ENVIRONMENTAL EFFECTS AND HEALTH RISKS ASSOCIATED WITH THE LOCATION OF KALUNDU DUMPSITE, KITUI COUNTY TO LOCAL RESIDENTS

BY

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DECLARATION

I understand that plagiarism is an offence and therefore I declare that this thesis report is myoriginal work and has not been submitted to any other institution for any other award.

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DEDICATION

I dedicate this thesis to three entities, first to the County Government of Kitui for its desire to attain sustainable SWM in Kitui town.

Second, to the solid waste workers within Kitui whose work and dedication is not acknowledged.

Thirdly, to Kalundu residents who participate in SWM processes in pathetic situations.

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ABBREVIATIONS AND ACRONYMS

AIC	**:**	African Inland Church
CGoKTI	**:**	County Government of Kitui
CRA	**:**	Commission on Revenue Allocation
EMCA	**:**	Environmental Management Co-ordination Act
EPA	**:**	Environmental Protection Agency
FGD	**:**	Focus Group Discussion
IPC	**:**	Independent Presbyterian Church
IWM	**:**	Integrated Waste Management
MSW	**:**	Municipal Solid Waste
NGO	**:**	Non-Governmental Organization
PVC	**:**	Polyvinyl Chloride
RCRA	**:**	Resource Conservation and Recovery Act
SEKU	**:**	South Eastern Kenya University
SSCS	**:**	Senior Supervisor Cleaning Services (SSCS)
SWD	**:**	Solid Waste Disposal
SWM	**:**	Solid Waste Management
SWRM	**:**	Solid Waste Reduction Methods
WHO	**:**	World Health Organization

ABSTRACT

The rapid growth of urban centres of developing countries has created challenging problems in waste management. This problem is exacerbated by resource constraints, extreme poverty, lack of practical waste management policies, and the inability of local authorities to provide for this basic function. Waste disposal onto dumpsites located in close proximity to human settlements is a challenge to the local inhabitants. In Kitui, generated waste is dumped in Kalundu, located in a residential area surrounded by several businesses, a garage and a cattle traders market. At the edge of the dumpsite, there is the Kalundu River. Thus, the presence of the dumpsite can be a source of health risks to people in its vicinity and that of the surrounding environment. It is with this background that the study was conceptualised to assess the environmental effects and health risks associated with the presence of dumpsite. The study specifically aimed at (i) determining the health risks associated with the presence of Kalundu dumpsite on the surrounding residents (ii) determining the perceived environmental effects of Kalundu dumpsite by local residents and (iii) assessing the participation level of local residents in managing the solid waste dumped in Kalundu. 78 respondents were randomly selected and divided into two layers, those living between 0 m and 250 m from the dumpsite (near dumpsite) and those living between 250 and 500 m (far from dumpsite). They were administered with structured questionnaires for data collection. Patient visitor data was also obtained from local health facilities Statistical Package for Social Sciences (SPSS) software was used to analyse the collected data and results were presented using tables and graphs. The study revealed that poor handling of solid waste once dumped has led to outbreaks of environmental diseases such as Cholera, Malaria, chest pains, among others. Those residing near the dumpsite were the most vulnerable.. The residents blamed deteriorating environmental conditions of their surroundings to the presence of the dumpsite in their vicinity. The results further indicated that majority of the residents had not received public education on waste management practices implying that they were unaware of the different aspects of waste management once it arrived at the dumpsite. The results of logistic regression analysis indicated that location, age, household size and income, did not significantly influence participation in SWM activities but was significantly influenced by education level. To achieve sustainable development in respect to Vision 2030 and Sustainable Development Goals, the study recommends that Kitui County Government should employ sustainable solid waste management strategies in Kalundu dumpsite. The county should provide waste management infrastructure, public education on waste management, implementation of reduction, recycle, reuse and recover concept and the introduction of Community Based Organizations for waste collection and enforcement.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

In recent years, the population of the world has seen a rapid increase with a majority of the increase experienced in urban areas (Liu *et al*., 2020). The trend is projected to exhibit itself more in developing countries as they become more urbanised and developed (Antwi-Afari *et al*., 2021). This will definitely increase consumption demands for food and other essentials (Antwi-Afari *et al*., 2021) whose inevitable consequence will be a unprecedented increase of generated solid waste (Ameen and Mourshed, 2017). To prevent detrimental effects to human health and the environment, these produced wastes should be managed (Ferronato and Torretta, 2019). Since many developing country urban centres have very limited land for waste disposal (Smit, 2018), the collected solid waste is often deposited both within and on the outskirts of these urban centres (Smit, 2018). This waste is ultimately thrown into dumpsites often located in the outskirts of the towns where it is poorly and ineffectively managed. The dumped waste end up contaminating the environmental and becomes a health hazard to the surrounding communities (Aluko *et al*., 2021).

The major growth in urban population has been identified to be an influencing factor contributing to the ever-increasing waste generation and subsequent socio-environmental degradation (Ameen and Mourshed, 2017). The unprecedented expansion of these cities and urban centres therefore, negatively impact the management of these waste and other social services that are required for their proper functioning. In developed countries, local devolved units collect, transfer and dispose of produced wastes (Zerbock 2003). In Kenya since 2010, this role has been taken by the county governments (Constitution 2010, county government Act 2012). However, developing country local authorities often lack the infrastructure and ability to provide this basic function (Hettiarachchi *et al*., 2018).

According to (Ogutu *et al*., 2021) various attempts have been raised by the donor community, aid agencies and researchers to enhance the capacity of developing country governments, societies and companies management of solid waste. Unfortunately, most of

these attempts have failed due to lack of public – private partnerships participation in SWM. This has resulted into abandoned installations, funded by these agencies with western expertise within developing countries.

The link between environmental pollution arising from waste dumpsites and public health was established by a study conducted by the United Nations Environmental Programme, (2006) at Dandora Waste Dumpsite in Nairobi, Kenya. This was through carrying out water and soil tests of samples collected within the dumpsite and comparing the results from soil and water collected in areas further from the dumpsite. The study further collected medical tests on humans living in the vicinity of the dumpsite. The results demonstrated that infections arise from contaminated land, water and polluted air (UNEP, 2006) emanating from the dumpsite. This clearly demonstrates that the landfills can be polluted by fluids and leachates generated from the dumped wastes and this can then pose a danger to public and environmental health (United Nations Environment Programme, 2007). The conclusion from this and other similar studies (Norsa'adah *et al*., 2020; Olu and Iyere, 2020; Amugsi *et al*., 2020; Etea *et al*., 2021) have seen an increased interest in researching of the effects and related aspects of SWM in urban centres of many developing countries (Boadi and Kuitunen, 2005; Yongsi, 2008; Aluko and Sridhar 2005 and Nwanta 2010.).

Management of disposed solid waste is part of general prescribed waste management procedures. It therefore needs to conform to the Integrated Waste Management (IWM) processes for sustainable development. McDougal (2001) defines IWM as "an overall approach to waste management; that combines a range of collection and treatment methods to handle all materials in the waste stream in an environmentally effective, economically affordable and socially acceptable way". On the other hand, Hediger (2000) describes IWM as the process of managing solid waste taking into consideration the three triple bottom limes of economic affordability, social acceptability without ignoring the environmental sustainability. It is unfortunate that in many urban areas of developing countries, management of solid waste involve open dumpsites which were located on the outskirts but now within the town's vicinity as a result of urbanisation and migration (Karak *et al*.

2012). This process has been accelerated in Kenyan towns with the introduction of devolved administration system.

It should be noted that, for achievement of environmentally sustainable waste management solutions in resource scarce communities, decisions must be evidence based and this can only be possible through thorough research activities (Yap and Sher 1999). The results of this study will be beneficial in influencing policy, through provision of educating the public, to enable people to be informed and mobilized to positively participate in local engagements. Furthermore, it will mobilise them to manage the wastes they produce in their homes, workplaces, etc. while making them aware of their actions and their implication in policy formulation and planning challenges for SWM in their locality and beyond.

Once waste has been dumped, there are many ways it can reach people to cause a negative impact on them. It can either be directly or indirectly be transferred to them. Directly, it can be through direct contact with dust or other toxic waste releases (Medina, 2002). On the other hand, indirect contamination can be through eating food that has been contaminated through bioaccumulation of toxic substances (crops or animals) or drinking contaminated water (Romanova and Lovell, 2021). Once waste leakages flows to land, it damages terrestrial ecosystems, dirties the environment, reduces land value, and even affects the biological diversity of the concerned land. Once this toxic waste releases reach man's system, they can lead to several health issues such as: complicated respiratory system, skin irritation, eye problems, nose infections, problems in the gastro-intestinal system, it can also elicit allergic reactions and psychological problems (Vinti *et al*., 2021). The waste dumpsite can also provide fertile ground for the proliferation of flies, mosquitoes, rodents and other disease vectors and pathogens. Furthermore, the dumpsite can provide a feeding place for dogs and cats which can be a source of zoonotic diseases.
In spite of these negative impacts, dumpsites can offer positive effects such as a source of employment to waste workers and income to the residents of the surrounding settlements who engage in scavenging of recyclables (valuable items) and selling them (Kibwage 2002).

It is very important to keep the environment clean and less polluted. To attain this, there is need to sustainably manage waste in relation to its effect on the environment, especially on its disposal. It is on this background that this research focuses on studying the health risks and social-environmental effects of disposing solid waste onto Kalundu dumpsite in Kitui Town of Kitui County.

1.2 Statement of the Problem

Haphazard waste dumping especially in open dumping sites is the preferred method of final disposal of MSW in developing countries (Ferronato and Torretta, 2019). The same applies to Kitui County in Kenya. Kitui town, which is the County headquarters and largest town within the county, is faced with many SWM challenges. Solid waste collection, transfer and disposal in Kitui County is bestowed upon the Town Administration unit. However, the Administration unit has little ability to cope with the large amounts of solid waste generated as evidenced in the presence of the uncollected waste along the streets. The little which is collected and transferred is finally disposed at Kalundu dumpsite which derives the name from the adjacent Kalundu slum, a residential area that is surrounded by several businesses, a garage and a cattle traders market. At the edge of the dumpsite, there is the Kalundu River. As a result of improper disposal methods, the dumpsite in Kalundu constitutes an ugly mountain of solid waste with enormous aesthetic, health and environmental implications. When it rains, some wastes from the dump are washed into the Kalundu River thereby exacerbating the health risks to the nearby human settlements. This forms a basis of concern as the presence of this dumpsite, creates a health hazard by degrading the surrounding environment. The haphazardly disposed waste can negatively affect the health of those living in close vicinity of the dumpsite.

Further, Kalundu dumpsite is located within ten metres of the upper side of Kalundu riverbank, at the edge of Kalundu cattle traders market and a motor vehicle garage. Its location at the middle of a slum residential area (Kwa Mbui Sub-Village) renders its location to be inappropriate. The dumpsite is not protected or fenced making it easier for scavengers and animals to flock into and out of it at will without any restriction. This

increases the chances of causing pollution and contamination of neighbouring environment and also transporting pollutants, vectors and even pathogens.

Also, dumping in Kalundu dumpsite is not controlled and therefore the waste is dumped off unprocedurally. Therefore, this makes the status of the dumpsite to risk the health of the scavengers who handle and mingle with the unsorted waste during waste harvesting process. The scavengers come in to conduct with hazardous waste during waste recycling. There is pollution of the water source by waste thrown or flown there from the dumpsite which is too near. These challenges have led to negative implications towards waste management in Kalundu that include unhygienic living conditions, emergence of environmental consequences diseases and environmental degradation. Kitui County government has the responsibility of managing solid waste generated in Kitui town. Its management lacks capacity to implement safe waste disposal options while limited budgets for environmental projects and poor implementation of sound environmental policies and regulations pose several risks associated with the health and safety of Kalundu Dumpsite and that of the people living close by. It is in this background that this study was designed to assess these issues environmental effects and health risks of the Kalundu dumping site to the people living close by.

1.3 Study Objectives

1.3.1 General Objective

To assess environmental effects and health risks associated with disposing of solid waste at Kalundu dumping site in Kitui County on the people living nearby.

1.3.2 Specific Objectives

i. To assess the health risks associated with waste dumped at Kalundu dumpsite on the surrounding residents.
ii. To determine the perceived environmental effects of Kalundu dumpsite by local residents.
iii. To assess residents involvement in managing waste dumped at Kalundu.

1.4 Research questions

i. What health risks can be linked to waste dumping at Kalundu dumpsite on the surrounding residents?
ii. What are the perceived environmental effects of Kalundu dumpsite by local residents?
iii. How are local residents involved in managing the dumped waste in Kalundu dumpsite?

1.5 Justification of the Study

The high housing costs in Kenyan urban centers is making many people to opt to stay in informal settlements located in the centre's outskirts where housing is cheaper. This has been exuberated by the rapid population growth in in urban centres in search of jobs and other opportunities resulting from the emergence of county governments after the 2010 Kenyan constitution was fully implemented. Unfortunately, most of these people cannot afford decent housing and opt to live in peri-urban areas (Lambere, 2011). The abrupt increases in population lead to a failure of the waste management infrastructure leading to haphazard disposal and dumping options. The dumpsites which normally accommodate little waste become overwhelmed because of the lack integrated waste management plans consistent with the rapid increases in waste generation. Furthermore, the location of these dumpsites in slum areas with large numbers of people can adversely affect the health of humans living within the dumpsite vicinity even as it degrades the surrounding environment.

The characteristics of Kalundu dumpsite in Kitui Town of Kitui County offers the best case study opportunity to establish these facts. It is located within ten metres of the Kalundu River, at the edge of Kalundu cattle traders market and a motor vehicle garage. It is also located in a middle of a slum residential area (Kwa Mbui Village). The dumpsite is not fenced making it easier for animals and other vectors to move into and out of it the surrounding human settlements enhancing the chances of transmission of vector/pathogen and pollution. All these make Kalundu dumpsite a great case for this type of study.

1.6 Significance of this research

This study is important to those people directly involved in waste management since it will propose solutions to the challenges facing solid waste management and the effects these challenges pose to the people living close to Kalundu dumping site.

1.6.1 Government

This research study is of great significance to government as it outlines challenges of dealing with haphazard waste disposal in dealing with waste management issues. This can be of benefit for developing policy options that will enhance the involvement of local people in SWM options. The collected data will provide provides some foundational information that will alert relevant agencies in developing countries on the urgent need to deal with the mounting SWM issues in order to achieve the highly sort sustainability of the environment.

1.6.2 Policy makers

The results will provide baseline information that policy makers can use to develop sustainable and integrated solid waste management programs. Furthermore, these results provide a data base for other relevant agencies such as NEMA and county governments. It provides relevant information that is beneficial in formulation of better policies that include better education, proper planning and decision making.

1.6.3 Researchers

The study adds to existing knowledge and therefore is of great significance to researchers. The study recommendation proposes research gaps that need further research, and therefore provides a baseline for other future studies.

1.6.4 Local governments

Finally, the study results will enhance the development of policies and structure aimed at controlling haphazard solid waste disposal in Kalundu area and Kitui town at large.

1.7 Study scope

This study was carried out in Kalundu in Kitui Town and targeted the people living in close proximity to Kalundu dumpsite. The study limited its scope on the assessment of the environmental effects and health associated risks to those people that live within 500 metres of Kalundu dumpsite. It will only examine the frequency of people surrounding the dumping site getting ill, the local community's perception towards their residential environment in relation to the location of the dumpsite and to ascertain the level of the local community's awareness (knowledge) in environmental pollution and their attitude, responsibility and participation on solid waste reduction methods.

1.8 Study Assumption

1. The sampled household heads participated freely without any coercion and that the information they availed was not prejudiced or biased.
2. The sample size chosen provided essential data to answer the research questions adequately. The sample represented the entire population and that the results attained gave a true reflection of what is on the ground.

1.9 Definition of Terms

A**ttitude -** believes focused on specific objects (may be physical, social, concrete or even abstract) or a situation that predisposes an individual to respond in a preferential way.

Augment – to add to, or enhance, or boost, it can also mean expansion, enlargement or supplement.

Integrated waste management - The overall approach to waste management that entails collection and treatment methods that handle all materials in the waste stream in an environmentally effective, economically affordable and socially acceptable way.

Open dump – site used to dispose solid waste in most cases indiscriminately. Very little protective measures are put in such places to control on-going operations or to protect the surrounding environment from any harm.

Solid waste management – the administration and coordination of SWM activities that include waste collection, source separation, its storage, transport and transfer, processing and any associated treatment and its final disposal.

Solid waste – This is solid waste material, that can be either organic or inorganic that has lost its value. It is produced in households, markets or from industrial, commercial or institutional activities.

Sustainability – The ability of the environment to conform to the triple bottom-line principles of environment, economics and social aspects.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

According to the World Health Organisation (2007), waste is anything that has no value and the owner does not want. This means that it is something that has no market value, at least to the eyes of the owner. The waste can be generated from different human activities. When the waste arises from residential houses, industrial activities, commercial operations institutional engagements, and even in construction of buildings and structures and demolitions of the same is generally called municipal solid waste (Rachel *et al*., 2009). Depending on their origin, they can are divided into several categories. For example, household waste originates from homesteads, industrial waste from industries, and biomedical waste from hospitals.

Because of the negative consequences the generated waste material can have environment coupled with the risk of causing human disease, their management are intrinsically linked to human advancement. They have been historically managed through burying in pits, burning, dumping into water etc. (Ndwiga *et al*., 2019). However, when urban population increased with subsequent increase in waste generation, these wastes were viewed as a human and environmental health threat (McGill, 2018). It therefore led to the development of advanced technological waste management technologies (Nathanson, 1996).

