INTEGRATED HOUSEHOLD GARBAGE DISPOSAL AND MANAGEMENT IN KISII TOWN, KISII COUNTY

ANNCLETAS AMBIA ATAMBA

A Thesis Submitted to the School of Education, Humanities and Social Sciences in Partial Fulfillment of the Requirements of the Award of Degree of Master of Arts in Geography of Jaramogi Oginga Odinga University of Science and Technology

DECLARATION

I declare to the best of my knowledge that this research is my original work and has not been presented for a degree of any other academic work to any other university or institution of higher learning.

Signature …….. Date …….

Anncletas Ambia Atamba

Z451/4210/2014

Approval

This research has been presented with our approval as university supervisors.

Signature …….. Date …….

Dr. Otieno, A. Charles (PhD)

Department of Social Studies,

School of Education, Humanities & Social Sciences,

Jaramogi Oginga Odinga University of Science and Technology.

Signature …….. Date …….

Dr. Tonui, K. Warkach (PhD)

Department of Social Studies,

School of Education, Humanities & Social Sciences,

Jaramogi Oginga Odinga University of Science and Technology

DEDICATION

To my late father, Mr. Jackson Mate and my late husband Henry Marube who always insisited that that I give my best in everything I do. Special dedication also goes to my loving mum Geraldine Shibeka, my daughters Lisa and Chloe, sons Liam and Henry, brothers and sisters for their moral support, may God bless you.

ACKNOWLEDGEMENT

I write to register my heartfelt gratitude and praise to God for the far He has brought me and sustaining me through-out the course, proposal and thesis writing. I express my special thanks to my supervisors Dr. Otieno Charles and Tonui, K. Warkach who accorded their support and ensured that I complete this thesis. Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

CBD	Central Business District
CBO	Community Based Organization
ISWM:	Integrated Solid Waste Management
LDC :	Least Developed Countries
MSW:	Management of Solid Waste
NEMA:	National Environmental Management Authority
SLUM	Solid Waste Management
SPSS:	Statistical Package for Social Sciences
UNEP:	United Nations Development Program
USEPA:	United States Environmental Protection Agency

ABSTRACT

The research explored the integrated disposal of household waste to manage garbage effectively in Kisii town, Kenya, with 370 randomly selected households participating in primary data collection. The data analysis incorporated both descriptive and inferential statistics. The results disclosed that 67% of household waste generated was non-biodegradable, while 33% was biodegradable. Within households, garbage found secondary use, such as fetching and storing water (60%), engaging in vegetable gardening (14%), and storing other liquids like kerosene and used oil (37%). Furthermore, the study found that the majority of respondents (34%) disposed of household garbage by burning it in rubbish pits, followed by 30% who discarded it in vacant lots or roadside areas, 18% at designated collection centers, 15% in landfills, and 3% using other methods. These alternative methods included discarding waste in flowing water streams and sewers. The study revealed that both urban and residential zones lacked adequate facilities for waste management, which was a major concern for most respondents (87% agreement), a lack of suitable dumping sites (86% agreement), unsustainable waste collection, transportation, and disposal systems (83% agreement), and limited domestic waste recycling (81% agreement). In terms of waste collection and disposal services, the survey revealed that 52% of household garbage was handled by the county government, 14% by private waste collectors, 11% by self-help groups, 8% by Community-Based Organizations (CBOs), and 15% had no specific provider. The results showed that the majority of respondents (31%) were dissatisfied with garbage collection and disposal services, 25% were slightly satisfied, 24% were satisfied, and 16% were very satisfied. Four percent expressed uncertainty. These findings imply that most residents were either satisfied or slightly satisfied with the services. As a recommendation, the study suggests the need to educate Kisii residents on the importance of adopting a comprehensive waste management approach, allowing them to address the challenges associated with waste management in the town. Additionally, implementing initiatives like deposit refunds and pay-as-you-throw regulations could be effective in monitoring and controlling the disposal of items like plastic bottles. Collaborative efforts among the County government and other relevant stakeholders are also advised to increase the number of collection points, storage facilities, and improve transportation for proper garbage disposal.

CHAPTER ONE: INTRODUCTION

This chapter delves into the study's context, articulates the problem statement, outlines the study's objectives, provides the rationale for conducting the research, emphasizes the study's significance, defines its scope and limitations, and presents the conceptual framework.

1.1 Background of the Study

The management and disposal of household waste have evolved into a global concern, predominantly impacting developing countries (Mawire, 2010). Kirov (2005) points out that no nation can lay claim to having a definitive solution to household waste management. Global estimates indicate that a staggering 1.7 to 1.9 billion metric tons of household waste are generated daily (Omara-Ojungu, 2002).

One of the factors that affect the composition of Municipal Solid Waste (MSW) is the type and amount of organic and inorganic materials. Organic and paper waste make up a large part of MSW, while plastics, glass, and metals are less common. However, this varies depending on the income level, economic growth, lifestyle, and location of the people who generate the waste. For example, poorer households and rural areas tend to produce more organic waste than richer households and urban areas. This kind of waste is heavy, wet, and difficult to collect, transport, and recycle. On the other hand, in rich countries, people consume more processed and packaged goods, which result in more inorganic materials like metals, plastics, and glass. In Europe, packaging materials account for almost half of the municipal solid waste (Eawag, 2018).

Rapid urbanization has given rise to a range of land use and infrastructural issues, including the management of municipal solid waste (Hoornweg & Bhada-Tata, 2012).

Bandyopadhyany (2013) argues that while cities occupy only 2% of the world's land surface, they consume over 75% of the planet's resources and generate 75% of the world's waste. Dealing with this solid waste has become a significant organizational, financial, and environmental challenge in recent years. Challenges associated with household waste management encompass garbage collection, waste reduction, transportation, behavioral change, reuse and recycling, treatment, separation, and disposal. These challenges vary from one country to another depending on their level of industrialization (Zhao, 2005).

Urbanization, economic growth, and industrialization have led to unsustainable patterns of production and consumption, resulting in a substantial increase in both the quantity and variety of waste (NEMA, 2014). Urbanization and industrialization have led to shifts in lifestyles and behavior, which have consequently affected waste composition, transitioning from predominantly organic to more durable synthetic materials like plastics and other packaging materials (Idris et al., 2004).

The challenges and solutions of solid waste management in Africa and other developing regions are different from those in developed countries. In developed countries, the main goal is to recover as much resources as possible from waste, while in developing countries, the priority is to collect, treat, and dispose of waste properly. A possible way to address this issue is to implement an environmentally friendly, economically feasible, and socially acceptable waste management strategy, one effective approach is Integrated Solid Waste Management (ISWM), is a framework that can help develop a sustainable municipal solid waste service and is widely suggested as a suitable waste management approach, offering various options for collection, transport, and treatment (White, Frank, and Hindle, 1999).

Household garbage refers to materials discarded or unwanted in the home. There are two primary approaches to managing household waste. The high-waste approach involves discarding, burning, or burying waste, while the low-waste approach focuses on minimizing household waste production and diverting solid waste from landfills and incinerators (Miller & Tyler, 2005). In recent years, the former has been seen as cost-effective and irresponsible, while the latter is considered initially expensive but ethically fulfilling.

Globally, waste generation is outpacing the rate of urbanization (Hoornweg & Bhada-Tata, 2012). Presently, world cities generate around 1.3 billion tons of solid waste annually, and this figure is projected to rise to 2.2 billion tons by 2025. Waste generation rates are expected to more than double in lower-income countries over the next two decades (Ibid). UNEP (2012) underscores that the health and environmental implications associated with waste disposal are becoming increasingly urgent, particularly in developing countries, especially in low-income settlements where services are frequently inadequate (UN HABITAT, 2010).

Municipal waste management in Asia and Africa's developing countries faces difficulties in coping with the fast increase in waste production (Omara-Ojungu, 2002). Satterthwaite (2001) states that waste collection rates in low-income countries are often lower than 70%. More than half of the collected waste is often dumped in unregulated landfills and unsafe informal recycling. Solid waste management is a major problem in Kenya, as in other developing countries. The systems for collection and disposal are ineffective and that the aspect of collection entails not only gathering solid waste and materials that can be recycled but also transporting them to the disposal site, which was environmentally unfriendly (Gakungu, N. K., 2011).

Additionally, it is important to highlight that approximately 30 to 40 percent of solid waste in urban areas remains uncollected, and this service reaches less than 50 percent of the population (Otieno, 2010). Furthermore, up to 80 percent of waste collection transport is either non-operational or requires maintenance. Addressing the challenge of sustainable solid waste management in Kenya is imperative, garbage could potentially engulf all of Kenya's cities, as warned by Rotich, Zhao, and Dong (2006). The problem of residential garbage management remains unresolved, particularly in informal settlements, where solid waste management is an even more formidable challenge. For instance, Mwangi (2011) found that 80% of households in Makina village, Kibera, use shallow refuse pits for waste storage, which become large dumpsites due to irregular waste collection.

Integrated household garbage disposal management is considered an effective coping strategy by many households in municipalities and cities. Various methods, including reuse, recycling, decomposition, reduction, prevention, treatment, and landfill, are used to manage household waste (NEMA, 2014). This approach encourages urban authorities to adopt policies aimed at resource efficiency and a society based on recycling. This is intended to provide a clean, healthy, and pleasant living environment for current and future generations (Dong et al., 2005). Despite the growing importance of household waste management, there has been insufficient scholarly attention given to its success as a waste disposal strategy, particularly at the local level, in fast-developing urban areas like Kisii.

While numerous studies have explored solid waste management in Kenya (Obera, Okecha, & Oyier, 2002; Ochieng, 2016; Omambia & Ogonya, 2015; Rotich, K., Zhao, & Dong, 2006), there is a scarcity of local empirical research concerning

integrated household garbage disposal for waste management, especially in rapidly developing urban centers like Kisii. Kisii town has recently experienced rapid transformation characterized by industrialization, urbanization, population growth, and changing consumption patterns. Consequently, the town now grapples with household garbage disposal challenges. It is thus essential to investigate the strategies, challenges, and effectiveness of integrated household garbage disposal for waste management in Kisii town. This study explored integrated household garbage disposal for waste management in Kisii town, focusing on strategies, challenges, and effectiveness.

1.2 Statement of the Problem

According to a global assessment of solid waste management in 2012, waste production is outpacing urbanization worldwide. The report revealed that cities around the world generate approximately 1.3 billion tons of solid waste each year, and this figure is expected to rise to 2.2 billion tons by 2025. In particular, lower-income countries like Kenya are projected to experience a more than twofold increase in waste generation rates over the next two decades (Hoornweg & Bhada-Tata, 2012).

While the quantity of waste generated in urban areas continues to rise, the efficiency of waste management, particularly concerning collection and disposal, remains unacceptably low. Rotich, Zhao, and Dong (2006) assert that although Kenya has made commendable efforts in waste management, the issue of household garbage management remains unresolved in the country. Their observations are supported by Otieno (2010), who highlights challenges in waste management, including inefficient collection systems and environmentally unfriendly disposal methods, particularly in rapidly growing Kenyan towns. He reports that 30 to 40 percent of solid waste in

urban areas goes uncollected, and less than half of the population receives waste management services. Additionally, up to 80 percent of waste collection transport is either in disrepair or requires maintenance. Otieno argues that without addressing the matter of sustainable solid waste management in Kenya urgently, all Kenyan towns could soon be overwhelmed by waste.

Like many other expanding towns in Kenya, Kisii town has undergone rapid transformation, characterized by industrialization, urbanization, population growth, and shifts in consumption patterns. As a result, the town now faces challenges in managing household garbage effectively. Hence, it became essential to investigate the strategies, challenges, and effectiveness of integrated household garbage disposal for waste management in this specific region.

While numerous studies have explored solid waste management in Kenya (Obera, Okecha, & Oyier, 2002; Ochieng, 2016; Omambia & Ogonya, 2015; Rotich, Zhao, & Dong, 2006), there is a notable absence of local empirical research addressing integrated household garbage disposal, particularly in rapidly developing urban areas like Kisii town. Moreover, the objectives of these previous studies differed from those of the present research, revealing both contextual and conceptual gaps. This study investigates integrated household garbage disposal for waste management in Kisii town, focusing specifically on the strategies, challenges, and effectiveness of this approach in managing household garbage in the Kenyan context.

