ROLE OF STAKEHOLDER PARTICIPATION IN SOLID WASTE MANAGEMENT AND RESTORATION OF NGONG RIVER, IN NAIROBI CITY COUNTY, KENYA

ROGERS KIPKOECH

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DECLARATION

Student

I hereby declare that this project is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Signature _____ Date_____

Rogers Kipkoech

Department of Spatial and Environmental Planning (N50/37011/2017)

Kenyatta University

Supervisor

I hereby declare that the preparation and presentation of the project was supervised in accordance with the guidelines on supervision of project laid down by Kenyatta University.

Signature _____ Date_____

Prof. Aggrey Thuo

Department of Spatial and Environmental Planning

Kenyatta University

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DEDICATION

To my mum Joyce and my siblings Flora, Robert and Ronald for their love, encouragement, inspiration and financial support towards my education.

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ABBREVIATIONS AND ACRONYMS

ADB	African Development Bank
AWSB	Athi Water Service Board
CBOs	Community Based Organisations
CGA	County Government Act
EAC	East African Community
EMCA	Environmental Management and Conservation Act
ISWM	Integrated Sustainable Waste Management
KII	Key Informant Interview
KIPPRA	Kenya Institute for Public Policy Research and Analysis
LULCCs	Land Use Land Cover Changes
MWI	Ministry of Water and Irrigation
NACOSTI	National Commission for Science, Technology and Innovation
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NRBP	Nairobi River Basin Program
NRC	Nairobi Rivers Commission
SPSS	Statistical Package for Social Science
SWM	Solid Waste Management
PLUPA	Physical Land Use and Planning Act
UACA	Urban Area and Cities Act
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WRMA	Water Resources Management Authority
WRUAs	Water Resource User Associations

ABSTRACT

River's ecosystem provides support and cultural roles through nutrient recycling and recreation services. Globally urban rivers are vital water resources that are being altered through introduction of pollutants by urbanisation, industrialization and agricultural activities. Ngong River, is a vital water resource which is heavily polluted due to improper waste disposal. Despite restoration programmes that have been ongoing for decades and efforts to develop and implement restoration strategies such as integrated system of solid waste management, little has been achieved. The aim of this study therefore, was to examine the role of stakeholder participation in solid waste management as a strategy towards restoration of Ngong River. Descriptive survey research design was used to address the problem of the study. Data for this study was obtained through the use of questionnaires, and key informant interviews. Cluster sampling, and simple random sampling were used to administer 243 questionnaires to the households within Ngong River riparian area, and waste collectors in Kibera Slum. While purposive sampling was used in selection of 30 respondents; community leader and officials from institutions such as Nairobi City County Government, National Environment Management Authority, Nairobi Rivers Commission, Non-Governmental Organizations and Community Based Organizations operating in solid waste management in Kibera Slum. Questionnaires were used to obtain information on the types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies and on the effectiveness of stakeholder's role in solid waste management. In addition, key informant interviews were used in obtaining data on the effectiveness of stakeholder's role in solid waste management. Statistical Package for Social Science and Microsoft Excel were used for statistical analysis to generate frequencies, percentage, ordinal regression, and Spearman's rank-order correlation analysis. Furthermore, distributions of dumping sites in Kibera Slum were mapped and were processed using ArcMap. The results were presented in form of tables, graphs, and pie charts. The findings revealed that the solid waste management strategies that were implemented were slightly effective based on 48 % of the respondents. Furthermore, regression analysis ($p<0.001$) shows a significant relationship between the strategies used in solid waste management and the restoration of the Ngong River. There was also a significant relationship between the types and characteristics of household solid waste collection by service providers($rho=0.005$). Among stakeholders, Nairobi City County Government was rated ineffective (75%) in waste collection and disposal services. The role of stakeholder participation was imperative in solid waste management and river restoration though significant gaps undermined its effectiveness. Impacts of solid waste management strategies implemented were not realized fully. High demand, inconsistent service delivery, operational costs, unreliable collection schedules, weak enforcement of policies etc, negatively affected types and characteristics of household waste collection service, and effectiveness of stakeholder's role, thus posing challenge to the restoration process. The study recommends holistic approach to improving solid waste management in restoration of heavily polluted Ngong River restoration and these include; institutionalization of community clean-up campaigns, enforcing segregation of household's waste, and defining stakeholder's roles in restoration to avoid overlapping among others.

CHAPTER ONE: INTRODUCTION

1.1 Chapter Overview

This chapter established the context of the role of stakeholder participation in solid waste management in restoration of Ngong River. It discussed the background of the study, problem statement, research objectives, research questions, hypothesis that were tested, the justification for the study, significance, the scope of the study, limitation, and define the key operational terms.

1.2 Background of the study

Rivers are vital water resources that are being altered by pollutants such as solid waste material, sewage, chemical waste and other contaminants through urbanisation, industrialization, and agricultural activities which poses risk to environment and human health (Hassan *et al.,* 2018). Rivers ecosystems are about 10 % of the global biodiversity and provides support through nutrient recycling as well as cultural and recreation services (Colloff *et al.,* 2019; Geist & Hawkins, 2016; Hawkins & Lankford, 2023).

Negative impacts on the freshwater ecosystems resulting from development activities and related impacts are magnified more by the rapidly raising number of people in the urban areas, together with improper management of solid waste in both the developed and least developed countries (Cantonati *et al.,* 2020; Ndichu, 2024). Replication of this has been observed in rivers including Citarum River in Indonesia, Motogua River in Guatemala, Hackensack River in United States among many other urban rivers. Citarum River, however is considered the world most polluted river with solid waste originating from households, industries and agricultural activities (UNDP, 2024; Zainalarifin *et al*., 2023). Effects of ineffective management of solid waste, poor sanitation, pollution of water, growth of population and weak regulations combined together increases the pollution of urban rivers and these hinders restoration efforts especially in the low-income countries (Cantonati *et al*., 2020).

Restoration of polluted rivers in cities, has been of great concern globally over the last century(Geist & Hawkins, 2016; Hawkins & Lankford, 2023). River restoration projects are dependent on ecological, social and scientific factors for their success

(Hering *et al.*,2015). River's restoration project should combine ecological, social, and scientific factors as well as stakeholder participation and learning process in order to be effective (Guimarães *et al.*, 2021).

Stakeholder participation is important in achievement of long-term environmental recovery as shown by the successful projects worldwide involving restoration of urban rivers (UNEP,2024). Restoration of the Thames River in United Kingdom, for example, is where the role of stakeholder participation was a fundamental element for the success of SWM strategies due to high amount of waste generated and dispose into the river. Different stakeholders, played a unique but interconnected roles to ensure waste were properly disposed hence restoring the river(Sharma *et al.*, 2021).

The role of stakeholder participation is a crucial component of the current management of solid waste and it stresses consultation in community, raising of awareness and actively participating in making of decision in management of solid waste (Lissah *et al.*, 2021; Mbui *et al.*, 2016). Countries in Africa have witnessed restoration of urban rivers that were heavily polluted with solid waste where stakeholder participation was used as one of the strategies. Examples include; restoration of Oued Fez River and Kuils River restoration projects in Morrocco and South Africa respectively (Chedadi, *et al.*, 2024; Hagen, 2022). In East Africa restoration of Nairobi River Basin which is made up of three tributaries namely; Nairobi River, Mathare River and Ngong River has been ongoing for two decades (Sobowale, 2019). The restoration strategies of Ngong River are anchored on infrastructural development which include waste management, urban greening, and pollution control. In addition, the strategies are further anchored on stakeholder participation such as community participation, and public awareness. Campaigns and publishing of thematic maps on pollution status on the Ngong River database are also anchored on stakeholder participation (Ondigo *et al.*, 2018). However, the approach was hindered by low level of awareness among the communities living along river basin (Mwiti, 2014).

The problems of Ngong River were neglected and it worsen in previous 25 years. A significant step however, has been taken by the government through the establishment of Nairobi Rivers Commission. The commission was recently formed with the mandate of regenerating Nairobi River Basin and improving the quality of life along their bank. However, the commission faces several challenges in ensuring effective stakeholder

participation in solid waste management. These challenges include; poor coordination and collaborations among the key stakeholders in solid waste management, such as government and its agencies, private companies in waste management, industries and community-based organizations. In addition, overlapping of roles among these stakeholders, have resulted in effective waste management (Odha&Mbataru,2024; UN-Habitat, 2023).

The lack of effective stakeholder's participation in solid waste management, the rising generation of solid waste triggered by population that is rapidly growing and the related economic activities in slums along Ngong River as well as poor regulatory frameworks and weak implementations of policies governing waste has led to the increase in pollution of the river (Ochieng, 2016;Odha&Mbataru,2024). Furthermore, Ngong River is facing heavy pollution as a result of improperly disposed solid waste. Key aspect of challenges facing the river includes solid waste pollution caused by plastic materials which is made up of bags, bottles and packaging material. Improper disposal and inadequate waste management infrastructure has led to large amounts of plastics, raw sewage, waste from industries, agro and petro chemicals waste, heavy metals and other waste resulting in depletion of oxygen level, extinction of aquatic life and turn its water unusable(Mugeni, 2023; Njuguna *et al.*,2017). Despite the attempts to invoke restoration strategies on development and implementing a system of an integrated solid waste management little has been achieved (Mulligan & Kipkemboi, 2017). The challenge of solid waste in Ngong River is a significant environmental problem that affects the river's health and its ecosystem(Ndunda *et al.,* 2018). Given the situation of pollution of Ngong River and the way solid waste is poorly managed, the study therefore, sought to assess stakeholder participation in solid waste management (SWM) as a strategy towards restoration of Ngong River to achieve its successful implementation.