In the urban centres of developing countries, open dumping i.e. land disposal (disposing waste material onto land) is the most common method of final waste treatment (Muiruri *et al*., 2020).). The disposal sites often referred to as dumpsites are found within or in the outskirts of these centres. There is a projected increase of urban population in many African urban centres as we approach 2050 (UN-Habitat, 2010). This population increase will also mean increased use of resources and a tremendous increase in waste generation. The waste will ultimately be thrown into the waste disposal sites which are poorly and ineffectively managed coupled with deteriorating living standards and poor environmental management awareness and governance levels (Rachel *et al*., 2009). These dumpsites could enhance the

chances of disease infection to people and have a deleterious effect to the environment especially on people residing near to these dumping sites (Wilson *et al*., 2009).

2.2 Effects of dumpsites to the surrounding communities.

Solid waste is currently disposed onto three categories of landfills (Madon *et al*., 2019). They include (i) the secured landfill which is again referred to as sanitary landfill. These ate safely constructed in a secure way that minimises negative effects to the environment by securing the waste in a closet comprising a depression into the ground that prevents leaching of waste material out of the landfill; (ii) the second type is the controlled landfill where waste is dumped and then soil is used to provide a cover to the waste; finally, (iii) open dumps where waste is haphazardly dumped without any mitigating factor (Gouveia and do Prado, 2010).

Sanitary landfills are more common in the developing countries but because of the cost involved in their construction and maintenance, they are out of reach for developing countries. Even though controlled dumpsites can be found in developing countries, the haphazard dumping is the preference method because of the cost implications. This method actually has several implications to the environment and health of the people in the location it happens. For example, in Sao Paulo only 47 per cent of collected waste is dumped in sanitary landfills while 23 per cent is dumped in controlled ones. The balance of 30 per cent of the waste is actually dumped in the uncontrolled open dumping sites (Gouveia and Prado, 2010). Another example is Manzini, a city in Swaziland, where open dumping is the preferred waste disposal option (Abul, 2010). This study also discovered the challenges these dumped waste posed to the local community especially on health of those living in close proximity to the dumping sites. In this study, just like in many developing country urban centres, these dumping sites were located in the outskirts of the urban centres where provided conducive environment for breeding disease causing vectors and pathogens (Abul, 2010). Because of cost implications, several developing country authorities have mulled to develop cost reduction measures and yearned towards adopting the 3Rs waste management strategy of "reduce, reuse, and recycle" (Ferronato and Torretta, 2019). Unfortunately, for this to be a success, people should be engaged, educated and involved

in every stage of waste management from generation to disposal (Goldman and Ogishi, 2001). Such activities will not only improve on the people's environment but can also have economic implications and enhance peoples' livelihoods.

Because of the implications of haphazard waste dumping in majority of the developing countries, there is an urgent need to assess the environmental and health consequences especially to the people living in the areas close to the dumping sites. This was actually the case in Cameroon where there was a positive link between solid waste management methods and disease incidence (Yongsi, 2008). The diseases identified included diarrhoea among others. A similar study carried out in Swaziland yielded the same results (Abul, 2010). The Swaziland study, divided respondents according to the distance they resided from the dumping site. Thus, one group comprised of those living within 200 metres of the dumpsite and another living beyond the 200 m radius of the dumpsite. In this study, a negative association was established between home distance from the dumpsite and negative impact from the pollution arising from the waste disposed in the site. Another study that was designed to investigate how dumpsite pollution impacts public health in Nairobi's Dandora dumping site also demonstrated a strong link between the two (UNEP, 2010). It established that the presence of heavy metals in waste discharges can have negative effects to people's health. Further, carrying out medical check-ups on individuals in two categories (those near the dumpsite and further afield) revealed the same results with those near the dumpsite having significant respiratory issues. Their blood also had higher levels of heavy metals that exceeded the international allowed limits (UNEP, 2007).

There are limited studies related to SWM in Kitui. The only available carried out in Mutomo – Kitui, Kenya reported the importance of health education of managing generated waste (Selin, 2013).. The study recommended increasing the number of dustbins and increasing the number of waste workers. To attain sustainable waste management, local action by all those responsible should be prioritised. There is need for cooperation between the local authority leaders, the public health sector and the private sector. This will be able to provide efficient tools that can be used to initiate measures of collaboration between people in the community and their leaders.

2.3 Health Risks of living close to solid waste dumpsites

Because it has been shown that haphazard dumping of waste and not managing it well can lead to ill-health (Rachel et al., 2009; Abul, 2010), it is very important to assess the environmental and health risks of open dumpsites to the surrounding inhabitants. Solid waste is defined as the end product of human activity (Martin and Odell, 1995). It is either be organic or inorganic arising from household operations, commercial enterprises, industrial activities and institutional operations and the owner has no value of the end product (Cointreau, 1982).

When SWM and its disposal are not done properly, it can lead to serious health impacts on people living in close proximity to dumping sites. The most vulnerable people from haphazard waste dumping are the people living close to the dumpsites and those who are likely to use contaminated water by leachate from these dumpsites. There are also high probabilities of being injured by uncollected solid waste especially during recycling process and infection when in contact with contaminated waste (Cannata *et al*. 1997).

Wastes from health centres or hospitals when not well managed pose serious health problems especially concerned with infectious diseases. The incubation and proliferation of disease vectors and pathogens in the open dumpsites can enhance the risks of infecting people with associated diseases especially children whose defence organs have not fully developed (Mattiello et al., 2013).

Eight distinct pathways have been identified that contaminants from waste can reach man (Chang *et al*., 2001). Once they are transmitted to humans, they will negatively impact human health. These include:

1. Pollutant transmitted to man via soil.
2. Pollutant transmitted to man by eating crops planted in infected soil.
3. Pollutant transmitted to man after eating animals that have grazed on infected plants.
4. Pollutant transmitted to man from an infected dust in the atmosphere.

5. Pollutant transmitted to man through infected water in surface runoff in surface water.
6. Pollutant transmitted to man through infected water in groundwater.
7. Pollutant transmitted through infected animal directly from the waste material.
8. Pollutant transmitted to man through infected airborne particulate matter.

From the above pathways, it can be observed that waste mishandling will at end come back to haunt humans where it negatively impact their health through the bioaccumulation and bio-magnification of toxic compounds in the food chain. Some of the health risks associated with dumpsites on human health are highlighted below according to the type of waste.

2.3.1 Organic waste

This are wastes capable of decomposition. Through the fermentation process, they seriously impact human health by providing suitable conditions that favour the proliferation of disease pathogens such as bacteria, fungi and other microbes. When a person comes into contact directly with these pathogens, they are infected with a variety of diseases. The most vulnerable people are the those directly involved in SWM such as waste pickers, and those involved in recycling activities (Vimercati *et al*. 2016; Heldal *et al*., 2003).

2.3.2 Clinical and Hazardous waste

Exposure to clinical waste resulting from hospital and other health facilities are dangerous because of its propensity to spread infectious diseases. Furthermore, toxic poisoning can result once these waste toxins are released into the environment. Children are the most affected because they not only play waste material but their bodies are not fully developed. Links between hazardous waste and human health have been established (Jarup, 2003).

2.3.3 Unattended waste

When waste is left unattended and in unhygienic condition, it becomes a habitat for harmful organisms that can easily act as a medium of spreading disease. For example, flies can be

attracted to such waste as a feeding and bleeding ground, same as rats, mosquitoes and other disease vectors. Decomposing waste also release leachate which not only releases bad smell but can also infect both ground and surface water. Such situation creates suitable conditions for increased health risks and can easily affect those living near to dumpsites. Diseases that can result from these interactions include stomach pain, diarrhoea, common cold, coughing, skin disorders, malaria, allergy among others (Sankoh *et al*., 2013; Brender *et al*., 2011; Vrijheid, 2000).

Figure 1: Photography showing solid waste disposed off haphazardly in kalundu

2.3.4 Plastic waste

Plastics usage has increased over the last few years. When they are unsustainably utilised and haphazardly discarded, the inherent toxic compounds within them are released to the environment where they are of serious concern (Jiang *et al*., 2020). They also harbour carcinogenic compounds and traces of heavy metals that include copper, lead, cobalt, cadmium and even selenium. It should be noted that the use of these plastics has been banned or their use is heavily regulated in many countries including Kenya (Behuria, 2021).

2.3.5 Chemical waste

Many chemicals contained in waste material are highly toxic when exposed to human, animals or even plants. These chemicals include mercury, cyanides and several types of phenyls which have highly toxic compounds which not only cause disease but can be fatal. Links have been established where exposure to some of these chemicals has led to cancer and other health issues (Duruibe *et al*., 2007; Jarup, 2003).

2.3.6 Hospital and Medical waste

Hospital and other hazardous waste that includes all other medical waste streams require special treatment since because of their propensity to cause major health risks. This waste stream arises from health centres, hospitals, laboratories dealing with medicine examinations, health care centres and research institutions involved in medical research that include discarded used syringes and needles, waste bandaging materials, plasters, swabs, and related contaminated substances (Niyongabo et al., 2019).

2.3.7 Waste disposal and treatment sites

These facilities when not managed well would provide key sources of various health hazards for the neighbourhood where they are located. Incineration plants that are improperly operated can cause air pollution while landfills that are not well build and managed can entice harmful organisms into them like rodents, insects and microbes that can transmit diseases to locals. It is therefore important to locate these facilities away from residential areas. It is necessary that they should be well lined and walled to prevent leakages into the nearby ground water sources (Yadav *et al*., 2018).

2.3.8 Recycling process

Without proper precautions, this too can carry health risks. This is especially toxic exposure to those working with toxic wastes contained in chemicals and metals. Health care waste disposal requires special attention because it can be a source of serious risks to human and environmental health. This can be through unsegregated waste that can contain harmful substances like syringes and needles that can harm and cause disease to waste workers involved in scavenging at waste in dumpsites for recyclables (Zafar, 2019).

2.3.9 Other Infections arising from solid waste

Several other contaminations and contagions can result from solid waste. These include, blood and skin infections caused when an individual comes into contact with contaminated waste, inhales or ingests infected substances, etc. during normal duties especially on those involved in SWM operations. In many instances, these waste dumping sites are not fenced and therefore animals such as stray dogs, snakes, rodents, mosquitoes, etc. can easily go into and come out of these sites. There may be instances when these animals bite humans. When this happens, the chance is that they will transmit diseases some of which are deadlier such as rabies from dogs or snake bite poison. Mosquitoes too transmit malaria. Similarly, there are cases where contact with the waste can transmit cancer through exposure to carcinogen substances within the waste such as batteries and other electronic waste materials (Song'oro 2019).

Most of the waste scavengers in these dumpsites lack health and safety facilities and are most vulnerable to occupational hazards that include but are not limited to lifting strains, injuries from sharp objects and other accidents. The fact that local administrations do not provide separate waste segregation/collection facilities worsens these scenarios since material that may be infected within the waste (e.g. chemicals, bottles, glass, hypodermic syringes and other hospital generated waste materials, blades, etc.) risk injuring or poisoning the waste workers or even playing children (Davis and Cornwell, 2008).

2.4 Environmental effects of solid waste dumpsites

When solid waste is improperly managed, it can result in degradation of the environments. This is what happens in developing countries urban centres (Rachel *et al*., 2009). Some of the environmental effects are destruction of the ecosystems through pollution of water, air, land and vegetation. Also, smelly, filthy, dirty and an un-aesthetic environment is observed in the residential environments of the nearby residents (UNEP, 2007).

2.4.1 Water Pollution

Waste dumped near a water source causes contamination of the water body or the ground water source (De Feo *et al*., 2013). Furthermore, the proximity of a dumpsite will have

significant negative impacts on property values (Mmom and Mbee, 2013; Bouvier *et al*., 2000).

2.4.2 Air Pollution

Dumpsites can be an environmental menace to the surrounding where it can contaminate breathing air (Marshal, 1995) through resulting emissions that not only causes diseases to people but can be of an environmental concern. For example, they contribute to the anthropogenic greenhouse gas emissions mostly methane resulting from the decompositions of dumped organic waste in and other gaseous chemical contaminants, volatile organic contaminants and dust (De Feo *et al*., 2013; Sakawi *et al*., 2011; Kumar *et al*., 2004; Wrensh, 1990). Methane is one of the potent greenhouse gases; together with other landfill generated gases, they can have a deleterious effect not only to the environment, but also to human health once introduced into the ecosystem (Boningari and Smirniotis, 2016). For example, when the gases reach the atmosphere they fall down as acid rain and can have a negative effect on the growth of plants (Swain and Padhi, 2015).

2.4.3 Polluted Soil

Once waste is released to land, the most likely consequence is contamination of the soil in the point of release or leachate path if the waste is in fluid form. In most developing countries these method is very common especially in urban areas of these countries (Karak *et al*., 2012) whose dumping sites are located in the peri-urban areas that practice agriculture and therefore this wastes can easily contaminates soil used in agricultural activities. When organic waste deposited in these sites decompose, it decays and returns to the environments (Karak *et al*., 2012), in different forms mostly comprising of simplified organic compounds like H_2O, CO_2, NH_4, CH_4, etc. (Karak *et al*., 2012). On the other hand, there is the waste comprising of non-degradable material such as plastic polymers, metals etc. which persist in the environment for long once released. Here, they provide both environmental and economic challenges to clean. The harmful compounds in these plastics that often contain heavy metals that are highly toxic are released to the environment. Examples of these metals include cobalt, copper, chromium, lead, cadmium and selenium. These compounds degrade the soil environment once they get contact to it (Essien *et al*.,

2019). Because of these, most of the plastic materials especially the coloured ones have been banned in developed countries unlike developing countries. Further, polythene plastic bags cause an aesthetic nuisance and cause injury to livestock or even death of animals if eaten (Tchobanoglous, *et al*., 1993).

In Africa, environmental concerns have been shown to cause problems to the surrounding environment (Karak *et al*., 2012). These calls for their location in designate areas where they can be managed to mitigate these negative impacts to nearby communities (Chander *et al*., 2007). Otherwise, if nothing is done, it would be dangerous and very expensive to rectify the situation once the harm will have been done.

Agricultural and industrial waste too can also cause serious harm to the environment. For example, the chemicals used in agriculture, crop cuttings, containers, animal product wastes from agriculture and industrial leachate and other by-products from industrial activities which can contaminate soil and water, can contain harmful toxins, can pollute the air we breathe, or even contain radioactive hazardous material among other effects (Rana and Ganguly, 2020). Uncollected solid wastes that are haphazardly dumped in the streets can actually block drainage systems which can result in floods during heavy rains, can lead to filthy and smelly environment and lead to the formation of stagnant water bodies which is not only a health hazard but also an environment problem (Muthuraman and Ramaswamy, 2019). When this untreated waste is dumped into water bodies, it can accumulate the toxic material in them such that it will be transmitted to animals and plants residing in the water where they will be transmitted to higher animals in the food chain through bioaccumulation and bio-magnification (Sonone *et al*., 2020). This also applies to dumped waste close to water ways and sources. This is because once the leakages enter water ways; they result in bioaccumulation of these dangerous substances in the primary producers, secondary producers and can actually end up in humans through the food chain (Medina, 2002).

2.5 Public Participation and Attitudes towards SWM

The lack of technical, human, financial and structural resources in the SWM sector coupled with the unprescented increase in population of developing country urban centres, the issue of waste management has become even more challenging. This is because the quantity, quality and composition of generated waste is becoming so varied even has the change of status change consumption behaviour of the people (Hoornweg and Laura, 1999). In Kenya, the responsibility for waste management is placed on county governments under the 2010 constitution. Much of the waste generated in the third world countries is organic. This is disadvantageous because the nature of this waste is easily decomposable and therefore not good for long-term recycling safe composting or incineration to recover energy which is actually expensive (Hoornweg and Laura, 1999). This leaved dumping this waste into open spaces (open dumping) the most viable option in these countries where they have not only become a nuisance but also of great environmental burden (Oduro, 2004). In spite of these, it is possible to collect some recyclable and valuable materials from these waste streams.

In Kitui, garbage is dumped into streets, open drains, rivers and illegal dumpsites, where they create serious pollution challenges and harbour conducive habitat for breeding disease causing vectors and pathogens. It is therefore important to assess what local people in this dumpsite perceive in relation to dumped waste within their community. It has been found that people react in different ways. While some respond positively by participating in sustainable ways of dealing with the dumped waste (Ameen and Mourshed, 2017), others will continue to actually deal with it in an haphazard way like dispersing it into waterways, open drains, pits or even onto land. It is therefore important to know how individuals react towards the management of waste dumped in their vicinity, a character influenced by their attitude and situation. Attitudes comprise of believes that predispose an individual to respond in a particular manner (Rokeach 1968).

If an integrated SWM approach will be practiced in Kitui, it will provide an avenue through which the town can sustainably manage its waste. This study is therefore important since it may benefit Kitui by proposing an ISWM model for the town. It will emphasise a local

focus by involving those people who are most affected by the dumping of waste in Kalundu. This is necessary for the dumpsite's long-term maintenance (van de Klundert and Anschutz, 1999).

This approach of sustainability will involve a mixture of the county government authorities and locals at Kalundu and will encourage the use of the 5Rs (Reduce, Reuse, Recycle, Recycle, Recover, Refuse). In this case, it will result to generation of less waste, increased reuse and recycling and if possible energy recovery from the waste, composting and lastly anaerobic biogas production before disposal (Medina, 2002; Zerboc, 2003).

By involving all the stakeholders, it will be possible to come up with decisions that will create a desired outcome in SWM in Kitui. Further, through educating the residents it will create awareness and enhance the people's participation regarding managing the dumped waste for example to hasten public participation in recycling and decision making. This has been actually demonstrated scientifically where participation in recycling activities was greatly enhanced significantly through imparting knowledge on the same to participants (Vining and Ebreo, 1992; Derkson and Gartell, 1993; Schultz and Oskamp, 1996).