1.3 Study Objectives

The main objective of this study was to investigate integrated household garbage disposal for garbage management in Kisii town, Kenya.

The specific objectives of this study were to;

i. Identify the strategies of integrated household garbage disposal for garbage management in Kisii town, Kenya.
ii. Find out the challenges facing integrated household garbage disposal for garbage management in Kisii town, Kenya.
iii. Determine the effectiveness of integrated household garbage disposal for garbage management in Kisii town, Kenya.

1.4 Research Questions

This research was guided by the following research questions;

i. What are the strategies of integrated household garbage disposal for garbage management in Kisii town, Kenya?
ii. What are the challenges facing integrated household garbage disposal for garbage management in Kisii town, Kenya?
iii. What is the effectiveness of integrated household garbage disposal for garbage management in Kisii town, Kenya?

1.5 Justification of the Study

The findings of this study can be a valuable resource for the managers, planners, and policymakers responsible for Kisii town. They can use these findings to develop and implement more effective strategies for managing garbage. Additionally, this research can help assess the effectiveness of integrated household garbage disposal and guide improvements based on the study's recommendations. The study offers insights into

household garbage management in developing towns and highlights the role of community participation in supporting government efforts for garbage collection.

Garbage management continues to pose a significant challenge in urban areas, attributed to inadequate policies and suboptimal solutions proposed by authorities. The shortcomings in the operations of solid waste management facilities also contribute to this concern. The lack of support from authorities, including the county government, has adverse effects on public health and the environment. Household solid waste management has become a pressing public health issue in Kisii town, primarily due to a lack of awareness and proper waste management systems among its residents. As a result, this study was conducted to investigate integrated household garbage disposal strategies, identify the challenges associated with this approach, and assess its effectiveness in managing garbage in Kisii town, Kenya.

1.6 Significance of the Study

Scholars interested in this field of study can benefit from examining this phenomenon over time. This research would therefore help in opening up opportunities for doing further research on integrated household garbage disposal and garbage management. The study will be a source of reference material for future researchers on other related topics.

1.7 Scope of the Study

This research examined the integrated disposal of household waste for the purpose of waste management in Kisii town. This research was confined within Kisii town, the headquarters of Kisii County, Kenya. Kisii town was chosen because it is one of the fastest developing towns in Kenya. The concepts studied included strategies,

challenges and effectiveness of integrated household garbage disposal for garbage management. Baseline survey was adopted to conduct the study. The study was carried out between October 2020 and August 2021.

1.8. Limitations of the Study

The study had some limitations based on the data collection methods adopted and willingness of the respondents to give precise and accurate responses. The respondent may have deliberately decided to give misleading or incorrect responses in order to achieve some unknown objective. They may have also given misleading information owing to the privacy of the answers required and ambiguity of some of the questions. In order to address and reduce the risk of bias, the researcher used research assistants who were dedicated familiar with the study area.

The researcher and the research assistants also had to explain to the respondents the objectives well and the confidentiality of the information provided. The respondents therefore did not withhold information they had. In order to deal with ambiguous questions, the researcher did a pre-test and all the ambiguous questions were addressed. The research was also limited to Kisii town CBD and the environs of the town, however, the researcher managed to adequately cover the geographic area of Kisii town.

Although the study covered a small population in a narrow geographic area, it would be useful to other areas with similar challenges as the findings can be generalised to other areas involved in garbage management. However, to be able to assess the specific regional differences, further research should be conducted in other areas and expand the study to include additional household waste management strategies.

1.9 Definition of Terms

Garbage : Refers to household waste which consists of leftover food, fruit, vegetables, peels fallen leaves of potted plants, waste paper nwanted plastic objects, glass articles, metal objects, old wooden objects, rags, discarded shoes and sewage

Intergrated solid waste Management: Strategic approach to sustainable management of solid wastes covering all sources and all aspects covering generationa, segregation, transfer sorting, treatmnte, recovery and disposal in an integraded manner with an emphases on maximizing reosurces use efficiency.

Incineration is the method of subjecting hazardous materials to elevated temperatures in order to eliminate contaminants.

Incenerator: A type of furnace designed for burning hazardous materials in combustion chamber.

Reuse: The act of turning a discarded item into something usable.

Solid Waste: Any carbage, sludge, or other discarded matrial from homes and businesses and industrial, commercial mining, agricultural or community activities

Waste management is a practice that involves the convergence of contributions from producers and users, aiming to address and recycle residual materials and natural resources, ultimately clearing them from the environment.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides literature review of related works on household garbage disposal management. The major research issues are established, highlighted and consequently the study has tried to fill the gaps found.

2.2 Strategies of Integrated Household Garbage Disposal

A Strategy implies a general approach to the problem. It involves a purposeful use of instrument, capacities and situational opportunities to achieve long term goals. Implementation of a strategy requires a long term process involving cooperation and coordination between various actors and partners contributing and building upon the existing activities and programs (Schubeler, 2020 The strategy used to develop an integrated waste management system is to identify the levels at which the highest values of individual and collective materials can be recovered. The most favorable is reduction, which suggests using less to begin with and reusing more, thereby saving material production, resource cost, and energy. The least desirable is landfilling. The approach not only aims at maximizing recovery of reusable and recyclable materials, but also reduces pollution and protects human health and the environment (USEPA, 1995).

Household garbage refers to any discarded or unwanted materials that are produced in the house. Household garbage originates in homes. Integrated household garbage management refers to the strategic approach to sustainable management of garbage covering all sources and all aspects, covering generation, segregation, transportation, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis

on maximizing resource use efficiency. Integrated approach entails the use of different methods of garbage disposal in the management of household garbage.

Waste reduction, also known as prevention, is the best approach to waste management. It ensures that less waste is generated, or none at all. This is because waste that has not been generated will not cost you to manage it. For instance, waste can be reduced through avoiding unnecessary packaging of produce and products by manufactures. Given that if this excess packing had not been done there will be no need to collect waste and incur costs of separating, transporting, and recycling among others. The reduction leads to effective use of resources and their conservation for the sake of future generations, this also helps keep the environment clean.

To reduce household garbage produced, people must reduce discarded products. We can cut back on the amount of trash we produce by buying things with changed product packaging and content. This is buying items from companies that use recycled products. It is called pre-cycling, and the whole process of recycling what you buy and buying recycled things is called completing the cycle. Reducing and reusing will not work unless a market exists for this material, and the consumers of these recycled goods should be the public (Arena, 2021). Manufacturers who deal with hazardous waste management can attempt to reduce the toxins and harsh chemicals in their products. People must learn to reduce and recycle the household garbage produced. These can be done through change in the life style and trying to minimize the amount of garbage they produce (Mawire, 2010).

Reuse and repair: Reusing entails the use of an object or something after it has already been used, whether used as intended or in a different way that is similar or different from its original purpose. This can be done without altering its physical form. Reuse

is quite different recycling, given that with recycling the physical form of the given object is altered significantly. Compared to recycling reuse utilizes less resources and energy, that is the main reason why many people prefer reuse in comparison with recycling. If we reuse objects we prevent them from becoming waste given that waste is any material that has no use and there is no one with the intention of reusing it (Eawag , 2018).

Recycle: Recycling entails using waste or something that was to be discarded. Recycling transforms waste into new reusable products, but it produces waste itself, thus recycling is different from prevention of waste generation (Eawag, 2018). Recycling is the separation of reusable materials such as glass, metals, and paper from solid waste. The recyclable materials are then processed and returned to the economy as parts of other products.

Recycling remains the most popular environmental activity among the people of industrialized nations simply because it is done as often as we throw something away. These resource recovery programs extend the globe's mineral supply by reducing the amount of virgin materials that need to be removed from the globe to meet the demand. Resource recovery saves energy, causes minimal pollution and land disruption, cuts waste disposal costs, and extends the life of landfills by preventing waste from residing there.

The percentage of paper that is being recycled in other nations sends a clear message to Kenyans: we are not doing enough. Americans recycle 28% of the paper they use, although they lead the world in paper consumption and paper waste. France, Sweden, Switzerland and Finland recycle at least one-third of their paper expenditures. Japan,

Mexico, and the Netherlands are at a 44% rate, which is the highest in the world (Tyler, 2005).

Composting- breaks down organic matter into soil amendment.Anything that is naturally degradable can be thrown into a compost bin. Food and organic waste created by food processing plants, kitchens, galleys, animal feedlots, yard work, and municipal sewage treatment plants. Paper, leaves, and grass clippings can be decomposed in this process in backyard compost bins, and the end result can be used in gardens and flower beds (Chifamba, 2007). Composting is therefore a form of recycling.

Sanitary landfills: Many landfills operate as dumps on open sites, wetlands or lands with water near the surface. The sites are usually not protected therefore waste pickers use the chance to visit the sites and sort valuable materials for selling or for their own consumptions (Achankeng, 2020). Notably in many situations landfill is the only municipal solid waste management option available after municipal solid waste is collected (UNEP & UNITAR, 2013). Landfill operation mostly depends on the administration and management of the municipal solid waste management system. Types of landfills include uncontrolled open dumps, controlled dumps and secure sanitary landfills.

Uncontrolled open dumps are the least effective disposal of municipal solid waste in relation to appropriate local health and environmental standards (Mawire, 2010). Most landfills are operated below the standards of sanitary practice leading to air and water pollution. Though incineration is a better option to landfilling, the high operation and maintenance costs associated with it and the organic content remain to be the limiting factors to this option. The practice of reusing plastics, paper, metals and other

materials is a good recycling approach which is among the preferred methods for an integrated waste management practice (Mungure, 2008).

Household garbage disposal in the area involves open-air burning at dumpsites, which emits harmful pollutants into the atmosphere. Residents also burn piles of waste within neighborhoods, releasing a mixture of noxious gases (Kidd, 2009). This unregulated burning poses ecological concerns due to air pollution and toxic fumes (Medina, 2008). Furthermore, it carries the risk of serious explosions that could damage entire neighborhoods and property (Medina, 2008). One limitation of existing by-laws is their failure to specify the location of incinerators and dumpsites concerning residential areas (NEMA, 2014). This lack of clarity allows for abuse and uncontrolled refuse burning within developing towns' residential zones (Marshall & Farahbakhsh, 2013).

Currently, there are three primary types of initiatives: community-based, private-based, and cooperative/association-based, all driven by social objectives, and many also incorporate economic goals to varying degrees of success (Marshall & Farahbakhsh, 2013). Community-based initiatives are prevalent in peri-urban areas, while private initiatives are more common in wealthier neighborhoods. The work is labor-intensive, and the income generated is often modest (Obera, Okecha, & Oyier, 2002).

The informal sector is a major source of secondary materials in developing countries. According to the World Bank, approximately 2% of the population in developing nations work as scavengers, make a living by collecting and selling recyclable materials. Scavengers pick recyclables from the streets, bins, and even disposal sites where the waste is unloaded. They mainly recover paper, cardboard, plastic, glass,

and some metals and sell them to larger distributors or recycling companies. Scavengers often face health problems due to poor living conditions and exposure to waste (Eawag , 2018). Waste is transported to the dumpsite in open trucks, causing pollution along the way. In areas with solid waste collection, two primary methods are utilized: door-to-door collection and station-type garbage collection (Eawag, 2018). Due to increasing land costs, municipalities face challenges in finding landfill sites near urban areas, leading to higher transportation expenses (Memon, 2010). Inefficiencies often arise from institutional and organizational shortcomings, along with a lack of management capacity (Zurbruegg, 2003). For example, in Surat, India, outsourcing services like night sweeping, waste collection, and transportation to private firms significantly improved collection coverage to over 90% and reduced roadside garbage containers by 36% (Prasad, Yang, Hongyuan, & Choudhury, 2011).

Omambia and Ogonya (2015) conducted a study whose objectives The study aimed to identify various types of household solid waste, evaluate household waste management practices, examine common waste management challenges in Baraton Centre, and identify factors influencing these practices. Employing a quantitative descriptive case study design and convenience sampling, the research found that the majority of respondents (78%) were knowledgeable about solid waste management. The study provides valuable insights into household solid waste-related issues. Notably, it revealed a negative association between the education level of a family head and their solid waste management practices, emphasizing the need for increased awareness and education in the community regarding responsible waste management.