1.3 Statement of the Problem

The major polluters of Ngong River are slums, and the industrial activities however, slums are the most complicated to deal with due to socio-economic issues such as population growth, level of poverty, and many others(Vane *et al.*, 2022; West *et al.*, 2020). Ngong River is flowing adjacent to Kibera Slum and is used for disposing solid waste (Nyika, 2017). The condition is exacerbated by lack of effective stakeholder participation by deliberately excluding slums from the city's plan (Kienja, 2017) and hence insufficient solid waste management services. Solid waste and untreated effluent have turned water into dangerous sludge and at some points the rubbish from the household totally blocks the river. Pollution from slums combine together with the unmonitored negative effect of industrialization has exerted a lot of pressure on Ngong River (Wangui, 2022).

Previous efforts on Ngong River have concentrated on areas such as water quality, pollution, and morphology of the river as discussed in various studies (George & Alice, 2016; Ngatia, 2022). For example, Ngatia, (2022) carried out a study on activities that are anthropogenic on water quality of Ngong River and the findings revealed how the status of water in the river is greatly determined by dumping sites, domestic and wastes from industries and highest pollution level was in Mosque site at Lindi Village while lowest level of pollution was in Ngong Forest. However, a few studies have been conducted on the restoration strategies for example an examination of stakeholder participation and learning outcomes (Sobowale,2019). A research gap, therefore, exists, since none of these studies looked at the stakeholder participation in solid waste management as a strategy towards the restoration of Ngong River.

1.4 General Objective

The study therefore, sought to examine the role of stakeholder participation in solid waste management as a strategy towards the restoration of Ngong River.

1.4.1 Specific Objectives

i. To evaluate the types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies.
ii. To assess the effectiveness of the stakeholders' roles in solid waste management in restoration of Ngong River.

1.5 Research Questions

i. What are the types and characteristics of household solid waste generated along the Ngong River?

ii. How do stakeholders incorporate these characteristics into their solid waste management and river restoration strategies?

iii. How effective were the stakeholder's role in solid waste management in restoration of the Ngong River?

1.6 Hypothesis

i. **H_1:** There is a significant relationship between the types and characteristics of household solid waste and the stakeholder restoration strategies along the Ngong River.

1.7 Justification of the study

Ngong River, currently is one of Kenya's most polluted rivers, is vital for community livelihoods and urban sustainability but has suffered severe degradation from solid waste pollution. The restoration of the Ngong River is crucial for environmental stewardship, public health, economic development, and community wellbeing. It aligns with local and global sustainability goals and contribution to the vibrancy of the urban environment. Managing solid waste essentially is important for addressing environmental, social, and economic challenges. The urgency of this research arises from the worsening pollution levels and the current efforts by the Nairobi Rivers Commission to regenerate the river system. Timely research on stakeholder participation in solid waste management will provide critical insights and evidence-based recommendations to strengthen ongoing interventions. Restoration of the Ngong River cannot be achieved through government efforts alone. The involvement of multiple stakeholders. Research on role of stakeholder's participation in solid waste management as a strategy towards restoration of Ngong River can help in protection of public health and improvement of water quality. Effective solid waste management are essential for complying with national environmental regulations, such as the EMCA, 2019, Sustainable Waste Management Act, 2021, and Integrated Solid Waste Management Plan for Nairobi City County.

1.8 Significance of the study

River restoration programs have been implemented in many countries across the world; however, the majority of these efforts have been concentrated in the United States and Europe. Limited research has explored the role of stakeholder participation in solid waste management as a strategy for river restoration in developing countries (Ambe & Obeten, 2020; Mueller *et al.*, 2014). This study therefore seeks to bridge that knowledge gap by focusing on the Ngong River in Nairobi City County. Specifically, it aims to evaluate the types and characteristics of household solid waste and the stakeholder restoration strategies applied, as well as to assess the effectiveness of stakeholders' roles in solid waste management in the river's restoration. The findings are expected to provide valuable insights that can strengthen ongoing restoration initiatives, promote environmental conservation through improved waste management and disposal, and consequently reduce river clogging, pollution, and flooding in surrounding communities. Furthermore, by enhancing solid waste management and developing recreational spaces, the restoration process could generate economic opportunities and employment for local residents, particularly the youth.

1.10 Definition of Key Operational Terms

Integrated solid waste management- is an innovative technique which controls generation of waste, material recovery for recycling, energy production and to reduce hazardous effects for safety and efficiency in disposal of waste (Gurjar & Gaur, 2022).

Recycling – process of conversion of waste material to new product and objects (Liu *et al.,* 2023).

River degradation- is a complicated issue resulting from combination of natural processes and human activities(Pelicice *et al.,* 2021).

River Restoration- is a process that involves return of degraded river that has been negatively impacted by human activities to their original condition using hydrological, morphological, and geological measures(England *et al.*, 2021).

Segregation – to sort and separate waste types which facilitate recycling and proper disposal afterwards(Chepa *et al.,* 2021).

Solid waste management- is an intricate process involving a range of strategies aim at minimizing environmental impact and promotion of sustainable practices(Nanda & Berruti, 2021).

Stakeholder participation – is a procedure followed by organization in listening to, collaborating with, or inform the existence of their stakeholders (Woldesenbet, 2021).

Waste- material or substance that is no longer useful (Nayanathara Thathsarani Pilapitiya & Ratnayake, 2024).

1.11 Conceptual Framework

The conceptual framework highlights the relationship between independent variable, dependent variable and intervening variables **(Figure 1.1)**. The framework highlight how various stakeholders(formal, informal, governmental and non-governmental) (Mwangi&Thuo,2015) participates in solid waste management practices. Stakeholders' types who are crucial to the management of solid waste is broadening and rising within time. Solid waste management practices (dependant variable) such as generation and separation, storage, collection, transport and, transfer as well as disposal, rely on three major factors (independent variable) which are; Strategies in SWM, the types and characteristics of household solid waste collection by service providers, and effectiveness of stakeholder's roles in SWM. The three major factors (Strategies in SWM, the types and characteristics of household solid waste collection by service providers, and effectiveness of stakeholder's roles in SWM) influences the solid waste management practices adopted, either positively or negatively, and their influence was determined. The expected result is the success in developing and implementing an integrated solid waste management as a strategy towards restoration of Ngong River. According to Maryanti, (2017) integrated solid waste management is therefore, an innovative technique which controls generation of waste, material recovery for recycling, energy production in addition to reducing hazardous effects for safety and efficiency in disposal of waste.

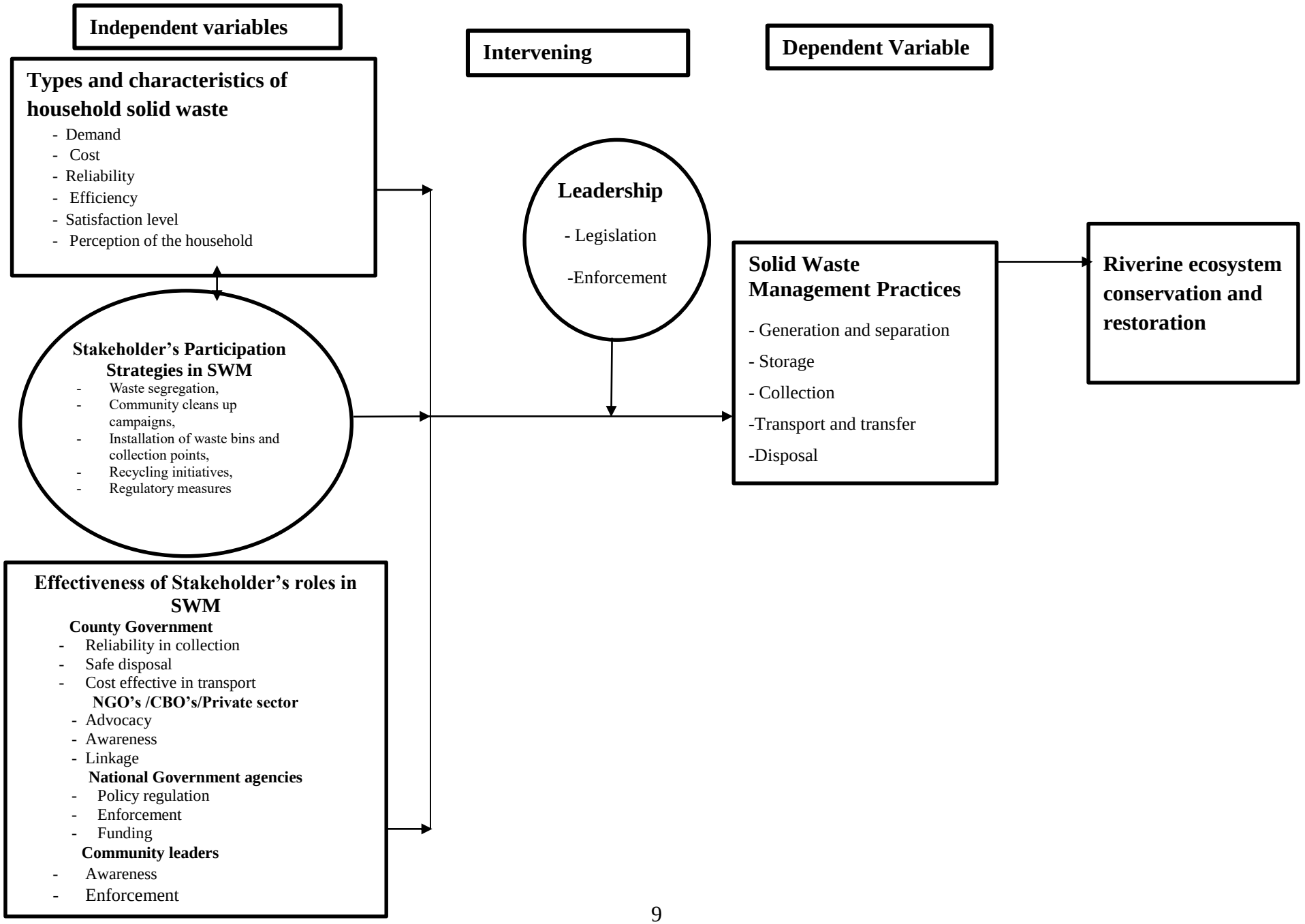

Figure 1.1: Conceptual Framework for Solid Waste Management
Source: Researcher, (2025)

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The Chapter gives suitable literature useful in contextualizing the themes for the research. The arrangement of review was done thematically with an attempt of identifying research gaps addressed by this study. The themes that were covered are; empirical literature which were made up of the factors influencing stakeholder participation in solid waste management as a strategy towards river restoration. The factors were; Strategies in solid waste management, the types and characteristics of household solid waste collection by service providers, and effectiveness of stakeholder's roles in solid waste management. The chapter further review literature on waste management practices, the dimension of integrated sustainable waste management, Kenya legislation on solid waste and conservation. Finally, the chapter presents, theoretical underpinnings which are relevant to the study and conceptual framework used and ends with and summary of literature review and research gap identification.