Including all the relevant people involved in the waste management sector can enhance opportunities for job creation and a source of livelihood for many locals. It also contributes to the reduction of pollution while conserving natural resources (Medina, 2002). Actually, the propensity of reusing and recycling waste products is one desired method of sustainable management of waste as it would discourage use of resources (2002). An example is in Kenya where glass bottled soft drinks sold by the Coca-cola Company are recycled by a customer either consuming the drink instantly or leaving a deposit behind that will be collected when the bottle is returned. This return policy means that the same bottle will be used several times by the company. Here, the bottle producer doesn't require producing new ones. It is unfortunate however that the recycling option which is well advanced in the developed countries may not be a very viable option in the developing countries because of the compositional nature of the generated waste. Other inherent factors preventing recycling include lack of efficient waste segregation to prevent mixture of different waste

categories. It is common to find items of value that can be reused mixed and discarded together with organic waste.

In spite of this, many people agree that waste has become an issue that needs to be dealt with. Nevertheless, this recognition has not influenced the behaviour of citizens to stop haphazard littering or participate actively in sustainable SWM practices (Moore, 2012). This may be attributed to several reasons that include: access, unwritten rules, peoples' attitudes, convenience, inadequate information and knowledge of appropriate techniques and lack of awareness (Milea, 2009; O'Connell, 2011).

These attributes, may account for the difference on people's inaction and environmental issues that can be attributed to solid wastes and even their personal conduct on the same e.g. reusing, recycling, segregating and even disposing wastes they themselves generate (O'Connell, 2011). There are several reasons that can result in throwing off waste haphazardly into the environment. For example, when the authorities have no capacity to enforce dumping regulations, when there is nothing to pressure people not to litter, lack of relevant knowledge and environmental information, or when authorities are not able to enforce compliance and administer punishment for those who don't comply (Al-Khatib *et al*., 2009). This was actually demonstrated in Cuba where there was a link between peoples' attitudes and pro-environmental behaviour (Heri and Mosler, 2008). Governments can support these efforts for economic reasons and for social pressures resulting from stakeholders. In this case, citizens will be encouraged to change behaviour and adapt to the new norms. Those who don't adapt will feel left behind and are despised by others since they will be viewed as outsiders (Heri and Mosler, 2008).

Another study from Gaborone in Botswana, gave conflicting results. It established that even when people are made aware of sustainable waste management practices; it does not translate to their involvement in practicing the same. The respondents in this study did not embrace sustainable SWM because of their knowledge on the same (Bolaane, 2006). This non-participation maybe attributed to culture, attitudes, and other local engagements. For

successful implementation and people participation in sustainable SWM, all stakeholders should be involved and be ready to take responsibility of their actions (Poswa, 2001).

The importance of making people aware of and encouraging them to participate in community SWM activities has gained an interest among researchers recently as prerequisite in enhancing sustainable waste management systems that promote environmental citizenship amongst community members (Pérez *et al*., 2017). In general, individuals will be actively involved in SWM processes if these activities are practiced within their locality and by people they know and can relate with (Pérez *et al*., 2017).

When people are fully aware of their actions on the environment it can positively influence their recycling attitudes (Aini *et al*., 2002). Waste managers should therefore take steps that link information they present to the public with the knowledge that is not already in the public domain. The aim should be to cover the deficit gap and enhance the people's involvement in waste management programs.

2.6 Legislation and Policy on Waste Disposal

Many cities of developing countries lack sound legislation of solid waste and when they are present, they lack the capacity to enforce the same (Guerrero *et al*., 2013). This is more so the case for hazardous, electric, radioactive and hospital waste which is more dangerous because of its effect not only on residents but also on the environment (Manzoor and Sharma, 2019). The fact that most of these generated wastes are haphazardly dumped into open places without any protective measures actually makes this a matter of concern that should be urgently dealt with.

What is happening in the developing world was actually happening in the United States in the 1960 where open air burning of waste was the preferred was disposal option. The US congress responded to this by coming up with the Solid Waste Disposal Act of 1965 which was later amended to the Clean Air Act. The two piece of legislation were meant to ensure better options of deposing off waste that took environment into consideration.

Later the SWDA was amended resulting to the Resource Conservation and Recovery Act (RCRA), which enhanced the participation of government authorities' onto the SWM sector. This provided baseline legislated mechanisms to enforce Laws, Policies, Acts and Regulations on environmental protection worldwide.

The RCRA, an amendment to the SWDA, was enacted in 1976 with the aim of addressing the huge solid waste generated countrywide in USA. This legislation has a mandate of protecting people from the harm caused by hazards associated with the disposal of waste and related by-products, the conservation of energy and natural resources through recovery processes, and the overall reduction of produced wastes. The overall goal of this was to ensure that generated waste is sustainably and environmentally managed. This would ensure a cleaner environment by limiting negative impacts of waste to the environment and human health.

Just like other countries, Kenya has also formulated laws, by-laws, Acts of Parliament and related regulations to deal with waste issues. The most prominent one is the Environmental Management and Co-ordination Act (EMCA No. 8 of 1999). This legislation formulated the mechanisms of dealing with environmental issues in the country. Solid waste issues are dealt with in Section 87 which provides the guidelines on how this waste is handled and disposed. According to Section 87(1) of this Act, it is illegal to dispose off waste no matter the source in a way that can endanger environmental or the health of an individual. It is mandatory that this waste should be treated appropriately before release to the environment; this is stipulated in Section 87(5) of this Act.

It is however unfortunate that with all of these regulations, the Dandora dumpsite in Nairobi, the focal dumping site of waste generated in Kenya's capital city is operating without a NEMA license. This is in contravention with section 88(1) and (2) of the EMCA 1999 Act. This is in-spite of NEMA having powers provided for in Section 90 to terminate operations of non-compliance operators. Actually Kalundu dumpsite in Kitui is also operating in the same scenario as Dandora. Kitui County Government has not been able to

formulate any draft legislations to deal with the solid waste menace within the county in the form of By-laws since its inception.

2.7 Conceptual Framework

Distance from the dumpsite was considered an independent variable while the depended variables were the health risks identified by residents, perceived environmental effects, and residents' awareness and participation in SWM processes. These relationships between variables in this study are shown in figure Figure 2 below.

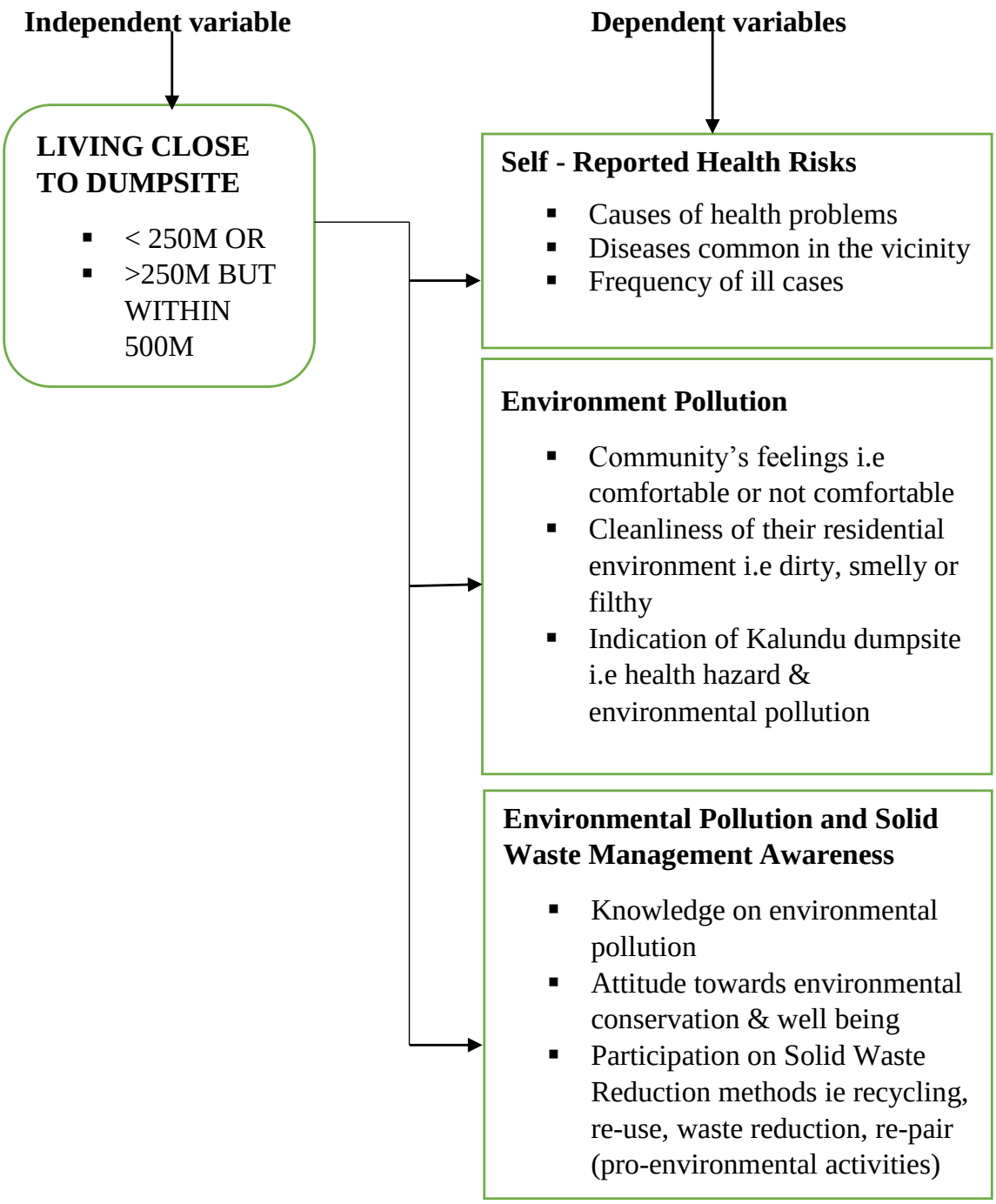

Figure 2: Conceptual Framework: constructed by the author, 2020

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

Here, data collection methods that include techniques employed during data collection over the study period are discussed.

3.2 Study Area

This research was carried out in Kitui Town. Kitui lies between latitudes 0º10 and 3º0 South and longitudes 37º50 and 39º0 East. Kitui town is headquartering Kitui County, which is bordered to seven other counties (Figure 3). Kitui is situated 180 km from Nairobi and 105 km from Machakos. There is a high influx of people into the town since the advent of devolution in Kenya.

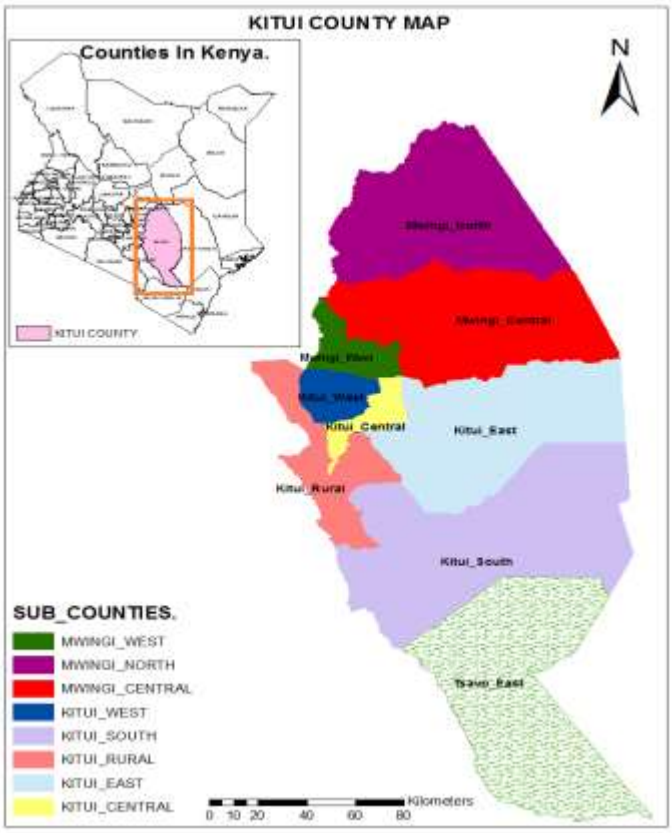

Figure 1 Map showing location of Kitui County and its Administration in Kenya

Kalundu open dumpsite is currently the only point where all generated and collected waste in Kitui town is disposed. It lies in Kitui Central Sub County, Kitui Township Ward in Kalundu village. Kalundu locality is at the entrance of Kitui Town along Kitui– Kibwezi road (A9 road) from Machakos direction (Figure 4).

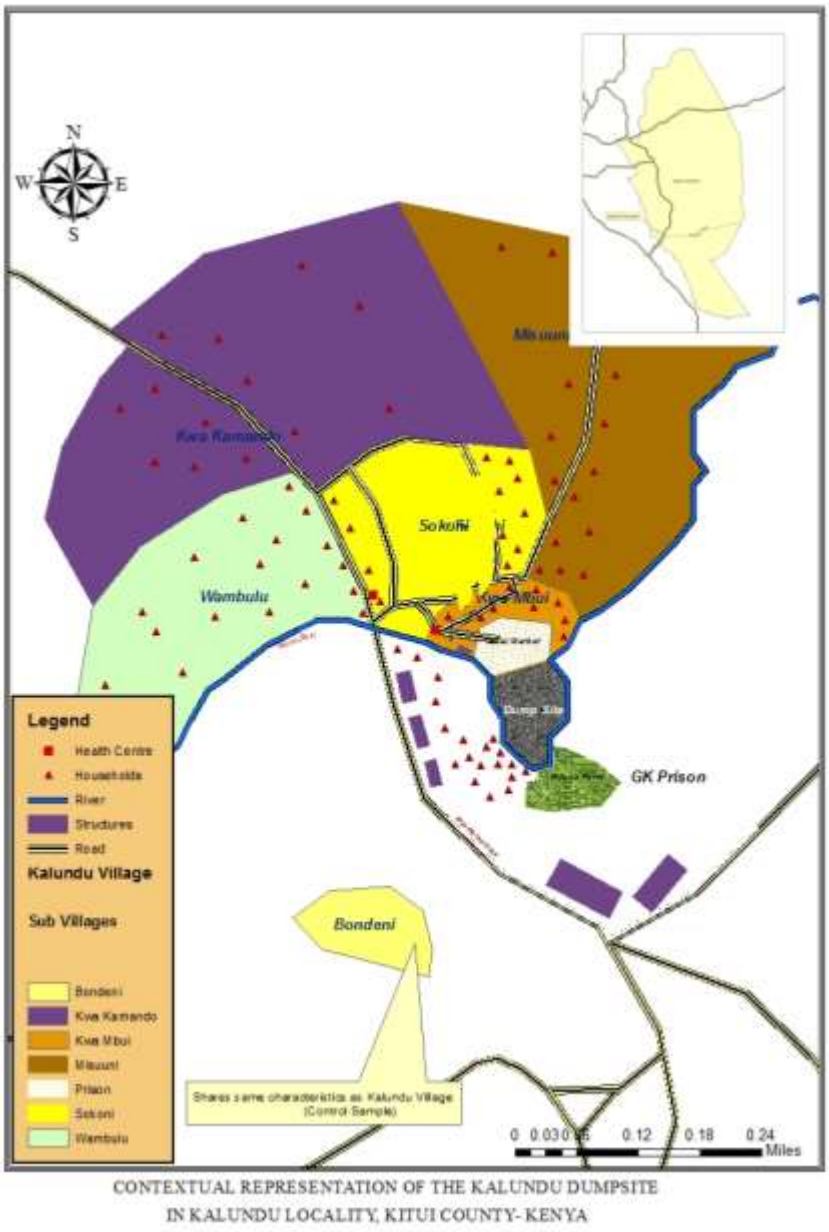

Figure 2 Location of Kalundu Dumpsite in kalundu locality, Kitui county- Kenya Source; GIS Field Survey

3.2.1 Population of Kitui County

According to the 2019 census, there are 1, 136, 187 people in Kitui County that comprises 262,942 households in an area covering 30,430 km^2. Kitui County constitutes of 2.6% of the national population with 52% being female and 48% being male (Census 2019). Kitui town is the largest urban population taking 10.8% of the county's population and Mwingi 1.6%, respectively. Kitui County has a population density of 37/km^2, lower than the national population density of 94/km^2. Kitui town, which is the location of this study, has 155,896 people residing there (2009 Census) and it is the 12th urban centre in the country in terms of number of people.

3.2.2 Administration of Kitui County.

There are eight sub-cunties in Kitui County which are further sub-divided into forty different wards and 247 villages.

3.2.3 Climatic features of Kitui

Kitui County is hot with temperatures ranging from 14°C in July-August which happens to be the coldest months to 34°C in January-March which are the hottest months. Annual rainfall ranges from 500mm to 1050mm averaging 900mm. There are two rainy seasons; the short rains between April and May and the long rains between October and December.

3.2.4 Kitui Economy

The economy of the county is mainly anchored in agriculture. Most farmers within the county are subsistence with cotton, tobacco, sisal, pigeon peas, beans, maize, cassava, millet, sorghum, green grams and mangoes being the common crops. The crops have adapted to the climatic conditions of area. These crop produce are either consumed locally or sold to traders from Nairobi, Machakos, and neighbouring counties. Farmers here also keep small numbers of livestock to provide surplus income. A low key activity is tourism, where hotels and lodges build to cater for visitors coming there for business and leisure. There are also a number of tourist attraction sites such as South Kitui Reserve, and Mwingi Reserve attract vistors to the area as well as baskets and wood carvings cottage industry.

3.2.5 Health Facilities

There are a number of hospitals and health facilities in the county to cater for the needs of locals. They include Kitui General Hospital, Nema Hospital, and Jordan among others. In the study location, there are four private health facilities located in Kalundu village, which formed a Key informant groups for data collection in this study.

3.2.6 Religion and Culture of Kitui County Residents

Christianity is the main religion practiced in by Kitui residents with Catholicism comprising the majority and minor percentages of the African Inland Church (AIC), IPC, Redeemed among others. There is a significant Muslim community with several mosques already build in the county's urban centres. Traditional beliefs are being neglected by majority of the population. The Akamba refer to their god as *Mulungu* or *Asa in Kikamba.* Men were hunters, herders, carvers among other menial jobs while women did domestic chores including the rearing of children and tending to farms.