The study was conducted in a small geographical area with a small population- Baraton Centre- but this study was conducted at bigger geographical area, Kisii Town with a bigger population. The study investigated integrated household garbage disposal for waste management in Kisii, Kenya, to fill gaps in knowledge.

Kaundal and Sharma (2007), conducted a study at Palampur, Himachal Pradesh, India whose objectives were: to examine the problems of household waste and to study level of awareness regarding household waste utilization. Multi-stage stratified random sampling was used to draw a sample of 108 respondents from female respondents from teaching and non-teaching communities. Both primary and secondary data were collected. The primary data were collected with the help of structured and pre-tested interview schedule through personal interview method. Based on sample survey, the study reveals that the garbage disposal outside the house was a major problem. Polythene was burnt along with other waste in both the communities. Waste recycling awareness was found to be higher in teaching community as compared to non-teaching community.

This study was conducted in a different geographical and cultural background from the one the current study was conducted. The objectives of the study are also different therefore contextual and conceptual gaps were noted. The study aimed at filling the gaps by studying how integrated household garbage disposal can help manage household garbage in Kisii town in Kenya.

2.3. Challenges Facing Integrated Household Garbage Disposal

Household garbage management has emerged as a pressing issue in major towns, particularly following the economic upheaval triggered by the land reform program initiated in Kenya in 2000. This has led to a financial crisis in the cities, severely limiting the collection and disposal of solid waste. Hardoy et al. (2001), the conventional approach of large-truck-based house-to-house collection is often wasteful and ill-suited for many municipalities with narrow or impassable roads, especially during adverse weather conditions. The problem is exacerbated by narrow, potholed roads in areas like Highfield suburb, particularly in sections such as Engineering and Paradise, which are unsuitable for smooth waste transportation (Guerrero, Maas, & Hogland, 2013).

Hardoy, Mitlin, and Satterthwaite (2001) emphasize that the lack of regular waste collection services in urban areas, particularly in lower-income areas, is a significant challenge for towns undergoing urbanization, like Kisii. These towns have grappled with severe issues concerning refuse collection and disposal. Insufficient refuse collection trucks and fuel shortages have contributed to the proliferation of large amounts of uncollected waste, leading to significant litter and pollution, which, in solid waste form, poses a threat to public health (Kidd, 2009). These challenges encompass issues such as waste production prevention, reduction, collection, transportation, behavior modification, household garbage separation, treatment, reuse, recycling, and disposal.

As per Mbanga (2011), developing towns tend to prioritize economic development, often overlooking household garbage disposal in their planning. With limited resources allocated to this sector, efforts to enhance household garbage disposal are

hampered, further exacerbated by corruption, rapid population growth, urbanization, changing income dynamics, evolving consumption patterns, and developing economies, among other factors. These factors collectively contribute to increased household waste production (Munowenyu, 2007). The collection, transportation, and disposal systems in developing towns are typically neither efficient nor environmentally sustainable. These towns often lack adequate collection and transportation resources, and even if they exist, these resources tend to be outdated, overused, and in dire need of repair, with maintenance being neglected (Mbanga, 2011). Consequently, uncollected household waste is a common sight in these towns, often due to the irresponsibility of collectors, negligence, improper disposal, or simply a lack of awareness (Mbanga, 2011).

Waste management challenges are not unique to Kenyan towns; they are a global issue. Even in the United States, the Bureau of Household Garbage Management (2000) acknowledges the rising costs of waste handling. These costs are particularly problematic in densely populated, revenue-limited urban areas, underscoring the importance of efficient solid waste management. This sentiment is echoed by Omara-Ojungu (2002), who points out inadequate garbage storage and collection systems in numerous African cities. Kisii Town is an illustrative example of a city struggling to manage household garbage effectively.

Furthermore, town budgets in developing countries are typically strained, exacerbating the waste disposal problem. As observed by Mapira (2001), this financial strain often worsens the waste disposal challenge. Kenya's politically induced economic crisis has resulted in a collapse of solid waste management in most urban areas. In an attempt to address this issue, the Ministry of Environment and

Natural Resources Management is set to initiate a baseline assessment for the development of an integrated household garbage disposal management plan for the country (Mawire, 2010).

Illegal dumping of solid waste is reported to affect sewer systems due to blockages, particularly from non-biodegradable materials like plastics. Chifamba (2007) notes that the accumulation of metals like copper (Cu), lead (Pb), and zinc (Zn) is found in waste disposal sites. Mismanagement of solid waste not only contaminates the land but also pollutes surface and groundwater. This study seeks to compile an inventory of waste infrastructure and waste sources to advocate for an integrated solid waste management strategy.

Urban areas, despite their increasing population, face their own set of problems. The growth of urban domestic solid waste has surged considerably over the years due to urbanization. Kirov (2005) warns that the escalating solid waste generation rates, coupled with rising population densities, place heavy demands on existing collection and disposal systems (Munowenyu, 2007). An increase in population density, often leading to more individuals living in a single room or house, directly correlates with the proliferation of solid waste. Omara-Ojungu (2002) highlights the issue of inadequate garbage storage and collection systems in several African cities. This extraordinary growth in urban population necessitates an extraordinary approach to waste collection and disposal.

In a different geographical context, Ochieng (2016) conducted a study to address challenges and propose interventions for effective solid waste management in Ngomongo village of Korogocho informal settlement. The study's objectives were to determine the solid waste management system in the village, identify primary

challenges, and propose planning interventions for improved solid waste management. The research involved households and business enterprises within Ngomongo village, with a sample of 140 households and 40 business enterprises. The findings revealed that SWM in Ngomongo village is primarily conducted by youth groups and is characterized by limited waste separation, erratic collection, and poor disposal systems.

The study also identified challenges in SWM in Ngomongo, encompassing a lack of designated disposal sites, leading to a poor disposal system, erratic collection, and high costs imposed by private waste collectors. Planning issues further hinder SWM in Ngomongo, such as the lack of designated disposal sites and solid waste receptacles, congestion, and accessibility problems. In sum, SWM in Ngomongo is found to be inadequate (Otieno, 2010). However, it's important to note that this study was conducted in a different geographical context from the current one, and the research objectives also differ, highlighting contextual and conceptual gaps. The present study aims to investigate how integrated household garbage disposal can enhance household waste management in Kisii town, Kenya.

Another relevant study by Otiso (1993) explored urban environmental issues, examining solid waste pollution and management in Kisii Town, Kenya. The research revealed that most waste in Kisii town was generated from residential areas. The results showed that the receipt of municipal SWM services depended on one's location within the town. Services were affected by distance decay, meaning that the quality and frequency of services declined as one moved further from the city center. Commercial areas, corresponding to the Central Business District (CBD), received more municipal services, including storage facilities and more frequent trips. Some

areas immediately outside the commercial zone did not receive services, despite residents paying for them. In response to this situation, 48% of the town's residents felt that the municipality's responsibility for solid waste management should be transferred to other entities, such as private companies. While this study covered Kisii town and focused on pollution and waste management, it was conducted 23 years ago, and significant changes may have occurred since then. Therefore, a more recent study was essential to provide current insights into the situation.

2.4 Effectiveness of Integrated Household Garbage Disposal

The quality of waste management in terms of collection and disposal is still low, while the amount of waste produced in cities keeps growing every day. Urban growth leads to more and more waste production, which is also more complex (Hoornweg & Freire, 2013). Therefore, cities should have plans that ensure the availability of affordable, serviced land, which is probably the most important factor for sustainable urbanization. Effective SWM needs clear roles and legal responsibilities of institutions and government bodies to avoid conflicts, inefficiency, inaction, and political instability in SWM systems (Schübeler, 1996). Even when there are regulatory and legislative frameworks, governments with weak institutional structures are easily overwhelmed by the increasing needs for SWM as urban populations grow rapidly (Hardoy et al., 2001).

One of the responsibilities of a municipality is to collect, transport and safely dispose waste generated within its area. In many African municipalities this goal is barely accomplished as a result of inadequate coverage services due to poor infrastructures, limited utilization of recycling activities and poor landfill disposals techniques (Tchobanoglous et al., 1993). An effective and efficient SWM system should

minimize transport costs, through proper equipment maintenance and limiting distances travelled to and from dump sites. This study sought to examine if this is true regarding waste management in Kisii town.

Khamis (2016) conducted a study about the effectiveness of Solid Waste Management System at Local Government Authorities in Tanzania, the case of Moshi Municipal Council. It specifically describes the solid waste management systems deployed by Moshi Municipal Council and assess the extent to which solid waste management systems enhance the management of solid waste in the Municipality and challenges which impact on the effectiveness of the solid waste management systems in the Municipality. The research approach used is qualitative, and the research design used was case study design. The study population included all people who had the role in overseeing and managing the solid waste management systems in the Municipality and all the selected wards. Data were collected by using both primary and secondary sources.

The major findings showed several systems that were used by the Moshi Municipal Council to ensure both effective and efficient SWM in the area. They included formulating of By-Laws, availability of cleanness facilities, wards cleanness competitions as well as provision of incentives to cleaners. The study was conducted in a different geographical area. The study population only included people who had the role in overseeing and managing the solid waste management systems in the Municipality in all the selected wards. However, this study targeted households from where waste was collected. This study was therefore aimed at filling both the contextual and conceptual gaps.

Wang'ombe (2010) conducted a study whose objective was to study the amount and composition of waste handled by waste management service providers, their equipment and personnel capacity, how this capacity affects their performance and identify opportunities available to increase their capacity thus render better services. This study used purposive sampling method. A simple random sampling technique whereby five Community Based Organizations (CBOs), were selected as representatives of SWM service providers within Kasarani Constituency. The data was gathered mainly through the use of questionnaires, interviews and observation. The results gotten from the research revealed that the capacity of the various service providers is wanting both in terms of personnel and equipment. This study was aimed at filling both the contextual and conceptual gaps found in the study.

Gakungu et al. (2012) in there study examined the generation, collection and disposal of solid waste in the public technical training institutions by quantification of the various components of solid waste generated and evaluation of the attitudes of the people responsible for generation and management of waste. From 42 technical training institutions, a sample of 29 institutions (73%) was selected for study. It was established that the 29 institutions generate about 23 tons of waste per week composed of mainly vegetable and food remains (82%). Other waste includes plastics, papers, ash, metals and glass. It was also established that the cost of waste management in the institutions is dependent on both the waste generated and the institutional population. The cost of planning and managing the waste ranged from Ksh 0.13 to 0.59 /week/student while per capita waste generation ranged from 0.28kg/week/student to 0.71kg/week/student. This study was aimed at filling both the contextual and conceptual gaps found in the study.

2.5 Garbage Management

Waste management in all ramifications, is simply a planned system aimed at effectively controlling the production, storage, collection, transportation, processing and disposal of waste. Waste management is an important element of environmental protection. Its purpose is to provide hygienic, efficient and economic solid waste storage, collection, transportation and treatment or disposal of waste without polluting the atmosphere, soil or water system (Iyeke, 2011). The various steps involved in the management of solid waste from generation to the point of sanitary disposal are referred to as solid waste chain. It therefore means that the solid waste chain is the path trace by solid waste from generation to the final disposal point (Iyeke 2011).

Waste generation, waste composition, collection, recycling, treatment, and disposal are the aspects of municipal waste management. These management functions depend on the specific socio-economic, behavioral, cultural, institutional, and political context that involves various stakeholders (Eawag , 2018). In most developing countries, appropriate treatment technologies are rarely used. Some of the common disposal and treatment technologies (from all over the world) are dumping, burning, sanitary landfills, compositing, and recycling (Eawag , 2018).

Jacobi and Besen (2011) observe that richer countries generate larger amounts of waste and garbage but have greater management capacity due to a host of factors, including economic resources, environmental concern of the population, and technological development. On the other hand, cities in developing countries with very rapid urbanization lack financial and administrative capacity to provide infrastructure and essential services, garbage collection and disposal included (Ibid). According to the United Nations Environmental Program (UNEP, 2008; Senkoro,

2003; Srinivas, 2003) half the urban population in developing countries do not have adequate solid waste disposal.

Achankeng (2003) revealed that municipal household solid waste management constitutes one of the most serious service provision challenges facing African towns and cities. Due to the complexity of household solid waste management, Zurbrugg (2003) indicated that collaboration by a large number of stakeholders is essential for the success of an effective household solid waste management system. Factors influencing household solid waste management include; lack of awareness, proper waste management equipment and facilities, laws and policies and low income to help improve solid waste management systems among the households (Issam et al., 2010).