2.2 Types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies

Stakeholder participation in the management of solid waste as strategy towards river restoration are influenced by a complex interaction of environmental, economic, social, and political factors. These factors can differ broadly depending on the specific river, its ecosystem, and the goals of the restoration project(Guimarães *et al.,* 2021). Among the factors are; strategies used in solid waste management, types and characteristics of household solid waste collection by service providers and effectiveness of stakeholder roles in solid waste management in river restoration

Solid waste management strategies in restorations of urban rivers are very important since improperly disposing waste results in harming of ecosystem and public health through waste pollution. United Nation Environment Programme (UNEP) in its strategies of 2020-2025 is promoting comprehensive approaches of waste management with the global focus on waste reduction, recycling and resource recovery with the aim of conserving resources and creating jobs (UNEP, 2024). Rapid urbanization in Sub-Saharan Africa is worsening waste management related challenges and thus the need for alternatives which are sustainable instead of hazardous dumping. With the guidance of UN-Habitat's 2020-2025 plan, cities in East

Africa are prioritizing integration of ecosystem restoration and protection of urban rivers through improvement of waste infrastructure(Zhang *et al.,* 2024). Initiatives such as community clean-ups, recycling, partnerships in Kenya are used with the aim of restoring Nairobi Rivers Basin and among them is Ngong River which is a tributary. However, these initiatives are faced with myriads of challenges including weak coordination, insufficient fundings, poor infrastructure among others(Kienja, 2017). In overall, UNEP is emphasizing sustainability in waste management and robust stakeholder collaboration which are vital in restoration of urban rivers(Abubakar *et al.,* 2022; UNEP, 2024).

Managing solid waste is an intricate process involving a range of strategies aimed at minimizing environmental impact and promotion of sustainable practices. Waste reduction at the source, waste segregation, composting programs, waste-to-energy conversion technologies, and responsible landfill management are some of the sustainable practices (Zurbrügg *et al.,* 2014). Reduction of waste at the source inspires the production and consumption of goods with low environmental footprints, while waste segregation categorizes waste into organic, recyclable, and non-recyclable materials(Zaman, 2022). Composting programs divert biodegradable materials from landfills, while technologies of converting waste-to-energy handles non-recyclable waste. Responsibility in waste management is promoted through public awareness campaigns and educational initiatives, while legislation and regulations imposes proper practices(Nazari *et al.,* 2021). Initiative such as community engagement empowers the local residents in participating in decision making in waste management. Technological solutions for instance smart waste bins enhances the process of waste collection as well as disposal(Nanda & Berruti, 2021).

In developing countries generation of solid waste is accounting for an average of 71% of the entire waste, and collections activities accounts for a minimum of 30 % to a maximum of 50% of expenditure(Nanda & Berruti, 2021). Management of solid waste aims at protecting of population health, promoting the quality environment, developing sustainable, as well as supporting economic productivity(Tennakoon & Kulatunga,2021). However, many cities as well as towns in developing countries faces challenges in solid waste management, with insufficient collection services(Marcussen, 2020). Factors contributing to waste generation include growing populations, urban areas, middle class growth, fast-changing consumption, globalization, and economic

growth. Many challenges hinder solid waste management, including inappropriate planning, lack of proper governance, insufficient resources, poor collection, and improper disposal. In Kenya, county governments use a centralized system of managing solid waste, which consists of public, private, and public-private partnerships(Akimana&Letema,2022; Muzvondiwa, 2021). Public management of waste is limited due to lack of managerial, technical, and financial resources. Private sector participation enhances service quality, as their services are highly demanded, less costly, reliable, efficient, and customer-satisfying. Waste collection service quality is measured according to indicators which are; timeliness, reliability, and effectiveness. Provision of effective service is affected by factors such as customer satisfaction, frequency of waste collection, revenue gathered, and customer service. Quality of service is also affected by factors like cost recovery, awareness, participation, and satisfaction(Akimana & Letema, 2022).

2.3 Effectiveness of stakeholder roles in solid waste management in river restoration

Solid waste management involves various stakeholders, including local authorities, landlords, NGOs, national government, residents, garbage collectors, CBOs, manufacturers, and office workers. Successful management of solid waste relies on involving these stakeholders and clearly defined terms of service(Tennakoon & Kulatunga,2021). Sustainability in managing solid waste varies in different municipalities due to the diversity of their roles. Local authorities have a responsibility of collecting, transporting, and disposing waste as well as issuing licenses for waste management. They also ensure proper zoning of waste collection areas and emptying facilities to prevent nuisance. Local authorities are responsible for cost-effective transportation using licensed trucks and disposing of waste to designated areas (Mugambi *et al.,* 2021;Wangui, 2022).

Landlords and tenants are responsible for waste generation within their household's premises. They ensure sufficient waste management and ensure adequate storage points for waste, and controlling littering by tenants or wind. In slum areas, local authorities provide waste collection points and facilities, while landlords ensure tenants dispose-off their waste in designated storage sites. NGO's/CBO's/private sector performs a critical role in provision of solid waste management services, for example advocacy, awareness creation, mobilization of funds, and creating links between authorities and

local communities. Programs of NGO/CBO's/private sector within solid waste management systems improve awareness and training, encouraging waste separation, collection, and utilization as raw materials for job creation (Kathambi & Ogutu,2022). The Kenyan constitution (2010) created national government and county government and appropriate departments. The functions of waste management are fully vested on county government and the appropriate departments, while the national government has a general role of policy regulation on waste management. The National Environment Management Authority (NEMA) is the main agency of the national government, responsible for formulation of policies, enforcement of laws, and surveillance on waste activities (Munayi, 2023).

2.3.1 The Role of Nairobi River Basin Rehabilitation and Restoration Project (NRBP)

NRBP was formed in 1999 through an elaborate consultation involving many stakeholders and participatory process (UNDP, 2014). Partners in collaboration that were involved in planning and implementation included; UN agencies (UNEP, UNDP and UN-Habitat), Ministry of Environment and Natural Resources, NEMA, Nairobi City Council, University of Nairobi, Athi Water Service Board (AWSB), Water Resources Management Authority (WRMA), Ministry of Water and Irrigation (MWI), the African Development Bank (ADB) and Nairobi Central Business Association (UNDP, 2014).

The roles of NRBP consisted of three phases when it was launched. Phase 1 was carried out with an aim of providing background information on the matters that were to be solved, which consisted of determination of the state and pollution impacts on the Ngong River as well as the tributaries of Nairobi River Basin. Phase II was focussing on monitoring the pollution and assessing Ngong River. Phase III had an aim of implementing strategies of improving, rehabilitating and restoring the Ngong River and Nairobi Rivers tributaries. Phase III of the NRBP identified the project's major objective as to be ''rehabilitate, restore and sustainably managed in order to provide improved livelihoods, enhance environmentally quality and values through well-regulated economic and recreational ventures''. A ten-point strategy listed below, was to be used in attaining this major objective(Ministry of Environment and Mineral Resources, (NRBP leaflet,2009),.2016).

1. Creating awareness and assessing social impacts
2. Survey and delineation of the riparian reserve
3. Stopping illegal discharges
4. Completing work on a 2.5 km demonstration stretch
5. Relocating economic activities and informal settlements
6. Developing and implementing an integrated solid waste management system
7. Rehabilitation of Nairobi Dam
8. Repairing and installing sewerage and associated infrastructure
9. Developing a master plan for economic utilization of the riparian zone
10. Landscaping and beautification of the riparian zone

The strategy on "Development and Implementation of Integrated Solid Waste Management System for Nairobi River Basin Restoration" is a comprehensive strategy which addresses the matters relating to solid waste in the entire basin including Ngong River. It proposes the integration of sustainable waste management practices into river restoration, which fosters a cleaner, healthier, and more resilient environment. The system aims to reduce, manage, and prevent solid waste pollution, hence contribution to the restoration and general improvement of the river basin ecosystem. Key objectives include waste reduction, efficient collection and disposal, community engagement, and recycling and waste-to-energy initiatives (Ministry of Environment and Mineral Resources, (NRBP leaflet,2009),.2016).

2.3.2 Challenges of NRBP

Stakeholders such as NEMA, County Government of Nairobi and others, play crucial roles in managing of solid waste. However, conflicts as well as overlaps in issues associated with collection of waste, transportation, and disposal are becoming contentious since there is ambiguity in roles and responsibilities. Overlaps occur due to inadequate coordination and communication between the national and county levels, leading to inefficiencies in management practices and loss of information on solid waste (Marcussen, 2020; Muturi, 2021).

A number of things have been achieved through the NRBP though there have been challenges that have been encountered which include solid waste removal from the demonstration stretch, low level of awareness, delineation of riparian reserve and identification and stopping illegal discharges (Ministry of Environment and Mineral Resources, (NRBP leaflet,2009),.2016).

