OCCUPATIONAL HAZARDS AND CHALLENGES ASSOCIATED WITH SOLID WASTE MANAGEMENT: A CASE OF SOLID WASTE WORKERS IN KAWEMPE DIVISION, KAMPALA CAPITAL CITY

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A DISSERTATION

SUBMITTED TO THE FACULTY OF ENGINEERING, DESIGN AND TECHNOLOGY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN ENVIRONMENTAL, HEALTH & SAFETY MANAGEMENT

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ABSTRACT

Occupational hazards refer to potential adverse health and safety impacts individuals undergo in their working environment and work places. Annually 2.1 billion tons of waste is produced around the world which is normally managed by municipal solid waste workers (MSW). Similarly, in Kawempe Division, Kampala Uganda, managing the waste produced, is not an easy task as they work tirelessly to ensure waste is removed and transported to designated disposal sites. The municipal workers undergo many occupational hazards due to their poor working conditions, poor health and hygiene facilities, lack of proper protective equipment (PPE), and minimal knowledge of proper waste management techniques. The occupational risks include biological risks from pathogens and pathogen-carrying agents such as viruses, flies rodents, bacteria and flies among others; chemical risks from wastes such as biomedical wastes, soaps and detergents, and other poisonous substances and physiological risks due to their working conditions in addition to heavy physiological activity. The health problems of municipal solid waste workers can be classified into musculoskeletal, respiratory, headaches, and dermatological and gastrointestinal problems. Prolonged exposure often leads to problems such as stomach pain, allergies, asthma, and other diseases such as dysentery. Poor working conditions, low education or illiteracy, and socioeconomic conditions also act as factors that increase the risk of occupational health and safety hazards. This dissertation emphasized on the occupational health and safety hazards associated with the types of waste handled by municipal waste workers throughout their work during waste management.

DECLARATION

DECLARATION OF AUTHORSHIP: I declare that I am the author of this dissertation and that any assistance I received in its preparation is fully acknowledged and disclosed in the paper. I have also cited any sources from which I used data, ideas or words, either quoted directly or paraphrased. I also certify that this dissertation was prepared by me specifically for the partial fulfilment for the degree of Master of Science in Environment, Health and Safety Management at Uganda Christian University.

Signature _____ Date: 15th September 2025.

Name: John OKATCH Date: 15th September 2025

DEDICATION

This dissertation is a dedication to my late parents, ACP J.M.O. Okatch and Mrs. Winfred Kabagahya, My wife, Children and last but not least Adyeeri Silvia Mbabazi for the guidance and support in my life.

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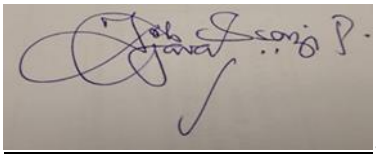
This is to acknowledge the support and guidance received from my faculty supervisor Mr. Gava Job Ssazi Pius during the writing up of the report and my current employer the National Environment Management Authority of Uganda for the unlimited accessibility to the NEMA Resource Library providing me with scientific and technical information used in the preparation of this dissertation.

This master's degree dissertation has been submitted for examination with my approval as the university supervisor.

Signature:  …Date: 6th October 2025

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GLOSSARY OF TERMS AND ACRONYMS

CBD:	Central Business District
GKMA:	Greater Kampala Metropolitan Area
GoU:	Government of Uganda
KCCA:	Kampala Capital City Authority
NCD:	Non-Communicable Diseases
NEA:	National Environment Act, No.5 of 2019
NEMA:	National Environment Management Authority
SWCFs:	Solid Waste Collection Facilities
SWM:	Solid Waste Management
SWMS:	Solid Waste Management Strategy
UCU:	Uganda Christian University –Mukono
IPSK:	Institute of Petroleum Studies -Kampala
UNEP:	United Nations Environment Programme
WHO:	World Health Organization
WMT:	Waste Management Theory

CHAPTER ONE: INTRODUCTION

Background

Solid Waste Management (SWM) generally means the management of unwanted waste. SWM-related safety and health hazards are major public health concerns worldwide and are as old as humans are. Workplace hazards, occupational diseases, and deaths contribute significantly to the increase in the global burden of non-communicable diseases (NCDs) (ILO, 2019). Municipal solid wastes (MSWs) refer to undesirable or unutilized materials or products mainly from households, gardens, markets, restaurants, among others (Mouhoun Chouaki et al. 2019). The International Labor Organization (ILO) also estimates that every day, 1,000 people die globally from accidents at the workplace and 6,500 from occupational diseases, while about 65% of this global work-related mortality is reported annually in Asia (ILO, 2019). Wolf et al., 2018) noted that NCDs, injuries, and infectious diseases contribute 70%, 22%, and 8%, respectively, to the total disease burden from occupational health risks, according to the World Health organisation (WHO).

The genesis of this dissertation lies in the critical intersection of public health, environmental sustainability, and the often-overlooked labor force responsible for managing municipal solid waste. The process of waste management, an essential service in any urban environment, inherently exposes workers to a multitude of hazards (Kaphle, M et al, 2024). These hazards encompass physical risks, such as sharp objects and heavy machinery; chemical risks, arising from the composition of the waste itself; biological risks, stemming from exposure to pathogens and infectious agents; and psychosocial risks, including stress and demanding work conditions (Shuvani Chikombe, 2017). The research aimed to assess these risks comprehensively.

The selection of Kawempe Division, Kampala, Uganda, as the case study location is deliberate. Kampala, as a rapidly growing urban center, faces significant challenges in waste management, including inadequate infrastructure, limited resources, and a high volume of waste generation. Kawempe Division, a densely populated area within Kampala, reflects these challenges acutely. The characteristics of waste handled by municipal solid waste workers in this division are diverse, ranging from organic waste to hazardous materials, thereby amplifying the potential for exposure to occupational hazards (Kiggundu, A. T. (2024). The existing literature reveals a gap in comprehensive assessments of occupational health and safety within this specific context. The research intends to fill this void by providing empirical data and insights relevant to this particular setting.

The researcher's perspective is shaped by a commitment to understanding and addressing the health and safety challenges faced by municipal solid waste workers. The work is driven by a desire to contribute to the development of evidence-based interventions and policy recommendations that can improve working conditions and protect the well-being of this vulnerable workforce. The process involves a combination of literature review, data collection, and analysis. The researcher anticipates encountering both quantitative and qualitative data, which will require careful interpretation to derive meaningful conclusions. The study's design incorporates ethical considerations to ensure the protection of the participants' rights and privacy.

The dissertation's ultimate goal is to provide a comprehensive assessment of the occupational health and safety risks associated with the type of waste handled by municipal solid waste workers in Kawempe Division. The findings will inform practical recommendations for improving waste management practices, enhancing worker safety, and contributing to the overall health and well-being of the community. The research seeks to provide insights that can be applied not only in Kawempe Division but also in other urban areas facing similar challenges in waste management.

Problem Statement

The assessment of occupational health and safety (OHS) within the context of municipal solid waste management presents a multifaceted problem, demanding rigorous investigation. From a third-person perspective, the inherent dangers associated with waste handling are readily apparent (Ngwira, M et al, 2024). Municipal solid waste workers are routinely exposed to a complex cocktail of hazards, including biological agents, chemical substances, physical stressors, and ergonomic risks (Gowda, B et al, 2023). These exposures can lead to a spectrum of adverse health outcomes, ranging from acute injuries and infectious diseases to chronic conditions and long-term disabilities (Vinti, G et al, 2021).

My own observations, informed by the literature and preliminary data, suggest that current OHS practices within many municipalities are insufficient to adequately protect municipal solid waste workers. This inadequacy stems from several contributing factors. Firstly, the heterogeneous nature of waste streams complicates hazard identification and risk assessment (Chu, M et al, 2025). Secondly, the dynamic and often unpredictable nature of waste management operations necessitates flexible and adaptive safety protocols (Adamides, E. D, 2023). Thirdly, the economic constraints faced by many municipalities can limit the resources available for implementing and maintaining robust OHS programs (Tshivhase, S. E, et al 2022).

The problem, therefore, is not simply the presence of hazards, but the systemic failures in identifying, assessing, and mitigating these hazards effectively (Golzary, A, et al, 2024). This necessitates a comprehensive understanding of the specific types of waste handled by municipal solid waste workers, the nature and magnitude of their exposures, and the effectiveness of existing control measures. Furthermore, it requires an examination of the organizational and regulatory factors that influence OHS performance within this sector.

From my point of view, the lack of adequate OHS provisions represents a significant ethical concern. Municipal solid waste workers perform an essential service, and they deserve to work in environments that prioritize their health and safety. The failure to provide such environments constitutes a violation of their fundamental rights and can lead to a decline in the quality of life (Solaja, O. M, et al, 2024). The core of the problem statement is the need for a systematic and thorough assessment of OHS in municipal solid waste management. The scope of this assessment must encompass the identification of hazards, the evaluation of exposure levels, the assessment of existing control measures, and the identification of areas for improvement. The ultimate goal is to provide evidence-based recommendations for enhancing OHS practices and protecting the health and safety of municipal solid waste workers. This research aims to contribute to a safer and healthier working environment for those who provide a crucial service to our communities.

General Objective

To assess occupational health and safety hazards associated with the type of waste handled by municipal solid waste workers and challenges during solid waste management in Kawempe Division, Kampala Capital City, Uganda.

Specific Objectives of the Study

The study was guided by the following specific objectives:

(i) Determining the different occupational hazards associated with SWM in Kawempe Division, Kampala Capital City, Uganda.

(ii) Determining the different types of solid wastes handled by waste handlers in Kawempe Division, Kampala Capital City, Uganda.

(iii) Determining the challenges in solid waste management in Kawempe Division, Kampala Capital City, Uganda.

Research Questions:

(i) What are the occupational hazards associated with municipal solid waste management in Kawempe Division, Kampala Capital City, Uganda?

(ii) What are the different types of solid wastes handled by waste handlers in Kawempe Division, Kampala Capital City, Uganda?

(iii) What are the challenges in solid waste management in Kawempe Division, Kampala Capital City, Uganda?

A Conception Framework of occupational hazards amongst solid waste handlers

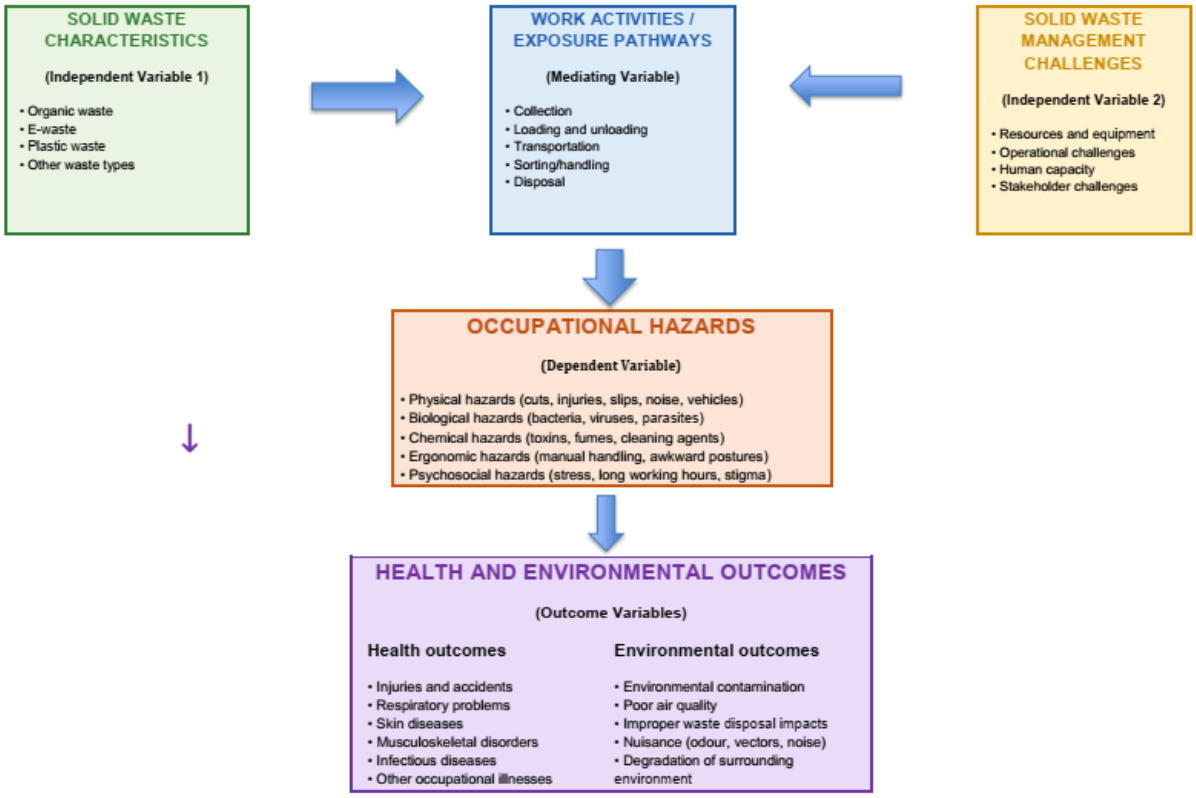

Figure 1: Conceptual framework of occupational hazards and challenges associated with solid waste management among municipal solid waste workers

The conceptual framework illustrates the assumed relationship between the types of solid waste handled, challenges associated with solid waste management and occupational hazards among solid waste workers in Kawempe Division, Kampala Capital City. The framework assumes that the nature of solid waste handled by workers, including organic waste, e-waste and plastics, influences the type and level of occupational exposure encountered during waste management activities.

The framework further assumes that challenges associated with resources and equipment, operational processes, human capacity and stakeholder involvement may increase workers' exposure to occupational hazards. These factors may consequently manifest as health and

environmental risks associated with solid waste management. The framework therefore provides a basis for examining how the characteristics of waste and the conditions under which it is managed are related to occupational hazards among solid waste workers in Kawempe Division.

The framework consists of three major components:

A. Solid Waste

The first component represents the types of solid waste handled by the workers, namely:

1. Organic waste
2. E-waste
3. Plastic waste

The nature of waste handled determines the types of exposures workers may encounter. For example, organic waste may expose workers to biological hazards, while plastics and e-waste may involve physical or potentially hazardous chemical exposures.

In the framework, an arrow connects Solid Waste → Occupational Hazards, indicating that the nature of waste handled is expected to contribute to the occupational risks experienced by workers.

B. Challenges in Solid Waste Management

The second component represents the management and operational challenges encountered in the solid waste management process.

Your framework identifies four broad categories:

1. Resources and equipment
2. Operational challenges
3. Human capacity
4. Stakeholder-related challenges

These challenges can affect how safely waste is collected, transported, handled and disposed of.

For example, inadequate equipment or resources may make workers rely on manual handling, while inadequate human capacity may result in insufficient training or poor adherence to safe working procedures.

The arrow from Challenges in Solid Waste Management → Occupational Hazards therefore indicates that these challenges may increase workers' exposure to occupational hazards.

C. Occupational Hazards

This is the outcome/dependent component of your framework.

The framework groups the consequences into:

1. Health risks

2. Environmental risks

The occupational hazards therefore represent the risks associated with workers' exposure to the waste and the conditions under which solid waste management activities are undertaken.

Justification of the Study

The genesis of this dissertation stems from a confluence of personal observation and academic curiosity, interwoven with the critical need to address occupational health and safety (OHS) concerns within the municipal solid waste management sector. The choice of Kawempe Division, Kampala, Uganda, as the case study area is deliberate, born from an understanding of the unique challenges faced by workers in this specific context.

From a third-person perspective, the study is justified by the significant and often overlooked risks inherent in waste management. Municipal solid waste workers are consistently exposed to a myriad of hazards, including biological agents, chemical substances, physical injuries, and psychosocial stressors. These exposures can lead to a range of adverse health outcomes, from minor ailments to life-threatening conditions. Despite the prevalence of these risks, OHS practices in many developing countries, including Uganda, are often inadequate. This inadequacy is frequently attributed to resource constraints, lack of awareness, and insufficient enforcement of existing regulations.