Municipal collection is more common in the Least Developed Countries (LDCs). It entails the establishment of a waste disposal department within the local authority whose responsibility is to collect, transport, and dispose of all garbage in the urban center. SWM is normally a labor intensive activity which can make coordination difficult leading to inefficiency. For instance, Wachira (1980) has identified worker indiscipline as one of the major reasons behind inefficient waste management in Nairobi. He observes that many cleansing workers are employed through political influence, and tend to lack a sense of job responsibility. Workers hired in this manner usually rely on their godfathers for job security when disciplinary actions are taken against them. This situation is invariably found in other urban centers in Kenya including Kisii town. Waste collection services are thus frequently irregular and inadequate. The study therefore wanted to rate the effectiveness of waste collection services in Kisii town.

UN HABITAT, points out that urban waste management services are often woefully inadequate in informal settlements. These settlements are deprived economically and are not able to pay for collection and transportation of wastes generated within their localities thus resulting in illegal dumping in streams, rivers, highways and other undesignated areas (UN HABITAT , 2014).

2.6 Theoretical Literature Review

This study was based on the solid waste management hierarchy, a model that entails the use of various approaches in management of waste. Many methods of household garbage disposal have been invented, but none of the methods can properly work on its own. The waste hierarchy has been recommended worldwide, thus majority of the countries use it. The hierarchy is an integrated approach to household garbage disposal. The hierarchy establishes the order of the most preferred order of solid waste management alternatives to the least preferred strategy in case. Kisii town as a developing town adopts the waste hierarchy in the disposal of household garbage, the issues and challenges that are emerging daily may be dealt with. Overreliance on the old outdated methods of household garbage disposal does not work for the town currently.

2.7 Summary and Knowledge Gaps

This section reviewed literature related to integrated household garbage disposal and garbage management. Strategies for integrated household garbage include reduction and reduce, recycle, incineration, compositing, and landfills. While the challenges of integrated household garbage disposal include unsustainable collection, transportation and disposal systems, lack of serviceable refuse trucks, strained town budgets and population size. From the empirical literature review the following gaps have been

identified. Several researches have been conducted on solid waste management in Kenya (Obera, Okecha., & Oyier, 2002; Ochieng, 2016; Omambia & Ogonya, 2015; Rotich, Zhao, & Dong, 2006) there is no local empirical research related to integrated household garbage disposal for garbage disposal, especially in fast developing urban areas like Kisii. These are the gaps the study aimed to fill.

2.8 Conceptual Framework

The conceptual framework in Figure 1.1 illustrates that the integrated household garbage disposal (independent variable) is a strategy for garbage management (dependent variable). Between the Independent Variables and Dependent Variables there is intervening variable (government regulations). The conceptual framework suggests that the strategies for integrated household garbage include reduction and reuse, recycle, incineration, compositing, and landfills. While the challenges of integrated household garbage disposal include unsustainable collection, transportation and disposal systems, lack of serviceable refuse trucks, strained town budgets and population size. The effectiveness of integrated household garbage disposal is measured in terms of quality of collection, storage, transportation, and disposal of household garbage. Garbage management is measured in terms of collection, storage, transportation, treatment, and disposal.

The conceptual framework illustrates that the strategies of integrated household garbage disposal which includes reduction and reuse, recycle, incineration, compositing, and landfills if adopted can lead to effective garbage management which involves production, collection, storage, transportation, treatment, disposal of waste. However, there are challenges which include unsustainable collection, transportation and disposal systems, lack of serviceable refuse trucks, strained town budgets, and

population size. Government intervention mediates the relationship between the independent and dependent variables. The study also sought to establish the effectiveness of integrated household garbage disposal for garbage management.

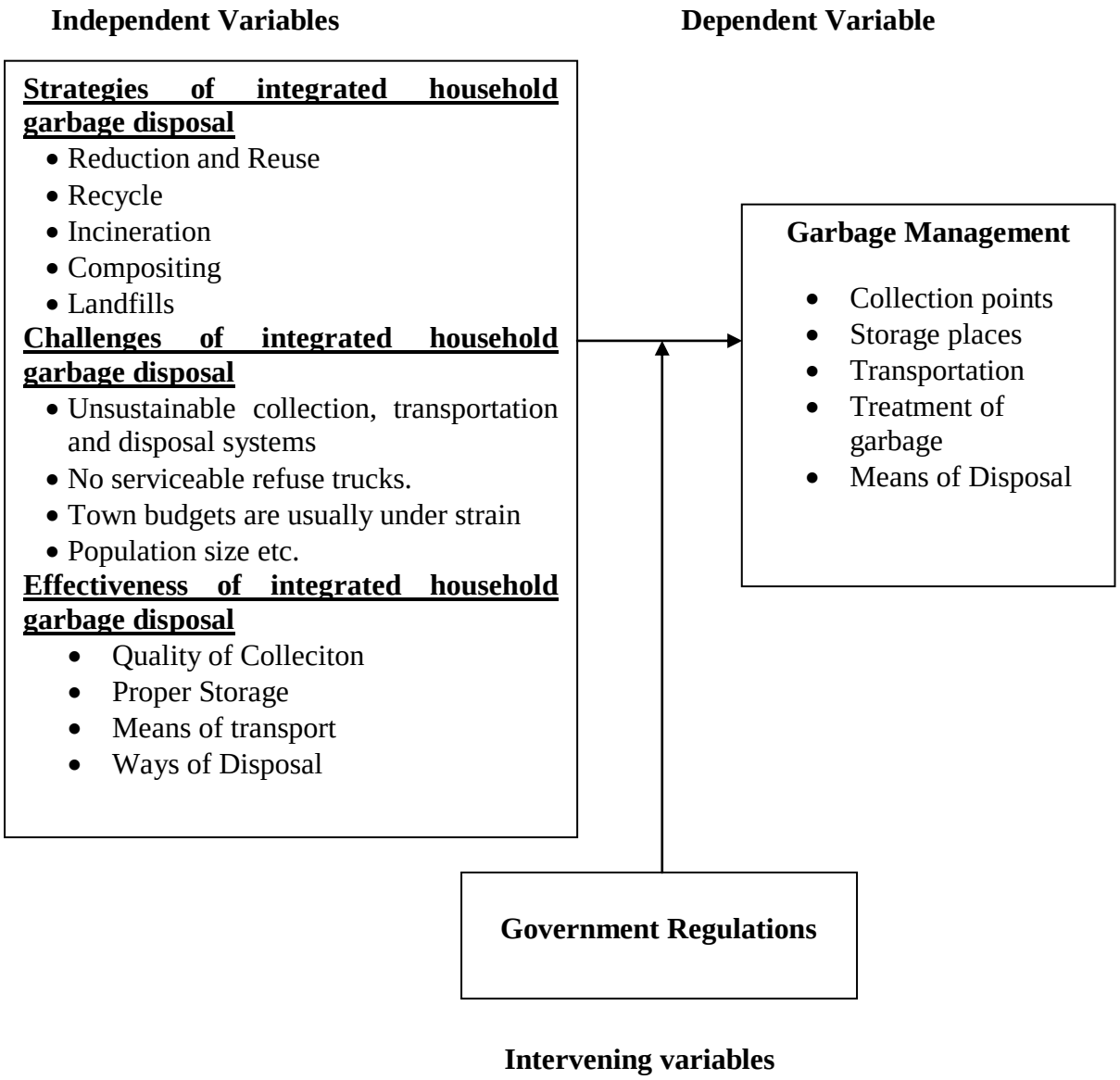

Figure 2.1: *Conceptual Frame Work showing the Relationship between Integrated Household Garbage and Garbage Management.*

Source: Researcher (2022)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research design that was used to achieve the objectives of the study. The sections herein will include among others; research design, area of study, sampling design, data collection and analysis and presentation techniques.

3.2 Research Design

This study examined integrated household refuse disposal as a strategy for waste management in the Kenyan city of Kisii. The research was conducted utilizing a baseline survey study design. The design of the baseline study allowed the researcher to determine if integrated domestic waste disposal contributes to effective waste management (Best & Kahn, 2003). This research design was chosen due to its application and conceptual simplicity. It also enhanced internal validity because the majority of data collected at different times yielded the same result. A baseline survey was conducted to measure the success or failure of a given endeavor (Kothari, 2006). However, the design proved to be difficult due to the necessity of traversing dispersed areas of Kisii. The researcher surmounted this obstacle by enlisting the aid of research assistants.

3.3 Study Area

Kisii Town is in southwest Kenya's Kisii County, near the equator and between 34O 42' E and 350 05' E. It covers 15,5 km2 and has hills and valleys. The rocks are mainly phyolites, Nyanzian, and felsites. It rains twice a year, averaging 2000 mm. The town has 50,363 people, with more males than females. It is bordered by Keumbu, Mosocho, Nyanchwa, Kiogoro, and Ogembo (KDDP, 2012; KNBS, 2019).

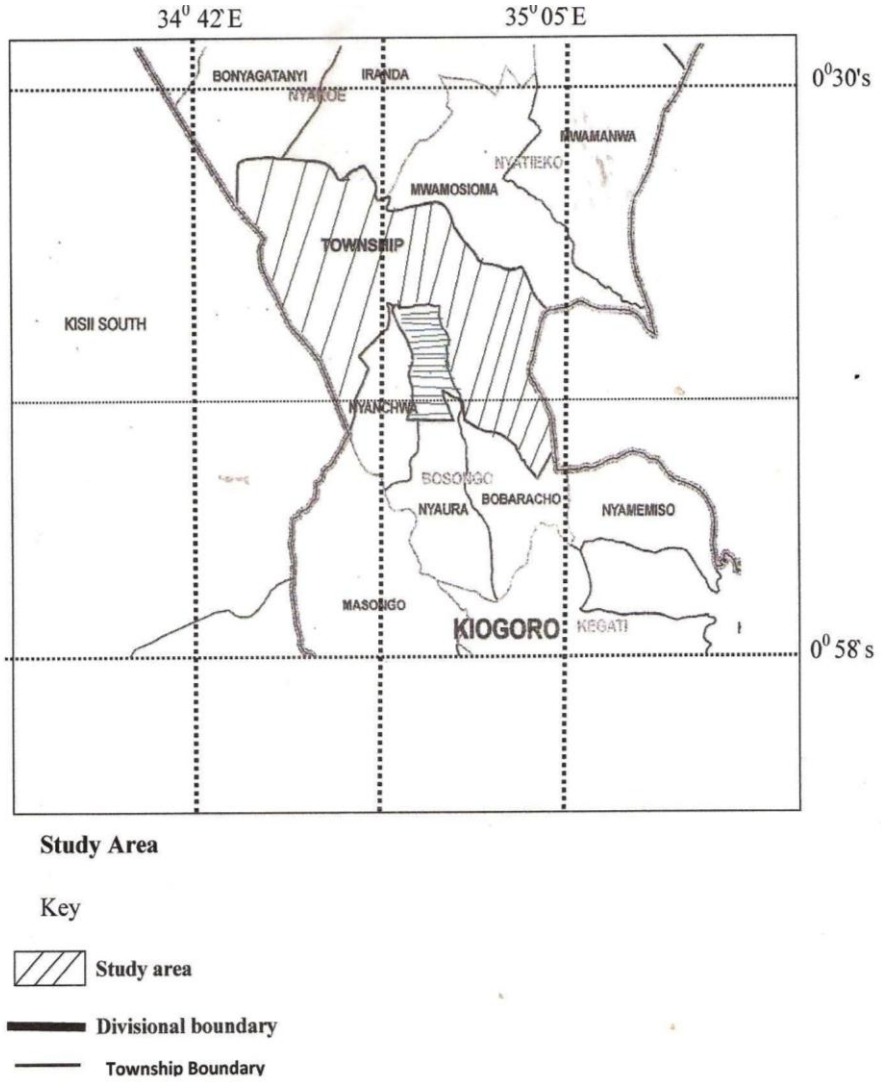

Figure 3. 1: *Map of Kisii town*
Source: KNBS (2019)

3.4 Target Population

(Mugenda & Mugenda, 2004). The target population is a comprehensive set of individuals, cases, or objects of the study. This study's target population includes every household in the city. According to Table 3.1, the total number of households in the municipality was 12,637 (KDDP, 2019).