In addition, other challenges faced by NRBP include institutional overlaps and bottlenecks whereby there have been overlapping roles in the areas of mandatory roles resulting in duplication of activities and thus causes conflicts among the institutions involved in the restoration. A common example is between NEMA and County Government of Nairobi on environmental approvals where by one party does not always regard the other party's concern resulting in conflict during implementation or enforcement.

Moreover, there is lack of political will, despite many promises from the leaders since the restoration programme started in 1999 which have resulted in failure of restoration programme. During the years of implementation of successive phases of restoration programmes, heavy turnover of staff working on the programme has been witnessed and relevant national ministries re-emerging, resulting in loss of institutional memory and useful information. Capacities of ministries and parastatal handling waste and refuse have been eroded and weakened by corruption(Ministry of Environment and Mineral Resources,2016).

At the moment, the clear data does not exist on the extent of pollution of Nairobi Rivers. Also, there is lack of comprehensive picture of the population living along the Nairobi River and its tributaries or the main land activities they involve in, for example big industries, small -scale industries and agricultural practices. Given that several organizations and groups are involved in the restoration of Nairobi Rivers, the relevant information available is fragmented, uncoordinated, unconnected of the right information and in some situation outdated and not useful(Ministry of Environment and Mineral Resources, 2016).

Research conducted in 2006, by University of Nairobi identified certain initiatives which relates to research, pollution management and information management of Nairobi Rivers restoration did not have a central coordination system (UoN 2006). Additionally, there were no analysis done before or synthesis of the available data,

information and environmental issues. Coupled with this challenge, the information and data gathered were complicated and could not be understood easily due to its complex scientific nature(Ministry of Environment and Mineral Resources, 2016).

2.4 The dimensions of integrated sustainable waste management (ISWM)

ISWM is a systemic approach that consist of three major dimensions which include stakeholders, system elements and strategic aspects. These various dimensions have interrelation and which allows the general functioning of the system. In conclusion therefore, ISWM put in consideration of management of solid waste at municipal not only as system of technology having infrastructure and facilities which handles and disposes solid waste but a system which manages and contributes as well as dealing with several other element for example socio economic, environmental and others (Imad,2011) and (Klundert & Anschutz, 2001). According to U.N. Habitat, (2010) the introduction of ISWM framework in the advanced countries made it clear to municipalities that the problem facing management of solid waste were not only technical based. This is because successful waste management requires service users to actively cooperate. In addition, solid waste management is dependent on institutions, government and policy frameworks. **Figure 2.1** is an outline of the major dimensions of ISWM framework as provided by Van de Klundert and Anschutz (2001) based on the discussion of the three dimensions.

The number of important types of stakeholders in solid waste management has been increasing and widening for sometimes. It was a tradition for the local government to be responsible for the management of waste however, the private and community sectors have increasingly taken over some functions (Fernando, 2019). Cities are faced with environmental challenges relating to poor management of solid waste which could be addressed largely through the interactions among various stakeholders or actors(Wanjiru, 2020). ISWM as one of the approaches offers solutions to the challenges of SWM in urban places and identifies the high interactions among several stakeholders. Based on Imad (2011) stakeholders are made up of people and organizations who participate in the management of solid waste and this definition is consistent with the statement by Ola and Suleiman, (2022) that stakeholders consists of people or organizations operating in waste management sector and are having a stick or interests in proper management of solid waste management and their participation as well as their

activities is making it possible. Adabanija, (2023) expounded on that topic by stating that there is a variation of stakeholders involved in management of waste in different cities which creates the necessity for identifying them in all the context. Adabanija, (2023) supported the statement by stating that, stakeholders' identification, participation and their interest in every city is supreme in coordinating solid waste management.

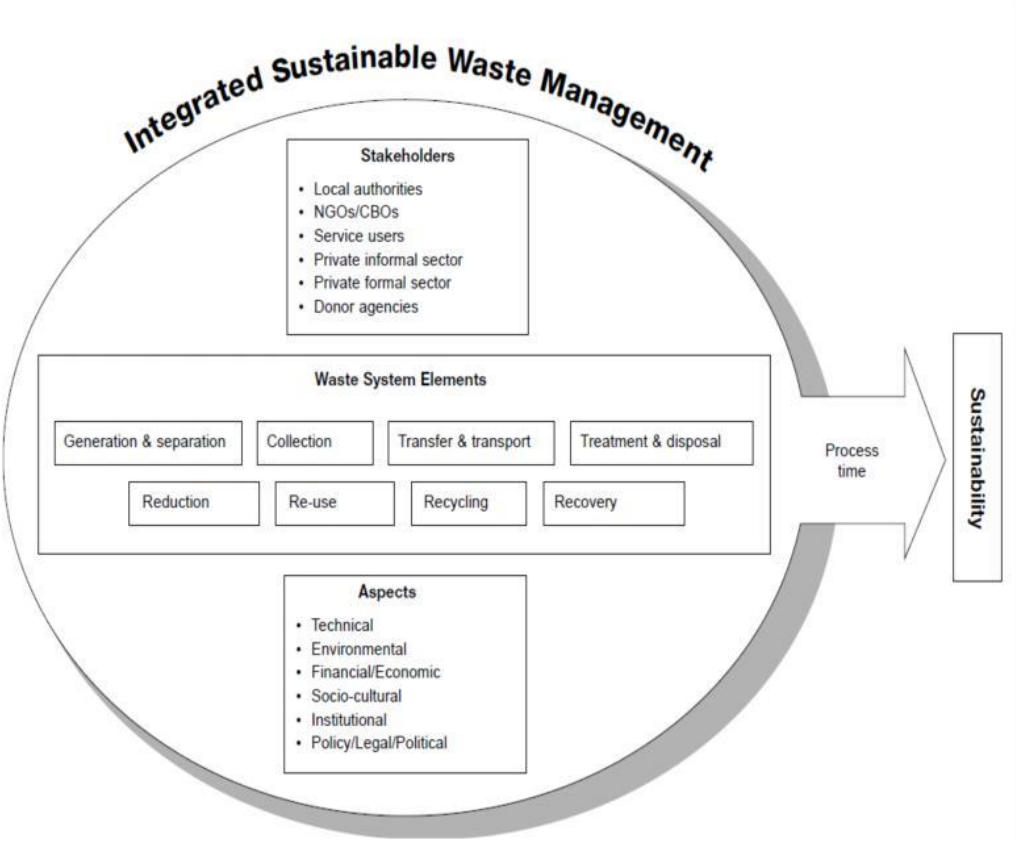

Figure 2.1: ISWM framework

Source: Adapted from Klundert and Anschutz (2001)

2.5 Kenya Legislations on Solid Waste and Conservation of Rivers

2.5.1 County Government Act (CGA) Of 2012

The current Kenyan Constitution, was promulgated in 2010, which gave birth to the County Government Act of 2012, and which avails opportunity for economic physical, social and environmental planning to be integrated through County planning framework according to Article 104(2). The Act offers a legal framework for governing within the county which include stakeholder participation while making decisions that are linked to service delivery for example solid waste management. Public participation in governance is a mandatory process and is promoted by the county government

according to section 87-91 of this Act (County Governments Act, 2012). This ensures, the residents and players in private sector and community organizations participate in implementing waste management policies. Nairobi City County therefore, within the framework of restoration of Ngong River is mandated to include residents, waste collection service providers, environmental organizations and the government agencies in planning, executing and to monitor solid waste management strategies. In addition, the Act authorizes waste collection services to be regulated and enforcement of environmental protection laws by the county government. This is critical in preventing contribution of waste disposal in degrading Ngong River. Therefore, the need for stakeholder participation is reinforced by the county government and this is useful in achievement of sustainable solutions and efforts in waste management and river restorations(Kathambi & Ogutu, 2022).

2.5.2 The Urban Areas and Cities Act, (UACA) 2011

An Act of Parliament giving an effect to Article 184 of the Constitution to classify, govern and manage urban areas and cities, to provide criteria for the establishment of urban areas, provision of the principle of governance and participation of residents and for interrelated purposes. The Act gives a legal framework for governing and managing urban areas, which emphasizes stakeholder participation in delivery of services which include management of solid waste. Service provision by the county government should be efficient through comprehensive governance structure, which encourages participation of residents, business, community organizations and government agencies in urban environmental management (Section 21 and 22) (Urban Areas and Cities Act No. 13 of 2011 Revised, 2012). The Act reinforces the roles of multiple stakeholders within the framework of restoration of Ngong River through design and implementation of sustainable strategies for the waste management. Based on this Act, effective waste management in urban areas involved public-private partnerships, engagement of the community and transparency in governance and these ensures collection of solid waste disposal and recycling efforts are contributing to environment that is clean. Through promotion of stakeholder collaboration, the Act addresses the challenges associated with illegal dumping and pollution, which are major concerns in restoration of Ngong River. Therefore, the Act has an important role to strengthen inclusivity in decision making and to enhance accountability in efforts of solid waste management.

2.5.3 The Environmental Management and Coordination Act (EMCA), 2019

According to this Act, all Kenyans have right to a clean and safe environment and everyone has a duty of safeguarding it. Various sections of EMCA 2019 are significantly consistent with the stakeholder participation in solid waste management as a strategy towards restoration of Ngong River(EMCA, 2019). The relevant section include:

2.5.3.1 Part V: Protection and conservation of the environment

The Act is clear on conserving water resources in Kenya according to section 42 and 43 and development can only be undertaken in these areas after carrying out an Environmental Impact Assessment and a written approval of the Director-General is provided. District Environmental Committees are commanded by section 46 to established areas where afforestation and reforestation are urgently needed. Section on directives to protect the forests, renewable energy, biological diversity and genetic resources are outlined in (48), (49) and (50-54) of the EMCA. The Sustainable Development Plan with earmark conservation areas within the Nairobi City County identify areas for restoration for instance Ngong River and relocation of the dumpsite close to the river(EMCA, 2019).