The first-person perspective enters here, as I, the researcher, observed first-hand the working conditions within similar environments. This observation fuelled a desire to understand the specific risks faced by waste workers in Kawempe Division. The study aims to provide a detailed assessment of these risks, focusing on the types of waste handled and their associated health and safety implications. The research intends to identify the specific hazards encountered by workers, evaluate the effectiveness of existing OHS measures, and ultimately propose practical recommendations for improvement.

The justification for this study also lies in its potential contribution to the existing body of knowledge. While research on waste management and OHS is available, there is a notable gap in studies that specifically address the context of Kampala, Uganda. This dissertation seeks to fill this gap by providing empirical data and insights relevant to the local situation. The findings will be valuable not only for academic purposes but also for informing policy and practice.

Furthermore, the study is justified by its potential impact on the lives of the workers themselves. By identifying and assessing the risks they face, the research can contribute to the development of targeted interventions aimed at improving their health and safety. This could include recommendations for better personal protective equipment, improved waste handling

procedures, and enhanced training programs. Ultimately, the goal is to create a safer and healthier working environment for these essential workers.

Finally, the choice of Kawempe Division as a case study is strategically sound. The division represents a microcosm of the broader challenges faced by waste management systems in urban areas of developing countries. The findings of this study can therefore be extrapolated to inform OHS interventions in other similar contexts. The research aspires to be a catalyst for positive change, contributing to the well-being of municipal solid waste workers and promoting sustainable waste management practices. The study seeks to provide a comprehensive understanding of the occupational hazards associated with waste handling, paving the way for a healthier and safer working environment for the dedicated individuals who manage our waste.

Significance of the Study

The significance of this study, focuses on occupational hazards and challenges associated with solid waste management in Kawempe Division, Kampala Capital City, Uganda, is multifaceted, impacting several key areas.

Firstly, the research directly addresses a critical public health concern. Municipal solid waste workers are at the forefront of waste management, exposing them to a variety of health hazards. These hazards include, but are not limited to, exposure to infectious agents, toxic chemicals, physical injuries, and ergonomic stressors. The study's findings will provide a detailed understanding of the specific risks faced by these workers, which is essential for developing targeted interventions to protect their health and well-being. From my perspective, understanding these risks is the first step in creating a safer working environment.

Secondly, the study contributes to the body of knowledge on occupational health and safety in the context of developing countries. While research in this area exists, it is often limited, and the specific challenges faced by waste workers in rapidly urbanizing areas like Kampala are not always adequately addressed. This research offers a localized perspective, considering the unique environmental, social, and economic factors that influence waste management practices and worker safety in Kawempe Division. This localized focus is vital, as it allows for the development of tailored solutions that are relevant and effective.

Thirdly, the study has practical implications for policymakers and waste management authorities. The data collected and analyzed will provide evidence-based recommendations for

improving waste management practices and implementing effective occupational health and safety programs. This could include suggestions for improved waste segregation, the provision of personal protective equipment (PPE), training programs, and the establishment of health surveillance systems. The implementation of these recommendations can lead to a reduction in work-related injuries and illnesses, ultimately improving the quality of life for waste workers. I believe that these recommendations will provide a roadmap for improving the safety of the workers.

Furthermore, the study can serve as a catalyst for raising awareness about the importance of occupational health and safety among waste workers, the general public, and other stakeholders. By highlighting the risks faced by waste workers, the research can encourage a greater appreciation for their work and the need for their protection. This increased awareness can lead to improved working conditions and increased support for waste management initiatives.

Finally, this study may serve as a foundation for future research. The findings can be used to identify gaps in knowledge and to develop more in-depth studies on specific aspects of occupational health and safety in the waste management sector. This could include research on the effectiveness of different types of PPE, the impact of specific waste types on worker health, or the development of innovative waste management technologies. In my opinion, this study will open doors for further research.

The study intends to basically highlight various occupational health and safety issues affecting municipal and/or town council solid waste management workers where future research can be usefully carried out for example in the management of various classes of wastes (that is hazardous and non-hazardous wastes), protecting the communities from being affected by pollution, the solid waste treatment technologies such as landfills, in situ burial etc. as may be deemed appropriate in the Ugandan setting. The study is beneficial to the sub-contracted waste management companies to better understand their position in terms of environment management. This would be an important tool for sustainable development and one, which can be adjusted wherever possible.

Lastly, the study will assist various stakeholders in reviewing and re-designing appropriate policies and standards related to occupational health and safety among waste management workers and environment compliance in most Town councils and Divisions of Uganda.

Scope of the Study

The scope of this study was to assess the occupational hazards or challenges associated with solid waste management in Kawempe Division, Kampala, Uganda, focusing on the specific types of waste they handle during waste management processes. The research employed a mixed-methods approach, combining quantitative and qualitative data collection techniques.

The study area was geographically delimited to Kawempe Division, a specific administrative Division within Kampala Capital City. This choice allowed for a focused investigation, ensured manageable data collection and analysis. The study's temporal scope encompassed the period of data collection, analysis, and reporting. The data collection phase was clearly defined for three months from April, May and June of 2024, allowing for a snapshot of the OHS situation at a particular point in time.

The primary focus was identifying and evaluating the hazards and challenges associated with solid waste management specifically the types of waste handled. This includes but is not limited to, organic waste, recyclable materials, hazardous waste (such as medical waste if present), and electronic waste. The assessment also considered the physical, chemical, and biological hazards waste workers are exposed to during solid waste management.

The research investigated the existing OHS practices and infrastructure within the waste management system in Kawempe Division. This included evaluating the availability and effectiveness of personal protective equipment (PPE), training programs, waste handling procedures, and emergency response protocols. The study also examined the workers' awareness and understanding of OHS risks and their adherence to safety guidelines.

Data collection methods involved a combination of direct observation of waste handling activities, interviews with waste workers, supervisors, and relevant stakeholders, and, the review of existing records such as incident reports and health records. Quantitative data was analysed using statistical methods and identified patterns and trends in OHS risks and outcomes. Qualitative data from interviews was analysed thematically to gain in-depth insights into workers' experiences, perceptions, and challenges.

The study's findings were presented in a comprehensive report, including a detailed analysis of the identified OHS hazards, an evaluation of current OHS practices, and recommendations for improving worker safety and health. The recommendations were tailored to the specific context

of Kawempe Division and considered the local resources and constraints. The research aimed to contribute to the body of knowledge on OHS in the informal waste sector, provided valuable insights for policymakers, waste management authorities, and other stakeholders.

The ultimate goal of the study was to provide evidence-based information that can be used to inform the development and implementation of effective OHS interventions, ultimately leading to improved working conditions and reduced health risks for municipal solid waste workers in Kawempe Division. The study acknowledged the limitations of its scope, such as the potential for generalization to other contexts and the inherent challenges in capturing the complexity of the informal waste sector. However, the research strived to provide a rigorous and insightful assessment of the OHS challenges faced by waste workers in this specific setting.

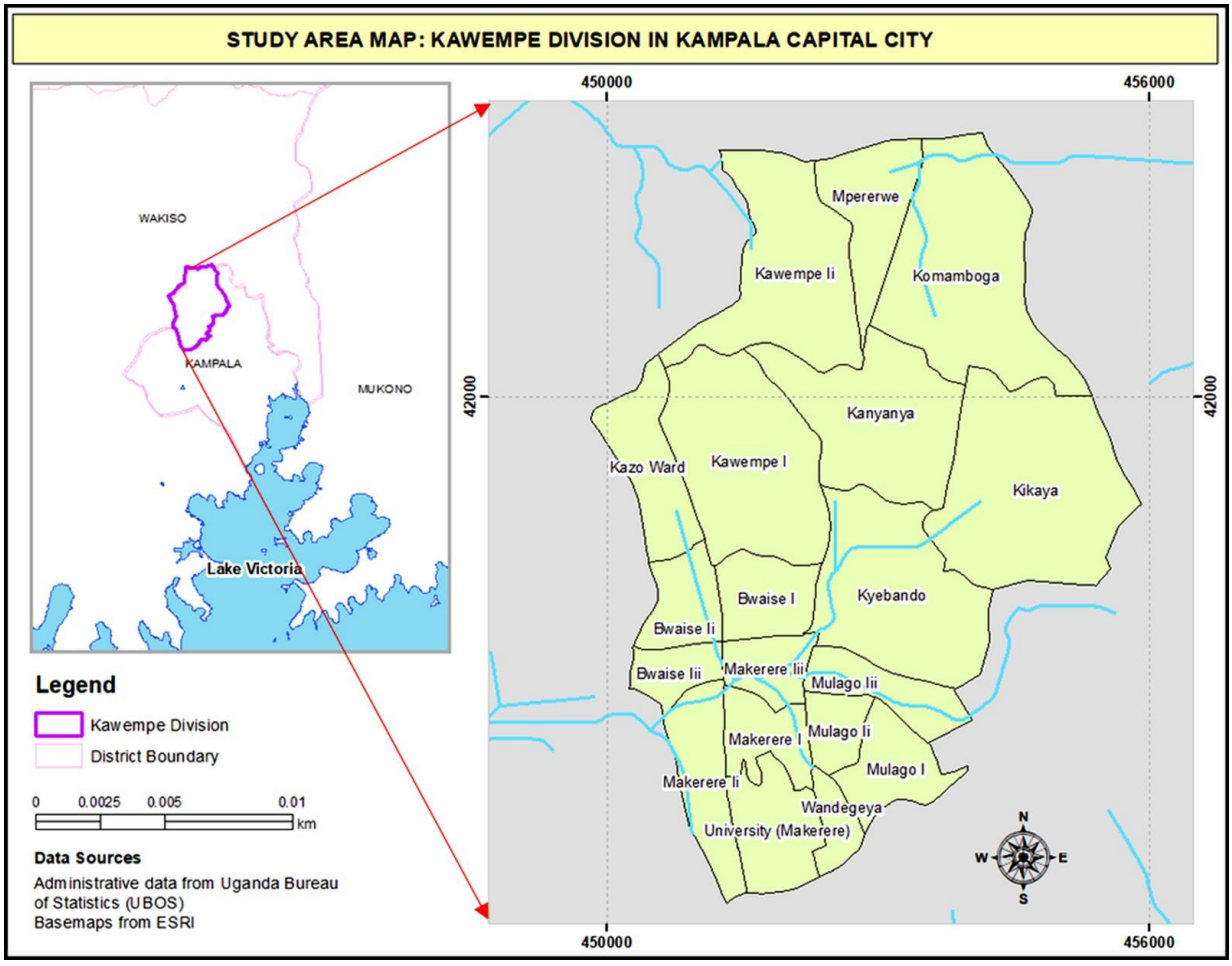

Figure 2: Map showing the location of Study Area and 19 Parishes

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Municipal Solid Waste (MSW) management is a critical public service with significant implications for urban health, environment, and sustainability. Workers within this sector are on the front line, directly exposed to a heterogeneous and often hazardous mix of waste materials. In developing countries, particularly in Sub-Saharan Africa (SSA), the challenges are exacerbated by rapid urbanization, inadequate waste management infrastructure, and high volumes of organic and unsegregated waste. This literature review synthesizes current knowledge on the occupational health and safety (OHS) hazards faced by MSW workers, with a specific focus on the nexus between the types of waste handled and the resulting health risks. It situates the research within the context of Uganda, specifically Kampala Capital City and Kawempe Division, to identify critical gaps this thesis aims to address.

2.2 The context of municipal solid waste management in sub-Saharan African and Uganda

MSW management in SSA is characterized by inefficient collection, limited recycling, and heavy reliance on open dumping and informal sector involvement (Kasozi et al., 2021). Kampala, Uganda's capital, faces immense pressure from population growth, leading to waste generation that outpaces management capacity. Studies indicate that over 60% of generated waste in Kampala is organic, with significant portions of plastics, textiles, and other materials, often co-mingled with hazardous household waste like medical sharps, batteries, and chemicals (Ntayi et al., 2023). The Kawempe Division, being a high-density residential area, contributes substantially to this waste stream, presenting a unique case study of exposure risks. The workforce comprises both formal workers employed by the Kampala Capital City Authority (KCCA) and a vast informal network of waste pickers and handlers, the latter operating with minimal regulatory protection (Ahimbisibwe & Nabaasa, 2024).

2.3 Solid Waste Management

Solid waste management is a critical environmental and public health issue that poses significant challenges globally, particularly in urban areas. The management of solid waste involves the collection, transport, treatment, and disposal of various types of waste generated by households, businesses, industries, and institutions. Effective solid waste management is essential to protect

public health, preserve environmental quality, and promote sustainable development. Abubakar et al, (2022).

According to the World Bank, global waste generation is expected to increase to 3.4 billion tons by 2050, driven by rapid urbanization and population growth. Inadequate solid waste management practices can lead to a range of environmental and health problems, including air and water pollution, soil contamination, greenhouse gas emissions, and the spread of diseases. Vulnerable populations, such as waste workers and communities living near waste disposal sites, are particularly at risk of adverse health effects from poor waste management practices (Gutberlet, and Uddin 2017).

The complexity of solid waste management systems requires a multidisciplinary approach that integrates technical, environmental, social, economic, and policy perspectives. Sustainable waste management strategies aim to minimize waste generation, maximize resource recovery through recycling and composting, and ensure safe disposal of residual waste (Khan et al, 2022). These strategies are essential for achieving the goals of sustainable development, including reducing poverty, protecting ecosystems, and promoting public health. (Katila et al, 2019).

2.3.1 What is waste?

Solid wastes are defined as discarded solids that result from human-animal activities (Arivanandan & Aiswal, 2020). The United Environment Programme (UNEP) describes waste as substances or objects that are discarded of or intended be disposed of according to national laws. This includes hazardous waste, municipal solid waste (hold waste), radioactive waste, and others. Municipal solid wastes (MSWs) refer to undesirable or unutilized materials or products mainly from households, gardens, markets, restaurants, among others (Mouhoun Chouaki et al. 2019). The definition of waste varies depending on the specific type considered. Some common types of waste include municipal waste, solid waste, hazardous waste, electronic waste or e-waste. According to the United Kingdom's environmental agency, solid wastes be classified as controlled or non-controlled. Controlled solid wastes originate from households commercial settings, industries, production plants, demolition sites, and construction sites (Enerijiofi and Ekhaise, 2022). Non-controlled wastes, which can pose significant environmental and health risks, come from degradation operations such as agriculture practices and mining activities.

2.3.2 Differentiation of waste

There are three categories of waste: ordinary, dangerous, and hazardous. (Moshkal, M et al, 2024) realized earlier that there are four waste classes, collected and are illustrated in the Table 1 below.

Class 1	Non-wanted things, created not intended, or not avoided, with no purpose
Class 2	Things with a finite purpose, destined to become useless after fulfilling it
Class 3	Things with not acceptable performance due to a flaw in Structure or State
Class 4	Things with acceptable performance, but their users fail to use them for their intended purpose.