Table 3.1: *Population Distribution in Kisii town.*

ESTATE	**NUMBER OF HOUSEHOLDS**
Nyamataro	1273
Town Center	1053
Nyangena/ Botori	1654
Mwamogesa	1718
Bochura	580
Jogoo	2826
Nyankongo/ Nyambera	664
Daraja/Nubia	950
Nyanchwa	1794
Total	**12637**

Source: KNBS, 2019

3.5 Sampling Procedures and Sample Size

The sample size was calculated using Morgan and Krejcie's (1970) formula, published by the National Educational Association's research division, Eqn. 1.

$$S = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)} \quad \text{.....(Eqn. 1)}$$

Where **S** is the required sample size

X^2 is the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

P is the population proportion (assumed to be 0.5)

N is the population size

d is the degree of accuracy expressed as 0.05

$$S = \frac{3.841^2 x 12,637 x 0.5(1-0.5)}{0.05^2(12,637-1) + 3.841^2 x 0.5(1-0.5)} \quad \textbf{.....(Eqn. 2)}$$

= **370**

According to the formula of Morgan and Krejcie for determining sample size, the researcher selected 370 households from Table 3.2. The researcher used stratified sampling to divide the city into sections and then chose households that were willing to share information for the study (Equation 2). This was a purposive sampling method that helped the researcher get specific data quickly and efficiently from relevant and representative cases (Mugenda & Mugenda, 2004).

Table 3.2: *Estates within Kisii town, number of households and sample.*

ESTATE	HOUSEHOLDS	PROPORTION	SAMPLE SIZE
Town Centre	1053	$\frac{1053}{12637}\times 370$	31
Nyamataro	1278	$\frac{1278}{12637}\times 370$	38
Nyangena	1654	$\frac{1654}{12637}\times 370$	48
Mwamogesa	1718	$\frac{1718}{12637}\times 370$	50
Bochura	580	$\frac{580}{12637}\times 370$	18
Jogoo	2826	$\frac{2826}{12637}\times 370$	84
Nyankongo/Nyambera	664	$\frac{664}{12637}\times 370$	20
Daraja Mbili	950	$\frac{950}{12637}\times 370$	28
Nyanchwa	1794	$\frac{1794}{12637}\times 370$	53
TOTAL	**12637**		**370**

Source (Research Field Data, 2022)

3.6 Types, Sources and Methods of Data Collection

The researcher employed a combination of qualitative and quantitative approaches to gather data.The quantitative method involved using questionnaires. The researcher protected the respondents' identities and asked them to fill out the questionnaires honestly and completely, based on the research questions about household garbage management. The introduction letter also stated that the collected data would be used exclusively for academic purposes.

Questionnaires were used in the quantitative study, the large number of participants influenced this decision, as suggested by Mugenda and Mugenda (2004). The investigator had two assistants who helped collect data. They were trained on how to get data from the respondents. The data collection took three weeks.

3.7 Data Analysis and Presentation

Descriptive statistics were used to analyze and present the data. Questionnaires were checked for completeness and accuracy before compiling the results.Using descriptive statistics, the study's objectives and research queries guided the data analysis. Utilizing frequency tables, percentages, and narrative, Kothari (2011) analyzed the data. All statistical measures, including mean, standard deviation, and inferential statistics, were calculated using Statistical Packages for Social Scientists (SPSS). To assure data accuracy and security, data entry was performed concurrently with field work.

3.8 Validity and Reliability of the Instruments

Appropriate and pertinent items were developed to ensure the collection of valid data. Discussions with peers, administrators, and research experts result in the development of validation instruments. The researcher tested the instruments' validity with 12 respondents from the study area, but did not include their results in the main study. The researcher also tested the instruments' reliability with the split-half method after the pilot test. This method was chosen over others, such as Crobach's approaches, due to its ease of use (Fraenkel et al., 2000).

3.9. Ethical Considerations

It is important that the research, other than being meaningful to the researcher should be able to identify a problem that would benefit the individuals being studied. The proposed study ensured that the researcher got consent from the chosen participants and explained to them why they were chosen and what the research entailed. The researcher sought permission from relevant authorities starting with Jaramogi Oginga Odinga University of Science and Technology. The researcher was also given a research permit from the National Commission for Science, Technology and Innovation (NACOSTI). Consent forms were provided, and the participants' anonymity, privacy and confidentiality were guaranteed. Organizations being used were assured that the findings of this study would be used appropriately as with their reporting.

CHAPTER FOUR: FINDINGS

4.1 Introduction

This chapter presents the findings and interpretation of the study. The chapter has been sub-divided into sections and sub-sections. The demographic information of the respondents such as gender, age category, level of education, sources of income, average monthly income in USD, number of household members, and place of residence have been presented first. After the demographic findings of the study have been discussed the researcher presented the research findings based on the study objectives which were to determine the strategies of integrated household garbage disposal for garbage management, identify the challenges facing integrated household garbage disposal for garbage management, and determine the effectiveness of integrated household garbage disposal for garbage management in Kisii town, Kenya. The copies of questionnaires received from the respondents were 370 which is 100% response rate as the sample size was 370. The researcher was able to achieve this because the respondents were given enough time to respond to the questionnaire.

4.2 Demographic Characteristics of the Respondents

The data used in this research was drawn from a sample of 370 respondents representing a 100% response rate. The demographic characteristics of the respondents were summarized in Table 4.1 below.

According to the results in Table 4.1, most of the respondents; 191 (51.62%) were females compared to males accounting for 179 (48.38%). Moreover, the results show that many of the respondents; 204 (55.14%) were aged between 31-50 years followed by 91 (24.59%) of the respondents who were more than 51 years old. On the highest level of education completed, the results show that most participants; 315 (85.13%)

had the secondary or post-secondary level of education with only 33 (8.92%) of the respondents having completed the primary level of education.

In addition, the findings indicate that half of the respondents; 187 (50.54%) own a business which is their main source of income while three in 10 respondents were employed. Employment ranged from casual work or formal employment. The unemployment rate accounted for 5.68%. This finding contradicts the results in a study by (Karimba, et, al, 2022) that show that most Kenyan populations are engaged in agricultural activities as their main source of income. While only 21 (5.68%) of the respondents had an average monthly income of more than 100 USD, almost 5 in ten respondents had an average monthly income of 200 USD or less. The level of income in a household is directly proportional to the level of consumption, which translates to the amount of garbage a household produces.

Table 4. 1: *Distribution of Respondents by their Characteristics n=370*

Demographic Characteristics	Frequency (n=370)	Percentage
Gender		
Female	191	51.62
Male	179	48.38
Respondents Ages		
18-20	30	8.11
21-30	45	12.16
31-40	102	27.57
41-50	102	27.57
≥51	91	24.59
Mean Age= 42.8		
Av. Monthly Income (USD)		
≤ 10	97	26.22
11-20	121	32.70
21-50	92	24.86
51-100	39	10.54
≥ 101	21	5.68
Level of Education		
Non-formal	22	5.95
Primary	33	8.92
Secondary	149	40.27
Post-secondary	166	44.86
Income Sources		
Own Business	187	50.54
Employment	113	30.54
Unemployed	21	5.68
Others	49	13.24
Number of Household Members		
One	31	8.38
Two	65	17.57
Three and Above	274	74.05
Mean No. of Dependents = 2.7		
Residence Place		
Within CBD	234	63.24
Within CBD	234	63.24

Source: Research Field Data, (2022)

The findings further show that most of the respondents; 274 (74.05%) had three or more members in a household followed by 65 (17.57%) respondents with only 2

members within the household. The study results are also contrary to other researchers like (Kenny, et, al, 2021) whose findings show that many families in Kenya still have between 3-5 children despite the efforts on enhancing family planning. The number of members in a family affects the amount of garbage a household produces. Finally, six in ten respondents lived within the Central Business District (CBD) compared to 136 (36.76%) of the respondents from outside CBD. This may be attributed to the fact that the study mainly was conducted in Kisii town.

4.3 Strategies of Integrated Household Garbage Disposal For Garbage Management

The findings in Table 4.2 show that the majority of the respondents; 248 (67.03%) generated degradable wastes from their households compared to 122 (32.97%) whose main wastes were non-degradable. Almost half of the respondents, 177 (47.84%) stored their wastes in the dustbin before disposal (as shown in figure 4.1) followed by 93 (25.14%) and 78 (21.08%) who stored their wastes in polythene bags and rubbish pits respectively before disposal. The findings are consistent with results in a study by (Birara, & Kassahun, 2018) who established most people in Ethiopia store their wastes in dustbins awaiting disposal. This is to suggest that majority of the households used temporary storage equipment for their garbage.

Table 4. 2: *Strategies of Integrated Household Garbage Disposal For Garbage Management*

Indicator	Frequency (n=370)	Percentage
Types of wastes generated from households		
Degradable	248	67.03
Non Degradable	122	32.97
Methods of gargage storage before disposal		
Dustbin	122	32.97
Rubbish Pits	78	21.08
Polythene bags	93	25.14
Others	15	4.05
Non	7	1.89
Time taken to retain waste before disposal		
12 hours	196	52.97
1 Day	56	15.14
More than 1 day	118	31.89
Garbage Disposal is by		
Family member	181	48.92
Housekeeper	104	28.11
Someone else in the home	56	15.14
Private waste Collector	11	2.97
County council	18	4.86
Disposal Sites		
Landfill	44	11.89
Collecting center	41	11.08
Burning/Incineration pit	126	34.05
Composite	93	25.14
Empty plots/roadside	56	15.14
Other	10	2.70

Source: Research Field Data, (2022)

Figure 4. 1: *Dustbins for Garbage Storage Awaiting Disposal*

Source: Research Field Data (2022)

Furthermore, as shown in table 4.2, 196 (52.97%) take 12 hours to retain the waste in the residence before disposal followed by 118 (31.89%) who took more than one day to retain the waste in the residence before disposal. However, this study finding is contrary to the results by (Nicholas, 2022) that most wastes take between 1-7 days before disposal in Kisii. This implies that most of the waste (biodegradable) probably started decomposing before it was disposed to the designated sites; as shown in figure 4.2. The findings also indicate that slightly less than half of the waste management is done by family members and housekeepers as shown by 181 (48.92%) and 104 (28.11%) respectively. This finding is consistent with previous studies that housekeepers are the custodians of waste management in most Kenyan households (Wekesa, 2018). This is to suggest that housekeepers should be up to date with all the garbage management approaches.

Figure 4. 2: *Biodegradable Waste*

Source: Research Field Data (2022)

The findings further show that most disposal sites for the respondents were a pit for burning/incineration; 126 (34.05%) and composites; 93 (25.14%) respectively. Similarly, (Egbenyah, et, al, 2021) found out that most disposal sites for household wastes are either pits or incineration centers. Burning and composting are the best method to use especially in low income communities because they help eliminate nuisance such as bad smell, flies and rodents, reduces the volume of waste generated and also used where organic waste generated from homes is relatively little (Marden, 2009).

Odds Ratios analysis was used to determine the strategies of integrated household garbage disposal which significantly predicts the garbage management and the results are shown in Table 4.3 below

Table 4.3: *Predictors of Integrated Household Garbage Disposal for Garbage Management*

Intergrated Household Gargage Disposal for Garbage Management Main Effect	Odds Ratio	P-Value	95% Cl	
			Lower	Upper
Level of Educaiton				
Primary /Non Formal	1			
Secondary /Post – Secondary	1.87	**0.003**	0.180	2.43
Income source				
Unemployed	1			
Employment/own business	4.53	**0.023**	0.193	6.827
Average monthly income in USD				
≤ 100	1			
≥ 100	3.25	**0.021**	0.504	4.470
Number of household members				
One	1			
Two and above	2.46	0.061	0.209	3.752
Methods of storing household garbage before disposal				
None	1			
Dusbin/Rubbish-pits/Polythene bags	0.763	0.052	0.650	1.983
Time taken to retain the waste in the residence before disposal				
More than 1 day	1			
12 hours-1 Day	2.84	**0.001**	0.051	3.129
Garbage disposal is by:				
County council/Private waste collector	1			
Family Member/Housekeeper/Someone else in the home	0.821	0.072	0.584	1.397
Disposal sites				
Composites/Empty plots/roadside	1			
A pit for burning/incineration	3.872	**0.004**	0.872	4.982

Source: Research Field Data, (2022)

Furthermore, the findings in Table 4.3 indicate the respondents with Secondary/Post-secondary were 1.87 times more likely to have adequate knowledge of garbage management compared to those with primary or no formal level of education, (OR=

1.87, 95% CI 0.18-2.43; p = 0.003). The finding is consistent with a study by (Zulfiqar, & Prasad, 2021) that education is critical in garbage management.