3.3 Research Design

A descriptive survey research method was used in this study. The researcher employed field observations and structured questionnaires to households. Interview guides for SSCS CGoKTI and Health Officers in health centres within Kalundu and a focus group discussion with waste pickers (scavengers) and business people (those trading in the Kalundu Market, and cattle trading plus the garage workers near the dumpsite.

3.3.1 Sampling Procedure

Stratified sampling technique was used to collect data on the target the people living in close proximity to the dumpsite vicinity in a radius of 500 meters. In order to assess the effects of people living close to dumpsite on social-environmental aspects and health risks, stratified sampling method was adopted. It was crucial to divide the study area into two for the purpose of obtaining two strata (layers) of the respondents, thus those very close to the dumpsite (less than<250 meters), and those beyond 250 meters but fall within the 500 meters range.

This distance of 500 metres radius from the dumpsite was guided by reliability of the expected research data results., and the formula below was used to determine the number of respondents (Kothari, 2004). Due to financial and time constraints, the number of responded households within 500 metres radius from the dumpsite periphery was determined by the use of random sampling prior to administration of household questionnaires. The formula recommended by Zuelueta and Clostaled (2009), was used to determine the sample size.

$$n = \frac{N}{1+Ne^2} \qquad \text{Equation 1}$$

Where

n = Sample size

N =Population size = 3200

e = margin of error = (≤ 0.07)

Therefore size n = 3200/(1+3200 X〖0.07〗^2) = 78 respondents

By use of this formula, it was determined that 78 household respondents were required**.** Since stratified sampling was employed, respondents were selected from the two stratified layers (i) those lying within between 0-250 metres from the edge of the dumpsite and those between 250 and 500 metres of the dumpsite periphery.

The questionnaires were randomly administered to the two layers. The study administered questionnaires to residents who had resided in the study area for over 7 years thus before the establishment of Kalundu dumpsite. This was to select only those respondents with the information needed for the study. The data collected was qualitative and was used to identify the frequency of health risks of living close to dumpsite, to examine the local community's perception towards their residential environment in relation to the dumpsite and to ascertain the local community's awareness on environmental pollution, their attitude, and participation in solid waste reduction methods.

The Senior Supervisor Cleaning Services (SSCS) and the health officers were also interviewed. SSCS is the officer in charge of cleaning services, and all issues related to

SWM in Kitui town, while health officers were from the health facilities located in Kalundu. The data collected from this second group of respondents was qualitative. In a similar manner, waste pickers who are involved on day to day scavenging in the dumpsite, animals' traders and garage workers just adjacent to the dumpsite also administered the questionnaire.

3.3.2 Research Instruments

Both primary and secondary data collection methods were employed.

(i) Primary data collection

For effective identification of frequency of health risks of people living near the dumpsite, to examine the respondents' perception on their residential environment in relation to dumpsite and to ascertain the respondents' awareness on environmental pollution and SWM, attitude and participation in SWRM, a household heads' questionnaires was utilised. This data was augmented by records of visitation to the local health facilities and researcher's physical observation on the dumpsite. The various techniques that were employed to gather relevant information are described as below.

a. *Field Observation and socialisation*

This involved walking around the Kalundu solid waste dumpsite by the researcher, observing and photographing the environmental conditions (burning of solid waste, bad odour from rotting organic waste and state of the dumpsite) and any activities happening in the dumpsite.

It also involved socialising with the waste pickers (scavengers) and nearby residents living close to the dumpsite for obtaining data required for the study. Photographs were taken throughout as a physical demonstration of the conditions on the ground.

b. *Household heads' Surveys*

To get respondents' self - reported health risk, their perception on their residential environment in connection to the presence of dumpsite, and their levels of awareness on environmental pollution and SWM, attitude and participation in SWRM, semi-structured questionnaires were used. They were administered to the household heads. A total of 78 questionnaires were distributed to household heads for both group 1 and 2 (<250 meters and >250 meters) from the dumpsite. This comprised 39 respondents from households within distances <250 meters and 39 respondents from household beyond distance >250 meters from the dumpsite. The questionnaire was divided to several sub-sections as per data needed (Appendix 1).

The questions asked were meant to provide answers about knowledge on how respondents ensured that they were not negatively impacted from health risks associated with the presence of Kalundu dumping site in their vicinity. They also requested their suggestion on solid waste management system applied in Kitui town. Another sub-section was on the respondents' demographic aspects e.g. how far they live from the dumpsite, gender, marital status, age, levels of education, employment status and monthly income. This was important as it provided their personal and socio-economic characteristics.

c. *Waste worker and Health Officers interviews*

The first type of interview schedule was directed to the Senior Supervisor Cleaning Services (SSCS) County Government of Kitui. This is the person responsible for SWM in Kitui town. He is stationed at the dumpsite (Kalundu) where he is always located especially during solid waste dumping. The interview schedule was formulated in a way to collect as much information as possible on SWM systems invKitui.

Another second type of interview schedule was directed to the three Health Officers each stationed at the three health centres found in the vicinity of Kalundu village. This concentrated on disease outbreaks in the community, their views on relationship between disease and residence proximity to the dumpsite, disease prevalence, age group most vulnerable, their preferred waste disposal methods and their suggestions on corrective measures to alleviate the waste management problem in the area.

(ii) Secondary data collection

Secondary data was generated by reviewing the relevant empirical literature available in various published and unpublished research studies, journals, reports, internet sources, national census, area chief report and library books. This data was analysed to in order to answer the research questions and also put the study under an acceptable body of knowledge on social-environmental effects and health risks of living near a dumpsite.

3.3.3 Instruments Reliability

The instruments reliability was tested through performing a pilot assessment prior to the real sampling to assure respondents were conversant with the questions and also to understand the requirements and test data instruments. This was also important since it revealed the amount of time required to answer the questionnaire, and if there were any amendment to the questions on the questionnaire. During this reconnaissance survey, trial questionnaire was administered to eight different household heads, four in each group.

3.3.4 Data Collection Procedure

An introduction letter and letter authorising the researcher to go for data collection from the university and all the necessary documentation were obtained before the exercise commenced. Having completed the aforementioned, the researcher and together with her administered the questionnaires to respondents. Concurrently, the waste worker and health officer's interviews and the focus group discussion was conducted by the researcher herself to augment the quantitative data from households' heads' survey.

3.3.5 Data Processing

Collected data was edited; coded, classified and tabulated before analysis. This was necessary to detect and remove any errors, omissions, or outliers which would have messed the interpretation of the same and also to ensure accuracy. Finally, the data was run through SPSS for analysis.

3.3.6 Data Analysis

The cleaned data was input into the SPSS software where it was analysed for different tests meant to answer the study objectives.

Responses were analysed using SPSS software for Windows. Scores were ordinal rather than numerical, and statistical tests for differences in responses to different issues were based on comparisons of frequency distributions. With just 78 responses spread across 5 categories of a likert scale, the power of tests for variation in perception between issues was low. Therefore, the study tested whether the number of respondents scoring above "neutral" (e.g. "neither agree nor disagree") was significantly different from the number scoring below "neutral" for a given question. Thus, a simple Chi-square test was used to determine the chance of random expectations of equal number of respondents scoring agreement or disagreement with a proposition. Further, a two way contingency table analysis was used to test if the proportion scoring 'above' vs. 'below' neutral differed significantly for a given salient pair of questions (a two way contingency table analysis was used in this case). The Wilcoxon Matched Pair tests were used here because the same responded answered both questions in the comparison.

The findings were examined cleared, charted and sorted it in accordance study aims. This approach allowed the researcher to focus only to answers which responded to the research questions. The significant difference between households' location and frequency of Health Risk was tested by the chi-square distribution statistics. The linkages between locations (near dumpsite versus far from dumpsite) and the environmental pollution effect (smelly, dirty, and filthy) were determined by the use of Pearson Correlation Coefficient. Finally, the Relationship between the levels of awareness (knowledge) in environmental pollution and attitude and public participation in solid waste reduction methods will be tested by Pearson Correlation Coefficient.

3.4 Ethical Issues

The respondents' participation was voluntary, they willingly concented to respond to the questionnaires, and were not coerced or influenced in any way during the recruitment process. They were made aware of the research aims and objectives and that this was an

academic endeavour only and that results and participants' privacy will be kept confidential and will remain anonymous. The respondents also had a right to withdraw at any point of the study period.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

This chapter presents the findings of this study conducted at two layers < 250m which will be referred to in this thesis as near dumpsite and >250 m but within a radius of 500 metres from the dumpsite which will be referred to in this thesis as farm from dumpsite.

4.2 Demographic and socio-economic characteristics of the participants

4.2.1 Gender and Age of Respondents

Out of the 78 respondents who were interviewed, 50 of them representing 64.1% were males while 28 representing 35.9% were female. The mean age of the respondents was approximately 34 years. Their age distribution lied between 29 years to 34 years for females and 32 years to 35 years for males.

4.2.2 Education Levels of the Participants

Majority of the respondents in both groups had up to primary level education. A larger proportion of the respondents (44.9%) had primary level education while 12.8% had no formal education at all. Those who had attained secondary school level were 32%. It is only a small percentage (10.3%) that proceeded beyond secondary (Table 1).

Table 1 Education level of respondents (M stands for male and F stands for female).

Education level	Frequency		Total	
	Near Dumpsite	Far from Dumpsite	Frequency	%
No formal education	7 = M (5) F (2)	3 = M (2) F (1)	10	12.8
Primary level	20 = M (12) F (8)	15 = M (11) F (4)	35	44.9
Secondary level	10 = M (7) F (3)	15 = M (10) F (5)	25	32
Tertiary level	2 = M (2) F (0)	6 = M (4) F (2)	8	10.3
Totals	39 =M(26)F(13)	39=(27)F(12)	78	100

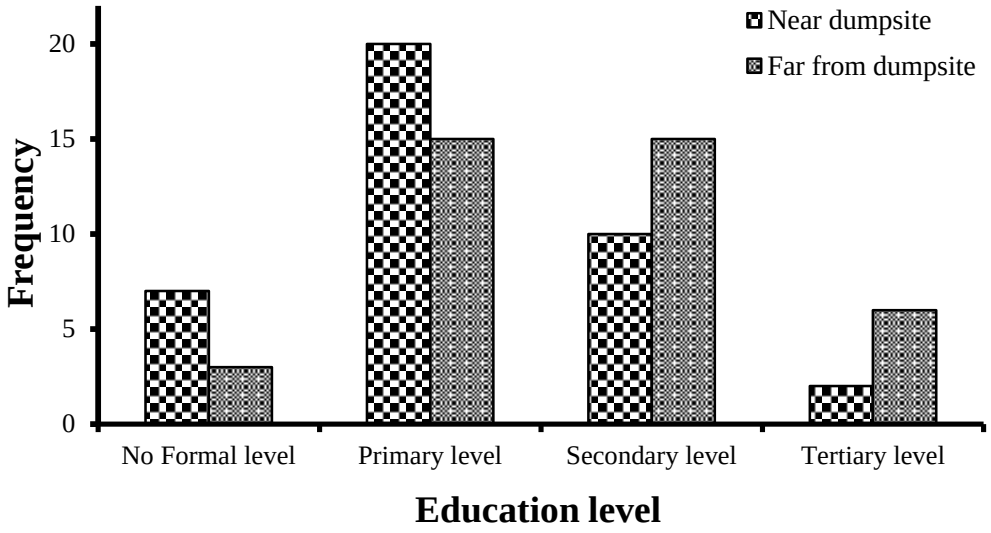

Figure 3 Education level of respondents in the sampled areas.

4.2.3 Employment status, monthly income and household sizes

Many of the participants were self-employed 56.4% in those closest to the dumpsite and 51.3% in those further that 250 m but within 500 m of the dumpsite. The average monthly earnings were below Ksh.10, 000 (Table 2). This basically translates to below 3 dollars in a day. 38.5% of the employed respondents were those living far from the dumpsite while only 25.6% lived closer to the dumpsite (Figure 6). Those unemployed comprising of 17.7% among those closer to the dumpsite and 10.2% those further engaged in dumped solid waste recycling and small scale farming.

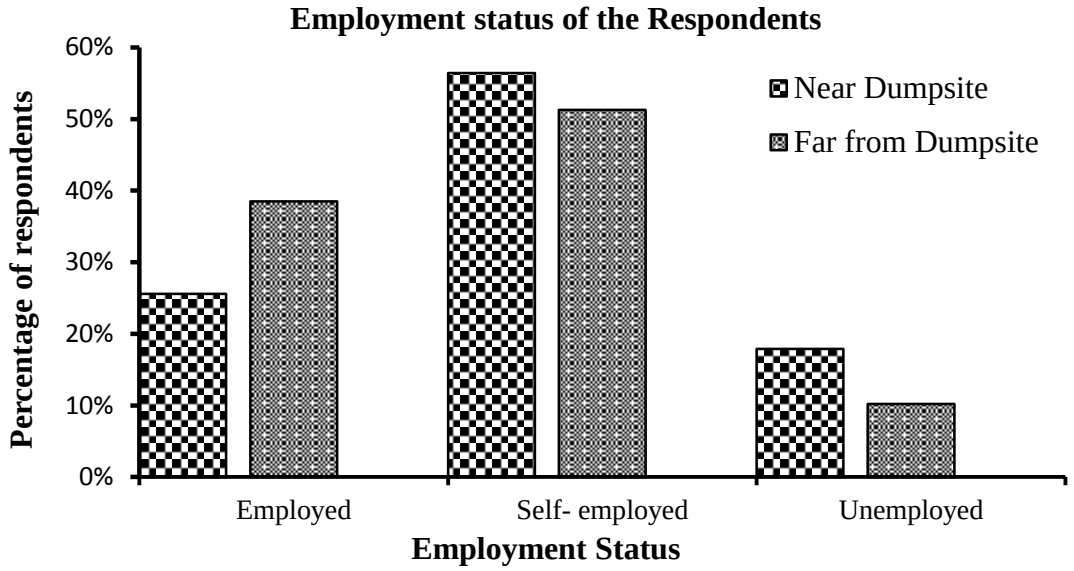

Figure 4 Respondents employment status

Table 2 Income Variance of respondents

Monthly Income (Ksh)	**Frequency**	**Percentage %**
0-5000	12=M (7) F (5)	15.4
5001-10000	30=M (18) F (12)	38.5
10001-15000	25 =M (17) F (8)	32.1
15001-20000	8 =M (6) F(2)	10.3
Above 2000-	3 =M (0) F (3)	3.8
Totals	**78 =M (45) F (33)**	100

NB; M stands for male and F stands for female.

42.3% of households had 3-4 dependants, meaning a family with one or two children while 35.9% of households with one or two dependants. Only 9% of respondent households had six or more dependants (Table 3).

Table 3 Respondent's household size (number of dependants)

Household size (dependants)	Frequency	Percentage
1-2	28	35.9
2-4	33	42.3
5-6	10	12.8
<6	7	9
Totals	78	100

4.3 Dumpsite influence on locals' health – Objective one

81% of the respondents agreed that Kalundu dumpsite posed a health hazard to the surrounding community, 91% agreed that it was a health hazard to the environment while 93% agreed that it was a health hazard to the surrounding individuals (Table 4). The number agreeing significantly differed from those scoring "disagree" (p=0.011 for surrounding community, p=0.011 for for surrounding environment and p=0.025 for surrounding individuals (Table 4).

Table 4 Respondent views on dumpsite as a health hazard to the health of the community, environment and surrounding people (the p values are derived from the Wilcoxon Matched Pairs test).

	Issue of concern	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	n=78	*p*-value testing asymmetry†
Kalundu dumpsite pose a health hazard to	Surrounding community	25	56	19			79	**0.019**
	Surrounding environment	25	66	9			79	**0.011**
	Surrounding individuals	40	53	7			79	**0.025**

Some of the reasons quoted by the respondents that made the dumpsite's location as a source of health hazards include: Smoke from burning waste and obnoxious odour emanating from the dumpsite as a result of rotting of organic waste (presence of leachate was observed). The respondents also cited that the dumpsite provides a conducive habitat for breeding mosquitoes and harbouring other disease vectors. Another health risk cited by residents that would arise from living close to the dumpsite is being bitten by snakes. This is because there are high incidents of encountering them in the dumpsite area (Figure 8). Human settlement areas, several mechanic garages and livestock market near the dumpsite together with the dumpsite itself act as a major source of contamination to water at Kalundu River (Figure 8). Most residents use this water for basic household chores (washing utensils, clothes and bathing). The water source maybe exposed to surface runoff pollution particularly by harmful chemicals that can result to various illnesses to the residents who use this water. Some of the health issues residents pointed out as resulting from the use of this river water included diarrhoea and stomach upsets (Figure 8). Only a small number of respondents (1.3%) mentioned other injuries associated with dumpsite plus eating contaminated foodstuff can lead to health problems (Figure 7) as opposed to 19.2% who thought of surface water pollution as a source of concern (Figure 7).