Table 1: Showing the classes of waste (Moshkal, M et al, 2024)

The table below provides an overview of these categories along with examples for type:

Ordinary waste (Non-Hazardous)	**Dangerous waste (Hazardous waste)**	**Hazardous waste**
Residual waste	Waste oil and/or chemical	Radioactive-waste-Low radioactive waste (LRW)
Sorted residual waste	Oil and/or chemically contaminated materials	Quick-silver (Hg)
Food waste	Oil filter without metal sheath and/or chemicals	
Contaminated food waste	Oil filter with metal sheath and/or chemicals	
Cardboard and brown paper	Solvents	
Paper	Paint unhardened	
Plastic foil	Liquid paint	
Hard plastic	Spray cans	
Wood	Acids, bases and asbestos	
Iron and metal	Bag wastes	
Glass	Empty barrels and cans	
Electric and electronic waste	Fluorescents tubes	
	Lead batteries and other batteries	
	Medical (clinical) waste	
	Oil based cuttings from drilling	
	Oil based drilling slam or drilling liquid	
	Oil based slops / oil emulations	
	Water based cuttings from drilling	

	Water based drilling slam / drilling liquid	

Table 2 : Showing differentiation of Waste (Dinis-Carvalho, et al. 2015)

Once generated, managing these wastes in a manner that protects human health and the environment is essential for limiting operators' legal and financial liabilities and makes good business sense. Operators must also determine if the waste is subject to hazardous waste regulations. At times, this determination is misunderstood and can lead to improper waste management decisions for instance prudent waste management decisions, even for nonhazardous wastes, should be based on the inherent nature of the waste. Not all waste management options are appropriate for every waste. Operators also should be familiar with state and federal regulations governing the management of hazardous and nonhazardous wastes for example the preferred option for preventing pollution is to avoid generating wastes whenever possible (source reduction). Examples include process modifications to reduce waste volumes and materials substitution to reduce toxicity.

2.4 Composition of Municipal solid waste and associated Hazard typology

The health hazards for waste workers are intrinsically linked to waste composition. A detailed typology is essential for risk assessment.

2.4.1 Biological Hazards

The high organic content (food waste, garden waste) makes MSW a breeding ground for pathogens. Workers are exposed to bacteria (e.g., E. coli, Salmonella), viruses (e.g., Hepatitis A & B, SARS-CoV-2), fungi, and endotoxins through direct contact, inhalation of bio aerosols, and vectors like insects and rodents (Nabatte & Oporia, 2023). A recent study in a similar urban setting found that waste handlers had a significantly higher prevalence of respiratory symptoms, skin infections, and gastrointestinal illnesses compared to a control group, directly correlating with exposure to decomposing organic waste (Mbabali et al., 2022). The presence of human faecal matter in solid waste, common in areas with poor sanitation, further elevates the risk of parasitic and enteric diseases (Nakibuule et al., 2024).

2.4.2 Chemical Hazards

Chemical Hazards Chemical hazards arise from household hazardous waste (HHW) improperly disposed of within the general waste stream. This includes:

• VOCs and Landfill Gases: Decomposing organic matter generates methane (CH_4), hydrogen sulfide (H_2S), and volatile organic compounds (VOCs). Chronic inhalation is linked to respiratory distress, neurological effects, and cancer (Ssemugabo et al., 2024).

• Heavy Metals: Discarded batteries, e-waste, and paints contain lead, mercury, and cadmium. These can leach and become airborne as dust, posing risks of toxic accumulation and organ damage through dermal contact and inhalation (Atuhaire et al., 2022).

• Pesticides and Cleaning Agents: Residual chemicals in containers can cause acute poisoning or chronic health effects upon contact.

2.4.3 Ergonomic and Physical Hazards

The manual nature of waste collection—lifting heavy bins, repetitive motions, and operating compacting mechanisms—predisposes workers to musculoskeletal disorders (MSDs), including chronic back pain and joint injuries (Abah & Ndejjo, 2021). Physical hazards include cuts and puncture wounds from sharps (needles, broken glass, metal), which carry a dual risk of injury and blood borne pathogen transmission (e.g., HIV, Hepatitis B/C). A 2023 study on Ugandan waste workers highlighted that over 70% had experienced a work-related injury in the past year, with cuts and needle stick injuries being prevalent (Kigozzi et al., 2023).

2.4.4 Psychosocial Hazards

Often over looked, psychosocial hazards are significant. Workers face social stigma, job insecurity (especially in the informal sector), and high-stress workloads. Exposure to distressing materials (e.g., medical waste, dead animals) and fear of disease contribute to anxiety and psychological stress (Nabayunga & Katushabe, 2024).

Research by Nsubuga et al. (2018) in Uganda highlighted the prevalence of musculoskeletal disorders among solid waste workers, with a significant number reporting back pain, joint pain, and other related issues. Similarly, a study by Kiggundu et al. (2017) identified exposure to harmful chemicals and biological agents as major risks faced by solid waste workers in Kampala. These findings underscore the urgent need to address occupational health and safety concerns in this vulnerable workforce.

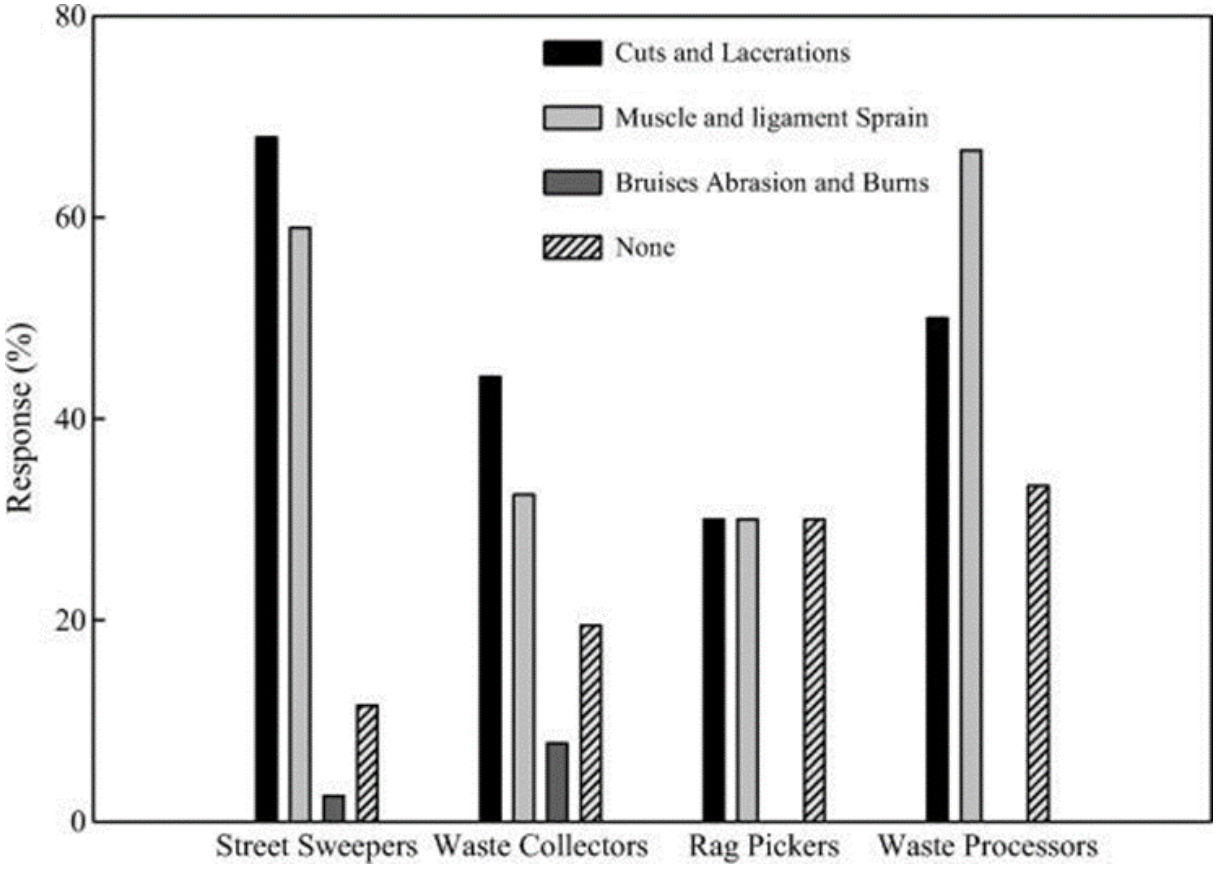

Figure 3: A graph showing injuries of different solid waste management workers (Source: Thakur et al (2018))

2.5 Solid Waste Management Practices

2.5.1 Land farming

It is a well-proven ex-situ bioremediation technology that has been successfully used since the 1980s for treating organically impacted soils/sediments. The material to be treated is incorporated into the surface soil with variable thickness. The waste is then tilled and amended with nutrients/ fertilizers such as urea and triple superphosphate (TSP) to provide nitrogen and phosphate necessary to enhance the biodegradation of organic contaminants while transforming them into carbon dioxide, water, and biomass. Maintaining optimum soil conditions for rapid biodegradation of organic contaminants can help meet clean-up goals within a reasonable timeframe, typically weeks to months. Once clean-up goals have been achieved, the treated material can be:

i). Reused in construction activities such as berms (compacted soil separating areas vertically and can serve as a terrace road and fortification line), landfill cover, and backfill for agricultural purposes.

ii). Disposed at a landfill, and

iii). Left in place and vegetated, depending on local regulations or site-specific considerations (Kamath et al., 2019).

2.5.2 Land spreading

This kind of treatment is comparable to land farming. But rather it relates to the single or short-term application of liquid manure, in conjunction with a porous layer at its containment location for removing organics from organic waste. It reduces waste components from stacking up in the soil (as would be typical for Land farming sites that acquire various applications of different wastes). Like those in land farming, some organic compounds and metals may be chemically diluted while others are incorporated into the matrix through chelation (or complexing), ion exchange reactions, covalent bonds or bioaccumulation; oxidation state changing redox reactions such as metallothionein interactions; precipitation by change in pH or reduction of solubility produce groundwater contaminates on account of potential leachability with accumulated density that is frequently much higher than baseline concentrations found within sediments.

Inland spreading, such as in land farming, aerobic biodegradation of hydrocarbons may be enhanced by nutrient addition to the waste/soil mixture and by periodic tillage of the mixture (to increase aeration). Hydrocarbon concentrations may be monitored after land spreading to measure progress and determine whether biodegradation processes should be enhanced. Land spreading is most effectively used as a disposal method for organic waste with low levels of hydrocarbons and salts (Abdelhafeez, I. A et al, 2022).

2.5.3 Landfills;

Landfills are specially constructed and monitored facilities designed to accommodate the burial of large volumes of waste. The term landfill relates to waste disposal mainly within a void space, although land is raised. It is generically referred to as landfill and refers to waste disposal mainly above pre-existing ground levels. Landfill is usually an engineered and pre-planned procedure not to be confused with onsite burial. Landscape architects can work with solid waste through transformation and re-designing of waste sites into landscapes with new function and appearance, as well as implementing prior waste products into design projects and raising awareness of the garbage-related issues among the public. (Grudziecki and Buachoom (2016).

2.5.4 Incineration;

Among all thermal treatment disposal options, incineration is the better one since after being exposed to this process, waste loads are decomposed into none or less hazardous by-product. Incineration of waste should happen other than its effects on human health and animal life with respect to the operation of the incinerators, atmosphere (Lewis, 2010). Such temperatures are

capable of causing complete thermal decomposition of such wastes, which by definition is hazardous. Finally, afterburners and scrubbers as well as electrostatic precipitators control solid & gas emissions. Incinerators can be used to incinerate non-hazardous and hazardous solids, liquids, and gasses. Lead, mercury or cadmium cannot be incinerated with other waste because such heavy metals concentrate in the fly ash and therefore present a leaching problem when landfilled.

2.5.5 Thermal desorption:

The thermal desorption process applies heat directly or indirectly to the wastes to vaporize volatile and semi volatile components without incinerating the soil. In some thermal desorption technologies, the off-gases are combusted, and in others, such as thermal phase separation, the gases are condensed and separated to recover heavier hydrocarbons. Thermal desorption technologies include indirect rotary kilns, hot oil processors, thermal phase separation, thermal distillation, thermal plasma volatilization, and modular thermal processors (Seetharaman, 2024).

2.5.6 Bioremediation

With natural biological processes and help these many organic wastes to biodegraded into carbon dioxide and water. The most important variables that direct the biological degradation of organic waste are presence other absence proper amount and types of degrading bacteria, ability for oxygen (and mixing) to meet with cells' metabolism demand cell availability a ratio nutrientz micronutrients necessary so bacterial best possible metabolize(colonizers), moisture controlling salinity. The biodegradation process can be strongly influenced by the concentration and nature of these compounds to be degraded. E.g. biodegradability petroleum hydrocarbon/meta follows order (saturates> aromatic > polar> asphaltin).

Soil organic contaminants degrade naturally by microbial action, and this degradation is greatly assisted to photo-degradation with wind. Several companies offer different combinations of microorganisms that will help to degrade the organic wastes much faster which are suitable for both liquid and solid phase treatment. The end products of degradation are carbon dioxide, water and fatty acids (Rizzarelli et al. 2021).

2.5.7 Vermiculture

Vermiculture refers to the process of using worms to recycle organic material into a rich soil additive capable of providing vital nutrients necessary for plant growth (Edwards, C. A., & Arancon, N. Q. 2022). Worms have churned organic waste into natural compost for many years and also process has been verified and can even treat some synthetic- based drilling wastes (Norman, 2002). (Edwards, C. A., & Arancon, N. Q. 2022).

2.6 Waste management Hierachary and Circularity

Practicing the waste reduction strategies is very important to waste generators as well as a municipality since it minimizes the cost of disposal, generates revenue, and prolongs the lifespan of disposal site (Awino, F. B., & Apitz, S. E. 2024).). Since waste storage and segregation determine the feasibility of recycling and composting in an economically and environmentally sustainable manner, it plays a vital role in MSWM system.

2.7 Existing Mitigation Strategies and Gaps in the Uganda Context

The primary framework for OHS in Uganda is the Occupational Safety and Health Act, 2006. However, its enforcement, particularly in the informal waste sector, is weak. Common recommended controls include:

- Personal Protective Equipment (PPE): Gloves, boots, coveralls, and masks. However, studies show access and consistent use are major challenges due to cost, availability, and discomfort in a tropical climate (Ssemugabo et al., 2024).
- Training and Awareness: Programs on safe handling practices, waste segregation at source, and first aid for injuries.
- Engineering Controls: Provision of automated collection trucks, safe waste sorting facilities, and sharp containers.

The literature reveals a critical gap between policy and practice. A recent assessment concluded that while policies exist, there is a severe lack of targeted, context-specific interventions for MSW workers in Uganda, and their specific exposure profiles based on waste type are not thoroughly documented (Ahimbisibwe & Nabaasa, 2024).

2.8 Summary and Research Gap

The existing literature establishes a clear link between MSW handling and a multitude of OHS hazards. Globally, the risks are well-documented, and in the SSA context, studies highlight the heightened vulnerability due to systemic challenges. Recent research has begun to quantitatively assess specific health outcomes, such as respiratory conditions and injury rates, among waste workers in Uganda.

However, a salient gap remains. There is a paucity of research that provides a comprehensive, hazard-specific risk assessment directly correlated with the actual composition of waste handled by workers in a specific, high-burden locality like Kawempe Division. Most studies treat "solid waste" as a monolithic hazard rather than deconstructing the risks posed by its individual

components (organic, sharps, chemicals, etc.). Furthermore, the differential risks between formal and informal workers within the same geographical context are underexplored.

This thesis, therefore, aimed to fill this gap by conducting a targeted assessment of the OHS hazards associated with the specific types of waste handled by municipal solid waste workers in Kawempe Division. By characterizing the waste stream and directly linking it to exposure and health outcomes, the findings will contribute critical evidence for developing targeted, effective, and locally relevant interventions to protect this essential workforce.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

Chapter three explains the approaches and techniques that were used for data collection to explore the safety and health hazards associated with the type of waste handled by waste workers during waste management in Kawempe Division, A multi-methods approach which employed both qualitative and quantitative paradigms was employed in the study. This chapter outlines the research design, methods of sampling, data collection tools and techniques and data analysis, in each instance justifying the choice of methods used.

3.2 Research Design

Research design is the conceptual structure within which the research is conducted and it constitutes the blueprint for the collection, measurement and analysis of data (Sileyew, K. J. 2019). Cross-Sectional Study was applied in this study. This design was appropriate as it collected data on hazards, health outcomes, and exposure (waste types) from a population of workers at a single point in time, allowing for the assessment of prevalence and associations.
The study was an explorative case study, which triangulated both quantitative and qualitative approaches. The design enabled the researcher to conduct a critical analysis of the occupational safety and health hazards, the types of waste handled by the solid waste workers and waste management methods utilised by the waste workers. The research was explorative in nature because very few studies pertaining to occupational safety and health risks associated with solid waste management have so far been conducted in Uganda.