Moreover, the findings indicate that the respondents who were either employed or owned a business were 4.53 times more likely to have adequate knowledge of garbage management compared to those not employed (OR= 4.53, 95% CI 0.193-6.827; p = 0.023).The same trend is observed in average monthly income where the respondents who earn more than a 100 USD per month were 3.25 times more likely to have adequate knowledge garbage management compared to those with less than a 100 USD (OR= 3.25, 95% CI 0.504-4.47; p = 0.021). This may be because they have an adequate source of income to pay for wastes management as well. This is in congruence with Alhassan's et al. (2020) study which indicated that those with an adequate source of income can easily afford garbage management unlike those without a sufficient source of income.

Additionally, findings indicate that the respondents who took 12 hrs to 1 day to retain the waste in the residence before disposal were 2.84 times more likely to have adequate knowledge of garbage management compared to those who took more than 1 day to retain the waste in the residence before disposal (OR= 2.84, 95% CI 0.051-3.129; p = 0.001). Also, the results show that the respondents whose disposal sites were pit for burning/incineration were 3.87 times more likely to have adequate knowledge of garbage management compared to those whose disposal sites were composites/empty plots and roadsides (OR= 3.872, 95% CI 0.872-4.982; p = 0.004); as shown in figure 4.3.

Finally, the findings on how the reused household garbage is generated in their homes are presented in Table 4.4.

Figure 4. 3: *Garbage Disposed by the Roadside (Mwembe Estate Near Blackhouse)*
Source: Research Field Data (2022)

As presented in table 4.4, the study established that some of the garbage was reused in households in several ways. Containers especially the plastic ones were used for fetching and storing water (60%), vegetable gardening (14%), and storing other liquids like kerosene and used oil (37%). Other containers were used for storing (46%). Wooden garbage was utilized as firewood (63%), and the ash was sprayed in gardens as manure and pest control in some of the homes (8%). Some respondents donated some of the used clothes (11%) while some were used as cleaning materials in homes (54%). Food remains were given to domesticated animals especially pigs and poultry (92%). The findings indicated that containers, plastic waste, wooden waste, used clothes, and food remains were reused in more than one way by households.

Table 4. 4: *Reuse of Household Garbage Generated in the House*

Household Garbage	Fetching/collecting water	Storing	Gardening	Firewood	Cleaning	Feeding domesticated animals	Others
Containers	82%	46%	25%	-	2%	12%	-
Plastic garbage	6%	37%	14%	-	-	-	14%
Broken glass	-	-	-	-	-	-	5%
Wooden garbage	-	-	8%	63%	-	-	2%
Used clothes	-	-	-	-	54%	-	11%
Food remains	-	-	16%	-	-	92%	34%
Metallic garbage	-	-	-	-	-	-	23%

Source: Research Field Data, (2022)

Metallic waste was sold off to vendors while some plastic garbage and broken glasses were not recycled in any way. Respondents however affirmed that the recycled waste was very minimal. Much of it was disposed of either to composite pits, burned, or collected by the garbage service providers. According to Tyler (2005), recycling is the best method of disposal in the world and remains the most environmentally friendly method. Recycling saves energy, causes minimal pollution and land disruption, cuts waste disposal costs, and extends the life of landfills by preventing waste from residing there (Tyler, 2005).

4.4 Challenges Facing Integrated Household Garbage Disposal for Garbage Management

The second aim of this study was to uncover the barriers to integrated household waste disposal for effective waste management in Kisii, Kenya. Respondents were surveyed to determine the obstacles they perceived as impeding the management of residential waste in Kisii town. The study results, employing a Likert scale ranging from 1 to 5 (where 4 signifies "strongly agree," 3 denotes "agree," 2 indicates "disagree," and 1 represents "strongly disagree"), are detailed in Table 4.5. The presentation includes key statistics like the mean (M), standard deviation (SD), frequency, and the percentage of respondents. Additionally, a chi-square test was conducted to ascertain whether there is compelling evidence indicating significant variations in waste management associated with the challenges posed by integrated household waste disposal.

According to the findings presented in Table 4.5, household waste management in the study area faced several significant challenges. A primary concern was the insufficient availability of garbage disposal facilities in both urban and residential areas, with 87% of respondents in agreement and only 13% in disagreement (Mean = 3.41, Standard Deviation = 0.965). Additionally, there was a shortage of appropriate damp sites for waste disposal, as indicated by 86% in agreement and 14% in disagreement (Mean = 3.27, Standard Deviation = 0.965). The study also highlighted sustainability issues in waste collection, transportation, and disposal systems, with 83% of respondents agreeing and 17% disagreeing (Mean = 3.07, Standard Deviation = 0.873). Notably, the recycling of domestic waste was identified as an area that needed improvement. These obstacles were further complemented by the findings

indicating a lack of resident involvement in waste disposal efforts, a substantial population in the town, ineffective household waste management strategies, and residents' limited awareness of the benefits associated with proper household waste disposal.

Failing to engage residents in waste disposal initiatives was a concern, as 71% of respondents expressed agreement, while 29% disagreed with this statement (Mean = 2.80, Standard Deviation = 0.100). The significant size of the town's population also emerged as an issue, with 70% of respondents in agreement and 30% in disagreement (Mean = 2.81, Standard Deviation = 1.063). Furthermore, ineffective household waste management strategies were reported, as 68% of respondents agreed with this concern, while 22% disagreed (Mean = 2.82, Standard Deviation = 1.054). Lastly, many residents seemed unaware of the benefits associated with proper household waste disposal, with 59% in agreement and 41% in disagreement (M = 76% of respondents disagreed with the statement asserting that town budgets are typically under strain, while only 24% concurred with this statement).

Table 4.5: *Challenges facing integrated household garbage disposal for garbage management*

Statement	Agree n(%)	Disagree n(%)	M	SD	P-value
Unsustainable collection, transportation and disposal systems	185(50.00)	30(8.11)	3.07	0.873	0.073
No serviceable refuse trucks	108(29.19)	66(17.84)	2.81	1.1	0.002
Town budgets are usually under strain	30(8.11)	97(26.22)	1.88	1.085	0.059
High population size in the town	153(41.35)	37(10.00	2.81	1.063	0.012
The town does not have enough damp sites	128(34.59)	7(1.89)	3.27	0.965	0.003
There are inadequate garbage disposal facilities in town and residential areas	101(27.30)	29(7.84)	3.41	0.842	0.042
Residents are not aware of the benefits of proper household garbage disposal interventions	128(34.59)	14(3.78)	2.39	1.189	0.063
Residents are not involved in garbage disposal interventions	166(44.86)	49(13.240	2.8	0.1	0.001
Ineffective household garbage management strategies	133(35.95)	58(15.68)	2.82	1.054	0.081
Recycling of domestic waste has been a serious problem	93(25.14)	17(4.59)	3.24	1.051	0.058

Source: Research Field Data, (2022)

The collective mean score on the Likert scale was 2.85, suggesting that a significant portion of the respondents were in agreement about the presence of challenges. The standard deviation of 0.932 indicates a certain level of consensus among the respondents concerning the obstacles impacting household waste management in Kisii town. These research findings align with previous studies that have also recognized similar hindrances in waste collection within urban areas of Kenya. These challenges encompass aspects such as the rapid expansion of the population (Tisdell, 2001),

instances of unlawful waste dumping, as illustrated in Figure 4.4 (Chifamba, 2007), and the financial constraints that exacerbate waste disposal problems, particularly in the face of escalating refuse collection and disposal expenses (US Bureau of Household Garbage Management, 2000).

Figure 4. 4: *Blocked drainage due to improper garbage disposal. (Daraja Mbili market)*

Source: Research Field Data (2022)

Further challenges encompass insufficiencies in garbage storage and collection systems (Omara-Ojungu, 2002), issues related to corruption and shifting consumption patterns (Munowenyu, 2007), as well as the presence of poorly maintained and impassable roads (Guerrero et al., 2013). Additionally, the absence of regular waste collection services, coupled with a prevailing culture of disposability in Kenya (Miller, 2008), inadequate infrastructure (Kidd, 2009), and the obstacles outlined in Table 4.5 and other research works, all contribute to improper waste collection,

transportation, and disposal. Consequently, these issues collectively lead to environmental degradation within the city.

In summary, the key challenges, including the absence of functional refuse trucks, a high population density within the town, insufficient damp sites, inadequate garbage disposal facilities both within the urban and residential areas, and a lack of active participation by residents in waste disposal initiatives, all play a significant role in hindering effective waste management (as illustrated in Table 4.5).

4.5 Effectiveness of Integrated Household Garbage Disposal for Garbage Management

While nearly 2 out of every 10 clients expressed high satisfaction levels with the garbage collection and disposal services, the majority of respondents, totaling 157 individuals (42.43%), reported low satisfaction levels with these services. On average, a significant portion of the respondents, nearly 5 in 10 clients, believed that there were inadequacies in the collection, storage, transportation, treatment, and disposal of waste in Kisii Town, thereby adversely affecting garbage management (refer to Table 4.6).

Table 4.6 displays the outcomes pertaining to the effectiveness of integrated household garbage disposal for waste management. The results reveal that the majority of respondents, constituting 255 individuals (68.92%), experienced irregular frequencies of waste collection, with 59 respondents (15.95%) having waste collection occurring twice per week. It is noteworthy that the data in Table 4.6 clearly indicates that a substantial 68.92% of the respondents reported irregular garbage collection. Following this, 16% of respondents specified a twice-weekly collection,

8% indicated a weekly collection, 5% reported more than twice-weekly collection, and finally, merely 2% mentioned daily collection. The primary reason behind the irregularity in garbage collection, as stated by a majority of respondents, might be attributed to several factors. This includes the relatively low percentage of garbage collection by the county council, which aligns with the claims made by NEMA (2014) that councils' ability and capacity to manage waste was overwhelmed due to urbanization and rapid population growth.

Furthermore, other contributing factors involve financial budget constraints that exacerbate waste disposal issues (as pointed out by Mapira, 2001), the increasing costs of garbage collection and disposal in line with the challenges identified in this study, such as budget constraints leading to issues with waste disposal, rising costs of garbage collection and disposal (as highlighted in the US Bureau of Household Garbage Management's report from 2000), and the inadequacies in garbage storage and collection systems, align with the observations made by Omara-Ojungu in 2002. Interestingly, these very same challenges were also noted in a study conducted by Ochieng in 2016. Ochieng's research focused on Challenges and Potential Solutions for Enhancing Effective Solid Waste Management in the Ngomongo Village of Korogocho Informal Settlement in Nairobi County, Kenya.

Moreover, the results in Table 4.6 highlight that respondents who experienced daily, once a week, or more than once a week waste collection were 2.41 times more likely to possess sufficient knowledge regarding garbage management when compared to those with irregular waste collection patterns (OR= 2.41, 95% CI 0.052-2.06; p = 0.023).

Table 4.6: *Effectiveness of integrated household garbage disposal for garbage management*

Effectiveness of integrated household garbage disposal for garbage management		
Frequency of waste collection		
	Freq, n	**Percent(%)**
Once per week	30	8.11
Twice per week	59	15.95
More than twice per week	19	5.14
Daily	7	1.89
Irregularly	255	68.92
Level of satisfaction with garbage collection and disposal services		
High	84	22.70
Moderate	129	34.86
Low	157	42.43
Rating the effectiveness of garbage management		
Collection		
Good	53	14.32
Average	102	27.57
Poor	215	58.11
Storage		
Good	78	21.08
Average	121	32.70
Poor	171	46.22
Transportation		
Good	38	10.27
Average	105	28.38
Poor	227	61.35
Treatment		
Good	68	18.38
Average	184	49.73
Poor	118	31.89

Source: Research Field Data, (2022)

Table 4. 7: *Level of satisfaction with garbage collection and disposal services.*

	Frequency	**Percent**
Very satisfied	37	10%
Satisfied	89	24%
Not sure	15	4%
Dissatisfied	148	40%
Very dissatisfied	81	22%
M=2.61 SD=1.325		
Total	**370**	**100%**

Source: Field Research data (2022)

As shown in table 4.6 majority of the respondents (62%) were dissatisfied with garbage collection and disposal services against 34% who were satisfied. Four percent of the respondents were not sure. The mean of the Likert item was 2.61 showing that majority of the respondents were dissatisfied. The standard deviation was 1.325 indicating that individual responses deviated from the mean by an average of 1.325 units indicating moderate convergence of the respondents on this question. The findings are supported by the studies by Gakungu, (2011) and Chandak, (2010) who contend that in Kenya and other developing countries, the collection systems of solid waste in cities are inefficient and disposal systems are not environmentally friendly; collection rates remain low and the quality of collection services are poor.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This section presents the summary, conclusion and recommendations based on the study findings.