2.5.3.2 Section VIII: Environmental Quality Standards

Environmental quality and enforcement and review is vested in the enforcement and review committee of NEMA formed under section 70(1) of EMCA. The committee in consultation with various lead agencies recommends water quality, sewerage, and general pollution standards. The establishment of various committees make service delivery easier in one way and access to the grassroots level such as at Kibera Slum(Kituku, 2020)

2.5.3.3 Section IX: Environmental restoration and conservation orders and environmental easements

Under the Act, an order might be served by the authority for the restoration of environment close to its earlier state, prior to any action which have adverse changes resulting in the state of emergency. An individual can move to court of competent jurisdiction for an order against harm or harming or likely to harm environment by a person. An environmental easement could be given by the court in accordance to section 112 (1). Section 112 (4) gives NEMA the power of imposing an order on

conservation of environment on burdened land. This makes the Act a key legal instrument which guides for example sustainable solid waste management efforts in restoration of Ngong River.

2.5.4 Physical and Land Use Planning Act, (PLUPA) 2019

PLUPA has an aim of providing solutions to the major problems which were faced previously by the owners of the properties and the developers while they seek to obtain the permission for development and to ensure the plan and development are carried out rationally and cohesively at both national and county levels in future.

The physical and land use plans preparation is the task of both county and national government at their respective level. The national, county, inter-county and local plans are supposed to be combined, and the way the land shall be used in Kenya is collectively guided by these plans (P LUPA, 2021).

The PLUPA, 2019 offers a lawful framework for the sustainably use of land and development control in Kenya, which ensures environmental conservation and proper waste management is incorporated in urban planning. The Act gives mandates to the county governments to prepare spatial plans designating locations for waste disposal, recycling, and environmental protection, preventing activities that could lead to river pollution and land degradation(P LUPA, 2021).

In this situation management of solid waste and the restoration of Ngong River in Nairobi City County, the Act stresses the protection of riparian land through regulation of development close to the water bodies and safeguarding land use planning that supports conservation of environment. It encourages stakeholder participation through community involvement, collaboration with environmental organizations, and coordination with relevant government agencies in ensuring that strategies for waste management are aligning with sustainable urban planning.

In addition, the Act gives supports to the enforcement of regulations on zoning, which ensures proper planning of locations for collecting and disposing waste which minimizes dumping it into the river which is an illegal act. Through integration of input of stakeholders in decisions pertaining land use, the Act is useful in creating a more structured sustainable solid waste management approach that is driven by the community which contribute to long-term restoration and protection of Ngong River.

2.5.5 Water Act of 2016

The Water Act of 2016 is a legal framework to use, manage, and conserve water resources in Kenya, which include rivers such as the Ngong River. In addition, it is useful in regulating and managing water supply and sewerage services. The Act stresses stakeholder participation in the management of water resources through recognition of different functions by various stakeholders such as government agencies, county governments, community-based organizations, private sector players, and local residents in protection of water sources from pollution and degradation. Water Resources Authority is mandated under the Act to regulate and oversee activities impacting the quality of water which include, the context of solid waste pollution of Ngong River in Nairobi City County. Furthermore, stakeholders are supposed to participate in monitoring, reporting, and implementation of pollution control measures. The Act provide supports to the formation of Water Resource User Associations (WRUAs), thus allowing local communities to engage in waste management initiatives, awareness campaigns, and sustainable practices hence preventing illegal dumping into the river. Through promotion collaborative governance, the Water Act of 2016 safeguards proper implementation of waste disposal system, enforcement of environmental regulations, and contribution to the long-term restoration and sustainability of Ngong River by stakeholders working together(MWSI, 2021).

2.5.6 Sustainable Waste Management Act, 2022

The Act seeks for provision of sustainable management of waste. For a long period of time, waste management issue has been the responsibility of the county council, and it thus it was not addressed at the national level. The Act therefore, addresses the systemic issues that have plagued the country for a long time while collecting and separating waste in addition to recyclability and the sustainable reuse of the discarded materials.

The establishment of the Act legally provides an institutional framework for managing waste sustainably and the objects of the Act was to; promote sustainable waste management and procurement services as well as the establishing infrastructure for waste management that is environmentally sound in addition to creating environment that enables employment opportunities in green economy, management of waste, and industry for recycling and recovery. Moreover, the establishment of the Act was to promote and ensure delivery of waste services.

The Act gives powers to county governments including municipalities and others in implementation of devolution of waste management while ensuring waste disposal is carried out with the boundaries of the county. The counties and other actors involved shall provide central points of collecting recyclable waste materials and mainstreaming of waste management together with planning and budgeting of the county.

In the situation of solid waste management and restoration of Ngong River in Nairobi City County, the Act gives mandate to the county to prepare integrated waste management plans, which ensures every stakeholder participates actively in waste collection, segregation, disposal and recycling. Also, promotion of partnership by the public and private which enhances services and infrastructural management hence curbing illegal dumping. Moreover, through the Act, extended producer responsibility (EPR) is encouraged which holds manufacturers accountable for waste generated from their products, which is vital in reduction of plastic and industrial wastes ending up in river(Report on the Sustainable Waste Management Bill, 2021).

2.5.7 Survey Act Cap 299

It was created through a Parliament's Act and is useful in making provisions which are related to survey. This Act relates to conserving and protecting riparian areas as it states requirement of a minimum of 30-meter of reserved area according to Part XII in section 111 under reservation of the tidal river. The measurement of this reservation is in consideration of the highest watermark, and it is useful for the purposes of government. In addition, government minister alone can give directive for reserving lesser than 30 metres. When critically defining the boundaries in the land which include riparian areas, which have a direct impact of management of solid waste the Act is useful. Stakeholders' participation in SWM, which include, government agencies, surveyors, local communities, and environmental organizations, is important to ensure that, there is compliancy with the Act through a clear delineation of riparian zones and prevention of illegal settlements which contribute to the accumulation of solid waste (Draft National Land Surveying and Mapping Policy, 2022)

2.6 Theoretical Framework

2.6.1 Stakeholder theory

Stakeholder theory, initially put forward in 1984 by R. Edward Freeman directed this study (Freeman *et al.,* 2023). The theory is used mostly in roles of stakeholder's participation in various organizations. Based on the theory, it is easy to establish the implication of interactions that are controversial among the stakeholders through the introduction of the similar interests and connecting trends among them. Moreover, the empirical data utilises the instrumental approach of the theory in determination of links existing among stakeholder's roles among different groups and achieving the communal goal. The theory aligns well with objective of the study which seeks to examine roles of stakeholder's participation on solid waste management as a strategy towards restoration of Ngong River.

2.7 Summary of Literature Review and Research Gap Identification

Relevant literature which are related to the research questions that were presented in this study were systematically reviewed in this chapter. It examines river restoration, and factors influencing stakeholder participation in solid waste management as a strategy towards river restoration from a national, regional and global perspective. The factors are; strategies in SWM, the types and characteristics of household solid waste collection by service providers, and effectiveness of stakeholder's roles in SWM. It is clearly shown that majority of the research that were highlighted have used one or more of the variables in the study but integrated solid waste management in river restoration is assured on integration of all the three variables. Therefore, this study is relevant. Evidence revealed how the role of stakeholder in solid waste management influences Ngong River restoration but very little has been done, in order to control pollution of the river. Summary of some of the reviewed literature, their findings and gaps of the study are therefore, provided below.

Previous studies on restoration of Ngong River and other tributaries of Nairobi River Basin, shows little has been done on stakeholder participation in solid waste management. For instance, a research on ''river restoration in Nairobi, Kenya: exploring stakeholder participation and learning outcomes'' by Sobowale,(2019) focussed on identification of stakeholders playing role in the restoration programme, explored the mechanism applied in participation and civil society involvement as part of the restoration strategies and investigation of the contributions of the public in terms

of project's design and implementation. Moreover, little research has been carried out on effectiveness of the stakeholders' roles in managing solid wastes in restoration of Ngong River. For instance a research by Kienja, (2017) reviewed the roles of institutions as part of stakeholders responsible for the management of Nairobi River Basin including Ngong River but the effectiveness of the stakeholders' roles in management of solid waste as a restoration strategy of Ngong River Basin were not highlighted. The aim of this research therefore, is build up body of knowledge and fill the gap by examining the roles of stakeholder participation in management of solid waste as a strategy towards restoration of Ngong River.

CHAPTER THREE: STUDY AREA AND METHODOLOGY

3.1 Introduction

This chapter is a discussion of data collection to support the research. It contains element which are; research design, target population, sampling procedure and sample size, validity and reliability of the research instruments, response rate, data analysis and logistical and ethical issues for consideration when carrying out the study.

3.2 Study Area

The research was conducted among residents living along Ngong River which is located between 1°10' - 1° 20' S and 36° 40' - 37° 50' E. The selection of Ngong River and the riparian settlements within Kibera Slum as the study area is justified by the severity and persistence of environmental degradation in this region, particularly from poor solid waste management practices. Ngong River enters Kibera Slum villages in Soweto West, where the pollution starts as it passes through the following villages; Raila, Gathwekera, Kisumu Ndogo, Lindi, and Silanga **(Figure 3.1)**. Ngong River flows through Kibera Slum and in spite of many residents living in the slum, solid waste disposal system is lacking (Juma *et al.*, 2021; Mobegi, 2015).