3.3 Target population

The target population is the entire group of individuals or entities that share a specific characteristic and are the focus of a study's conclusions (Willie, M. M. 2024). The target population was for waste workers employed in various waste management firms licensed by the National Environment Management Authority (NEMA) to operate in Kawempe Division, Kampala Capital City in Uganda. The population was drawn basing on the position ranging from field personnel, direct supervisors to operations managers. The Environment managers were included, in order to gather their perceptions on occupational safety and health hazards encountered by solid waste workers. Solid waste workers were targeted because they are directly involved in waste collection and removal, and as such, their experiences enabled them to reveal the hazards that were not identifiable by mere observations. The solid waste workers were also

targeted in order to gather their perceptions of the effectives of the waste management practices and safety and health policies in Kawempe Division.

The researcher targeted the immediate supervisors and those in managerial positions in order to assess the level of management commitment in Occupational Safety and Health in the licensed waste management firms with in Kawempe Division.

3.4 Sampling size and its determination

A research study can be conducted either by enumerating the entire study population (census survey), where every individual is given an opportunity to respond or by examining only a portion of the total study population in which one is interested (sample survey), where the obtained results are then inferred to the whole study population. A non-probabilistic census sampling approach was employed in this study since this study is a qualitative study with a goal of an in-depth understanding of individual experiences (Samuel, A., & Merkebu, J. 2025). Therefore, the population sampling technique involved 122 participants from waste management firms operating in Kawempe Division, Kampala Capital City. Purposive sampling involves selecting members from the population to comprise a sample because they specifically meet some prescribed purpose or possess specific attributes of interest that address the purpose of a particular research problem under investigation (Rai, N., & Thapa, B. 2015). This method was used to select key informant interview respondents such the direct and immediate supervisors, operations managers and environment, health and safety experts.

3.5 Data types and Data Collection Methods or instruments

The research employed qualitative and quantitative data collection methods. Both primary and secondary sources of data collection were used during this study to complement each other and these were questionnaires, interviews and observations. Their vast experience in solid waste management was also key in identifying the safety and health hazards encountered by solid waste workers. The managers and supervisors were also targeted because of their vast knowledge and experience in identification of hazards as well as giving recommendations on how to achieve preventive culture. Secondary data was also sourced from other publication which have been referenced.

3.5.1 Primary Data Sources

This type of data involved the extraction of first-hand information from the field of investigation. In regard to this particular study questionnaires and key informant interviews were used for data collection.

3.5.2 Secondary Data Sources

Secondary data was obtained from text books, Journals, News Papers, reports among others. These were used to enrich the research with literature and knowledge basing on theories, making critiques and eased analysis of the collected data. Since the secondary source of data collection had weaknesses such as being outdated, field study was conducted to obtain primary data

3.5.3 Data Collection Methods

a) Observation

Observation as an instrument of research involved the use of vision as a means of data collection. It also involved the selection, recording and encoding of certain set behaviour and concern through empirical methods. Field observations give the researcher an insight of the actual workplace setting and can provide new ideas to the study. Personal observations were undertaken to assess the typical tasks performed during waste collection and disposal and the associated hazards. A hazard identification and risk assessment methodology was used and a checklist was used as the data collection tool. The checklist covered areas including general workplace environment outlook, signage, provision of PPE/C and use, and environmental pollution. Direct observations were essential in conducting job safety analysis for each task during the handling of waste by solid waste workers at the municipality. The information gathered during walk through surveys is useful in validating data collected from other research instruments.

b) Questionnaires

A questionnaire is a data collection instrument and tool comprised of a series of questions and their prompts for the purpose of gathering information from respondents and participants (Amato, C. et al, 2024). Interviews involved engaging participants in a face-to-face conversation focused on questions related to the research study. The participants were asked specific questions related to the study objectives for their thoughts, opinions, perspectives or descriptions of specific experiences. The reason for this choice was based on the anticipation about an availability and time for potential participants. Thus, the interview method was used to ease data gathering because of its flexibility, yet with generality, and allowance it gave to the interviewee in responding as they deemed important. For this particular study, interviews were purposive for

example the waste management company's representatives in management positions as they were key informants to the study carried out.

c) Key informant interviews

An interview is a research technique that involves collecting data by asking questions (Strand, A. 2025). Interviews were used for the purpose of gathering information on safety and health hazards associated with solid waste management. The interviews targeted the key informants' namely Environmental Health Technician, Health and safety officers, Operation managers

d) Validity and Reliability of all study indicators and/ or variables

In order to ensure relevance of the research findings more than one method of data collection was used. The use of different data collection tools such as questionnaires, observations and interviews was a strategy that ensured validity. Triangulation of these methods was done to validate the findings. Data on hazards affecting solid waste workers was obtained from workers performing different tasks as well as from the employers and the regulatory authorities, to incorporate information on the practical experience and the theoretical knowledge, thus further triangulating the findings. The results were compared with empirical studies by previous researchers to check for consistency. The respondents were given the assurance of confidentiality and that the research was being conducted for academic purposes only. As a result, they provided information without reservations thereby increasing the reliability of the research. The researcher also consistently checked and verified the collected data to ensure that it satisfied the objectives of the study. The researcher also ensured validity by pilot testing the data collection instruments prior to the actual data collection by checking if the instructions on the questionnaires were clear and if all questions were adequately answered such that in case there were some questions that remained unanswered the questionnaire would then be corrected before the final data gathering. The use of a checklist in the field observations ensured that all observations were carried out in a methodical way, thus ensuring consistency in data collection.

e) Ethical considerations

Research ethics are rules of conduct guiding professional conduct within research. It is also very pertinent to consider ethics prior to undertaking research. Scrutiny is unprecedented when it comes to research ethical behavior (Ombaka, B., & Muturi, M., 2024). The researcher observed various ethics while carrying out the study. Consent to carry out a research was sort from waste management firms with and permission was granted. The researcher ensured that participation

of the respondents was voluntary by informing them the purpose of research and the components of the research, prior to their agreement or refusal to participate in study. In this regard, the findings from the research were used for study purposes only. As such, the researcher ensured that there was no influence on the information provided by the respondents. The ethical principle of anonymity was observed in the research and as such, no names of respondents were mentioned thereby maintaining anonymity in the report. Secondary data sources were acknowledged to their respective authors and plagiarism was avoided.

f) Data presentation and analysis

Statistics involves processing of data by editing, coding, classification and tabulation and also analysis of data (Alem, D. D. 2020). Quantitative and qualitative data was inputted into the Statistical Package for Social Scientists program for processing, analysis and interpretation. Qualitative data from questionnaires, interviews and observations was critically analysed and inferences and conclusions were made about the occupational safety and health hazards associated with types of waste handled by waste workers during solid waste management. The findings were presented in table form and graphically.

CHAPTER FOUR: RESULTS AND FINDINGS OF THE STUDY

4.1 Introduction

This chapter presents the results and the discussions on the findings related to the occupational safety and health hazards associated with the type of waste handlers by waste workers during waste management in Kawempe Division, Kampala Capacity City. The data was collected through questionnaires, interviews, walk-through surveys and secondary data. The participants were selected from waste management firms operating in Kawempe Division, Kampala Capital City. The response rate acquired was 74.07% which is 60 out the 81 firms that were targeted for this study and a response rate 50% or 60% many argue is representative for the findings of this study.

Target	Acquired	Response Rate (%)
81	60	74.07

Table 3: Response rate for the study

4.2 Firm Characteristics

This section highlights the attributes of the firms that were engaged in the management of solid waste, whose personnel accepted to willingly participate in the study.

Number of staff in the enterprise	Count	Percent	Cumulative Percent
6 - 10	1	1.7	1.7
10 - 20	9	15.0	16.7
21 - 40	24	40.0	56.7
Over 40	26	43.3	100.0
Period this enterprise has been operating in Central region	Count	Percent	Cumulative Percent
Less Than 4 yrs	10	16.7	16.7
4 - 6 yrs	28	46.7	63.3
Over 6 yrs	22	36.7	100.0
Number of Trucks Enterprise Has	Count	Percent	Cumulative Percent
1-4 Trucks	8	13.3	13.3
Over 4	45	75.0	88.3
None, We Hire	7	11.7	100.0

Years since first receiving of KCCA Approval	Count	Percent	Cumulative Percent
Less Than 5 yrs	2	3.3	3.3
05 - 10 yrs	19	31.7	35.0
Over 10 yrs	39	65.0	100.0
Period of partnership with NEMA	Count	Percent	Cumulative Percent
Yes	58	96.7	96.7
No	2	3.3	100.0

Table 4: Firm Characteristics, Total N = 60 Firms

4.2.1 Number of Staff in the enterprise;

83.3% of these firms were operating with at least 21 workers. Only 16.7% were noted to be in operation with less than 21 workers. This is an indication that the firms which participated in the study, were relatively medium sized and thus, could give very good and dependable information regarding solid waste management in Kawempe Division, Kampala Capital City in Uganda.

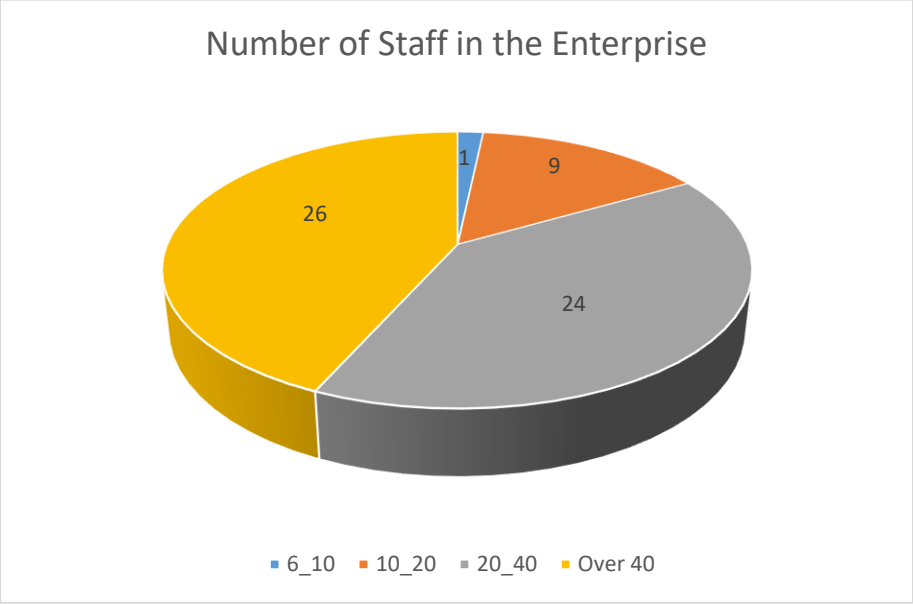

Figure 4: Pie chart showing number of staff in Enterprise

4.2.2 Period this enterprise has been operating in Central region;

83.4% of these firms have been operating in central region more than 4 years. Only 16.7% have been operating for less than four years. This is an indication that the firms which participated in the study, were operating mostly in the central region of Kawempe Division, Kampala Capital

City and thus, could give very good and dependable information regarding solid waste management in Kawempe Division, Kampala Capital City in Uganda.

4.2.3 Number of Trucks Enterprises Has;

75% of these firms own more than 4 truck in operating the waste management business in central region while 13% of the firms that were engaged /interviewed during the study own less than 4 trucks. On the other hand, 11.7% of the firm don't own any trucks but rather hire to conduct waste management. This is an indication that most of the firms which participated in the study could give very good and dependable information regarding solid waste management in Kawempe Division, Kampala Capital City in Uganda.

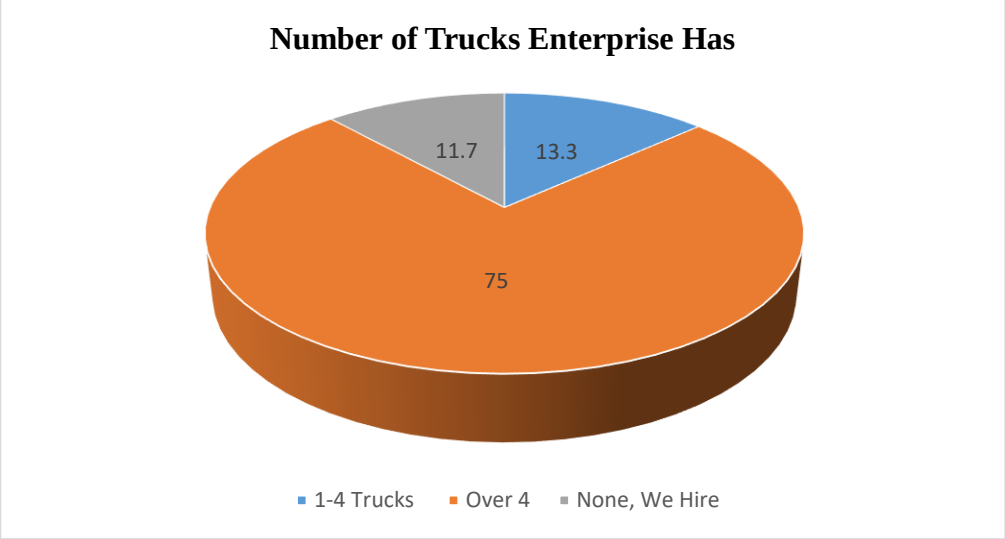

Figure 5: Pie chart showing number of Trucks an Enterprise has

4.2.4 Years since first receiving of KCCA Approval

96.7% of the firms have operated with Kampala Capital City Authority (KCCA) approval with 65% of these, having operated with KCCA approval for more than 10 years. Only 3.3% have been operating with KCCA approval for less than five years. This is an indication that most of the firms which participated in the study have been operating legally with approval from the KCCA.

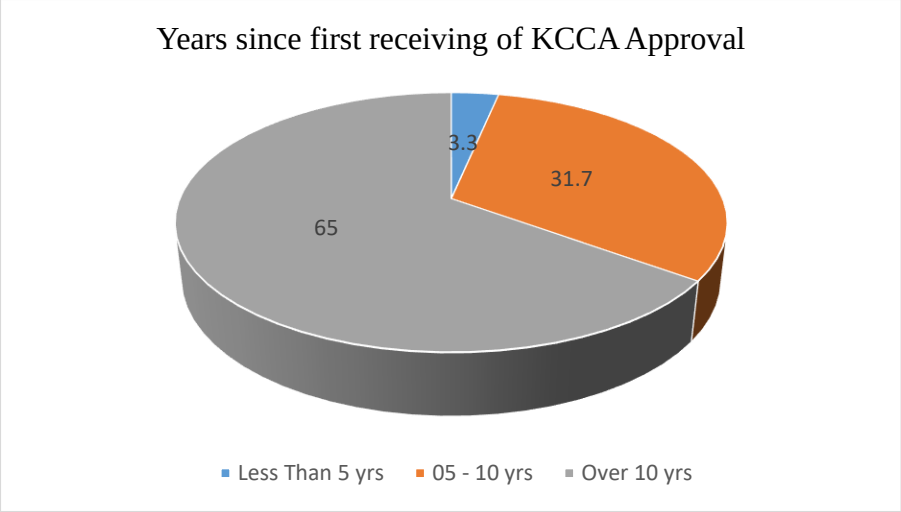

Figure 6: Pie chart showing the percentage of firms with KCCA approval

4.2.5 Period of partnership with NEMA;

The frequency distribution in this case, shows that the majority of the firms (96.7% have been in partnership with the National Environment Management Authority (NEMA) and 3.3% of the firms operating in central Uganda Kawempe Division, Kampala Capital City, Uganda have not been in such a partnership or are in the process of acquiring a license. This shows that most of the firms that participated in this Study are operating with licenses from the National Environment Management Authority.