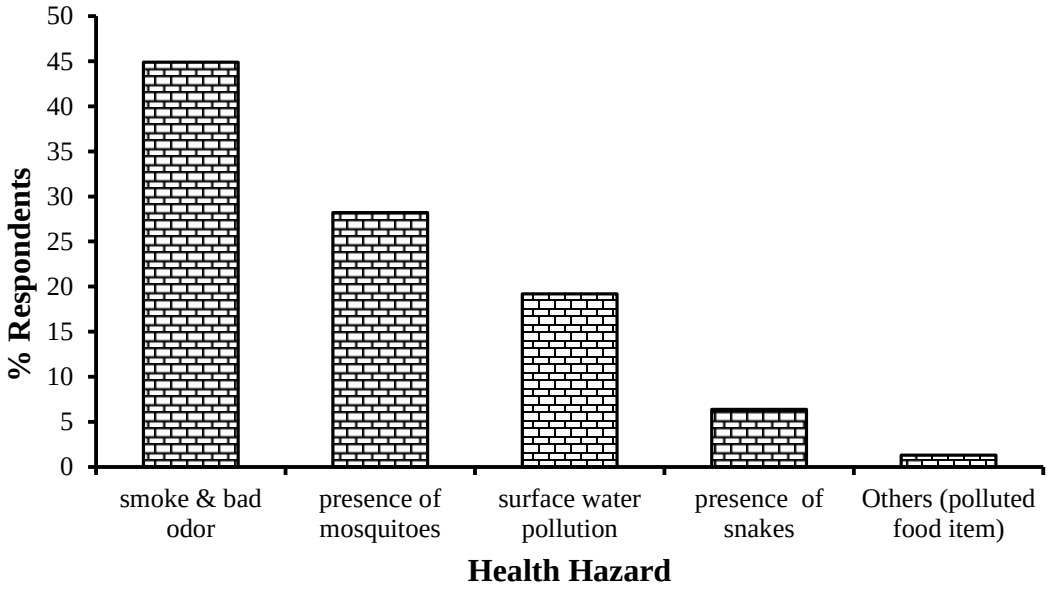

Figure 5 Causes of health problems emanating from close proximity to the dumpsite

Figure 6 Photo showing presence of leachate at Kalundu dumpsite

The respondents cited Malaria as the most prevalent disease with majority of the respondents confirming to have been infected with at some point (Figure 9). This was followed by chest pain; diarrhoea and cholera (Figure 9). However, the respondents' view of cholera was that it is a seasonal disease with high incidences during the rainy season. Skin infections, eye irritation and nose irritation were only cited as minor occurrences. The residents attributed the high incidences of malaria in the surrounding human settlements to mosquito bites. This information was corroborated by the collected data from the three local health centres (Table 5)

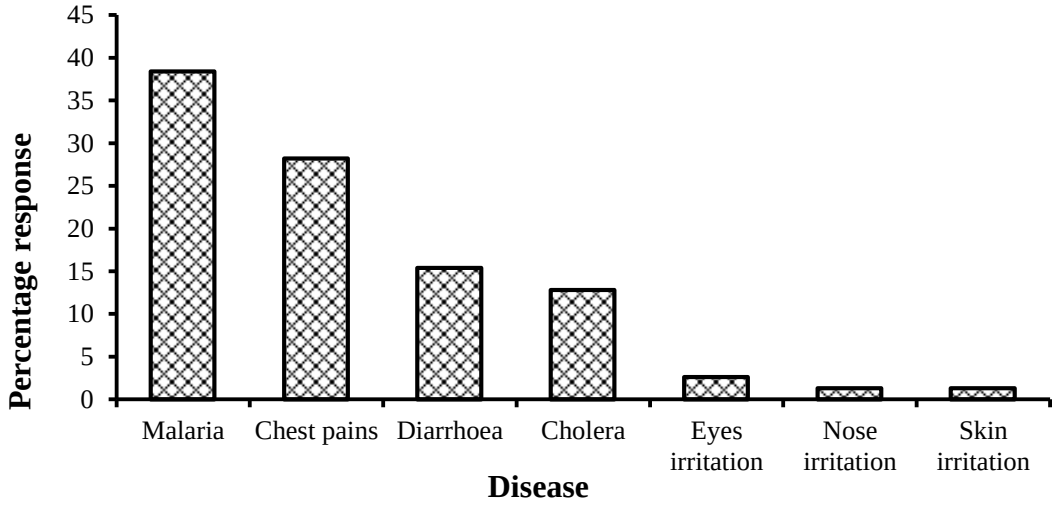

Figure 7 Hierarchy of percentage disease incidences in Kalundu Dam vicinity

Table 5 Percentage distribution of health complaints of visitors (location and gender) to local dispensaries as reported from the three local health centres.

Complaints	Males		Females	
	Near dumpsite	Far from dumpsite	Near dumpsite	Far from dumpsite
	% visitors	% visitors	% visitors	% visitors
Diarrhea	8.7	7.3	11.0	10.2
Back pain	1.7	2.3	2.0	6.6
Eye irritation	5.5	7.3	5.1	8.4
Chest pain/Cough	26.3	16.0	22.6	12.9
Abdominal pain	5.6	8.7	6.5	7.5
Malaria/Fever	24.3	32.2	28.5	35.4
Headache	5.7	5.8	10.5	6.3
Injury	3.6	0	1.0	0.2
Common cold	3.5	4.2	1.3	3.7
Wounds	4.2	0.7	1.3	0.2
Skin irritation	3.3	0.9	3.0	1.0
Joint pain	2.1	3.3	2.1	1.7
Others	5.5	11.3	5.1	5.9
Total	100	100	100	100

4.3.1 Relationship between distance from the dumpsite and ill-health Frequency

Although both those living near the dumpsite and those living further as per the study demarcation, respondents acknowledged that Kalundu dumping site pose health challenges to the residents. The frequency was higher for those living near the dumpsite (Figure 11).

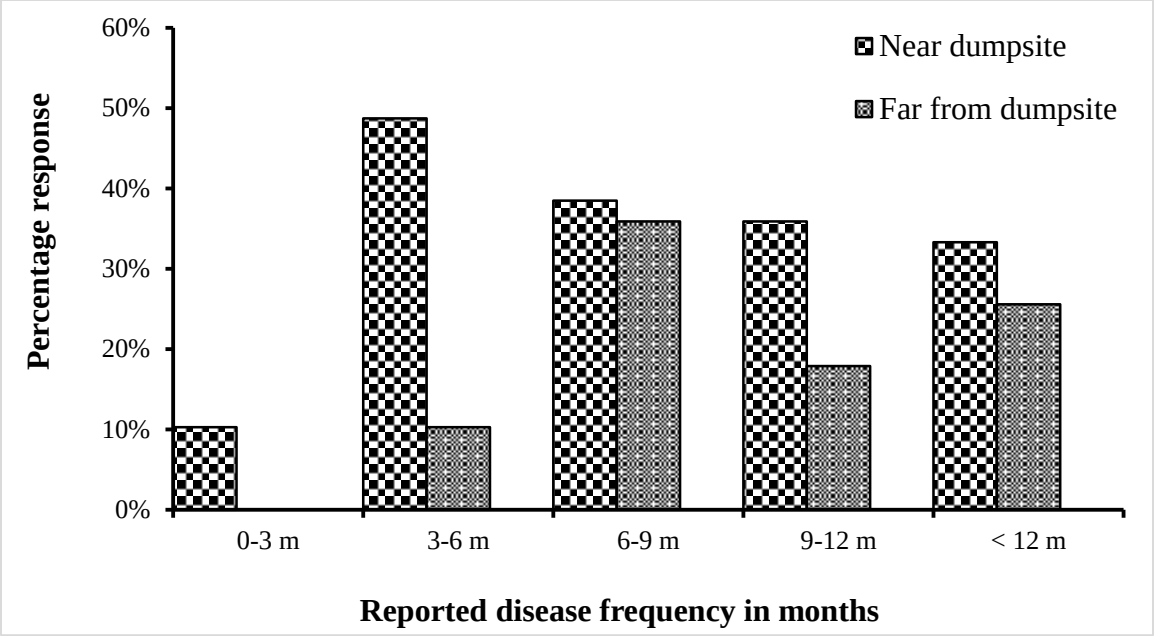

Figure 8 Relationship between distance from dumpsite and reported frequency of ill-heath cases specified over time

This information was actually confirmed by the health officers from the three health centres (Table 6). From the results, it can be noted that the dumpsite may increase the susceptibility of local residents being infected or affected by the hazardous conditions of residing near Kalundu dumping site.

Table 6 Distribution of absolute number visitors to local health centres by location of residence and gender as reported by local health practitioners.

Residence	Male	Female	Total
Near dumpsite	189	221	407
Far from dumpsite	161	193	354
Total	350	414	764

4.3.2 Relationship between Distance from the Dumpsite and disease age group vulnerability

Children under the age of 5 were the most culpable to contract disease compared to other age groups (Figure 11). This was the case for both those living near and far from the dumpsite. However, children from the group living near the dumpsite were more susceptible with 70% of them affected compared to 55% in the group living further away from the dumpsite (Figure 11). The respondents also ascertained that the establishment of the dumpsite in the area has led to the deteriorating of the health standards in the area. This was actually reported by 80% or respondents living near the dumpsite and 60% of those living far from the dumpsite according to the study's classification of far and near. Thus, the residents viewed the dumpsite as a health hazard. The same information was corroborated with the information collected from the three health centres in close proximity to the dumpsite (Figure 12).

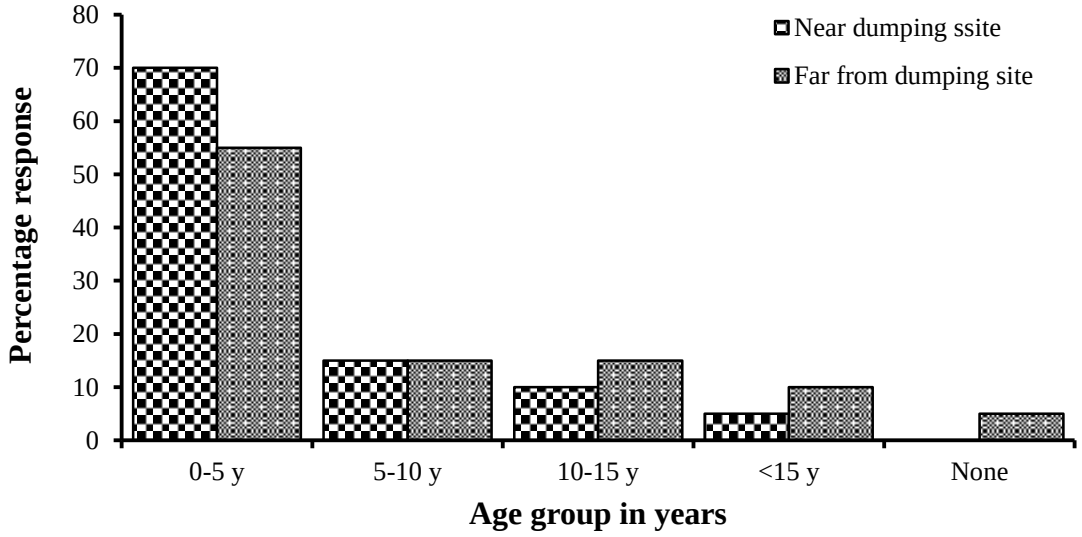

Figure 9 Age group vulnerability to diseases associated with living in the dumpsite vicinity

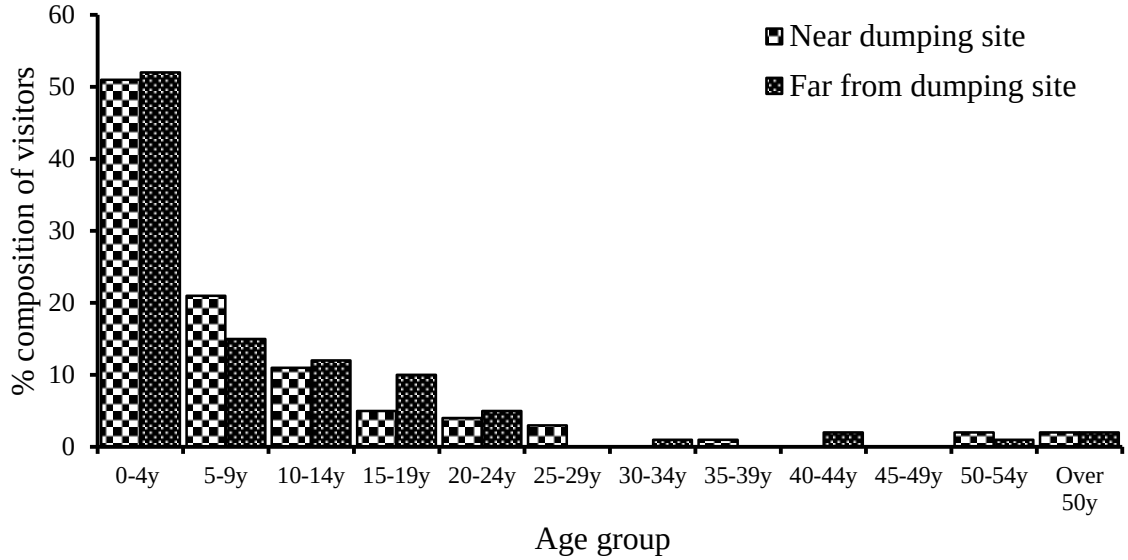

Figure 10 Distribution of age groups of visitors with health issues to the local health centres by location of residence as reported by local health practitioners

4.4 Respondents' perception on their residential environment in relation to location of the dumpsite and its physical status- objective two

Majority of the residents did not approve the presence of Kalundu dumping site in their locality (Figure 13). It being close to their hoses was an issue where they felt that it caused a lot of environmental pollution (water, air and soil) which in the long run leads to ill – health. They also confirmed that the existence of the dumpsite within their settlement causes environmental pollution (water, air, land, and vegetation). The dumpsite led to smelly, filthy and dirty surrounding in their settlements. Apart from pollution, the dumpsite has also led to economic degradation of the area.

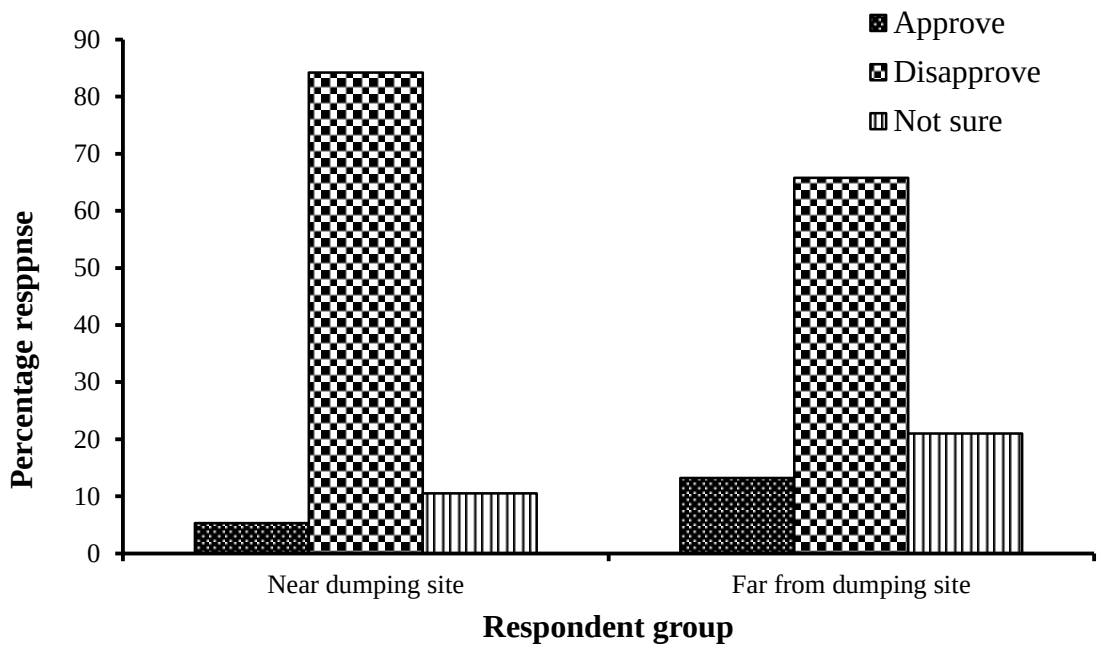

Figure 11 Respondents' perception towards dumpsite presence in their vicinity

84.2% of the respondents residing near the dumpsite disapproved the presence of the dumpsite in their vicinity (Figure 13). For those residing further, 65.8 of them disapproved it. This clearly implies that the environment closer to the dumpsite suffered most negative environmental disturbances as compared to further environment. However, there was a small percentage of respondents who approved the location of the dumpsite within their vicinity group (5.3% of those near) and (13.2% of those far from it). This group comprised of those who drew some form of benefit either directly or indirectly from the dumpsite by either recycling of the waste or through farming at the dumpsite (Figures 10 and 15)

Figure 12 Presence of plastics and other recyclable at kalundu dumpsite

The presence of the dumpsite elicited the perception of smelly, dirty and filthy environment (Figure 15). Some waste extended beyond the dumpsite to their homesteads which was a course of concern to the residents. The residents were able to associate proximity to the dumpsite with environmental degradation and pollution, especially for the group living near the dumpsite.is people living closer (group 1) to the Kalundu dumpsite experienced more environmental pollution compared to those living at far distances (group 2). Presence of dumpsite damages the economic value of property and also the amenity value of the environment; as it is evident that the settlements around the dumpsites are slums (occupied by less fortunate) and cost value is low.