5.2. Summary

The first objective of this study aimed to identify the strategies used for integrated household garbage disposal in Kisii town, Kenya. The research revealed that out of the household waste generated, 67% was non-degradable, while the remaining 33% was degradable. Degradable waste included food remnants and clothing, whereas non-degradable waste comprised items like plastics, cans, wood, metals, and broken glass. As Figure 4.2 illustrates, 53% of households held onto their garbage for 12 hours, 32% stored it for more than a day, and 15% retained waste for one day. This suggests that a considerable portion of the waste (especially biodegradable) may have decomposed before being disposed of at designated sites.

The study also uncovered that some household garbage was being reused in various ways. Plastic containers, for instance, were utilized for fetching and storing water (60%), gardening (14%), and storing other liquids such as kerosene and used oil (37%). Additionally, other containers were repurposed for general storage (46%). Wooden waste was employed as firewood (63%), with the ashes used in gardens as both manure and pest control in some households (8%). A number of respondents either donated used clothes (11%) or employed them as cleaning materials (54%). Food remnants found purpose as feed for domesticated animals, particularly pigs and poultry (92%). However, not all waste was recycled. Some metallic waste was sold to vendors, while certain plastic items and broken glass were not repurposed in any way. It is important to note that the recycled waste amounted to a minimal portion, with

most waste being disposed of in compost pits, incinerated, or collected by garbage service providers.

The study found that, in 49% of households, mothers were primarily responsible for waste disposal, followed by housekeepers in 28% of cases, other household members in 15%, the County Government in 5%, and private waste collectors in 3%. The limited involvement of the County Government in waste collection is explained by NEMA (2014), which suggests that the counties' capacity to manage waste was overwhelmed by the effects of urbanization and rapid population growth. Furthermore, the study noted that waste management was not given high priority in the allocation of limited resources, both financial and physical, by the counties.

The second aim was to find out the challenges of managing household waste in Kisii, Kenya. The study uncovered several challenges. The foremost issue was the insufficient availability of garbage facilities in urban and residential areas, with 87% of respondents in agreement, and 13% in disagreement, resulting in a mean score (M) of 3.41 and a standard deviation (SD) of 0.965. This was closely followed by the scarcity of suitable damp sites, where 86% agreed, and 14% disagreed, leading to an M of 3.27 with an SD of 0.965. Another critical problem was the inadequacies in collection, transportation, and disposal systems, with 83% in agreement and 17% in disagreement, producing an M of 3.07 and an SD of 0.873. Remarkably, domestic waste recycling was also notably low.

In addition to these, other obstacles were identified. These included the failure to engage residents in waste disposal initiatives, as 71% agreed and 29% disagreed, resulting in an M of 2.80 and an SD of 0.100. Furthermore, the town's large population posed a significant challenge, with 70% in agreement and 30% in disagreement, generating an M of 2.81 and an SD of 1.063. Lastly, there were evident shortcomings in household garbage management strategies (68% agree, 22% disagree, M = 2.82, SD = 1.054); and low awareness of proper household garbage disposal benefits, with 59% agreeing and 41% disagreeing (M = 76% of respondents disagreed with the statement that town budgets are typically under strain, compared to 24% who concurred with the statement). The average mean rating on the Likert scale was 2.85, suggesting that a significant proportion of respondents acknowledged the existence of these challenges. The standard deviation, at 0.932, indicated a consensus among respondents concerning the obstacles that impact household waste management in Kisii town. These findings align with those of prior researchers who identified similar challenges affecting waste collection in Kenya's urban areas, including rapid population growth, illegal dumping, budget constraints exacerbating waste disposal

problems, rising costs of garbage collection and disposal, and insufficient garbage storage and collection systems.

Furthermore, other challenges mentioned include corruption and changing consumption dynamics, poor road conditions, lack of regular waste collection services, people throwing away too much stuff, poor infrastructure, bad behavior of collectors, carelessness, wrong disposal, and low awareness, among others. These problems cause bad waste collection, transportation, and disposal, which harm the environment in the city.

The third objective sought to determine the effectiveness of integrated household garbage disposal for waste management in Kisii town, Kenya. The study used the frequency of garbage collection as an indicator of effectiveness. It was found that the majority (69%) reported that garbage collection was irregular, followed by 16% indicating twice-weekly collection, 8% once a week, 5% more than twice a week, and just 2% daily. The irregularity in garbage collection, reported by the majority, can be attributed to several factors. The low percentage of garbage collection by the county government aligns with NEMA's (2014) contention that counties were overwhelmed by the challenges of managing waste due to urbanization and rapid population growth. Other explanations include budgetary constraints, exacerbating waste disposal issues, escalating garbage collection and disposal costs, and insufficient garbage storage and collection systems, all consistent with prior research findings.

Additionally, the study revealed that various agents were responsible for providing waste collection and disposal services in Kisii town. The County Government collected and disposed of 52% of household garbage, followed by private waste collectors at 14%, self-help groups at 11%, Community Based Organizations (CBOs) at 8%. A notable 15% of respondents indicated "none," suggesting that waste was not collected in certain areas, leaving households to manage waste as they saw fit. This situation was in line with Omara-Ojungu's (2002) assertion that several cities in Africa faced challenges related to inadequate garbage storage and collection systems.

Finally, respondents were asked to express their level of satisfaction or dissatisfaction with integrated garbage collection and disposal services using a Likert scale of 1-5, where 5 signifies very satisfied, 4 is satisfied, 3 is neutral, 2 is slightly satisfied, and 1 is not satisfied. The data revealed that the majority of respondents expressed dissatisfaction with household garbage collection and disposal, which might be attributed to issues like communal waste containers that are typically open, resulting in contamination, attraction of pests, and increased flooding. This undesirable situation aligns with findings by Marden (2009).

5.3 Conclusion

In summary, the study's findings highlight that Kisii town employs various methods for household garbage storage and disposal, although some of these methods are unhygienic. Furthermore, the study revealed that the Kisii County Government assigns a low priority to waste management due to limited financial and physical resources. The investigation also exposed the multitude of challenges facing garbage management in Kisii town.

These challenges encompass inadequate garbage disposal facilities within both urban and residential areas, insufficient damp sites, unsustainable collection, transportation, and disposal systems, the recycling of domestic waste, the exclusion of residents from waste disposal initiatives, the town's substantial population size, ineffective household garbage management strategies, and residents' lack of awareness regarding the benefits of proper household garbage disposal. These challenges lead to bad waste collection, transportation, and disposal, which damage the environment in the town.

5.3 Recommendations

Based on the study findings, the study made the following recommendations:

i. There is need to sensitize Kisii residents on the need to fully employ the entire process of integrated waste management. This will enable them cope up with the challenges faces in waste management in the town

ii. There is also a need to implement rules for deposit refunds and pay as you throw to regulate waste disposal such as plastic bottles.

iii. The County government of along with other relevant stakeholders to increase collection points, storage places transportation and proper means of gabbage disposal.

REFERENCES

Achankeng, E. (2020). Globalization, Urbanization and Municipal Solid Waste Management in Africa-Africa on a Global Stage,. African Studies Association of Australasia and the Pacific 2003 Conference Proceedings— African on a Global Stage,. Adelaide, Australia, : University of Adelaide.

Arena, U. (2021). Process and technological aspects of municipal solid waste gasification. A review. Waste Management 32(4), , 625–639.

Best, J. V., & Kahn, J. V. (2003). Research in Education. London: Allyn and Bacon.: Allyn and Bacon.

Chalmin, P., & Gaillochet, C. (2009). From waste to resource, An abstract of world waste survey, Cyclope,Veolia Environmental Services, Edition Economica,. France.

Chandak, S. (2010). Trends in Solid Waste Management – Issues, Challenges, and Opportunities. International Consultative Meeting on Expanding Waste Management Services in Developing Countries, 18-19 March 2010, . Tokyo, Japan.

Chifamba, P. (2007). Trace metal contamination of water at a solid waste disposal at Kariba, Zimbabwe. African Journal of Aquatic Science 32 (1): , 71-78.

Coffey, M., & Coad, A. (2010). Collection of Municipal Solid Waste in Developing Countries. Malta.: UN-HABITAT, .

Contreau-Levine, & Conyers, D. (2010). Regional Development: Module GED 304. Department of Environmental Affairs . National Waste Management Strategy; Republic of South Africa.

Cunningham, W. (2009). Solid waste management. Utah Refuse Collection and Disposal Utah Refuse Collection and DisposalAssociation (URCDA),. University of Minnesota.

Eawag . (2018). Global Waste Challenge: Situation in developing countries. Swiss Federal Institute of Aquatic Science and Technology.

Environmental Management Agency. (2014). Solid Waste Management: What is Solid waste? Retrieved from http://www.ema.co.zw

Gakungu, N. K. (2011). Solid waste management; A case of technical technical in Kenya; . Nairobi, Kenya.: Unpublished MSc. Thesis, University of Nairobi, .

Gakungu, N., Gitau, A., Njoroge, B. N., & Kimani, M. (2012). Solid waste management in Kenya: A case study of Public technical training institutions Vol. 5, No. 3 . ICASTOR Journal of Engineering, 127 – 138.

Guerrero, L., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. . Waste Management 33(1), , 220–232.

Hardoy, J. E., Mitlin, D., & Satterthwaite, D. (2001). Environmental Problems in an Urbanizing World . London: Earthscan.: Earthscan.

Hardoy, J., Mitlin, D., Satterthwaite, D., & Hardoy, J. (2001). Environmental Problems Environmental Problems in an Urbanizing World: Finding Solutions for Cities in Africa, Asia, and Latin America. . London, Sterling, VA.: Earthscan Publications.

Hoornweg, D., & Bhada-Tata, P. (2012). What a Waste: A Global Review of Solid Waste Management. World Bank, Urban Development & Local Government Unit, No. 15, 98. Washington, D.C.

Hoornweg, D., & Freire, M. (2013). Building Sustainability in An Urbanizing World: A Partnership Report, Urban Development & Resilience Unit, . Washington, DC 20433 USA www.worldbank.org/urban: World Bank,.

Jacobi, R., & Besen, R. (2011). Solid Waste Management in São Paulo: The Challenges of Sustainability,. estudos avançados 25 (71), 201.

Jerie, S. (2006). Analysis of institutional solid waste management in Gweru. EASSRR, Vol xxii No 1 January .

Kaundal, R., & Sharma, A. (2007). Problems of Household Waste Disposal. Journal of Human Ecology, 21(3): , 199-201 .

KNBS (2019), 2019 *Kenya Population Housiing Census,* Volume II distribution of Population by Administrative Units. KNBS, Nairobi.

Khamis, A. A. (2016). Effectiveness of solid waste management systems in local government authorities in Tanzania: The case of Moshi municipal council.

Kidd, M. (2009). Importance of legislative development in Environmental Law in South Africa during 2009. IUCN Academy of Environmental Law.

Kirov, N. Y. (2005). Waste Management, Control, Recovery and Reuse. Michigan:: Ann Acbor Science Publishers.

Konteh, F. (2009). Urban sanitation and health in the developing world: reminiscing the nineteenth century industrial nations. . Health & Place 15 (1), , 69–78.

Kothari, C. (2006). Research Methodology:Methods and Techniques, Revised Edition. New Delhi: New Age Publishers.

Kothari, C. (2011). Research Methodology: Methods and Techniques. Second Edition. India: New Age International publishers.