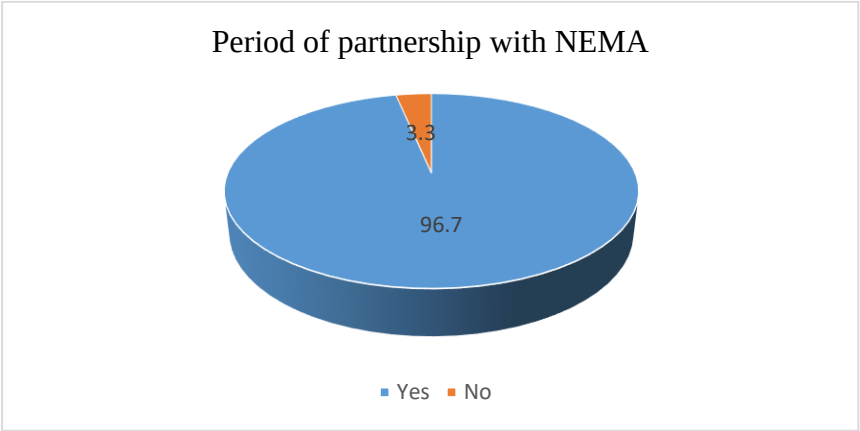

Figure 7: Pie chart showing period of partnership between Enterprises and NEMA

4.2 Individual Characterisation

Gender	Count	Percent	Cumulative Percent
Male	65	53.3	53.3

Female	57	46.7	100.0
Age Group	Count	Percent	Cumulative Percent
Less Than 31 yrs	7	5.7	5.7
31 - 35 yrs	58	47.5	53.3
36 - 40 yrs	51	41.8	95.1
Over 40 yrs	6	4.9	100.0
Position held in the Organisation	Count	Percent	Cumulative Percent
Top Management	12	9.8	9.8
Middle Management	76	62.3	72.1
Lower Management	34	27.9	100.0
Highest level of Education	Count	Percent	Cumulative Percent
Certificate	4	3.3	3.3
Diploma	31	25.4	28.7
Degree	68	55.7	84.4
Masters	19	15.6	100.0

Table 4: Respondent Characteristics, Total N = 122

4.2.1 Gender:

The frequency distribution in this case, showed that the majority of staff in these firms are male (53.3%) while the females are represented by 46.7%. This is an indication that the efforts at handling solid waste, have not only been taken up by males in these firms, but women are also engaged to some reasonable degree.

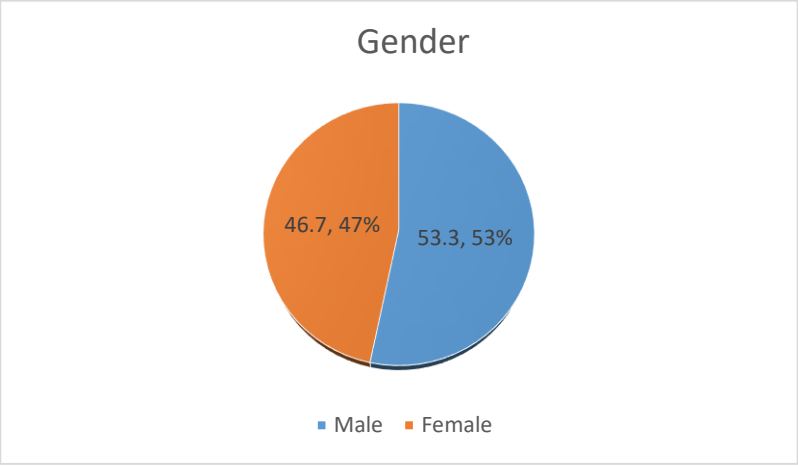

Figure 8: Pie chart showing percentage of Gender of participants

4.2.2 Age Group;

The frequency distribution in this case, showed that the majority of staff in these firms belong to the age group between 31-35 years (47.5%), followed by age group between 36-40 years (41.8%) then below 31 years (5.7%). Among the respondents, the least group was that above 40 years (4.7%). This indicates that the respondents who work in the firms that participated in this study are youthful.

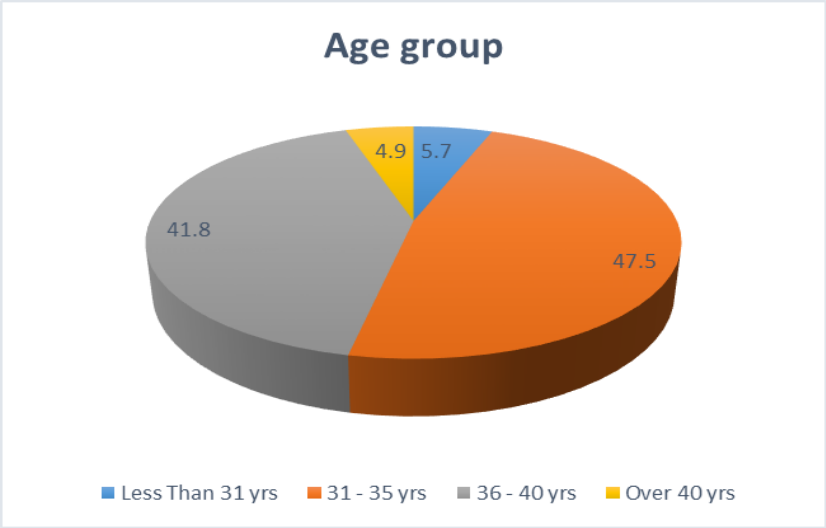

Figure 9: Pie chart showing the percentage of age brackets of workers

4.2.3 Position held in the Organisation;

The frequency distribution in this case of the positions held by workers of the firms that participated in this study indicated that most respondents were in middle management (76%), followed by Lower management (27.9%) and the respondents in top management (9.8%) were the least.

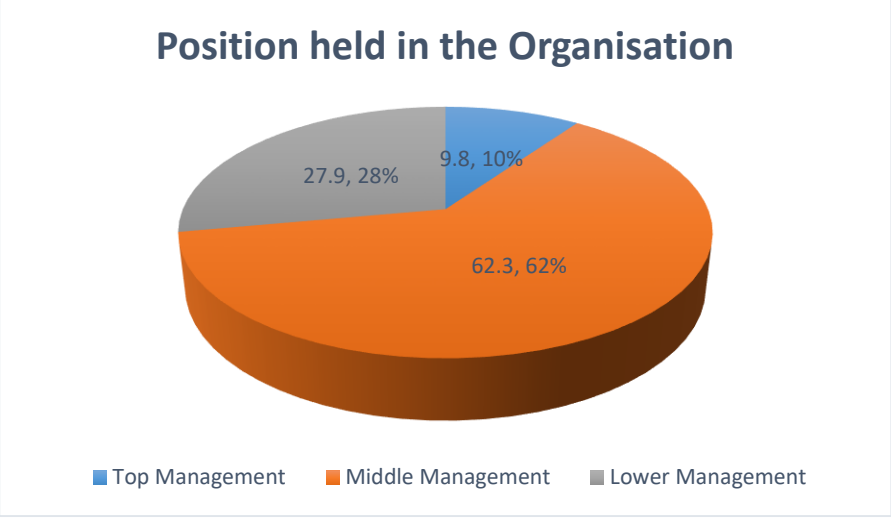

Figure 10: Pie chart showing percentage of positions held in the organisation

4.2.4 Highest level of Education;

The frequency distribution in this case indicated that the workers in the firms that participated in this study have attained some form of formal education with majority being degree holders (55.7%), followed by diploma holders (25.4%) and only 15.6% hold Master's degree. The least percentage of the workers are certificate holders (3.3%).

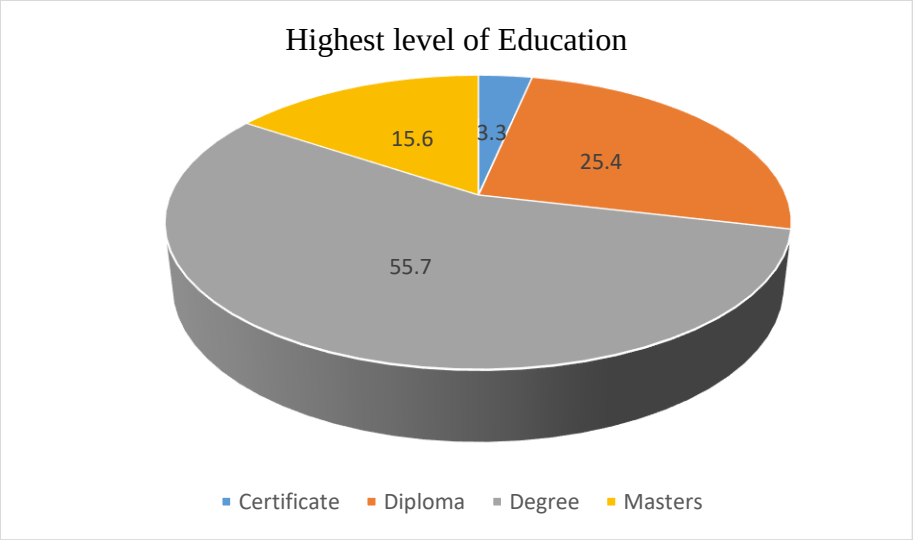

Figure 11: Pie chart showing the percentage of different levels of education

4.3 To determine the different types of hazards associated with SWM as well as challenges arising for the entire value chain in Kampala, Uganda.

Factor analysis was employed to determine the different types of hazards and/ or risks associated with SWM as well as challenges arising for the entire value chain in Kampala, Uganda. The Factor analysis tool, helps us in this way a) it helps us identify the main risk categories which in this case were; Environmental Risks and the Health Risks which constitute variances of 44.655% and 29.950% respectively.

	Environmental Risks	*Health Risks*
Dumping sites for solid waste do contaminate soil with hazardous chemicals and heavy metals, negatively affecting soil fertility	.611	
Improper Solid waste disposal has destroyed the natural habitats for wildlife	.730	

Landfills can release leachate, a toxic liquid formed as water percolates through waste, contaminating soil and water bodies.	.711	
Decomposition of Solid Waste sometimes produces methane, a gas that truly contributes to climate change.	.614	
Accumulation of combustible materials in landfills and dumpsites increases the risk of uncontrolled fires which release toxic smoke and gases.	.709	
Burning of solid waste sometimes releases toxic gases which harm our workers		.768
In the course of doing our work, we are always at risk of Waterborne diseases		.667
Decomposing waste is a breeding ground for vectors like rats and mosquitoes which have often caused sickness to our staff		.641
Handling of solid waste without protective gear has often led to injuries for our employees		.613
Some solid waste is easily flammable even on exposure to sunlight for long periods and poses a danger to workers		.638
Eigen Values	4.465	2.995
Variance %	44.655	29.950
Cumulative %	44.655	74.604

Table 5: The different types of hazards and/ or risks associated with SWM

4.3.1 Environmental challenges with Solid waste management

With environmental risks, the most serious ones included, the likelihood of destroying natural habitats for wildlife in the course of managing solid waste (0.730). For example, disposing solid waste into swamps such as chemicals e.g. pesticides, can destroy the habitat for the organisms like frogs, snakes, butterflies among others.

Landfills can release leachate, a toxic liquid formed as water percolates through waste, contaminating soil and water bodies surrounding the waste disposal sites (0.711)

Accumulation of combustible materials in landfills and dumpsites increases the risk of uncontrolled fires which release toxic smoke and gases.

4.3.2 Environmental Risks associated with Solid waste management

4.3.2 Additional Environmental Risks in the Solid Waste Management

The qualitative findings indicated in this case, revealed the additional environmental risks posed by the Solid waste.

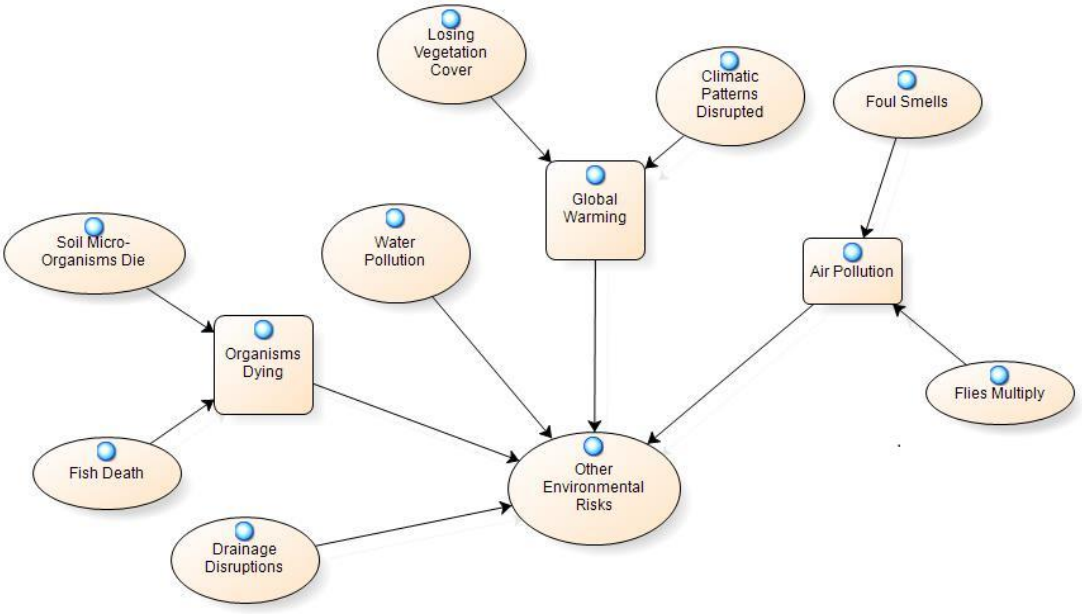

Figure 12: Visualisation of the environment risk in Solid waste management

The qualitative findings revealed that there are additional environmental risks which the solid waste possess and these include; *Drainage disruptions*, *Death of Organisms*, *Water Pollution*, *Global Warming* and *Air pollution*. The *drainage disruptions* include the blockage of the drainage channels, and other natural drainage avenues such as the flowing springs. On the other

hand, the toxic waste can cause death of the *organisms* and this may *include micro-organisms* such as bacteria, archaea, fungi (yeasts and molds) when they come in contact with toxic chemicals and very often, fish dies sometimes when the water sources are polluted by the actions of human beings who drop waste into these places.

Global Warming on the other hand, has been partly blamed for the loss of vegetation in vast areas on the earth, not only in Uganda but in the whole world. At the same time, there has been a disruption of the climate patterns. And this means that the climatic seasons are no longer very predictable for the agricultural sector and this has negatively affected the farming practices in the whole world.

4.3.3 Health Risk associated with Solid Waste Management

With health risks, it was clear that issues such as burning of solid waste can release dangerous toxic fumes and flames which can harm workers of the firms as indicated in table 5 (0.768) the fumes can cause chronic ailments. Water borne diseases such as cholera, dysentery, diarrhoea, hepatitis A, polio and typhoid as indicated in the table 5 (0.667). Inadequate or inappropriately management sanitation services exposes solid waste workers to health risks during execution of their work. Decomposing waste is a breeding ground for vectors like rats and mosquitoes which have often caused sickness to staff (0.641). Sickness like bubonic plaque, malaria are such diseases that solid waste workers are affected with in the course of their work.

Some solid waste is easily flammable even on exposure to sunlight for long periods and poses a danger to workers (0.638). Solid waste, especially organic waste when exposed to sun light and other conditions can produce methane gas which is a flammable gas exposing solid waste workers to health risks like burns and last but not least, handling of solid waste without protective gear has often led to injuries for waste handlers' employees (0.613). For example, injuries such as cuts from sharp items, bruises as a result of no or inappropriate personal protective equipment (PPE).