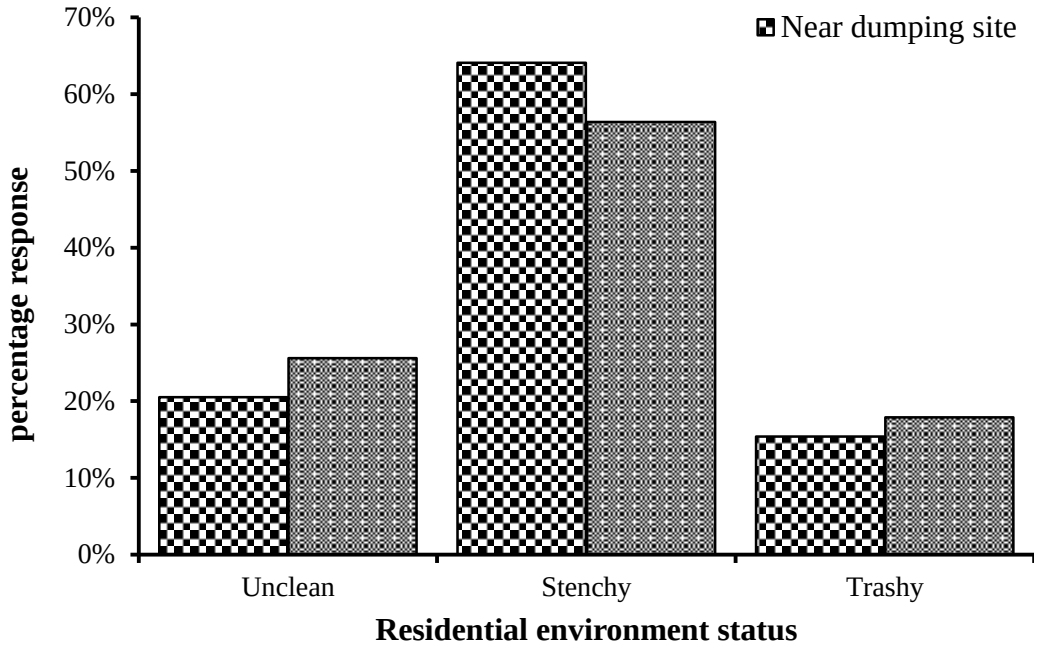

Figure 13 Respondents view of the residential area environmental status

Through observation process which involved physical walking and surveying around the dumpsite and photographs taken and recorded, lots of waste was observed a scenery of plastics of different types dumped at Kalundu dumpsite (Figure 14)**.**

During a walk by the dumpsite, presence of waste leachate in the dumpsite was recorded. It was actually flowing into the Kalundu River (Figure 16). This actually provided a clear evidence of soil pollution and eminence of bad odour. The presence of decomposing material in the waste led to decomposition and organic decay, a biological process that involve simplification of organic compounds such as CO_2 and NH_4 which result in bad odours emanating from the dumpsite.

Figure 14 Waste leakage and spillage along the banks of Kalundu River

Also, there is a clear indication of water contamination as it is evident through waste spilled from dumpsite lying along the bank of Kalundu River (Figure 16).

The study also brought into attention the environmental implications of poor solid waste management at Kalundu dumpsite on land degradation where 53.5% perceived the disposed waste to have a land degrading effect; 55.4% perceived it to be degrading the air while 44.1% perceived the waste as creating unhygienic conditions (Table 7). These effects were more severe in the near the dumpsite settlements compared with the far the dumpsite ones. In contrast, water pollution was perceived to be very intense or intense by over 75% of respondents residing far from the dumpsite compared to only slightly over 34% of those living near the dumpsite (Table 7).

Further, the result indicates a statistically significant relationship between intensity of air pollution, water pollution and unhygienic environments ($p<0.01$) whilst the association between intensity of land degradation and the study areas was not statistically significant ($p=0.203$) (Table 7).

Table 7 Respondents' perceptions' on effects of SW dumped at Kalundu on environment

Environmental implications	Intensity	Near dumpsite	Far from dumpsite	Average
Land degradation	Very intense	52.5%	54.5%	53.5%
	Slightly intense	19.8%	17.8%	18.8%
	Intense	4.0%	10.9%	7.45%
	Neutral	10.0%	6.4%	8.2%
	Not intense	13.7%	10.4%	12.05%
	X^2	4.60		
	P- value	0.203		
Air pollution	Very intense	62.4%	48.5%	55.5%
	Slightly intense	7.9%	25.7%	16.8%
	Intense	7.9%	12.9%	10.4%
	Neutral	8.6%	4.8%	6.7%
	Not intense	13.2%	8.1%	10.7%
	X^2	14.78		
	P- value	0.00***		
Water pollution	Very intense	13.9%	15.8%	14.9%
	Slightly intense	11.9%	61.4%	36.6%
	Intense	60.4%	8.9%	34.7%
	Neutral	7.8%	21.9%	14.8%
	Not intense	6.1%	22.7%	14.4%
	X^2	72.546		
	P- value	0.00***		
Unhygienic environment	Very intense	80.2%	7.9%	44.1%
	Slightly intense	13.8%	44.6%	29.2%
	Intense	3.0%	31.7%	17.3%
	Neutral	1.0%	6.3%	3.6%
	Not intense	2.0%	9.5%	5.7%
	X^2	109.09		
	P- value	0.00***		

Note ******* indicates significance at 1%

4.5 Residents' participation in management of solid waste dumped in Kalundu – Objective 3

Most community members were concerned with the status of their environment. They knew that improper handling of the waste dumped at Kalundu caused environmental pollution. This awareness created a positive attitude within them of wanting a clean environment. However, they were not sure of what best to do with the waste as slightly less than half of respondents (42.3%) were conversant with effective techniques of solid waste management while 57.7% did not (Table 8).

The respondents also confirmed of receiving information on environmental pollution versus solid waste management. However, majority of them (93.6%) felt that this this information was not adequate while only 6.4% thought it was adequate to elicit sustainable waste management practices (Table 8)

Collectively, 92.3% of participants view the dumped waste as a burden to their community and therefore had concern about the environment. Unfortunately, less than half (42.3) of the respondents had knowledge of Solid waste reduction techniques. Those who participated in solid waste reduction techniques were as low as 10(12.8%) although with the knowledge for the same was 42.3% and 68(87.2%) didn't participate. This clearly indicated the discrepancy between knowledge and willingness towards participation for the same. Out of who participated (N=10) in Solid waste reduction methods, only 5 (6.4%) re-used the items, 3 (3.8%) repaired some of the items and only 2 (2.6%) recycled the waste.

In overall, most respondents (70%) dumped their remaining waste at the dumpsite especially those who are near it, and the others (30%) burned theirs (far from the dumpsite).

The respondents further noted that their lack of involvement in deciding how the waste should be managed once at Kalundu was a failure of the local authorities who did not incorporate them. They felt that the county government of Kitui should consider for inclusivity of all the stakeholders if effective sustainable SWM is to be achieved in kitui.

Table 8 Respondents' knowledge on environmental pollution and SWM

Attribute	Percentage response		
	Near dumpsite	Far from dumpsite	Average %
Knowledge on pollution	30.8	53.8	42.3
Positive attitude	89.7	64.1	77
Participation	20.5	5.1	12.8
Formal education	30.8	53.8	42.3

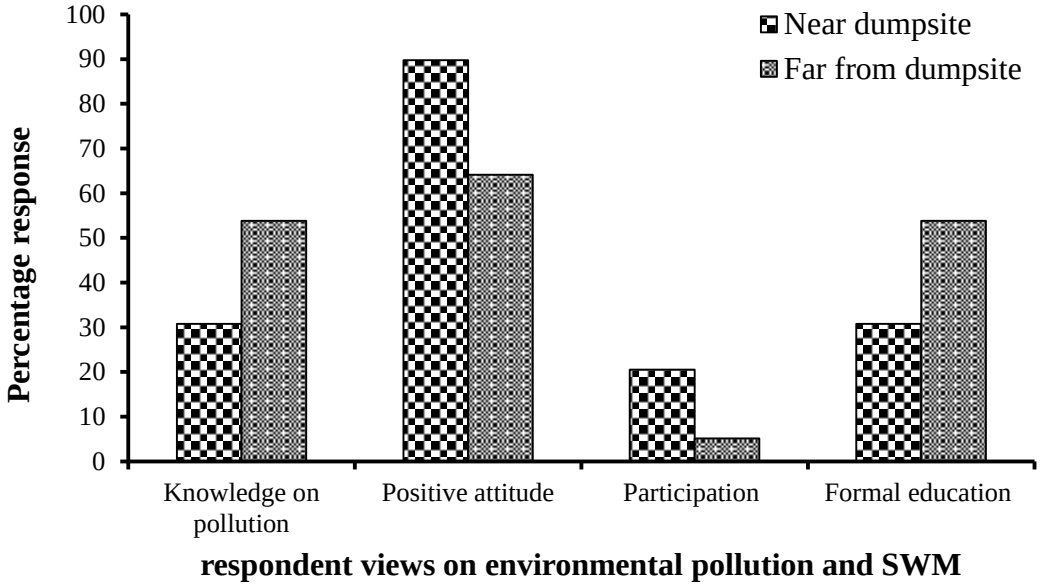

Figure 15 Respondent's knowledge on environmental pollution and SWM

It was established that even though some of the community members had knowledge on Environmental pollution and SWM and had positive attitude, only very few (12.8%) participated in implementing SWMR techniques (Table 8; Figure 17). This could be due lack of social pressure or Attitude-Action behaviour gap.

Though those people who participated on implementing SWRM technique were the ones with knowledge on SWM and aware on environmental pollution, this was a clear indication of a positive correlation existing between awareness and knowledge on Environmental pollution and SWM and participation in Solid Waste Reduction Methods.

4.5.1 Factors influencing respondents participation in solid waste management practices

Further, a logistic regression was run to determine how education level, age, gender, and level of income affected participation in solid waste management practices. Education level was found to significantly influence involvement on solid waste management practices (coefficient=3.74; p=0.00, ratio=42.27) as shown in table 8. From the results, a unit increase in education level increased household's ability to practice proper waste management by a factor of 42.2.

Another factor that significantly affected the level of participation was location (coefficient=2.62; p=0.59, odds ratio=1.17) This implies that residents far away from the dumpsite were 27 times more likely to practice proper SWM in comparison to those residing closer to the dumpsite.

Although age, household size and income were not significant in influencing the participation in SWM, the results also indicated that a unit increase in income (p=0.69) enhanced the likelihood of practicing proper SWM. The implication for this is that having an higher income would positively influence someone to practice proper HWM as compared to those with low income (Table 9).

The results clearly indicated that the household head's age (coefficient= -0.01; p=0.67, odds ratio=1.29) influenced negatively their participation in SWM activities. This implies that households with younger household heads were more likely to participate in proper SWM as compared to those with older heads (Table 9).

Table 9 Factors influencing involvement in SWM practices

Factor	Coefficient	P Value	Odds Ratio
Age	-0.01	0.67	1.29
Location	2.26	0.59	1.17
Education level	3.74	0.00*	42.27
Household size	-0.19	0.07	0.84
Household income	0.00	0.69	1.00
Constant	-1.37	0.22	0.26

Note: * denotes significance at 5% level of significance

4.5.2 Respondent's satisfaction with waste disposal at Kalundu dumpsite

The study results revealed that majority of the residents were not pleased with the presence of the dumpsite in their vicinity. This is evident as only 21.8% and 23.8% of respondents from near the dumpsite and far from the dumpsite respectively were happy to have the dumpsite in their proximity (Table 10). This clearly means that living near or far from the dumpsite does not influence the people's overall view of having the dumpsite in the present location ($p=0.74$) (Table 10). However, 63.4% of respondents from the far from the dumpsite group supported the idea of waste segregation, hence the relationship between respondents' support for waste segregation and location was significant statistically ($p<0.01$) (Table 10).

Table 10 Respondents' satisfaction with the location of the dumpsite in their locality

Attitudes	Near dumpsite	Far from dumpsite	X^2 Value	P-Value
Like how waste is disposed in the area	23.8%	21.8%	0.11	0.74
Support idea of waste segregation in the area	18.8%	63.4%	41.41	0.00***

Note ******* indicates significance at 1%

4.5.3 Responsibility share of solid waste management

Majority of respondents (55.4%) of those in the near the dumpsite group felt that the responsibility of SWM should be vested on the community while the majority of those far from the dumpsite (46.5%) felt that it should be vested on the County government of Kitui. Results further indicated that 19.8% of the respondents believed that the responsibility of SWM should be vested on the local chief for administration while 13.9% thought that the responsibility should be vested on the Central government (Table 11).

Table 11 Respondent views on who has the responsibility to manage solid waste management among stakeholders

Responsibility share of SWM	Near the dumpsite	Far from dumpsite	Total
Community	55.4%	11.9%	33.7%
Local Chief	15.8%	23.8%	19.8%
County government	18.8%	46.5%	32.7%
Central government	9.9%	17.8%	13.9%
Total	100%	100%	100%

4.5.4 Respondents' rating (%) of SWM in Kalundu dumpsite

It was revealed that majority respondents (45.0%) rated waste management in the respective areas as very bad (Table 12). The results also revealed that 39.6% of respondents rated SWM as bad while only 8.9% and 6.4% rated it as good and very good respectively. Further, the study established a statistical significant affiliation among respondents' rating of SWM and their proximity to the dumpsite ($X^2=28.83$; $p<0.01$) (Y=Table 12)

Table 12 Respondents ' rating (%) of solid waste managementt

Rating of SWM within the Kalundu dumpsite	Near dumpsite	Far from dumpsite	average
Very good	5.0%	7.9%	6.4%
Good	5.5%	5.4%	8.9%
Neither good nor bad	4.3%	2.5%	3.4 %
Bad	22.8%	56.4%	39.6%
Very bad	62.4%	27.7%	45.0%
X^2 value	28.83		
P- value	0.00***		

Note ******* indicates significance at 1%

4.5.5 Willingness of respondents to sue reckless dumpers

The research shows that 25.7% of those settled far from the dumpsite were very willing to sue reckless dumpers, willing are 17.8% and 31.7% are slightly willing while 24.8% are unwilling (Table 13). For those staying near the dumpsite, only 5.9% are very willing to sue, those willing comprise 13.9%, 17.8% are slightly willing while the majority (62.4%) are unwilling (Table 13). Generally, 43.6% of total respondents are unwilling to sue reckless dumpers. The study also found a positive relationship which was significant between respondents' willingness to sue reckless dumpers and their proximal location from the dumpsite (X^2=33.33; $p<0.01$) (Table 13).

Table 13 Willingness of respondents to sue reckless dumperss

Willingness to sue reckless dumpers	Near dumpsite	Far from dumpsite	Average
Very willing	5.9%	25.7%	15.8%
Willing	13.9%	17.8%	15.8%
Slightly willing	10.4%	18.4%	14.4%
Neither willing or unwilling	7.4%	13.3%	10.4%
Unwilling	62.4%	24.8%	43.6%
X^2 value	33.33		
P- value	0.00***		

Note ******* indicates significance at 1%

4.5.6 Respondents' awareness of sustainable solid waste management practices

Only 8.4% of respondents were very aware of SWM comprising of 8.9% and 7.9% in near dumpsite and farm from dumpsite respectively. Majority respondents (38.6%) were not aware of SWM while 25.2% were slightly aware. Generally, respondents residing far away from the dumpsite were more aware of SWM compared to those residing close by. After testing the data through a Chi square test, a significant association among location and respondents' awareness of SWM practice (X^2=51.14; p<0.00) (Table 14).

Table 14 Respondent awareness of SWM at Kalundu dumpsite

Awareness of SWM practices	Near dumpsite	Far from dumpsite)	Total
Very aware	8.9%	7.9%	8.4%
Aware	6.6%	23.4%	15.0%
Neither aware or unaware	4.3%	21.2%	12.7%
Slightly aware	18.8%	31.7%	25.2%
Not aware	61.4%	15.8%	38.6%
X^2 value	51.14		
P- value	0.00***		

Note ******* indicates significance at 1%

4.5.7 Sources of information on SWM in Kalundu

It was revealed that 53.3% of respondents residing far away from the dumpsite acquired information on SWM through television while 71.3% of those living near the Kalundu dumpsite acquired the information through radios. It was further established that a cumulative of 16.8% of respondents acquired information on SWM through phones (Table 15).

Table 15 Sources of information on SWM in Kalundu

Source of SWM information	Near Dumpsite	Far from dumpsite	Total
Television	11.9%	53.3%	38.6%
Radio	71.3%	29.8%	44.6%
Phone	16.8%	17.8%	16.8%
Total	100%	100%	100%

4.5.8 Respondents' awareness of the implications of poor SWM in Kalundu

It was established that a cumulative average of respondents (37.6%) were not aware of the health implications of poor SWM. However, 23.3% were slightly aware while only 20.3% were aware. Majority (41.6%) of respondents were not aware of the implications. Further, 41.1% of the respondents were slightly aware of the economic implications of poor SWM with 23.7% of those living near the dumpsite and 58.4% from the far from the dumpsite group in this category (Table 16). Many respondents were not aware of the economic, environmental and health implications of poor SWM especially for the group living near the dumpsite compared to those far from dumpsite. This was demonstrated through a Chi square test, which showed a significant association between implications of poor SWM among respondent location ($p<0.01$) (Table 16).

Table 16 Respondent's awareness of implications of poor solid waste management

Implications of poor SWM	Awareness	Near dumpsite	Far from dumpsite	Total
Health implications	Very aware	8.4%	13.5%	10.9%
	Aware	9.9%	30.7%	20.3%
	Slightly aware	21.8%	24.8%	23.3%
	Neither aware or unaware	6.5%	9.3%	7.9%
	Not aware	53.5%	21.8%	37.6%
	X^2	26.11		
	P- value	0.00***		
Environmental implications	Very aware	5.0%	8.9%	6.9%
	Aware	6.2%	8.3%	7.3%
	Slightly aware	13.9%	60.45	37.1%
	Neither aware or unaware	6.7%	7.5%	7.0%
	Not aware	68.3%	14.9%	41.6%
	X^2	65.62		
	P- value	0.00***		
Economic implications	Very aware	9.1%	6.4%	7.7%
	Aware	9.9%	18.8%	14.45
	Slightly aware	23.7%	58.4%	41.1%
	Neither aware or unaware	5.8%	4.5%	5.2%
	Not aware	51.5%	11.9%	31.7%
	X^2	43.17		
	P- value	0.00***		

Note ******* indicates significance at 1%

4.6 Corrective measures put in to place to protect residents from dumpsite effects, disposal methods and recommendation.

Respondents were not aware of any measures that can be put in place to protect them from severe effects of the dumpsite in their vicinity. Majority of them, 38.5% were in favour of relocating the dumpsite while 33.3 percentage suggested management (protecting the human settlement from adverse effects) of the dumpsite and 28.2 were in favour of protection (safeguarding the area either by fencing to avoid in how entering) (Figure 18).