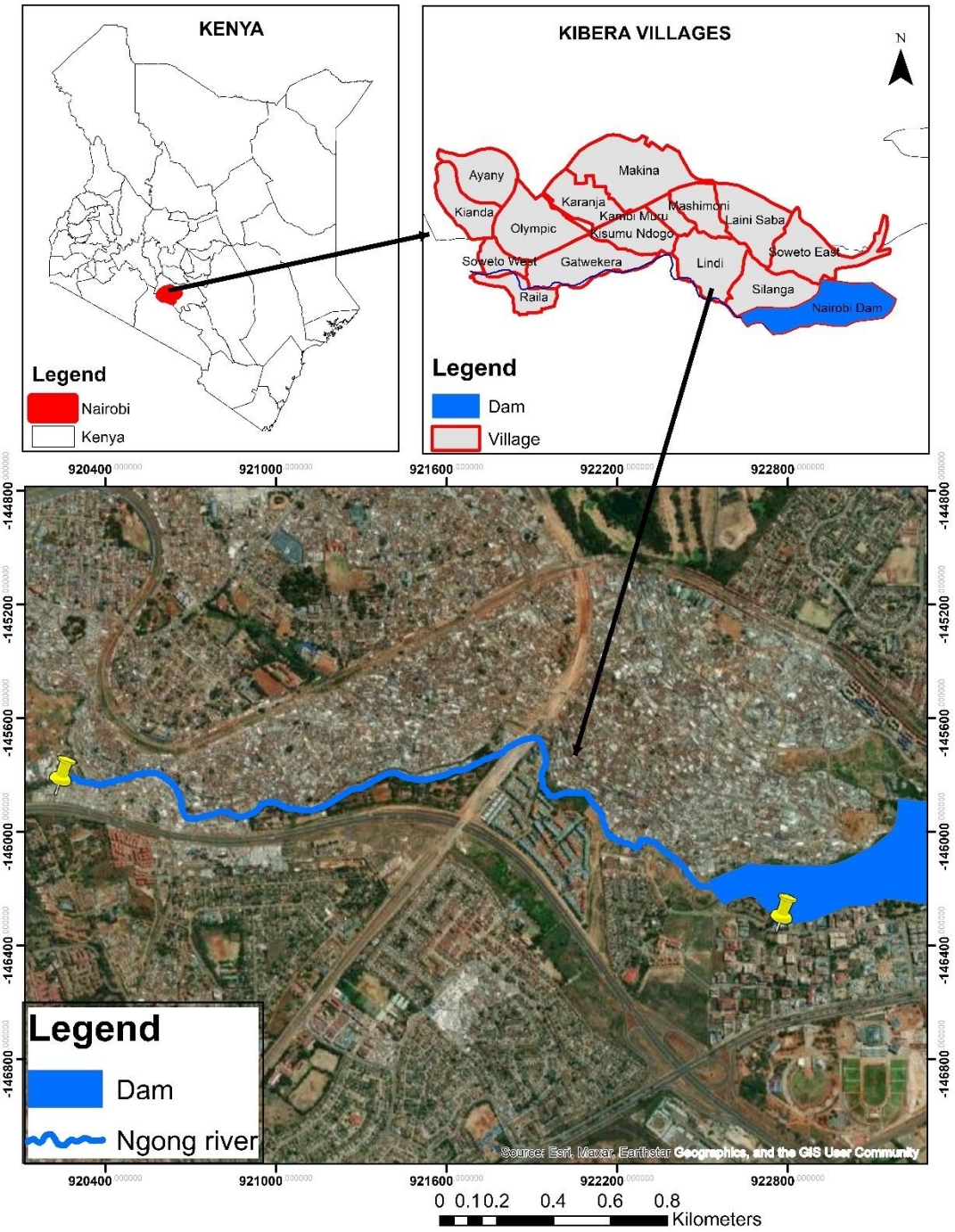

Figure 3.1: Ngong River and the surrounding villages

Source: Researcher, (2025)

3.3 Research Design

A descriptive survey research design was used to address the problem of the study (Siedlecki, 2020) by examining the role of stakeholder participation in solid waste management as a strategy towards the restoration of the Ngong River. This design was appropriate because, according to Schmuck *et al.* (2019), it focuses on existing conditions, prevailing practices, beliefs, attitudes, relationships, and ongoing processes, all of which align with the study's objective of understanding stakeholder dynamics and solid waste management practices. The main drawback of a descriptive survey research design is its inability to establish cause-and-effect relationships. However, it remains valuable because it efficiently provides a clear understanding of current situations and identifies patterns and trends for further research.

To comprehensively address the study objectives (i) evaluating the types and characteristics of household solid waste and stakeholder restoration strategies, and (ii) assessing the effectiveness of stakeholders' roles in solid waste management. A mixed-method approach was applied in data collection. This approach combined both qualitative and quantitative data to provide a deeper and more holistic understanding of the research problem. As Almalki (2016) notes, mixed methods are suitable when one form of data alone cannot sufficiently capture the complexity of the phenomena being studied.

The survey method facilitated the collection of data on the characteristics, views, and experiences of diverse categories of stakeholders, including residents, waste collectors, government officials, and representatives of NGOs and CBOs. It was also instrumental in assessing needs, evaluating demand, and examining the impacts of stakeholder participation (Osuagwu, 2020). Furthermore, the research design enabled the assessment of relationships between independent variables such as types and characteristics of household solid waste and stakeholder strategies and the dependent variable, the restoration of Ngong River. This ensured that the information collected was comprehensive, reliable, and reflective of real-world conditions, thereby providing consistent and accurate insights for both objectives.

3.4 Sample size and Sampling Procedure

Sample size for the residents within riparian zone was calculated using Cochran's formulae (**equation 1**) (Cochran, 1977). This formula is used since we know the

population size. It is estimated that about 30,000 residents are living within 30M of the main water course in Ngong River (Kipkemboi *et al.,* 2017).

The formula is applied as shown in equation 1:

$$n=\frac{p(1-P)}{\frac{e^2}{Z^2}+\frac{p(1-p)}{N}} \quad \text{…… ……equation 1}$$

n is sample size, e is the error of sampling (0.05) that is acceptable, p is the population proportion, 10% (0.1), z is reliability level or significance level value z=1.96 if significance level is 0.05 at 95% reliability level and N is Population. Therefore, from equation 1, the sample size is

$$n=\frac{0.1(1-0.1)}{\frac{0.05^2}{1.96^2}+\frac{0.1(1-0.1)}{127{,}000}}= \quad =138.147 \simeq 138$$

138 households

The sample size of 138 respondents was deemed statistically valid, cost-effective, and logistically feasible, adequately representing the population and capturing diverse views and practices of riparian residents on solid waste management and river restoration.

Waste collectors in Kibera were estimated to be 500 according to a report by Kamau, (2024), and out of these a sample size of 83 waste collectors were chosen using the mathematical formula provided by Cochran for finite population (**equation 2**) (Nanjundeswaraswamy & Divakar, 2021) **(Table 3.1)**. A simple random sampling technique was applied in selecting the sample. This technique was applied since it allowed a chance to every individual waste collector to be selected because there was no bias at all.

$n = NC^2v/(C^2v + (N-1)e^2$…… equation 2

where n is the sample size; N is the population; Cv is the coefficient of variation (take 0.5); e is the acceptable sampling error (5% or 95/100 = 0.05)
Equation 2 describes the calculation of sample size.
Therefore, from equation 2, the sample size is

$500 \times 0.5^2 / (0.5^2 + (500-1)(0.05^2)) = 83.47 \simeq 83$

83 waste collectors

The resulting computation produced a sample size of 83 respondents, which was adequate for ensuring sufficient data variability and precision of estimates.

Furthermore, simple random sampling was employed, giving each waste collector an equal and independent chance of being selected, thereby eliminating bias and enhancing the representativeness of the sample. This sample size was thus considered both statistically justified and practically manageable, ensuring reliable results within the available resources and timeframe of the study.

The study targeted residents living along the Ngong River riparian zone and waste collectors operating within Kibera Slum, with key informants drawn from community leaders, CBOs, government agencies such as the Nairobi Rivers Commission, Nairobi City County (Green Nairobi), NEMA, and NGOs involved in the river's restoration. Sampling involved selecting participants from residents within 30 meters of the riverbanks, as defined by the Survey Act Cap 299. A cluster sampling technique was used to divide the population into six clusters representing the villages of Soweto West, Raila, Gathwekera, Kisumu Ndogo, Lindi, and Silanga, from which simple random sampling was applied due to their homogeneity. Additionally, purposive sampling was used to select 30 respondents from relevant government agencies and organizations directly engaged in solid waste management, policy implementation, and river restoration efforts.

Table 3.1: Target Population of the Study

Categories	Target population	Sample size	Number of respondents	Sampling technique
Household heads	30,000	138	138	Cluster sampling and simple random sampling
Individual Waste collectors	500	83	83	Simple random sampling
Institutions (County and National Government, NGOs and CBOs)		30	22	Purposive sampling

Source: Researcher (2025)

3.5 Data collection instruments

The study utilised semi structured questionnaires (closed and open-ended questions), key informant interviews, and observation checklist in collection of primary data. Documentary review was used in collection of secondary data from relevant sources such as publications, journals, books, laws, regulations, and guidelines. Questionnaire was used in collecting data on types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies. A questionnaire and key informant interviews were useful in obtaining data on effectiveness of stakeholder's roles in solid waste management in restoration of Ngong River

Mapping of dumpsite near and away from Ngong River was done using ArcMap tool to support the data on the types and characteristics of household solid waste collection by service providers. Dumping sites, their spatial distribution and closeness to the river were assessed through mapping which provided useful insights on waste management practices in the study area.

3.5.1 Questionnaires

One questionnaire for both male and female respondents were used in the study. 138 households' questionnaire were administered to the household heads while 83 questionnaire was administered to informal waste collectors and 30 institutional questionnaires were used to collect data from officials from county government, government agencies, NGOs, and CBOs.

3.5.2 Key Informant Interviews (KII)

Six KII were used in amassing particular information from the key informants which included, NGOs, CBOs and community leaders. It was made up of open-ended questions in accordance with the objective of the study.

3.5.3 Observation Methods

3.5.3.1 Photography

Pictures were taken showing the relevant areas, and meetings in process of collecting data as a method for documentation of activities during the study.

3.5.3.2 Maps

Appropriate maps were drawn which were useful in identifying dumpsite for solid waste in six villages in Kibera Slum where research was carried out. And this assisted the researcher in making the relationship of dumpsite and solid waste pollution at Ngong River.