4.3.4 Additional Health Risks faced in the management of Solid Waste

Other than the health risks indicated in the table, the qualitative results indicated the following health risks which are faced in the management of solid waste.

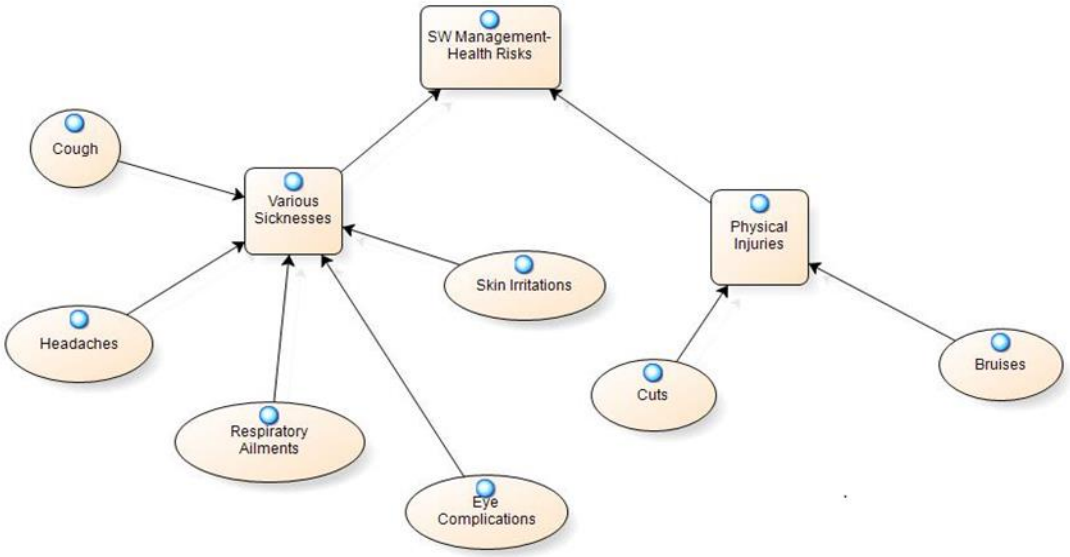

Figure 13: Qualitative visualization of health risks associated with Solid Waste management

Other than the health risks indicated in the quantitative measurement scale, the qualitative results revealed that the Management of Solid Waste poses challenges to the workers and these are mainly observed in terms of *Various Sicknesses* and the *Physical injuries.* The sicknesses mentioned include cough, headaches that may arise after inhaling some toxic fumes or due to the psychological discomfort after seeing some inappropriate items on the waste pits such as abandoned foetuses, decaying animals and such similar elements. Some also reported that they suffer from respiratory ailments such as asthma and others have to endure eye complications which may be caused by the touching of waste and then inadvertently touching the eyes with the unwashed contaminated fingers there after.

Further some have suffered from Physical Injuries such as cuts and bruises when they are handling items that are left strewn at the waste collection points. These are normally accidental elements that occur in the course of handling this waste.

4.5 Challenges in the management of Solid Waste

The results in this case highlight the challenges that are faced in the management of solid waste. These were reported by the respondents who willingly participated in the study.

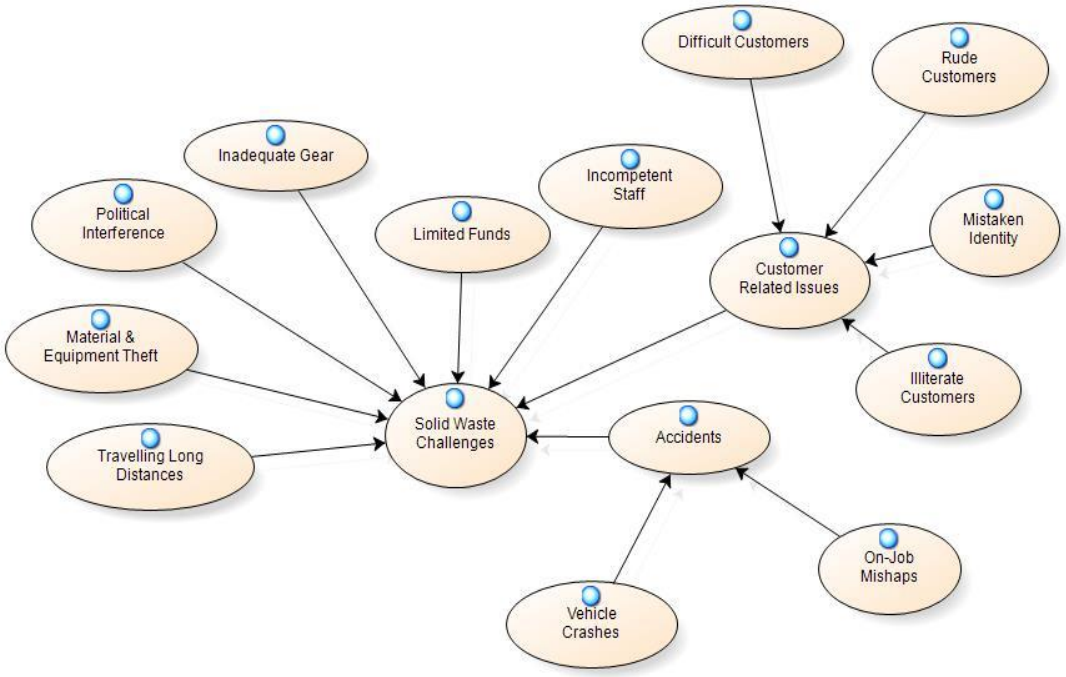

Figure 14: Qualitative visualisation of challenges in the management of Solid Waste

The results showed that the challenges include, Travelling *long distances, lack of Material* and *Equipment used in solid waste management, Political Interference, Inadequate Gear, Limited funds* and *Incompetent staff*. Additionally, the *customer related issues* included having to deal with difficult customers, rude customers, mistaken identity and the illiteracy of customers. Further, there are *accidents* which can be caused by vehicle crashes and the on-Job misfortunes such as a fall in the rubbish pits.

The *Political Interference*, often comes in the form of management clashes with politicians who sometimes wish to influence the contract terms of the solid waste management firm. Sometimes these politicians want to frustrate some firms and yet promote others which are of interest to them. Further, the *customer related issues* call for dealing with customers who are abusive, very arrogant and not willing to cooperate in the management of Solid waste. When these customers mistake the Solid waste workers for unscrupulous persons, then they can insult them and call for security personnel as though they have encountered thieves. Sometimes it calls for explanations and convincing with introductory remarks to make these customers understand that the solid waste workers mean no harm.

4.4 To determine the different types of solid wastes collected by waste handlers in Kampala, Uganda.

Table 6: Nature of solid waste which Firms mostly handle

No	Item	Count /60	Percent (%)
1	Plastics	41	68.3
2	Food Scrap	40	66.7
3	Carton & Paper	30	50.0
4	Yard Trimmings	26	43.3
5	Wood	19	31.7
6	Metals	15	25.0
7	Textile/ Clothing	14	23.3
8	Glass	6	10.0

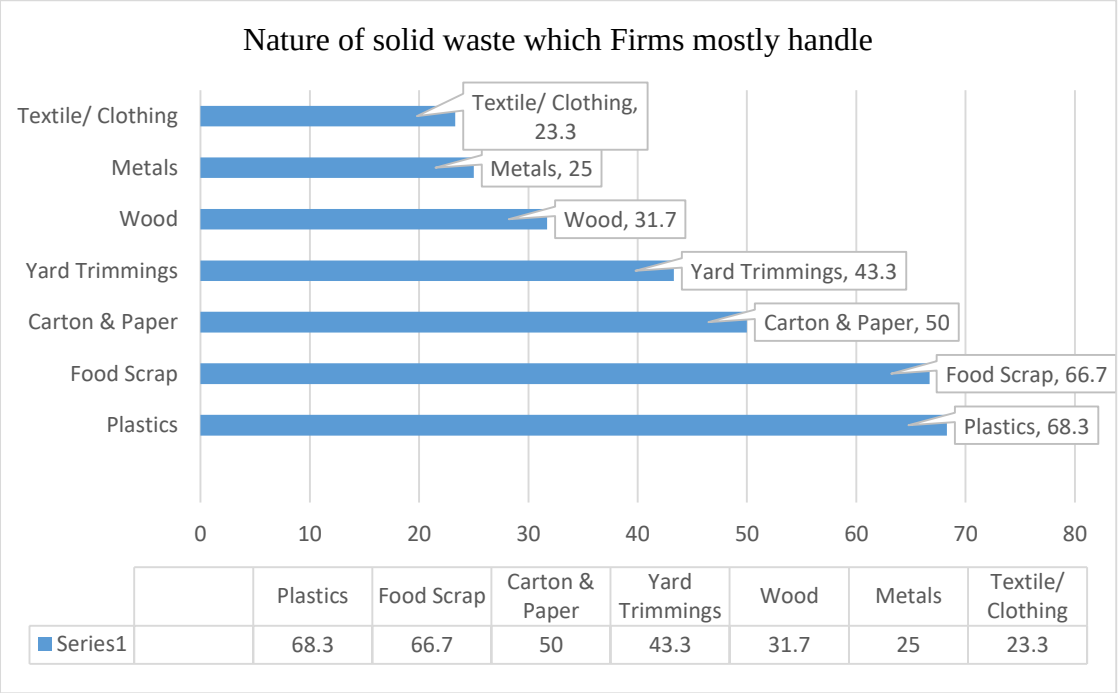

Figure 15: Nature of solid waste which Firms mostly handle

As showed in the graph above (figure 7) the highest waste disposed in Kawempe Division, Kampala Capital City is plastics at 68.3% from information collected for the firms that responded to the study. In addition, food scraps and carton & paper are 50% as disposed by the firms that participated in the study. Textile, metals, wood and Yard trimming are less than 44% as identified from firms that were engaged during this study.

4.5 To determine the different solid waste management methods utilised by waste handlers in Kampala, Uganda

Average(s) and SDs were employed to determine the different solid waste management methods utilised by waste handlers in Kampala, Uganda. The results were generated using a scale of the instrument coded such that

Table 7: Scale of Instrument

Very Untrue	*Untrue*	*True*	*Very True*
1	2	3	4

Means that can be rounded off to 1 or 2 show that the respondents rate the issue raised as being Untrue while means that are close to 3 or 4 shows that the issue is True. In this case, the respondents from the firms indicated that they indeed, encourage the residents they serve, to buy in bulk so as to reduce the waste that comes with packaging many items (average = 2.66, SD = 0.70)

Table 8: Solid Waste Collection Point Source:

	Min.	Max.	Mean	SD
Our firm encourages residents we serve, to buy in bulk so as to reduce the waste that comes with packaging many items	1.00	4.00	2.66	0.70
We often encourage people to use durable and reusable products	2.50	4.00	3.21	0.34
Our firm has taught people how to re-purpose waste materials into other products or raw materials	3.00	4.00	3.40	0.37
Our employees often teach people to dispose of garbage after sorting it appropriately.	3.00	4.00	3.59	0.40
We often teach communities how to decompose organic waste such as food scraps into nutrient rich manure.	3.00	4.00	3.55	0.33

4.5.1 Solid waste collection point source

Solid Waste Disposal

Table 9: To dispose of the solid waste better

	Min.	Max.	Mean	SD
We often burn some of the waste using immense heat	3.00	4.00	3.33	0.35
Some waste such as plastics, is sold to other firms that recycle it	3.00	4.00	3.42	0.41
We dispose the solid waste into landfills, where it is buried underneath the ground.	2.00	4.00	3.43	0.49
We employ the use of microorganisms to break down the organic Solid waste	2.50	4.00	3.40	0.36
We are constantly doing research so as to identify better ways of getting rid of the rubbish	2.00	4.00	3.39	0.41

4.5.2 Solutions for Solid Waste Management

Finally, some solutions were raised for the management of solid waste in the sector.

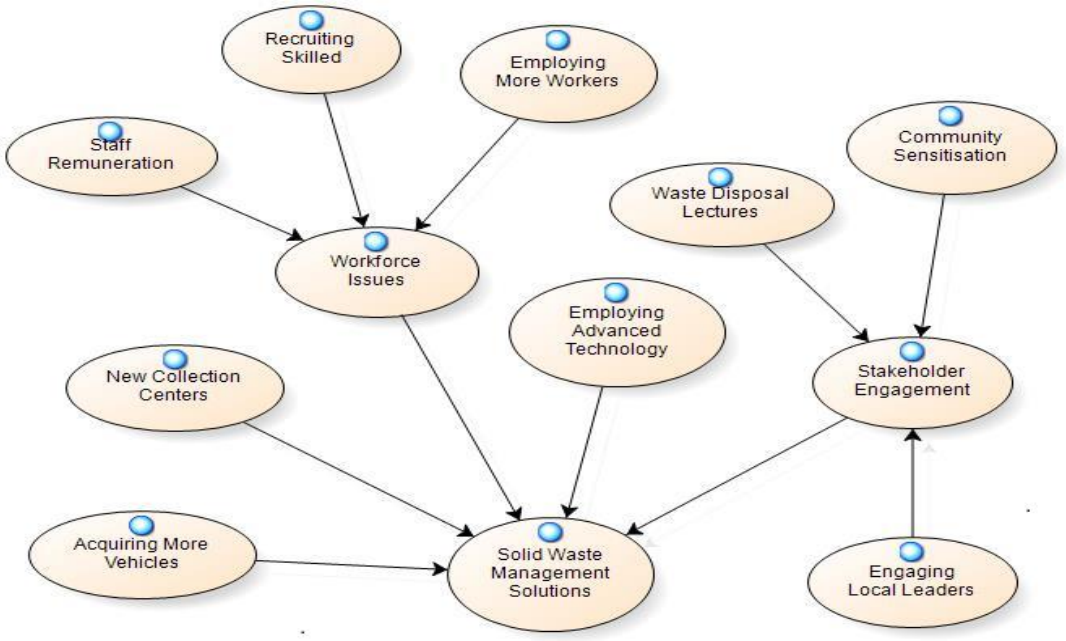

Figure 16: Qualitative Visualisation for the solutions for better solid waste management

Among the solutions that were raised as essential for the improved management of solid waste, the qualitative results revealed that there is a need to *acquire more vehicles* which are suited for the job, set up more and *New Collection Centres* so that the growing populations do not litter waste anywhere they desire to. The results further revealed that there is a need for handling the *Workforce Issues* in a competent way so that aspects like their remuneration are very fair and

satisfactory. In some cases, these firms engaged in the solid waste management sector, need to recruit skilled workers or even offer them on the job training after they are recruited. When the firms perceive that the scale of operations has grown, this calls for *Employing more workers.*

On the aspect of *Employing Advanced Technology,* More Technology should be introduced in this sector such as the use of advanced recycling machines which have to be imported from other nations that have developed this sector. Finally, the *stakeholder engagement* in this case, should involve engagement of local leaders such as the LC1 chairpersons, who can readily move and sensitise the people to improve the degree of compliance with good solid waste management disposal practices in the communities. At the same time *community sensitisation* and lectures to the *local communities,* are also very needful.

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Introduction

This chapter discusses the findings of the study on occupational hazards and challenges associated with solid waste management among solid waste workers in Kawempe Division, Kampala Capital City. The discussion is organized according to the three study objectives: occupational hazards associated with solid waste management; types of solid waste handled by waste workers; and challenges affecting solid waste management in Kawempe Division.

The findings are interpreted in relation to previous empirical and policy literature, with particular emphasis on Uganda, East Africa and Sub-Saharan Africa. The discussion also considers the implications of the findings for occupational health and safety (OHS), environmental protection, waste governance, sustainable waste management and circular-economy practices.

The study had a response rate of 74.07%, with 60 of the 81 targeted firms participating. Most participating firms were relatively established: 83.3% had 21 or more employees, 83.4% had operated in the Central Region for more than four years, 75% had more than four trucks, and 96.7% reported KCCA approval and a relationship with NEMA. These characteristics suggest that the findings largely reflect the experiences of established waste-management enterprises rather than very small or newly formed operators.