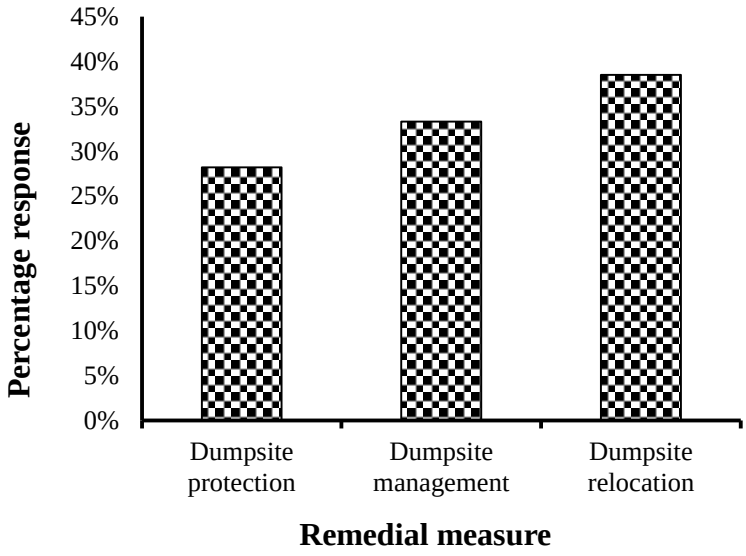

Figure 16 Suggested remedial measures

When asked of the appropriate waste disposal options of their produced waste, 19.2% of the respondents said that they take waste to street bins, 25.6% take the waste to the dumpsite, 28 35.9% burn their waste in the pits, 3.8% burry the waste, 2.7% recycle and re-use waste while 12.8% throw waste haphazardly (Figure 19).

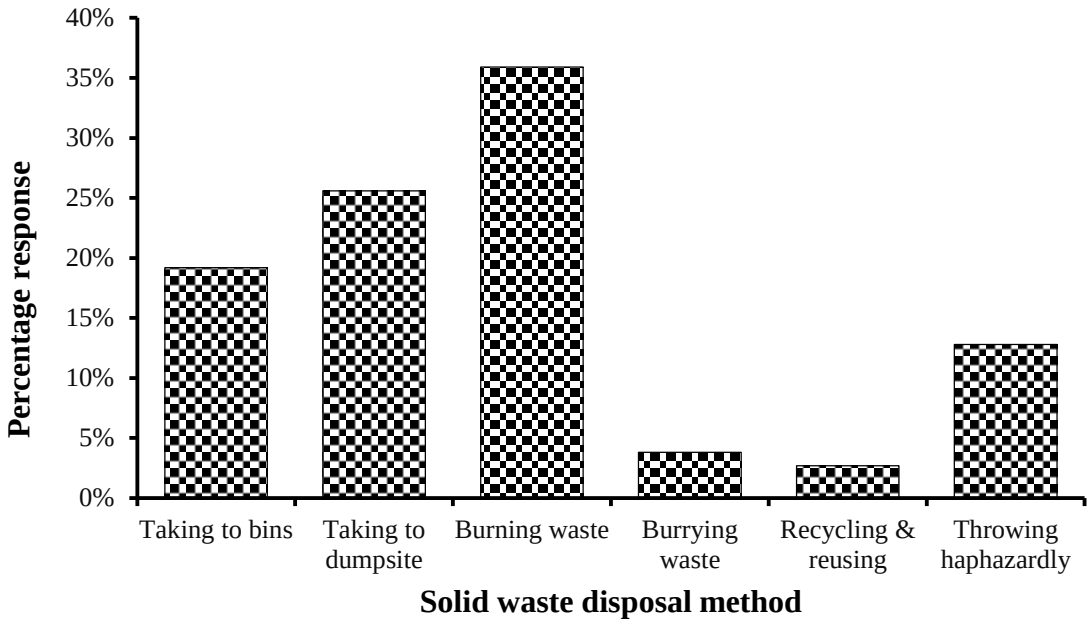

Figure 17 Suggested Solid waste disposal options

4.7 Recommendations given by locals on managing solid waste in Kalundu

Respondents also gave their recommendation to deal with waste management in Kalundu and Kitui in general. The suggested the following: immediate relocation was suggested by 38.5% respondents, dumping activities in Kalundu to be stopped progressively received 33.3%, proper dumpsite management received 15.4% and fencing around the dumpsite was suggested by 9% of respondents. 3.8% of respondents did not know of any suggestion or had no idea of what should be done.

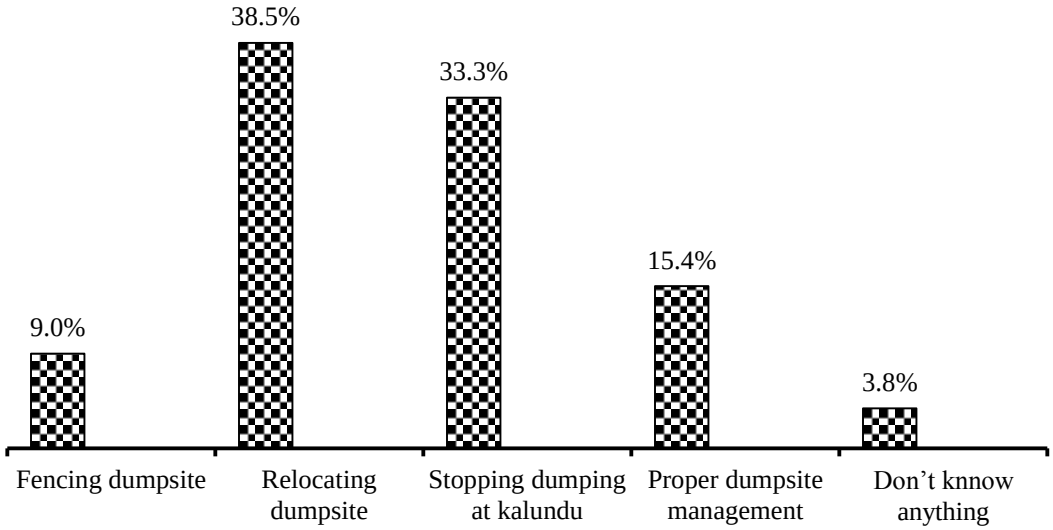

Figure 18 Recommendation to authorities on waste management in Kalundu dumpsite

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

The purpose of this study was to determine the environmental effects and health risks associated with waste dumping to the environment and people living close to Kalundu dumpsite in Kitui Town of Kitui County, Kenya. 78 respondents stratified into two categories (i) those living between 0 and 250 metres from the dumpsite and (ii) those living between 250 m but within 500 metres from the dumpsite margin. For the purpose of this study, those living between 0 m -250 m from the dumpsite margin are referred to as those near the dumpsite and those staying between 250 m - 500 m are referred to as far from dumpsite.

5.2 Health risks associated with waste dumping at Kalundu dumpsite on the surrounding residents

Kalundu dumpsite is the official disposal point of the waste generated in Kitui town. Since the county government was established, Kitui has seen an increase in population, leading to a rise of demand for resources and accommodation. This ultimately led to an increase in generated waste which ends up in Kalundu dumpsite. Because of the inability of the county government to manage this waste, Kalundu dumpsite is now a source of several risks emanating from the dumped waste. These wastes have an adverse impact to the environment and the health of the people living within the precincts of the dumping site. This was ascertained by local residents who blamed the dumpsite for the ailments affecting them such as Malaria, chest pain, and diarrhoea, among others. This finding corroborate other studies which demonstrate a direct link between health effects and location of dumpsites, thus dumpsites pose significant health risks to people living in close proximity (Yongsi, 2008; Abul, 2020; Gouveia and do Plado, 2010; Giusti, 2009). Actually this study found that those living within 250 m of the dumpsite (near to the dumpsite) were the most affected. This result implies that increasing the distance between settlements and dumpsite locations will reduce illness incidences among local communities.

Kalundu dumpsite is not fenced, and therefore waste dumping is indiscriminate. There is no control of whom or what entered into it or came out of it. This creates the conducive environments that pose the major health risks reported by the respondents. This scenario corroborated another study (Sood, 2004). Furthermore, it has been observed and reported that solid wastes not well managed can have deleterious health implications where they can often cause ill health or help spread disease (Nwogwugwu and Ishola, 2019). Unattended waste as observed at Kalundu may have attracted organisms such as rats, flies, dogs, mosquitoes and other disease vectors which facilitated the spread of the observed diseases to nearby residents. The observed waste leachate composed of decomposing wet waste may have may have been the cause of the bad odour described by residents. Moreover, this fermented waste can pose a severe risk by harbouring disease vectors and pathogens.

As observed, majority of Kalundu residents are unemployed and their income was very low. This lack of jobs may have influence the residents to engage in agricultural activities within the dumpsite vicinity to enhance their livelihoods. Furthermore, Kalundu river river water was used for domestic chores further exposing them to health risks of diseases that result from chemical exposure. This is so because some illnesses and risks maybe related to environmental pollution of the dumpsite through contaminated crops, animals, food products or water (Sibanda *et al*., 2017; Waturu *et al*., 2017; Awino, 2020; Aluko *et al*., 2021).

The low education and employment status of residents may have also contributed to them resolving to engage in scavenging in the dumpsite as a source of livelihood by collecting and selling waste valuables for sell. Direct handling of solid waste in the process of searching for the valuables can also lead to increased risk of infection.

The unhygienic conditions observed in the dumpsite can be a source of contamination of vended food in the local cattle and mechanic market and a source of the frequent stomach aches and diarrhoea, a major ill-health problem to the local people. The traders lamented of poor business profit margins since the existence of dumpsite in their vicinity prior to the dumpsite establishment. This is due to the fact that their main customers (middle / upper

cadres) opted to get their goods and services from areas further away from the dumpsite which they considered a "cleaner environment". According to them, the presence of dumpsite in Kalundu has led to economic degradation of the area. They also said that the value of property in adjacent areas has gone down. People do not want to see a dumpsite in their vicinity. Actually they said that the demand for property in the area has gone down since the introduction of the dumpsite.

5.3 Perceived environmental effects of Kalundu dumpsite by local residents

Respondents, more so those living near the dumping site weren't pleased with the dumping site being located closer to their homesteads. This closeness was causing them a lot of discomfort and health issues as they complained that it made their surrounding smelly and filthy. The fact that some of the waste from the dumpsite overlapped into their houses convinced them that it polluted their environment. This clearly indicates that respondents perceived the dumpsite as a major problem to their environment. Just like in other studies (Milosevic *et al*., 2018; Nair *et al*, 2019; Vaverková, 2019; Etea *et al*., 2021); they complained that the dumpsite emitted odours and smoke that polluted their air. This observation indicates that there is a link between living close to the dumpsite and perception of environmental pollution. That is people living closer to Kalundu dumpsite experienced more environmental pollution compared to those living further away. These observations are supported by other studies (Gakungu *et al*., 2012; Okot-Okumu, 2008) which indicate that most waste disposal systems in Kenya are inefficient and not environmentally friendly.

Also, there was an indication of water contamination evidenced through waste from the dumpsite spilling into the Kalundu River. There is a likelihood that these waste leakages may contaminate the river water and that harmful substances may not only impact human health directly or even accumulate in food and be transmitted to higher organisms in the food chain and food webs (Gupta *et al*, 2019; Hembrom *et al*., 2020; Sonone *et al*., 2020; Islam *et al*., 2021; Oruko *et al*., 2021). Kalundu River water is used by the residents for agricultural and domestic purposes as it was observed by presence of nearby small scale

irrigated gardens and people bathing at the Kalundu River. The water is also used for domestic chores ad animals drink from it.

5.4 Respondent participation in SWM of dumped waste in Kalundu

Many respondents weren't able to comprehend the consequences of ineffective SWM once it arrives at Kalundu dumping site. This may have been caused by the absence of public training on matters of dumpsite waste management. It should be noted that, awareness of SWM in the far away group was higher compared to those near the dumpsite. Actually this may have influenced their lack of involvement of its management once in the dumpsite. If they were conscious of the economic, health and environmental effects of the dumped waste within their vicinity, they would have probably acted differently. For example, the residents would have easily practiced composting activities if the beneficial effects of recycling were made manifest to them. Similarly, if they were mindful of the health effects associated with the dumped waste, they would have probably indulged in the management of the waste in a sustainable manner. This observation calls for mechanisms to be put in place to make the residents aware of this through provision of dissemination opportunities through media campaigns such as the local FM radio station and other forums.

The observation in this study is in consonance with findings of Medina (2002) who discovered that absence of attention and knowledge on environmental matters generates a culture of negligence in contributing towards policy making procedures and encourages taking responsibility for waste matters. On the other hand, this contradicts the findings of Oruonye *et al*. (2018) who in a study established that a large part of his participants were conversant with the effects of waste disposal.

A positive observation of this study was that those with awareness on environmental pollution and knowledge about the SWM techniques had a bright outlook on SWM and participated in SWM options. This was a representation of a positive correlation existing between awareness (knowledge) on environmental pollution and effective SWM and positive attitude and participation in SWM. Although these people did not participate wholly, it might be due to some other barriers.

It was also discovered that though residents believed that CGoKTI knew about the negative effects the dumpsite posed to the surrounding people, they did not put in place any corrective measures to mitigate the situation. This brought about the suggestion by the respondents to recommend that the dumpsite be relocated from kalundu with immediate effect to avoid further damage (Figure 18).

5.5 Factors influencing waste management practices

The effects of age, location from dumpsite, household size, education levels and level of income on solid waste management practices were determined.

5.5.1 Age of respondents

The fact that all the respondents age bracket was between age group 29-34 (Section 4.1.1) years means that they have more years to live and can have a greater influence if the right information is imparted into them. The logistic regression results generated on age of the respondents were not significant in influencing the practice of SWM. The results further indicated that age (p=0.67) negatively influenced the practice of SWM (Table 1). This implies that households with younger household heads were more likely to participate in SWM as compared to those with older heads. The results concur with findings of Alberti (1999) and of Longe *et al*. (2009) who found that the youth offer higher chances of adapting to new technology and assimilating new knowledge. This agrees with Bogoro *et al*., 2013 findings that determined the influence of age on SWM practices.

5.5.2 Location of household in waste management practices

Although the location was not significant in influencing the participation of SWM, the results analysis indicated location (p=0.59) enhanced the likelihood of doubling of practicing SWM. The implication is that residents staying far from the dumpsite increased the prospect of the residents to participate in SWM in comparison to those in closer to the dumpsite. This concurs with other studies indicating a poorly developed waste management sector in low income regions (Aparcana, 2017; Rodić, and Wilson, 2017; Das *et al*., 2019; Ferronato, N., and Torretta, 2019).

5.5.3 Household size

The results showed no significant relationship between household size and participation in SWM (coefficient= -0.19, p=0.07, odds ratio=0.86). However, an increase in the household size negatively influenced participation of SWM. This trend contrasts Alberti 1999's findings indicating that the higher the household size, the more generated waste which will correspond with an enhanced participation of waste management.

5.5.4 Education level

The respondents' level of education significantly influenced participation of SWM practices (coefficient= 3.74, p=0.00, odds ratio=42.27). It was noted that respondents staying far from the dumpsite had slightly higher education levels that those staying near the dumpsite and were aware of SWM practices, thus more likely to participate in SWM activities. Conversely, respondents residing near the dumpsite had lower education levels and therefore had less knowhow on SWM activities which influenced their inaction.

From the findings, it can be noted that solid SWM in the dump can be dealt with by educating the residents. This can offer a remedy of waste management where stakeholders will support the generation and implementation of the desired management practices. This actually corroborates the findings that allude that educating stakeholders in waste management is the best strategy towards a waste management behavior change for improved waste management practices (Rahardyan *et al*., 2003; Amasuomo *et al*., 2015). This observation necessitates provision of education to locals aimed at informing them on regulations governing waste handling in Kenya and also on waste management practices. This will ensure participation and avoid situations where ignorance influences inaction.

The fact that the results indicated that education level played a significant role in shaping an individual's participation in SWM practices corroborates a study by Kibwage (1996) which showed that those with tertiary education were more aware of health and economic impacts of solid wastes. This coupled with the fact that they were more aware of waste management practices; indicate that education can be a precursor to improved waste management (Kahsay *et al*., 2020; Espuny *et al*., 2021). This creates a need to create

mechanisms of engaging the community on the importance of this waste management practices if success has to be achieved as was observed by (Kaseva and Mbuligwe, 2005).

5.5.5 Monthly income

Income did not play a major role in persuading participation in SWM practices. The results further indicated that a unit increase in income (p=0.69) increased the probability of practicing proper HWM as compared to those with low income. Income level has been found to be a factor that determines amounts of generated wastes (Gakungu *et al*., 2012). Unfortunately, the study took place in a slum area and therefore would not establish how this would relate between this area and those inhabiting in more affluent areas. If this is the case, then affluent neighborhoods may be more "cleaner" than those inhabited by low income groups.

5.6 Residents satisfaction with location of the dumpsite in the area

The Kalundu residents are not pleased that Kalundu dumping site is located in their locality. Many of them, more so the ones residing far from the dumpsite support the idea of segregating waste. The residents lamented of lack of policy and framework for SWM action plans for the waste dumped at Kalundu. This was based on lack of waste management infrastructure and poor implementation of SWM policies once it has been damped in the area. This means that there is a lot to be done to enhance residents' confidence on this issue and to realize its full potential in terms of economic and social development. The County Government of Kitui should develop and implement policies and legislation towards achieving this. However, just like it has been found elsewhere (Kumar, 2006; Chakrabrati *et al.* 2009; Kibwage, 2002) the regulations of waste handling may not be followed as required.

5.7 Responsibility share of SWM in Kalundu

Majority of respondents of those in the near the dumpsite group felt that the responsibility of SWM should be vested on the community while the majority of those far from the dumpsite felt that it should be vested on the County government of Kitui. This corroborates a study by Lounge *et al*., 2009. However, residents did not expect much from authorities.