3.6 Pretesting of research instruments

Pilot study was undertaken within the households in riparian area of Ngong River in Soweto West, which is near Ngong Forest and where heavy pollution of river start. The area has the same demographic and other characteristics as the other riparian areas of Ngong River in Kibera Slum. The researcher utilised 13 respondents in this pilot study, representing 10 % of the study's sample size, in accordance to the recommendation by Lang,(2021). Piloting was useful to the researcher in identification of unclear questions and correction of directions that were not clear, space for writing responses that were not sufficient or questions that were wrongly phrased in the research instruments.

3.7 Validity and reliability of instruments

Validity and reliability ensure that research instruments accurately measure what they are intended to and produce consistent results. Validity was established through pilot testing, which allowed for critique and refinement of the questionnaire to improve question design and appropriateness (Lang, 2021). Reliability was ensured by designing instruments with multiple related questions covering similar themes, enabling consistency in responses. Any inconsistencies or poorly worded questions were reviewed and revised to enhance accuracy and dependability of the collected data (Chatterjee *et al.*, 2018).

The reliability and internal consistency were measured using Cronbach Alpha (**equation 3**) calculated as:

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum S^2(Xi)}{S^2(y)}\right) \quad \text{..... equation 3}$$

where; n= number of items s^2 (X_i)=variance of item and s^2(y)=Variance of the observed total scores. If the result was closer to 1 it implies the reliability of the instrument is greater but if close to 0 it is weaker. The Cronbach Alpha values obtained were 0.883 and 0.792 for objectives i and ii, respectively, on strategies used in solid waste management in restoration of Ngong River and on the types and characteristics of household solid waste collection by service providers. The results in **Table 3.2** shows that instruments of research were reliable.

Table 3.2: Reliability Statistics

Cronbach's Alpha	N of Items
.883	29
.792	24

Source: Researcher (2025)

3.9 Data analysis

Excel and SPSS were used for analysing data by generating frequencies, percentages, ordinal regression, and Spearman's rank-order correlation (rho) analysis and results were presented in form of tables, graphs, pie charts.

Ordinal regression was used to analyse effectiveness of stakeholder's solid waste management strategies using the equation which was expressed as; $Y_i = b0 + b_1X_{i1} + b_2X_{i2} + b_3X_{i3} + b_4X_{i4} + e$. Where Y_i represents the effectiveness of solid waste

management strategies, *b0* is the estimated parameter while *X* represents the variables influencing the effectiveness of solid waste management strategies which were categorized as; waste segregation at the source, recycling programs, installation of waste bins, community clean-up campaigns, public awareness campaigns, and community involvement. *e* is the error term that could have been any other factor affecting the effectiveness of solid waste management strategies. Y is formulated as provided in **Figure 3.3.** Where *Y*=1, 2,…..,5 indicated the answers which were; slightly effective, not effective, effective, moderately effective, very effective from d1 to d5 are critical points.

$$Y = \begin{cases} 1, \text{ if } Y \leq \delta_1 \\ 2, \text{ if } \delta_1 < Y \leq \delta_2 \\ 3, \text{ if } \delta_2 < Y \leq \delta_3 \\ 4, \text{ if } \delta_3 < Y \leq \delta_4 \\ 5, \text{ if } \delta_4 < Y \leq \delta_5 \end{cases}$$

Figure 3.3: Formulation of Y

Source: Akimana and Letema, (2022)

Spearman's rank-order correlation was used to analyse relationship among four key variables in household waste collection by service providers: the amount charged for waste collection, household response, demand for waste collection, and perceived reliability of the service. Where p-value was ≤ 0.05, and the relationship was considered statistically significant. Furthermore, the level and distribution of waste dumping sites in Kibera Slum villages were mapped using ArcMap.

Qualitative data were analysed using thematic content analysis. The data were systematically reviewed, organized, and categorized to develop detailed narratives and discussions. Subsequently, thematic analysis was applied to identify, analyse, and generate sub-themes, as well as to capture patterns aligned with the specific objectives and research questions. The analysed qualitative data were then presented thematically, with narratives and discussions structured according to the study's objectives.

Table 3.4: Data Analysis Procedures

Research Questions	Independent Variables	Dependent Variable	Quantitative Data Analysis	Qualitative Data Analysis
i. What are the types and characteristics of household solid waste generated along the Ngong River?	Household solid waste collection by service providers	effectiveness of solid waste management strategies	Percentages Ordinal regression	Thematic Analysis
ii. How do stakeholders incorporate these characteristics into their solid waste management and river restoration strategies?	Strategies in SWM - Waste segregation at the source - Recycling programs - Installation of waste bins - Community clean-up campaigns - Public awareness campaigns - Community involvement	Collection Transport and transfer Disposal	Percentages Spearman rank correlation coefficient	Thematic Analysis
iii. How effective are the stakeholder's role in solid waste management in restoration of the Ngong River?	Effectiveness of stakeholder roles in SWM	Collection Transport and transfer Disposal	Percentages	Thematic Analysis

Source: Researcher (2025)

3.10 Logistical and ethical considerations

Logistical consideration was ensured by obtaining permission to conduct research from the Department of Spatial and Environmental Planning and the School of Graduate Studies at Kenyatta University. Furthermore, NACOSTI approved the research which paved the way for data collection.

Ethical consideration was through adherence to ethical policies and measures that shield respondents from damage which is either physical and psychological and ensure there was no violation in their rights during the data collection, analysis and writing of the results. Furthermore, adequate information was provided to the respondents which was useful in making informed decision on their involvement prior to administering questionnaire or interview.

In addition, during collection of data, use of data that could be identified such as personal names were avoided. Instead, specific numbers for identifications were used in maintaining privacy and confidentiality of the participants. Data collected were only used for academic purpose as previously mentioned to the participants. Only participants who gave their consent were involved.

3.11 Limitations of the study

Varying commitment and cooperation of the respondents was the major limitation in the study. Various respondents which included local residents, officials from government agencies for example NEMA and NRC as well as NGOs and CBOs and community leaders had different level of involvement. This made it difficult in obtaining data that was consistent and comprehensive.

Secondary data such as official reports from some organizations were not available and those that were available, majority of them were not accurate specifically the history records on strategies on waste management and LULCCs. In addition, the resolution and classification of the satellite imagery used in assessment of land use changes faced challenges in identification of solid waste disposal sites.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This section discusses the key findings from the study. The sections are based on the objectives, which are:

i. To evaluate the types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies.
ii. To assess the effectiveness of the stakeholders' roles in solid waste management in restoration of Ngong River.

The objectives of the study as well as demographic information of the respondents such as gender, age, education, occupation, income and household size guided the output presented. Demographic information was useful in adding context to the data stipulated by the objectives. The first section presents demographic characteristics of the respondents in the first and second objectives. Second section evaluate the types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies. The third section presents an assessment of effectiveness of the stakeholders' roles in solid waste management in restoration of Ngong River.

4.1.1 Response Rate

Households' questionnaires were administered to the 138 respondents. In addition, 83 informal waste collectors were selected using simple random method in the six villages of Kibera Slum and each one of them filled a questionnaire. A total of 221 questionnaires were administered by the researcher and 221 questionnaires were filled representing a 100 % response rate among households and informal waste collectors. Furthermore, 30 officials from CBOs, NGOs, Nairobi County Government and two government agencies (NEMA and NRC) each participated in filling institutional questionnaire. Out of 30 institutional questionnaires administered, 22 responses were received which represent a response rate of 73 % **(4.1 a and b)**. Moreover, information was obtained by using key informant interviews from three officials; One from NGO and a CBO, and one community leaders who agreed to the interview while the rest of the officials from institutions declined to the researchers request for the interview.

The response rate for household's head, and informal waste collectors, whom questionnaires administered were 100 % while the officials from various institutions

and organizations whom institutional questionnaires were administered were 73 %. The difference in the response rate of 100% and 73 % as previously indicated was because households and informal waste collectors were accessible, freely available, willing to participate and felt a direct impact of the study. Alternatively, some of respondents in some institutions and organizations which included, government agencies, NGOs and CBOs were not willing to provide information despite numerous follow ups.

Table 4.1 (a): Distributions of respondents in the villages

No	Name of the village	Number of individual samples per village	Total respondents who participated in study per village	Male	Female
1	Soweto West	23	23	2	20
2	Raila,	23	23	4	19
3	Gathwekera	23	23	6	18
4	Kisumu Ndogo	23	23	10	13
5	Lindi	23	23	2	21
6	Silanga	23	23	3	20
	Totals	**138**	**138**	**27**	**111**

Source: Researcher (2025)

Table 4.1 (b): Distributions of respondents based on organizations

No	Category	Number of respondents
1	County Government staff	2
2	NEMA	1
3	NRC	1
4	NGO's and CBO's	18
5	**Totals**	**22**

Source: Researcher (2025)

4.1.2 Socio demographic characteristics of the respondents

Socio demographic characteristics which included factors such as gender distribution, age distribution, education levels, main occupation, income levels, and household sizes for the household heads in the first objective were presented. Furthermore, it was then followed by presentation of socio demographic characteristics for waste collectors in second objective of the study and these were; gender, age, education level, monthly earning, working experience and mode of working in waste collection sector.

4.1.3 Socio demographic characteristics of the household heads

Females were the most common respondents, and this was because most of the women were housewives and due to their gender roles in the society they were usually staying

at home, also socioeconomic pressures have resulted in a higher number of single mothers. In addition, majority of the women in the slums were heading their households and this was in line with research conducted by Mwangi, (2017) and Mwaura, (2022) who examined female headed households and factors contributing to their emergence. Based on the field data, 20 % of the respondents were males while 80 % of the respondents at the household were females. Alternatively, men headed households were few and this could be possible due to economic challenges, men leave their families in search of employment and thus leaving their wives to head their families.

