is collected by cleaning companies who work with transport companies through contracts to deposit the refuse to Nduba. A lesson that is necessary for Kenyan authority can get from Rwanda.

Private operators in Rwanda are entrusted with the waste collection; each district is charged with the duty to inspect waste collection in Kigali. However, the City of Kigali supervises the whole process. REMA has given its guidelines concerning the depositing of refuse; it is done between 6:00 a.m and 6:00 p.m EAT. Thus, you can't transport or deposit litter at Nduba after the time in the guideline.

The treatment of other non-biodegradable liter is done at a place called Mageragere. Plastics, papers, pharmaceutical and metal tins are treated through recycling or reusing subject to their condition. Papers from the offices are dumped in an industry in Bugesera district where they are treated, and they converted to hygienic toilet papers. Most plastics are done recycling at Mageragere. Nonetheless, some of the materials are not recyclable in Rwanda and thus taken to Neighboring countries like Kenya, Tanzania, and Uganda.

Additionally, pharmaceutical rubbish and other dangerous refuse are passed through incinerators for thermal heating. However, incineration process is not supportable because it pollutes the air through gas emission.

After sorting out the waste materials, it is dumped in landfill which is filled with soil. This method of disposing rubbish involves the burying it in the land. This process doesn't include plastics and pharmaceuticals because they are treated differently. The essence of sorting out the refuse at the household and office level.

Lastly, the liquid waste is produced by public and private operators, from institutions, homes hotels, bars, and restaurants. When collected, they are ferried to Nduba landfill where they

are dumped into two pit holes. Unfortunately, these septic pits are dug on the hills; the refuse sips in the soil hence, contaminating the regional groundwater.

If household liquid waste is well disposed, it poses no threat to the environment and even human. In fact, it can be a source of moisture or fertilizer rather than a pollutant. However, household liquid refuse should be appropriately disposed of with proper effluence disposal policies. Fluid garbage from medical facilities should be well gathered passed through treatment and transformed in a manner in which, they should not degrade the surroundings.

6.0 CONCLUSION

It is worth noting that solid waste management in most municipalities remains a big challenge irrespective of the laws enacted. Environmental conservation is a global concern and proper environmental management practices need to be embraced globally. The East African Legislative Assembly (EALA) put up a law on the plastic paper bags ban in East African states in which Rwanda was the first state to abide by in 2008. Kenya followed the Rwandan steps by submitting to the ban in August 28th 2017. To respond to the environmental hurdles, Kenya has further reviewed its legislations and guidelines to handle the problem. Of several laws that Kenya has approved, 1999 Environmental Management and Coordination Act (EMCA) allows rights and bestows on people responsibilities of environment protection and upgrade. It assures each Kenyan environment that is clean and healthy and its contingency also envisions environment safeguarding of the present and future generations gain Constitution of Kenya under section 42. This has been pegged to Kenyan Vision 2030. Every individual has been conferred with duties to collaborate with national institutions and other individuals to protect and conserve environment and make sure there is ecological development sustainability and utilize natural resources.

To foster country's growth, the requirements of generations of today must be fulfilled without future generations' ability compromise in meeting their requirements, (UNEP, 2010). This can be attained through a vehicle provision of the environmental integration in management and planning of socioeconomic. The rising concerns of environment and material and recovery of energy emphasis are slowly transforming the management and planning of solid waste. Engineering of sustainable and cost effective systems of solid waste management is the area of focus in modern world putting into considerations of different processes of management. Such a structure should suffice as a support system of solid waste considering both environmental and socioeconomic factors. The structure also considers generation rates,

collection, composition, disposal, treatment of solid waste besides possible environmental effects of different techniques of management of solid waste.

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