The emergence of devolved governments may have been done in haste thereby inheriting former municipal authority broken services. This may have given rise of rudimentary, vague and ambiguous waste management legislation by the county governments. Actually Kibwage 1996, observed that waste management in upcoming municipalities lacked comprehensive guidelines on waste management.

5.8 Sources of information on HWM in the study area

Those respondents residing far from the dumpsite mainly acquired information on SWM though television while those close to the dumpsite acquired theirs through radio. This excluded a wide range of sources through which useful information on proper SWM in Kalundu could be disseminated. If this communication will be enhanced, the public will be more informed and their perception on environmental issues will improve as was demonstrated by Rahardyan, *et al*., (2004) and Amasuomo *et al*. (2015). Reasons for poor communication might have been the source and channel through which the information is being disseminated. Has can be observed, the only information some of them have ever received concerning environmental pollution versus solid waste management came nation-wide through television channel where in, only view of them afforded. The local authority like county government of kitui has not been involved in publicising this major information to its citizens (locals). Majority of the respondents for both groups suggested that if information of such importance could be spread through public barazas, then it could reach many of them.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

From the study, it can be concluded that residing in close proximity to the dumpsite, resulted in various illnesses with those closer to the dumpsite most affected. The cause of ill- health can be associated with waste dumped at the dumping site and frequency of ill-health increases as the distance from dumpsite shortened and vice versa.

From the study, it can be deduced that presence of a dumpsite in the local community causes pollution to the surrounding environment and makes it dirty, smelly and filthy. Some of the polluting activities from the dumpsite include smoke, leachate, vermin, rodents, stray dogs, etc.

The study noted that Kalundu residents and other stakeholders have little awareness on the connection between waste management and environmental issues. Similarly, there is inadequate information concerning dumpsite pollution and effective solid waste management.

Lastly, the study concludes that there is no corrective measures put in to place by the County Government of Kitui to counteract the negative effects of the dumpsite to the surrounding people and the environment.

6.2 Recommendation

Kalundu dumping site should be well fenced, waste volume should be controlled and monitored and there should be pollution prevention mechanisms within the management of the dumpsite.

There is need for county government of Kitui to improve on public awareness on sustainable solid waste management methods which will motivate positive attitude towards environmental conservation.

The county government should provide proper waste infrastructural facilities. The use of 5R (reduce, reuse, recycle, recover and residual management) concept should be encouraged to minimize the quantity of SW produced and dumped in Kalundu.

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APPENDICES

APPENDIX A: HOUSEHOLD SEMI-STRUCTURED QUESTIONNAIRE

SURVEY FOR THE HOUSEHOLDS' HEADS ON

ON SOCIO-*ENVIRONMENTAL EFFECTS AND HEALTH RISK OF LALUNDU DUMPSITE TO THE SURROUNDING IN KITUI TOWN, KITUI COUNTY, KENYA*.

Collected data is strictly Confidential and will only be used for Academic Purposes Only.

Informed Consent Form

I am an MSc student at SEKU and I will be collecting social - environmental effects and Health Risks on people living close to Kalundu Waste Dumpsite in Kitui Town. I have identified you as a stakeholder in this study and request that you respond tosome questions. Your information will be confidently treated and it will be used for academic purposes only.

SECTION A: HOUSEHOLD HEAD INTRODUCTION (BIO DATA) AND DISTANCE FROM DUMPSITE GROUP 1 < 250 METERS ☐ AND GROUP 2 OR > 250 METERS ☐ BUT WITHIN 500 METERS FROM DUMPSITE:

DATE			
GENDER			
AGE			
QUESTIONNAIRE SERIAL NO.			

SECTION B: HOUSEHOLD HEAD PERSONAL ~~&~~and SOCIO-ECONOMIC AND PERSONAL CHARACTERISTICS

01. Education Level

a) Not educated ☐ (c) Secondary Level ☐

b) Primary Level ☐ (d) Tertially Level ☐

02. Employment status of the Household head

a) Employed
b) Self-employed
c) Unemployed

03. The range of household head income levels in Ksh?

a) 0 – 5000/=
b) 5000 – 10000/=
c) 10000 – 15000/=
d) Above the specified

04. Marital status?

a) Married
b) Not married

05. How many are your dependants?

a) 1 – 2
b) 2 – 3
c) 3 – 4
d) 4-5
e) Above the specified

SECTION C: HOUSEHOLD HEAD BELIEVE ON HEALTH RISKS .

1. Does living close to Kalundu Dumpsite have any health risk to you?

a) Yes
b) No

2. Does living close to Kalundu dumpsite have an health problem to people close by?

a) Yes
b) No

3. Name the health problems associated with Kalundu dumpsite to the people living close to the dumpsite?

a) Air pollution due to Smoke and bad odor
b) Water pollution from leachates
c) Mosquitoes and other infectious insects

d) Reptiles e.g. snakes

e) Others (polluted food items)

4. Name the common illnesses in this area influenced by the presence of dumpsite?

a) Malaria

b) Diarrhoea

c) Chest Pains

d) Cholera

e) Eye irritation

f) Nose irritation

g) Skin irritation

h) None

5. Have you or any your family member ever been infected by any of the aforementioned illness?

a) Yes

b) No

6. If yes in 5 above, how often?

a) 0-3 months; once ☐ twice ☐ thrice ☐

b) 3-6 months; once ☐ twice ☐ thrice ☐

c) 6-9 months; once ☐ twice ☐ thrice ☐

d) 9-12 months; once ☐ twice ☐ thrice ☐

e) More than 12 months; once ☐ twice ☐ thrice ☐

7. Which diseases made you or your dependants get hospitalized?

a) Malaria

b) Diarrhoea

c) Chest Pains

d) Cholera

e) Eye irritation

f) Nose irritation

g) Skin irritation

h) None

8. Rate your health status now as compared to when the dumpsite was not here?
    a) Very healthy
    b) Normal
    c) Less healthy
9. Which age - group is more susceptible to the diseases with higher magnitude?
    a) 0-5yrs
    b) 5-10yrs
    c) 10-15yrs
    d) Beyond 15 years

SECTION D: HOUSEHOLD HEAD GENERAL VIEWS ON THEIR RESIDENTIAL ENVIRONMENT IN RELATION TO THE DUMPSITE.

Tick where appropriate.

01. How do you feel regarding the presence of dumpsite near your residential area?
    a) Agree
    b) Strongly disagree
    c) Not sure
02. What are your reasons for living close to dumpsite?
    a) I have built my house
    b) The dumpsite has been established while we are already residences.
    c) I cannot afford to relocate
    d) We were promised that the dumpsite doesn't pose any threat to the people and that it will be relocated
    e) I don't know anything about the matter
03. Which negative effects is the dumpsite rendering to the surrounding?
    a) Health problems
    b) Environmental pollution
    c) None
    d) Don't know
04. In what ways is kalundu dumpsite polluting your residential environment?
    a) Makes environment filthy
    b) Adding solid waste to the environment

c) Causes diseases and sickness

d) Don't know anything

05. How do you perceive the cleanliness of your residential surrounding?

a) Dirty ☐ b) Smelly ☐ c) Filthy ☐

06. What is the indication of Kalundu dumpsite to the surrounding community?

a) Provided breeding ground for vectors

b) Leads to disease

c) Dirties the place

d) None

e) Don't know

SECTION E: HOUSEHOLD KNOWLEDGE, ATTITUDE AND PUBLIC PARTICIPATION ON SWM SYSTEMS IN KITUI

1. Do you have any knowledge concerning MSW in Kitui?

a) Yes

b) No

2. Do you know some of the effective SWM techniques?

a) Yes

b) No

3. Where do you obtain this information concerning environmental pollution versus solid waste management?

a) From Media like Radio and Television

b) Posters and Publication in magazines or advertisement boards

c) Public Participation Seminars like Barazas

d) School

3. Is the information received concerning SWM adequate?

a) Yes

b) No

c) I don't know

4. If the information received is not enough, how would you want it to be spread?.....

5. What is your attitude towards solid waste?
    a) Solid waste is a burden to the community
    b) Solid waste littering leads to unclean environment
    c) Improper solid waste handling can cause sicknesses to the people living near it
    d) Solid waste can become a resource if dwelt with appropriately
    e) I don't know anything about it
6. Do you participate in Solid waste reduction methods as aspects of SWM?
    a) Yes
    b) No
7. Which methods of solid Waste Reduction do you use?
    a) Reducing on waste production at source
    b) Re-using some of the items (waste)
    c) Repairing some of the items
    d) Recycling
    e) None
8. Where do you dispose dump your generated waste?
    a) Dumpsite
    b) Burning
    c) Others (specify)…….
9. Do you participate in SWM decision making processes?
    a) Yes
    b) No
10. Whose responsibility it is, for the MSW in your neighbourhood?
    a) County government of Kitui authorities
    b) Community members (yourself)
    c) Private waste collectors
    d) Both community and county government
    e) None
    f) I don't know

11. Who is responsible for the waste challenges in Kalundu dumpsite?
    (a) County Government of Kitui
    (b) Private waste collectors
    (c) Community Members (yourself)
    (d) Both community and county government
12. Are the responsible stakeholders handling solid waste menace doing it adequately?
    a) Yes
    b) No
    c) I don't know

SECTION F: AWARENESS OF ANY CORRECTIVE MEASURES PUT IN TO PLACE BY CGoKTI TO PROTECT THE RESIDENTS FROM THE EFFECTS OF DUMPING SITE AND RECOMMENDATION OFFERED

1. Are you aware of any measures put down by County Government or any other authority to protect Residents from the impacts of Kalundu?

a) Yes ☐ b) No ☐ c) I don't know ☐

2. Are you planning to migrate away from the dumpsite soonest?
    a) Yes
    b) No
    c) I don't know
3. Which are your suggestions on the remedial measures to be employed in kalundu dumpsite?
    a) Formulation and enforcement of environmental pollution policy and By-laws
    b) Protection of the dumpsite
    c) Management of the dumpsite
    d) Relocation of dumpsite to further site from town
    e) Emphasise on educating the respondents on the knowledge of waste management systems and associated environmental pollution.

4. Which solid waste disposal methods do you apply in your household?
    a) Taking to street bins or bags for collection
    b) Taking to dumpsite
    c) Burning it in the pits
    d) Burying the waste
    e) Recycling and reusing it
    f) Throwing it haphazardly
5. Which technique of solid waste management do you suggest for Kitui town?
    a) Burning the waste or burying it
    b) Sorting the waste, recycling & reusing, composting and anaerobic biogas production.
    c) Relocating the dumpsite from the residential area to further site
    d) Managing the existing dumpsite
6. Which recommendation to the authorities towards the management of the dumpsite do you suggest?
    a) Fencing round the dumpsite
    b) Relocating the dumpsite with immediate effect
    c) Stopping dumping activities to that site with immediate effect
    d) Proper management of the dumpsite
    e) I don't know anything

! END OF SESSION!

THANKYOU FOR THE TIME ACCORDED!!!

APPENDIX B: INTERVIEW QUESTIONS FOR THE WASTE WORKER -; SENIOR SUPERVISOR CLEANING SERVICES (SSCS) CGOKTI) ON SOCIO-*ENVIRONMENTAL EFFECTS AND HEALTH RISK OF LALUNDU DUMPSITE TO THE SURROUNDING IN KITUI TOWN, KITUI COUNTY, KENYA*.

The Information to be collected will strictly be confidential and only used for Academic Purposes Only.

Informed Consent Form

Kitui Town has been experiencing problems of SWM in terms of reliable and viable disposal site for Solid Waste. This study therefore tends to assess the socio-economic benefits of Kalundu Dumpsite, residents' views towards their residential environment in relation to the dumpsite and finally the implication dumpsite has to the surrounding. Recommendation attained will advise responsible stakeholders on what should be done to secure the environment and the surrounding community. I am a student at SEKU. I have identified you to help answer some questions to help in answering my research objectives. Welcome and feel composed to participate.

SECTION A; STAFF INTRODUCTION INFORMATION

01. How many Senior Supervisors Cleaning Services are you?
02. For how long have you been serving as the SSCS Officer?

……

……..

SECTION B; SOLID WASTE TYPES AND AVERAGE QUANTITIES DELIVERED TO KALUNDU DUMPSITE, SOCIO-ECONOMIC BENEFITS OF THE DUMPSITE, YOUR VIEWS ON LOCATION AND IMPLICATION OF THE DUMPSITE TO THE SURROUNDING

01 How many days in a week do you collect and transfer to the kalundu dumping site?

……

……

02 What is the average tonnage of solid waste delivered in each of the days?

……

……

……..

03 In your own assessment and the experience you have in SWM, in what proportions of the waste types delivered in each of the days?

……

……

……

04 Which is the major solid waste type delivered on the dumpsite?

……

……

……

05 Which are some of the socio-economic benefits of kalundu dumpsite to the community?

……

…….....

.....

.....

06 What are the implications of the dumpsite to the surrounding?

……

……

……

07 In your own views, do you think kalundu dumpsite is sited appropriately?

……

……

……

08 What can be done to enhance SWM at kalundu dumpsite?

……

……

……..

09 What recommendations would give to the Key Stakeholders of SWM in Kitui town?

……

……

……

……

APPENDIX C: INTERVIEW GUIDE TO HEALTH OFFICER

INTERVIEW FOR THE HEALTH OFFICER ON

ON SOCIO-*ENVIRONMENTAL EFFECTS AND HEALTH RISK OF LALUNDU DUMPSITE TO THE SURROUNDING IN KITUI TOWN, KITUI COUNTY, KENYA*.

The Information Collected from this Survey is strictly Confidential and is to be used for Academic Purposes Only.

Informed Consent Form

I am an MSc student at SEKU and I will be collecting social - environmental effects and Health Risks on people living close to Kalundu Waste Dumpsite in Kitui Town. I have identified you as a stakeholder in this study and request that you respond tosome questions. Your information will be confidently treated and it will be used for academic purposes only.

SECTION A: HEALTH OFFICER INTRODUCTION (BIO DATA) AND HOSPITAL DISTANCE FROM DUMPSITE < 250 METERS OR > 250 METERS BUT WITHIN 500 METERS FROM DUMPSITE

01. Position of the Health Officer being interviewed……
02. Specialization of the Health Officer…….
03. Name of the Health centre…….
04. How many years has the hospital been operating in Kalundu Vicinity?**.....**

SECTION B: HEALTH OFFICER's GENERAL VIEWS ON LOCATION OF KALUNDU DUMPSITE, ITS IMPLICATION TO THE SURROUNDING AND WASTE MANAGEMENT.

01. Do you think Kalundu dumpsite is located appropriately?

02. If the location of the dumpsite is not suitable, which are the parameters making it an appropriately situated?

03. Is kalundu dumpsite interfering with your operations? If yes describe how?

04. Which are the effects of kalundu dumpsite to the health of the surrounding community?

05. Which diseases have affected the community living close to dumpsite, and which one is more serious than others?

06. Which age group has shown more susceptibility to these diseases?

07. What remedial measures can be employed to counteract the deleterious impacts of the dumpsite?

08. Which solid waste disposal method do this hospital use?

09. Which solid waste management technique would you advise to be adopted for Kitui municipality?

10. Which recommendations do you suggest for the responsible authorities towards management of the dumpsite?

END OF SESSION AND THANKYOU FOR THE TIME ACCORDED!!!

APPENDIX D: FOCUS GROUP FOR SCAVENGERS

FOCUS GROUP DISCUSSION FOR THE SCAVENGERS ON

ON SOCIO-*ENVIRONMENTAL EFFECTS AND HEALTH RISK OF LALUNDU DUMPSITE TO THE SURROUNDING IN KITUI TOWN, KITUI COUNTY, KENYA*.

The Information collected will be strictly Confidential and used for Academic Purposes Only.

Informed Consent Form

I am an MSc student at SEKU and I will be collecting social - environmental effects and Health Risks on people living close to Kalundu Waste Dumpsite in Kitui Town. I have identified you as a stakeholder in this study and request that you respond to some questions. Your information will be confidently treated and it will be used for academic purposes only.

SECTION A: HEALTH OFFICER INTRODUCTION (BIO DATA) AND HOSPITAL DISTANCE FROM DUMPSITE < 250 METERS OR > 250 METERS BUT WITHIN 500 METERS FROM DUMPSITE

APPENDIX E: FOCUS GROUP FOR TRADERS

FOCUS GROUP DISCUSSION FOR THE TRADERS AND GARAGE WORKERS ON SOCIO-*ENVIRONMENTAL EFFECTS AND HEALTH RISK OF LALUNDU DUMPSITE TO THE SURROUNDING IN KITUI TOWN, KITUI COUNTY, KENYA*.

Collected data is strictly Confidential and will only be used for Academic Purposes Only

Informed Consent Form

I am an MSc student at SEKU and I will be collecting social - environmental effects and Health Risks on people living close to Kalundu Waste Dumpsite in Kitui Town. I have identified you as a stakeholder in this study and request that you respond tosome questions. Your information will be confidently treated and it will be used for academic purposes only.

SECTION A: HEALTH OFFICER INTRODUCTION (BIO DATA) AND HOSPITAL DISTANCE FROM DUMPSITE < 250 METERS OR > 250 METERS BUT WITHIN 500 METERS FROM DUMPSITE

APPENDIX F –THEMATIC ANALYSIS PROCESS.

Table 5: Thematic Phases in the framework process

Phase	Description of the process
1. Data familiarization	Data is transcribed, read and reread if necessary
2. Generation of codes	Involves coding features of the data systematically and linking relevant data together
3. Search of themes	Codes will be collated into their relevant themes
4. Theme review	Themes will be checked to ensure they worked to their coded extracts and then a map of the analysis will be generated
5. Theme naming	Theme specifics will be analysed and refined to generate clear definitions
6. Report production	This involves production of a scholarly report.