5.2 Occupational hazards Associated with Solid Waste Management

5.2.1 Overall occupational, health and Safety risk profile

The study established that occupational hazards among solid waste workers in Kawempe Division are multidimensional, rather than being restricted to one particular type of hazard. Factor analysis identified two major dimensions: environmental risks, with an eigenvalue of 4.465 and accounting for 44.655% of the variance, and health risks, with an eigenvalue of 2.995 and accounting for 29.950%. Together, these factors explained 74.604% of the total variance.

This finding is important because solid waste workers are exposed simultaneously to conditions arising from the physical waste environment and from direct contact with waste materials. The results therefore support an integrated approach to occupational risk management in which environmental contamination, biological exposure, physical injuries, chemical exposure, fire hazards and ergonomic risks are considered interconnected components of the same occupational environment.

The finding is consistent with evidence from Kampala. Byonanebye et al. reported that 65% of casual municipal solid waste workers surveyed at a Kampala landfill had experienced occupational injuries, while 33% reported not using PPE. Importantly, PPE use was associated with substantially lower odds of occupational injury (OR = 0.09; 95% CI: 0.01–0.57). Similarly, Tayebwa's 2020 Kampala study identified physical, biological, chemical and ergonomic hazards among municipal solid waste collectors and recommended PPE provision, training, enforcement and development of occupational safety policies. The present study therefore reinforces a growing Ugandan evidence base demonstrating that waste management is not merely an environmental-service activity but also an important occupational-health concern.

5.1.2 Environmental contamination as a major occupational and environmental risk

Environmental contamination emerged as the strongest overall risk dimension. Soil contamination had a factor loading of 0.611, habitat destruction had a loading of 0.730, while leachate contamination had a loading of 0.711. These results demonstrate that the consequences of poor waste management extend beyond direct worker injury. Waste workers operate within environments where improperly managed waste can contaminate soil and water, generate unpleasant or hazardous emissions and degrade surrounding habitats. This finding has particular relevance in Kampala because urban solid waste management occurs within a rapidly growing metropolitan environment characterized by increasing waste generation, limited space and pressure on collection and disposal infrastructure. Uganda's regulatory framework recognizes the importance of controlling these environmental pathways. NEMA identifies the National Environment (Waste Management) Regulations, 2020 and the Guidelines for the Management of Landfills in Uganda (2020) as key instruments governing waste management.

The finding is also consistent with broader Sub-Saharan African evidence. The World Bank has reported that Sub-Saharan Africa has historically experienced low collection coverage and extensive open dumping, while waste generation is expected to grow rapidly with urbanization. Recent World Bank work continues to identify Africa's rapid urbanization, population growth and changing consumption patterns as major drivers of increasing waste-management pressures. Thus, environmental contamination identified in Kawempe should not be regarded simply as an environmental problem. It constitutes an occupational exposure pathway because waste workers may be required to work directly in contaminated collection, transportation, sorting and disposal environments.

5.1.3 Fire hazards and flammable waste

The study identified waste-related fire risk as another important hazard, with the item relating to fire risk having a factor loading of 0.709. The accumulation of combustible materials, particularly paper, plastics, wood and other dry waste, may increase the possibility of accidental fires. The problem can become more serious where waste is stored for prolonged periods, where waste segregation is inadequate, or where open burning is used as a disposal method.

The finding is particularly relevant because plastics were the most frequently handled waste category in the study, while food waste was the second most common. Plastics, paper, wood and other combustible materials may increase fire loading when mixed together. Fire risk also has an occupational-health dimension because waste workers may be exposed to burns, smoke, toxic combustion products and emergency-response hazards. Consequently, fire prevention should form part of routine waste-management risk assessments in Kawempe Division. Measures should include source segregation, controlled storage, prohibition of uncontrolled burning, provision of suitable fire extinguishers and emergency preparedness.

5.1.4 Burning and exposure to toxic fumes

Burning of waste had the highest health-risk factor loading of 0.768, making it the strongest individual health-risk indicator identified by the factor analysis. This finding is particularly significant because the study also found that firms reported burning some waste using high heat, with a mean score of 3.33 (SD = 0.35). The coexistence of waste burning as an operational practice and as the strongest health-risk indicator demonstrates a potential contradiction in the current waste-management system: a practice used to reduce waste volume may simultaneously increase occupational exposure. Waste burning can expose workers to smoke and potentially hazardous combustion products. The risk is particularly important where mixed waste is burned because plastics, treated materials and other contaminants may generate harmful emissions.

The result therefore supports a transition from uncontrolled burning towards waste prevention, segregation, recycling, controlled treatment and environmentally sound disposal. This is consistent with the broader policy direction in Uganda, where environmental regulations emphasize environmentally sound waste management and pollution prevention. NEMA's regulatory framework includes the Waste Management Regulations 2020 and standards governing environmental discharges.

5.1.5 Biological hazards, vectors and waterborne diseases

The study identified waterborne disease as an important health risk, with a factor loading of 0.667, while vectors associated with decomposing waste had a loading of 0.641. The presence of decomposing organic material creates conditions favourable to rats, mosquitoes, flies and microorganisms. This is particularly important because 66.7% of the firms handled food scraps, representing 40 of the 60 participating firms. The finding provides a logical connection between waste composition and occupational health risk. Organic waste creates biological exposure pathways, particularly when it is mixed with other waste and handled manually.

The situation is relevant across Sub-Saharan Africa because the region continues to experience rapid growth in urban waste generation while collection, treatment and disposal infrastructure frequently lag behind demand. The World Bank estimates that Sub-Saharan Africa's waste stream is predominantly organic and that the region has historically experienced substantial open dumping. The occupational implications are therefore considerable. Workers who manually collect, sort and transport mixed organic waste may have greater opportunities for contact with biological agents, contaminated materials and vectors.

The findings support the need for:

- appropriate gloves and protective clothing;
- hand-washing facilities;
- vaccination and occupational-health programmes where appropriate;
- safe food and drinking-water practices at workplaces;
- regular cleaning and disinfection of work equipment;
- source separation of organic waste;
- controlled composting and biological treatment.

5.1.6 Physical injuries, cuts and bruises

Physical injury was another important hazard, with the injury-related item recording a factor loading of **0.613**. The qualitative findings further indicated that cuts and bruises occurred when workers handled improperly discarded materials. This result is consistent with recent East African evidence. In Kampala, Byonanebye et al. found a high prevalence of injuries among casual waste workers and demonstrated a significant relationship between PPE use and injury. Evidence from Ethiopia similarly demonstrates the magnitude of the problem. A study among municipal solid waste collectors in Hawassa found that many workers had experienced work-related injuries, with non-use of PPE being an important contributing factor. More than half of

respondents reported not using PPE and 73% had not received PPE-use training. Another Ethiopian study in Hawassa reported that lack of PPE utilization was independently associated with work-related injury (AOR = 2.30; 95% CI: 1.44–3.68). The similarity between the Ugandan and Ethiopian findings suggests that inadequate protection during manual waste handling represents a wider East African occupational-health challenge.

5.1.7 Respiratory, dermatological and musculoskeletal health outcomes

Qualitative interviews in the present study identified coughing, headaches, respiratory ailments/asthma, eye complications, skin irritation and physical injuries. Although these qualitative findings cannot be interpreted as prevalence estimates, they provide important contextual evidence showing that workers experience multiple pathways of occupational exposure. The findings are consistent with the broader occupational-health literature from Sub-Saharan Africa, where manual handling, poor PPE access, biological exposure, chemical exposure and inadequate workplace controls contribute to occupational illness and injury. The Ethiopian literature further demonstrates that work-related injury is a substantial occupational-health problem. A systematic review and meta-analysis covering occupational groups including municipal solid waste workers found considerable work-related injury burdens in Ethiopia. The implication for Kawempe is that occupational-health programmes should not focus exclusively on acute injuries. They should also incorporate surveillance for respiratory, dermatological, musculoskeletal and other work-related conditions.

5.2 Types of Solid Waste Handled by Waste Workers

5.2.1 Plastic waste

Plastic was the most commonly handled waste category, reported by 41 of the 60 firms (68.3%). The predominance of plastics has important implications for both occupational safety and environmental management. Plastic waste may create physical hazards, contribute to fire loading and, when burned, create potentially hazardous emissions. The finding also indicates that interventions targeting plastic waste could produce substantial environmental and occupational-health benefits. Improved source separation, collection, recycling and recovery can reduce the quantity of plastic requiring final disposal. The result supports the emerging emphasis on circular economy approaches in African waste management. Rather than treating waste only as a disposal

problem, plastic waste can increasingly be viewed as a resource stream requiring collection, sorting, recovery and recycling.

5.2.2 Food and organic waste

Food waste was handled by 40 of 60 firms (66.7%), making it the second most prevalent waste stream. This finding is consistent with the predominantly organic character of waste in Sub-Saharan Africa. The World Bank estimates that food and green waste constitute a major component of the regional waste stream. The high prevalence of organic waste provides an opportunity for biological treatment, composting and resource recovery. The study itself found that firms taught communities to decompose food scraps into manure, with a mean of 3.55 (SD = 0.33). This suggests that Kawempe's waste-management system already contains elements of circularity that could be strengthened through organized source separation and decentralized organic-waste treatment.

5.2.3 Paper, cardboard and other waste streams

Carton and paper were handled by 50.0% of firms, yard trimmings by 43.3%, wood by 31.7%, metals by 25.0%, textiles/clothing by 23.3%, and glass by 10.0%. The diversity of waste types demonstrates that workers are not exposed to a single homogeneous waste stream. Instead, they may encounter materials presenting different combinations of biological, chemical, physical, ergonomic and fire risks. Metals and glass are particularly relevant to physical injury because of their potential to cause cuts and puncture wounds. Wood and paper can contribute to combustible-waste risks, while organic materials increase biological exposure. Therefore, the results reinforce the importance of source segregation as an occupational-health intervention rather than viewing segregation merely as an environmental or recycling intervention.

5.3 Challenges Affecting Solid Waste Management

The third objective identified several organizational, financial, operational and governance challenges. These included long travelling distances, inadequate equipment, political interference, inadequate protective gear, limited funds, inadequately skilled staff, customer-related difficulties and accidents. These findings demonstrate that occupational hazards cannot be addressed entirely at the individual-worker level. Many risks originate from systemic conditions within the waste-management system.

5.3.1 Inadequate equipment and PPE

Inadequate materials, equipment and protective gear were identified as significant challenges. This finding strongly corresponds with evidence from Kampala. Byonanebye et al. found suboptimal PPE use and a high prevalence of occupational injuries among casual waste workers, while PPE use was associated with markedly lower odds of injury. Evidence from Ethiopia similarly demonstrates that inadequate PPE access and training remain important occupational-health problems. In Hawassa, 73% of collectors had not received PPE-use training. The implication is that PPE should not be considered simply a commodity to be purchased. An effective PPE programme should include:

1. hazard assessment;
2. selection of appropriate PPE;
3. adequate procurement;
4. correct fitting;
5. training;
6. supervision;
7. replacement;
8. enforcement; and
9. monitoring of actual use.

5.3.2 Limited financial resources

Limited funding was reported as a challenge affecting waste management. This finding reflects a broader structural problem in African waste management. Waste systems require sustained expenditure on vehicles, fuel, PPE, salaries, equipment, treatment infrastructure, disposal facilities and regulatory monitoring. The World Bank identifies technical, financial and institutional capacity as central determinants of sustainable waste management in developing countries. Thus, improving occupational safety in Kawempe requires financial planning that explicitly includes worker protection rather than treating PPE, training and health surveillance as optional expenditures.

5.3.3 Inadequately skilled personnel

The study identified incompetent or inadequately skilled staff as a challenge. This finding supports the importance of competency-based OHS training. Waste workers need practical knowledge covering:

- hazard recognition;
- correct PPE selection and use;
- manual handling;
- sharps management;
- fire prevention;
- chemical exposure;
- biological hazards;
- emergency response;
- traffic safety;
- waste segregation; and
- incident reporting.

The Kampala evidence similarly recommends training and sensitization of waste workers as part of injury prevention.

5.3.4 Political and institutional challenges

Political interference was identified as a challenge affecting contract and management issues. This finding is particularly significant because waste management is highly dependent on institutional coordination among local government, regulatory agencies, private contractors, communities and political leadership. The high level of regulatory engagement reported in the sample—96.7% KCCA approval and 96.7% reporting a relationship with NEMA—suggests that regulatory structures are present. However, the presence of regulatory relationships does not necessarily guarantee effective implementation at operational level. The finding therefore suggests a need to strengthen institutional accountability, transparent contracting, regulatory monitoring and coordination between KCCA, NEMA, waste companies and community leadership.

5.3.5 Customer and community-related challenges

Customer-related problems included non-cooperation, difficult customers, mistaken identity and other behavioral challenges. This demonstrates that waste management is a shared responsibility between waste companies and waste generators. Workers may face increased occupational risks when residents fail to segregate waste, dispose of sharp materials improperly, refuse collection arrangements or interfere with collection operations. Community participation is therefore not simply an environmental-awareness issue. It is also an **occupational-safety intervention**.

5.3.6 Vehicle accidents and long travelling distances

Vehicle crashes and falls were reported among the operational challenges. Long travelling distances were also identified. These findings indicate that occupational risk extends beyond direct contact with waste. Waste workers also face transportation and road-safety risks. Long travelling distances may increase fatigue and exposure time, potentially increasing the likelihood of accidents. Appropriate vehicle maintenance, driver training, journey planning, loading controls and enforcement of traffic-safety requirements should therefore form part of waste-sector OHS management.

5.4 Waste Reduction, Recycling and Circular-Economy Practices

An important finding of the study was the presence of preventive and circular-economy practices. Waste sorting recorded the highest mean among collection-point practices at **3.59 (SD = 0.40)**, followed by composting/organic-waste decomposition at **3.55 (SD = 0.33)**. Waste repurposing had a mean of 3.40, plastic recycling 3.42, landfilling 3.43 and biological treatment 3.40. These results suggest that waste-management enterprises in Kawempe are not solely focused on collection and disposal. There is evidence of waste minimization, reuse, recycling and biological treatment. However, waste burning also recorded a relatively high mean of 3.33 while simultaneously producing the highest health-risk factor loading. This creates an important policy contradiction. The preferred hierarchy should therefore move progressively from: waste prevention → reduction → reuse → recycling → recovery → treatment → controlled final disposal, while minimizing uncontrolled burning and other hazardous practices. The results are consistent with contemporary African waste-management policy, which increasingly recognizes resource recovery and circularity as alternatives to disposal-oriented systems.

5.5 Overall Interpretation of the Findings

The study demonstrates that occupational health and safety among solid waste workers in Kawempe Division is influenced by three interacting dimensions:

First, the characteristics of the waste itself such as Plastic, organic waste, metals, glass and combustible materials expose workers to different risks. Second, working conditions and operational practices like Inadequate PPE, manual handling, long journeys, inadequate equipment and accidents increase exposure. Third, institutional and community conditions like Limited funding, inadequate skills, political interference and customer behavior influence the ability of waste companies to implement effective controls. The study therefore supports a

systems-based OHS approach rather than relying primarily on individual worker behavior. This conclusion is consistent with recent evidence from Uganda and East Africa. Kampala research has demonstrated significant relationships between PPE use and occupational injury, while studies in Ethiopia have similarly identified PPE utilization, training and workplace conditions as important determinants of injury.

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.1 Introduction

This chapter presents the conclusions derived from the study findings and provides recommendations for improving occupational health and safety and solid waste management in Kawempe Division, Kampala Capital City. The recommendations are directed towards waste-management companies, KCCA, NEMA, workers, communities and other stakeholders.