Mandevere, B. (2015). An investigation into the Effectiveness of household solid Waste management strategies in Harare, Zimbabwe. Harare.: Unpublished MBA Research Project.

Mapira, J. (2001). Urban Geography.Module GED 204. . Harare: : Zimbabwe Open University.

Marshall, R., & Farahbakhsh, K. (2013). Systems approaches to integrated solid waste Management in developing countries. Waste Management 33(4),, 988-1003.

Mawire, W. (2021). Waste Management. The Kenyan Newspaper Volume 6 Number 48 .

Mbanga, W. (2011, August. 18-24). The Kenyan Newspaper Volume 7 Number 33 .

Medina, M. (2008). The informal recycling sector in developing countries - Organizing Waste pickers to enhance their impact. . Note No.44. October 2008, .

Memon, M. (2010). Integrated solid waste management based on the 3R approach. . Journal of Material Cycles and Waste Management 12, , 30-40.

Miller, G. (2008). Living in the Environment. An Introduction to Environmental Science. . Belmont: Wadsworth Publishing Company : Wadsworth Publishing Company .

Morgan, & Krejicie. (2006). Small Sample Techniques. The NEA Research Bulletin, Vol.38. Minesota.

Mugenda, O. M., & Mugenda, A. (2004). Research methods: quantitative and qualitative approaches. Nairobi, Kenya.: African Centre for Technology Studies.

Mungure, J. M. (2008). Governance and community participation in Municipal Solid Waste management, case of Arusha and Dar es Salaam Tanzania. Aalborg Universitet.

Munowenyu, E. (2007). “O” Level Geography. Harare: : Longman. .

Mutsvangwa, L., Nhandara, E., Noko, J., & Shumbayaonda, W. (2006). Geography Today: Human and Economic. . Harare:: Zph publishers.

NEMA . (2014). The National Solid Waste Management Strategy, . Nairobi: NEMA,.

NEMA. (2014). Solid Waste Management By-laws, 20014.

Obera, B., Okecha., & Oyier, M. (2002). Sustainable Solid Waste Management for Kisumu, Kenya in: . 28th WEDC Conference Kolkata . Calcutta, India.

Ochieng, G. (2016). Challenges and Possible Interventions For Effective Solid Waste Management In Ngomongo Village of Korogocho Informal Settelment, Nairobi County, Kenya. Nairobi.: Unpublished MBA Thesis, University of Nairobi.

Omambia, B., & Ogonya, A. M. (2015). Assessing household solid waste management systems in Baraton Centre. Baraton Interdisciplinary Research Journal (2015), 5(Special Issue),, 140-150.

Omara-Ojungu, P. H. (2002). Resource Management in Developing Countries. Themes in. New York: Longman.: Longman.

Oso, Y., & Onen, D. (2008). A General Guide to Writing Research Proposal and Project Report. Kampala: Makerere University Press.

Otieno, T. (2010, October 25). Storm clouds of our solid waste may blow us away if we don't act now;. Daily Nation Newspaper, . Nairobi.

Otiso, K. M. (1993). Urban environmental problems : the case of solid waste pollution and management in Kisii Town, Kenya. Ohio, 30 Park Place, Athens, OH 45701, USA: Ohio University Libraries .

Prasad, M., Yang, J., Hongyuan, Y., & Choudhury, R. M. (2011). Chapter –Municipal Solid Waste Management: Turning Waste into Resources. Shanghai Manual – A Guide for Sustainable Urban Development in the 21st Century.

Rotich, K., Zhao, Y., & Dong, J. (2006). Municipal Solid Waste Management Challenges in Developing Countries – Kenyan case study. . Waste Management - Volume 26, Issue 1, , 92-100.

Schübeler, P. (2019). Conceptual framework for municipal solid waste management in low-income countries. In K. C. Wehrle, UNDP/UNCHS/World Bank/SDC Collaborative Programme on Municipal Solid Waste Management in Low-Income Countries. St. Gallen Switzerland:.

Tisdell, C. A. (2001). Development in Environmental Economics volume 1. Economics of Environmental Conservation: Economics for Environmental and Ecological Management. . London: : Elsevier. .

UN HABITAT . (2014). Urbanization Challenges, Waste Management and Development, ACP-EC Joint Parliamentary Assembly 12-14 February 2014,. Mauritius.

UN HABITAT . (2010). Solid Waste Management in the World Cities, United Nations Human Settlements Programme . Washington DC.: UN-Habitat, .

UNEP . (2010). Integrated Solid Waste Management Plan for Nairobi, . Nairobi, Kenya: UNEP, .

UNEP & UNITAR. (2013). Guidelines for National Waste Management Strategies: Moving from Challenges to Opportunities, UNEP,. Nairobi: UNEP.

UNEP. (2005). Selection, Design and Implementation of Economic Instruments in the Solid Waste Management Sector in Kenya. United Nations Environment Programme, Nairobi. , 157-163.

UN-HABITAT. (2009). Solid Waste Management in the World's Cities: Pre-Publication Series,. Nairobi: UN-HABITAT, .

Upendra, M. P. (2008). Sustainable solid waste management in a mountain ecosystem: Darjeeling, West Bengal, India. Unpublished Research Project.

Wang'ombe, S. M. (2010). Inadequacies of solid waste management among public, private and community based organisations in Kasarani constituency, Nairobi County. Nairobi: Unpublished Thesis: Kenyatta University.

White, P., Franke, M., & Hindle, P. (1999). Solid Waste Management: A Lifecycle Inventory. An Aspen Publication.

Zerbock, O. (2003, June 18). Urban Solid Waste Management: Waste Reduction in Developing Nations. Michigan Technological University. Retrieved from http://www.cee.mtu.edu/peacecorps/documents_july03/Waste_reduction_and_i cineration_FINAL.pdf>

Zurbruegg, C. (2003). Solid Waste Management in Developing Countries: A Source book for Policy Makers and Practitioners: EAWAG/SANDEC.

APPENDICES

APPENDIX 1: LETTER OF INTRODUCTION

JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE & TECHNOLOGY

BOARD OF POSTGRADUATE STUDIES

Office of the Director

Tel. 057-2501804
Email: bps@jooust.ac.ke

P.O. BOX 210 - 40601
BONDO

Our Ref: **Z451/4210/2014**

Date: Wednesday, October 19, 2016

TO WHOM IT MAY CONCERN

RE: ANNCLETAS AMBIA ATAMBA - Z451/4210/2014

The above person is a bona fide postgraduate student of Jaramogi Oginga Odinga University of Science and Technology in the School of Humanities and Social Sciences pursuing a Master's Degree. She has been authorized by the university to undertake research on the topic: **" Integrated household garbage disposal for garbage management in Kisii town, Kisii county, Kenya."**

Any assistance accorded to her shall be appreciated.

Thank you.

JARAMOGI OGINGA ODINGA
DIRECTOR BOARD OF
POST GRADUATE STUDIES
DATE .....
P. O. BOX 210 - 40601, BOND
UNIVERSITY OF SCIENCE & TECHNOLOGY

Prof. Beatrice Anyango
DIRECTOR, BOARD OF POSTGRADUATE STUDIES

APPENDIX I1: RESEARCH PERMIT FROM NACCOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: **486436**

Date of Issue: **23/August/2021**

RESEARCH LICENSE

This is to Certify that Miss.. Anncletas Atamba Ambia of Jaramogi Oginga Odinga University of Science and Technology, has been licensed to conduct research in Kisii on the topic: Integrated household garbage disposal for garbage management in Kisii Town, Kisii County, Kenya. for the period ending : 23/August/2022.

License No: **NACOSTI/P/21/12445**

486436

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearence from relevant Government Agencies
5. The License does not give authority to tranfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one year of completion of the research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice

National Commission for Science, Technology and Innovation
off Waiyaki Way, Upper Kabete,
P. O. Box 30623, 00100 Nairobi, KENYA
Land line: 020 4007000, 020 2241349, 020 3310571, 020 8001077
Mobile: 0713 788 787 / 0735 404 245
E-mail: dg@nacosti.go.ke / registry@nacosti.go.ke
Website: www.nacosti.go.ke

APPENDIX III: QUESTIONNAIRE

PART A: SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Kindly tick where you belong.

1. Gender

Male	
Female	

2. Age of respondents

≤ 20	
21-30	
31-40	
41-50	
≥ 51	

3. Educational level

None	
Primary	
Secondary	
College	
Degree	

4. Source of income

Business	
Employment	
Unemployed	
Others	

5. Average monthly income

≤ 10,000	
10,001-20,000	
20,001-50,000	
50,001-100,000	
≥ 100,001	

6. Family members

One	
Two	
Three and above	

7. Number of household members

≤ 2	
2-5	
≥ 6	

8. Place of residence

Town Centre	
Nyamataro	
Nyangena	
Mwamogesa	
Bochura	
Jogoo	
Nyankongo/Nyambera	
DarajaMbili	
Nyanchwa	

SECTION B: To determine the strategies of integrated household garbage disposal for garbage management in Kisii town, Kenya.

9. Kindly tick (√) on the types of wastes generated in your household. Feel free to add more factors in the space provided.

Household Garbage	**Tick where appropriate**
Plastic waste	
Containers	
Wooden waste	
Waste clothes	
Metallic waste	
Broken glass	
Food remains	
Others	

10. Kindly tick (√) on how you store the wastes generated in your household, feel free to add more factors in the space provided.

STATEMENT	RESPONSE
Dustbin	
Rubbish-pits	
Composting	
Polythene papers	

11. How long do you retain the waste in your residence before disposal? Kindly tick (√) on the appropriate response, you are free to add whatever may be missing in the space provided.

STATEMENT	RESPONSE
12 hours	
One day	
More than one day	

12. Kindly tick (√) on how you reuse household garbage generated in your house in the table below

Household Garbage	**How do you reuse the garbage**
Containers	
Plastic garbage	
Broken glass	
Wooden garbage	
Used cloths	
Food remains	
Metallic garbage	
Others	

13. Who takes the garbage from your home/shop/stall for disposal? Kindly tick (√) and feel free to add in the space provided whatever you feel may be missing.

STATEMENT	RESPONSE
Myself	
Housekeeper	
Someone else in the home	
Private waste collector	
County council	
Other	

If "other" indicate: ……

14. Kindly tick (√). Where the waste is taken for disposal, feel free to add what may be missing in the space provided.

Land fill	
Collecting centre	
A pit for burning/incineration	
Composite	
Other	

If "other" indicate ……

……

……

15. Kindly tick (√). Who is responsible for disposing waste from your household?

Family member	
Housekeeper	
Private waste collector	
Town council	
I don't know	

SECTION C: To find out the challenges facing integrated household garbage disposal for garbage management in Kisii town, Kenya.

16. Kindly tick (√) the challenges that you feel might be affecting household garbage management in your town. Feel free to add more factors in the space provided. Indicate your response on a Likert scale.[1] Strongly agree [2] Agree [3] Disagree [4] Strongly Disagree

STATEMENT	**SA**	**A**	**D**	**SD**
Unsustainable collection, transportation and disposal systems				
No serviceable refuse trucks.				
Town budgets are usually under strain				
High population size in the town				
The town does not have enough damp site				
There are inadequate garbage disposal facilities in town and residential areas				
Residents are not aware of the benefits of proper household garbage disposal				
Residents are not involved in garbage disposal interventions				
Ineffective household garbage management strategies				
Recycling of domestic waste has been a serious problem				

……

……

……

……

SECTION D: To determine the effectiveness of integrated household garbage disposal for garbage management in Kisii town, Kenya.

17.What is the frequency of waste collection from your estate?

Once per week	
Twice per week	
More than twice	
Daily	
Irregular	

18. Who collects and dispose your wastes?

County government	
Registered private waste collectors	
Unregistered private waste collectors	
Youth groups	
None	
Other	

If 'other' specify ……..

19. Rate garbage management in Kisii town based on a Likert scale ranging from 1=Not very effective, 2=Not effective, 3=Moderate, 4=Effective, and 5=Very effective.

	1	2	3	4	5
Collection					
Storage					
Transportation					
Treatment					
Disposal					

20. Kindly tick (√). To what level you are satisfied with garbage collection and disposal services in Kisiitown.Kindly tick (√)

Statement	Response
Not satisfied	
Slightly satisfied	
Satisfied	
Very satisfied	

Thank you for your cooperation.