6.2 Conclusions

6.2.1 Conclusion on occupational hazards

The study concludes that solid waste workers in Kawempe Division are exposed to **multiple and interconnected occupational hazards**. Factor analysis demonstrated two principal dimensions of risk: environmental risks and health risks, accounting for **44.655% and 29.950% of the variance respectively**, with a cumulative variance explanation of **74.604%**. The most prominent individual indicators included waste burning and toxic fumes, habitat destruction, leachate contamination, fire risk, waterborne disease, vectors and physical injuries. The findings demonstrate that occupational risk in waste management extends beyond cuts and bruises to include environmental contamination, biological exposure, respiratory exposure and operational hazards.

6.2.2 Conclusion on types of waste handled

The study concludes that Kawempe's waste workers handle a diverse range of waste materials. Plastic was the most commonly handled waste stream at **68.3%**, followed by food waste at **66.7%**, paper/cardboard at 50.0%, yard trimmings at 43.3%, wood at 31.7%, metals at 25.0%, textiles at 23.3% and glass at 10.0%. This diversity means that workers face different combinations of physical, biological, chemical and fire hazards. Source segregation should consequently be regarded as both an **environmental management strategy and an occupational-health intervention**.

6.2.3 Conclusion on challenges affecting solid waste management

The study concludes that occupational hazards are reinforced by systemic challenges including inadequate equipment, inadequate PPE, limited financial resources, inadequate skills, political interference, customer-related difficulties, vehicle accidents and long travelling distances. These challenges indicate that improving worker safety cannot be achieved solely by instructing

workers to "be careful". Effective prevention requires organizational, technological, regulatory and community-level interventions.

6.2.4 Conclusion on sustainable waste management

The study concludes that Kawempe already has a foundation for more sustainable waste management. Sorting, composting, repurposing, plastic recycling and biological treatment were reported as existing practices. Waste sorting had the highest mean score of **3.59**, while composting/organic waste decomposition had a mean of **3.55**. However, the continued presence of waste burning indicates that resource recovery and environmentally sound treatment systems require further strengthening.

6.3 Recommendations

6.3.1 Recommendations to waste-management companies

1. Establish formal occupational health and safety management systems

Every waste-management company operating in Kawempe should establish a documented OHS management system covering:

- hazard identification;
- risk assessment;
- risk control;
- worker training;
- PPE management;
- emergency preparedness;
- accident reporting;
- occupational-health surveillance; and
- periodic OHS audits.

Companies should maintain documented Health, Safety and Environment policies and ensure that supervisors are responsible for implementation.

2. Strengthen PPE provision and enforcement

Companies should provide appropriate PPE based on the actual hazards encountered.

Minimum PPE should include, as appropriate:

- protective gloves;
- safety boots;

- high-visibility clothing;
- protective overalls;
- respiratory protection where justified by risk assessment;
- eye protection; and
- hearing protection where relevant.

PPE should be accompanied by training, supervision and replacement programmes.

This recommendation is strongly supported by Kampala evidence showing significantly lower odds of injury among workers using PPE.

3. Introduce compulsory induction and refresher training

Workers should receive training before commencing waste-handling activities and refresher training periodically. Training should cover hazard identification, waste segregation, safe lifting, PPE, fire safety, traffic safety, biological hazards, emergency response and incident reporting.

4. Develop an occupational-health surveillance programme

Companies should establish systems for recording:

- injuries;
- cuts and punctures;
- respiratory symptoms;
- skin disorders;
- musculoskeletal complaints;
- near misses;
- vehicle accidents; and
- occupational exposures.

The resulting information should be used to identify recurring hazards and improve preventive measures.

6.3.2 Recommendations to KCCA

5. Strengthen monitoring of waste contractors

KCCA should incorporate measurable OHS indicators into waste-management contracts.

Contractors should demonstrate:

- PPE provision;
- worker training;

- vehicle safety;
- accident reporting;
- emergency preparedness;
- waste segregation;
- safe disposal;
- worker welfare; and
- environmental compliance.

6. Increase collection infrastructure

Additional collection points should be established in areas where workers travel long distances or where waste accumulation is common. The study specifically identified the need for additional collection centres and suitable vehicles.

7. Improve vehicle and road safety

KCCA and contractors should establish minimum vehicle-safety requirements covering:

- vehicle inspection;
- preventive maintenance;
- driver competency;
- safe loading;
- speed management;
- seat-belt use;
- journey management; and
- accident investigation.
- Insurance (Public Liability)

6.3.3 Recommendations to NEMA and other regulatory authorities

8. Strengthen enforcement of waste-management regulations

NEMA should continue strengthening implementation of the **National Environment (Waste Management) Regulations, 2020**, alongside relevant environmental standards and landfill-management guidelines.

Regulatory inspections should include worker safety rather than focusing exclusively on environmental compliance.

9. Integrate occupational safety into environmental inspections

Environmental compliance assessments should examine whether workers have:

- adequate PPE;
- appropriate training;
- safe working procedures;
- emergency arrangements;
- access to sanitation facilities;
- accident-reporting mechanisms; and
- appropriate working conditions.

This would strengthen the integration of environmental management and occupational health and safety.

6.3.4 Recommendations on waste segregation and circular economy

10. Promote source segregation

Kampala should progressively strengthen separation of:

- organic waste;
- plastics;
- paper/cardboard;
- metals;
- glass;
- hazardous waste; and
- other specialized waste streams.

This would reduce direct worker contact with mixed waste and improve recycling and recovery.

11. Expand composting and organic-waste treatment

Because food/organic waste was handled by 66.7% of participating firms, decentralized composting and biological treatment could significantly reduce the amount of organic waste requiring disposal.

12. Strengthen plastic recovery

Since plastics were the most frequently handled waste stream at 68.3%, KCCA and private operators should strengthen collection, sorting, aggregation and recycling partnerships.

13. Reduce uncontrolled waste burning

Waste burning should be progressively minimized and replaced with safer treatment and recovery options. Particular attention should be paid to mixed-waste burning because the study identified burning/toxic fumes as the strongest health-risk indicator.

6.3.5 Recommendations on workers and communities

14. Strengthen worker participation

Workers should participate in:

- hazard identification;
- risk assessment;
- development of safe work procedures;
- PPE selection;
- incident investigations; and
- safety meetings.

15. Increase community sensitization

Community sensitization should emphasize:

- correct waste disposal;
- source segregation;
- safe packaging of sharps;
- collection schedules;
- payment/contract arrangements;
- prohibition of open dumping; and
- protection of waste workers.

Local Council leaders and community organizations should be involved because the study identified stakeholder engagement as an important intervention.

6.4 Proposed Occupational Health and Safety Intervention Framework

Based on the findings, an integrated intervention model for Kawempe can be conceptualized as: Waste generation → source segregation → safe collection → PPE and competent workers → safe transportation → sorting/recovery → controlled treatment → environmentally sound final disposal. This should be supported by four cross-cutting pillars:

Pillar 1: Worker protection

PPE + training + health surveillance + emergency preparedness.

Pillar 2: Engineering and infrastructure

Collection centres + appropriate vehicles + mechanization + recycling infrastructure.

Pillar 3: Governance

KCCA oversight + NEMA regulation + contractor accountability + transparent contracts.

Pillar 4: Community participation

Public education + source separation + responsible disposal + stakeholder engagement.

6.5 Areas for Further Research

Future studies should consider:

1. Longitudinal research to determine changes in occupational injuries and diseases over time.
2. Exposure assessment to quantify workers' exposure to biological, chemical and particulate hazards.
3. Ergonomic studies examining lifting, pushing, pulling and repetitive manual handling.
4. PPE intervention studies to determine the effectiveness of different PPE programmes.
5. Waste-composition studies to quantify the actual proportions of organic, plastic, paper, metal, glass and hazardous waste in Kawempe.
6. Economic studies examining the cost of occupational injuries to workers, companies and the city.
7. Gender-sensitive studies examining whether male and female waste workers experience different occupational exposures.
8. Circular-economy research examining how recycling and resource recovery can simultaneously improve worker safety and generate employment.
9. Comparative studies between Kampala's divisions and other Ugandan cities.
10. East African comparative research involving Uganda, Kenya, Tanzania, Rwanda and Ethiopia.

6.6 Contribution of the Study to Knowledge

The study contributes to knowledge in several important ways.

First, it provides division-level evidence from Kawempe, an important urban setting within Kampala. Second, the factor analysis provides empirical evidence that occupational risks can be represented through two major dimensions—environmental and health risks—which together

explained 74.604% of variance. Third, the study links waste composition directly with occupational risk. The high prevalence of plastics and organic waste helps explain the importance of physical, biological and fire-related hazards. Fourth, the study demonstrates that OHS problems are not exclusively worker-level problems. Financial, institutional, political, infrastructural and community factors influence the safety of waste workers. Finally, the findings support a shift from a traditional "collect and dispose" model towards an integrated model based on prevention, segregation, recovery, recycling, biological treatment, worker protection and environmentally sound final disposal.

6.7 Final Conclusion

Overall, the study concludes that solid waste management in Kawempe Division represents both an environmental-management challenge and an occupational-health-and-safety challenge.

The evidence demonstrates that workers encounter environmental contamination, biological hazards, physical injuries, fire risks, toxic fumes and other occupational exposures. These risks are intensified by inadequate PPE, equipment shortages, limited financial resources, inadequate skills, transportation challenges, institutional constraints and community-related problems. At the same time, the study demonstrates significant opportunities for improvement. Waste sorting, composting, repurposing, plastic recycling and biological treatment are already present and can provide the foundation for a more sustainable and safer waste-management system.

The central policy implication is therefore that Kampala's waste-management system should protect workers while simultaneously improving environmental performance and resource recovery. Occupational safety should be embedded in waste-management planning, procurement, contracting, regulation, community sensitization and monitoring.

This integrated approach is particularly important in the context of Sub-Saharan Africa, where rapid urbanization and increasing waste generation are placing growing pressure on municipal waste systems.

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APPENDIX

Appendix A: Questionnaire and Key Informant Interview

UGANDA CHRISTIAN UNIVERSITY.

Dear Respondents,
This research instrument is aimed at collecting data for a Master's degree at Uganda Christian University for a study entitled "*Assessment of occupational, health and safety among municipal solid workers: A case study of Kawempe Division, Kampala Uganda*." The information given herein will be treated with absolute confidentiality for only academic purpose so you are humbly requested to avail the information requested.

Section A: **Background Information**

Individual Attributes

A1- Gender

Male	Female
1	2

A2- Age Group

Less than 31 yrs	31-35 yrs	36-40 yrs	Over 40 yrs
1	2	3	4

A3- What position do you hold in the organization?

Top Management	Middle Management	Lower Management
1	2	3

A4- What is your highest level of education?

Certificate	Diploma	Degree	Masters	Others (Please specify)
1	2	3	4	5

A5- How long have you been working with this enterprise?

Less than 2 yrs	2 – 4 yrs	5 - 7 yrs	8 -10 yrs	Above 10 yrs
1	2	3	4	5

Business Characteristics

Name of Enterprise / firm……

A6-How many staff does the enterprise have?

1-5	2-10	10-20	20-40	40+
1	2	3	4	5

A8- How long has this enterprise been operating in Kampala region?

Less than 2 yrs	2 – 4 yrs	4 – 6 yrs	Over 6 yrs
1	2	3	4

A9- If the business owns some trucks/ Vehicles, how many are they?

1 - 2	3 – 4	Over 4	Own None, *We Hire*
1	2	3	4

A10- How long has it been since you first received KCCA *Approval*

Less than 5 yrs	5 – 10 yrs	Over 10 yrs
1	2	3

A11- Are you working in partnership with NEMA?

Yes	No
1	2

A12- What kind of solid waste do you mostly handle in your business?

Carton And Paper	1	Metals	5
Yard Trimmings	2	Wood	6
Food Scrap	3	Glass	7
Plastics	4	Textile/ Clothing	8
Other (*Please specify*)			

Section B: The *different types of hazards associated with Solid Waste Management as well as challenges arising for the entire value chain in Kampala, Uganda.*

Which of these hazards associated with Solid Waste Management do you encounter as you go about your job? ON a scale of 1 – 4, Please rate the degree to which each of these poses danger in the course of conducting your job.

	Health Hazards	*VeryUntrue*	*Untrue*	*True*	*VeryTrue*
H1	Burning of solid waste sometimes releases toxic gases which harm our workers	1	2	3	4
H2	In the course of doing our work, we are always at risk of Waterborne diseases	1	2	3	4
H3	Decomposing waste is a breeding ground for vectors like rats and mosquitoes which have often been a major contributing factor in causing sickness to our staff	1	2	3	4
H4	Handling of solid waste without protective gear has often led to injuries for our employees	1	2	3	4
H5	Some solid waste is easily flammable even on exposure to sunlight for long periods and poses a danger to workers	1	2	3	4

H6- Other than the risks indicated above, what other very pressing health risks do you face as you go about your work in Solid Waste Management?.....

…….....

	***Environmental* Risks** :	*Very Untrue*	*Untrue*	*True*	*Very True*
E1	Dumping sites for solid waste contaminate soil with hazardous chemicals and heavy metals, negatively affecting soil fertility	1	2	3	4
E2	Improper Solid waste disposal has destroyed the natural habitats for wildlife	1	2	3	4
E3	Landfills release leachate, a toxic liquid formed as water	1	2	3	4

	Percolates through waste, contaminating soil and water bodies.				
E4	Decomposition of organic Solid Waste sometimes produces methane, a gas that truly contributes to climate change.	1	2	3	4
E5	Accumulation of combustible materials in landfills and dumpsites increases the risk of uncontrolled fires which release toxic smoke and gases.	1	2	3	4

E6- Other than the environmental risks indicated above, what other very pressing environmental risks do you notice/face as you go about your work in Solid Waste Management?.....

…….....

F1- What is the most serious challenge *you have faced in the management of Solid waste in Kampala, Uganda (Please state one, the one you feel is most serious)……..*

…….....

F2- What is the most serious **consequence/outcome** that comes with poor *Solid Waste management in Kampala, Uganda (Please state one, the one you feel is most serious)……..*

…….....

…….....

To determine the *different solid waste management methods utilised by waste handlers in Kampala, Uganda*

Solid Waste Collection Point Source: At the points where you collect the rubbish, which of these measures have you taken to reduce the volume of waste?

	Solid Waste Management at Source	*Very Untrue*	*Untrue*	*True*	*Very True*
M1	Our firm encourages residents we serve, to buy in bulk so as to reduce the waste that comes with packaging many items How does buying in bulk reduce the waste that comes with packaging many items? Or is it the waste from the packaging material	1	2	3	4
M2	We often encourage people to use durable and reusable products. Specify what kind of durable and reusable products in question here. For instance it may not be the organic waste which is decomposable but maybe packaging material	1	2	3	4
M3	Our firm has taught people how to convert waste materials into other useful products or raw materials	1	2	3	4
M4	Our employees often teach people to dispose of garbage after sorting it appropriately. What do you mean by "disposing of"	1	2	3	4
M5	We often teach communities how to decompose organic waste such as food scraps into nutrient rich manure.	1	2	3	4

M6- What is the most common method other than those indicated above, which you have taken as a company, to reduce the waste from the collection points among people?.....

.....

	Solid Waste Disposal *To dispose off the solid waste better solid waste, sentence isn't very clear. There seems to be something missing*	*VeryUntrue*	*Untrue*	*True*	*VeryTrue*

D1	We often burn some of the waste using immense heat	1	2	3	4
D2	Some waste such as plastics, is sold to other firms that recycle it	1	2	3	4
D3	We dispose the solid waste into landfills, where it is buried underneath the ground.	1	2	3	4
D4	We employ the use of microorganisms to break down the organic Solid waste	1	2	3	4
D5	We are constantly doing research so as to identify better ways of getting rid of the rubbish	1	2	3	4

D6- What other very serious measure have you taken as a company, to generally make the solid waste disposal better?.....

…….....

…….....

Thank you very much

Appendix B: Satellite Image of Kawempe Division in Kampala Capital City