Gender has a significant role in solid waste management strategies for the Ngong River restoration, since the responsibilities and participation level for men and women differs. Women were considered to be the key stakeholders in the disposal of household waste, recycling, and community clean-up initiatives. On the other hand, men were more involved in waste collection, transportation, and decision-making. Solid waste management strategies should be gender sensitive to ensure inclusivity in participation, equity in decision-making, and accessibility to resources for both genders, hence promoting sustainability in waste management (Odha, 2024).

Majority of the respondents were in the age bracket of between 26-33 years and they were 28 % and was followed by 21 %, who were in the age bracket of 34-41years, while 17 % were in the age bracket of 50-57 years. Age bracket of 18-25 years, and 42-49 years had a similar percentage of respondents who were 14 % while age bracket of 58 years and above had 6 % respondents and this was the age bracket with the least number of the respondents **(Table 4.2)**.

Education level for the respondents is represented in the **Table 4.2**. According to the information in the figure, most of the respondents were educated to a level of secondary education and these were 46 % of the respondents and this was closely followed by the respondents (42 %) with primary level of education. Respondents with college level of education and university education were 8 % and 1 % respectively, while respondents with no formal education were 3 %.

Majority of the respondents were self-employed and these were 63 % while 20 % of the respondents were not employed. The rest of the respondents were employed in formal job and these were 17 % of the respondents **(Table 4.2).** The reason why, majority of the respondents were self-employed was due to many socioeconomic and structural factors making the formal employment inaccessible. These factors include,

limited job opportunities, low educational level, flexibility and necessity, informal economy dominance, cost of formal employment, entrepreneurial spirit, etc. According to the report by Erulkar & Matheka, (2007) majority of the residents in Kibera Slum were working in informal job which were not officially recorded in official government employment statistics. In addition, more than 45 % of the residents in Kibera Slum were self-employed or were involved in working day to day activities. Large number women were self-employed and were mostly engaged in activities such as businesses by selling fish, vegetable or cooked local food.

The major occupation of the residents living in the riparian areas of Ngong River was important in shaping the type of waste generated in the household and the effectiveness of solid waste management strategies used in restoration of the river. Some of residents were majorly working in informal sectors as vegetable vendors, and small-scale traders and operated their business close to the river. Therefore, contributing significantly to accumulation of plastics and organic waste because of prevalence use of materials for packaging that were disposable and food related waste. Majority of these businesses lacked strategies for management of solid waste, for example, formal waste disposal which include incentivized waste segregation, structured collections points and recycling activities which were important in preventing further pollution of the river. Moreover, residents who worked in formal jobs such as salaried workers are likely to have more support for the policies on waste management but usually rely on waste collection services which could be inadequate in that area.

The monthly income of the respondents was represented in the **Table 4.2**. Based on the information in the figure, majority of the respondents (49 %) were earning a monthly income of less than Kshs 5000, and this was followed by 25 % of the respondents who were earning an income ranging from 5001 to 10000. The monthly income of bracket 10001 to 15000, 15001 to 20000 and 20001 to 25000, had 12 %, 8 %, and 2 %, of the respondents respectively, while 4 % of respondents were earning above 25001 per month. The least number of respondents were earning 20001 to 25000. Several residents in Kibera were earning income of less than Kshs 5,000 because of different interrelated socio-economic factors. These factors for example include high rate of unemployment, underemployment and full reliance on informal and casual labour which most of the time offers payment that were inconsistent. Limitation in

terms of accessibility to quality educations and skills exacerbated their inability of securing well-paying jobs. In addition, Kibera Slum is densely populated and resources available are scarce and competitive making it hard for the residents to improve their economic situations. Based on Erulkar & Matheka, (2007), 68 % of the residents who had a nuclear type of families in Kibera were earning Kshs. 2645 per month which was below the poverty line set by UN HABITAT.

The disparities in income among the residents living in Ngong River riparian areas in Kibera Slum, influenced directly the solid waste management strategies used in restoration. Income disparities shaped the patterns of the household's waste generation, waste disposal behaviour, and accessibility to the formal waste services. Since majority of the residents (49 %) were earning little income, they were usually faced with systemic barriers such as inability to afford waste collection services by the private companies or individual. This encouraged illegal dumping of waste into the river, open burning or accumulation of waste in the riverbanks.

From the table below, majority of the respondents had a household size of between 4 to 5 persons per household and this was according to 41 % of the respondents. This was followed by household size of more than 6 persons, as per 33 % of the respondents. Respondents whose household size was between 2-3 persons, and 1 person were 24 % of the and 2 % respectively **(Table 4. 2)**. Majority of the households (74 %) were having a household size of more than 4 members which was considered large and this was due to combination of factors such as cultural, economic and social. According to the research by Mukeku, (2018) several families valued having many children as part of their culture, which is considered as source of labour and security in African settings. Due to high poverty levels, families lived in a shared arrangement, where extended family members were living together to reduce expenditures because of tough economic conditions. Socially large household sizes have been caused by limitation in accessing family planning service and education and awareness on reproductive health, which increases fertility rates.

Household size among the resident living in riparian areas of Ngong River in Kibera Slum significantly determines the effectiveness of the solid waste management strategies used in the restoration. Larger households (4-5 people, as per 41 % of the respondent and > 6 people, according to 33 % of the respondents) were considered to

generate huge volume of mixed waste such as organic waste, plastics and other household's waste. Huge generation of waste usually overwhelms waste collection services provided by informal waste collectors. Alternatively, households therefore, continues to dump waste into the river, hence worsening the state of the river and its surrounding.

Table 4.2: Demographic information of household heads

Variable	Category	Percentage (%)
Gender Distribution	Male	20
	Female	80
Age Distribution	18–25 years	14
	26–33 years	28
	34–41 years	21
	42–49 years	14
	50–57 years	17
	58+ years	6
Education Level	No formal education	3
	Primary education	42
	Secondary education	46
	College	8
	University	1
Main Occupation	Self-employed	63
	Unemployed	20
	Formally employed	17
Monthly Income (Kshs)	< 5,000	49
	5,001–10,000	25
	10,001–15,000	12
	15,001–20,000	8
	20,001–25,000	2
	>25,000	4
Household Size	1 person	2
	2–3 persons	24
	4–5 persons	41
	>6 persons	33

Source: Researcher (2025)

4.1.4 Socio demographic characteristics of informal waste collectors

A total of 83 waste collectors operating across the six villages in Kibera Slum participated in the study. The findings showed that waste collection is a male-dominated activity, with 81% males and 19% females. Most respondents were aged between 26–41 years (66%), reflecting the physically demanding nature of the job that Favours younger, more energetic individuals. In terms of education, the majority had primary (55%) and secondary (40%) education, with very few having college-level or no formal education. Income levels were generally low, with nearly half (49%) earning between Kshs. 10,001–15,000 per month. Regarding work experience, most had 1–3 years (42%) or more than six years (29%) in the field, indicating both new and seasoned collectors. A significant proportion (60%) worked independently, while 33% were affiliated with companies and 7% worked in groups. Overall, the results indicate that waste collection in Kibera is dominated by relatively young, moderately educated males who rely on the activity as a primary source of income due to its accessibility and low entry requirements (**Table 4.3)**.

Table 4.3: Demographic information for waste collectors

Socio demographic characteristic	Description	Respondents	
		Frequency n=83	Percentage (%)
Gender	Male	67	81
	Female	16	19
Age (years)	18-25	17	20
	26-33	27	33
	34-41	27	33
	42-49	8	10
	50-57	4	4
Education level	No formal education	1	1
	Primary	46	55
	Secondary	33	40
	College	3	4
Monthly earning	<5000	1	1
	5001-10000	18	22
	10001-15000	41	49
	15001-20000	19	23
	20001-25000	3	4
	>25001	1	1
Working experience(years)	Less than 1 year	8	10
	1-3 years	35	42
	4-6 years	16	19
	More than 6 years	24	29
Mode of working	Work independently	50	60
	Affiliated with a company	27	33
	Others	6	7

Source: Researcher (2025)

4.2 Types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies

4.2.1 Types of Household Waste Collection Services

4.2.1.1 Types of waste collection services

Different methods were used by the waste collectors when collecting wastes from the households in various villages of Kibera Slum. The methods were; scheduled collections days, on-call collection services, door to door collection, community collection points, and public waste bins. The popular methods were scheduled collection days, on-call collection services, door -to-door collection and community collection points and these methods accounted for 15 %, 25 %, 42 % and 16 % correspondingly. However, collecting waste from public waste bins as a method used by the respondents was the least used method and only accounted for only 2 % (**Table 4.4**).

Door to door collections services (42 %) was a commonly is used method because, waste collectors could easily navigate through the narrow pathways and roads to pick the waste from individual households, which was a convenience method to the residents. This findings were in accordance to the research by Nthambi (2013), who asserted that roads and drainage in Kibera Slums are poor because it is informal settlement and has therefore been neglected by the authorities.

On call collection days as the type of waste collection by service providers was the second most commonly used method because it was flexible since the household can request for collection of waste whenever they need it, though it may have depended on the additional fees. Community collections points was third popular method because the waste collections by the private waste collectors was simplified since the households' deposits waste in the designated areas. Additionally, in very few collection points there were waste bins which accounts for 2 % of respondents who mentioned use of public waste bins as the method of waste collection and was the least used method which provided option for waste disposal to the households. Scheduled collection days was second last common approach, which allowed the residents to anticipate the date waste is collected and this fosters regular habits. A research in Kibera by Waweru & Kanda, (2012a) revealed that, several households lacks waste collection services and those few that are available were collecting waste two times a week. Generally, the

volume of waste released is exceeding the amount collected. Foul smell emanates which is more intense especially among the households near Ngong River as a result of uncollected wastes and which also often mix with human faeces, as a result of insufficient sanitation facilities. This is a critical challenge which exposes the population to outbreak of sanitation and hygiene related diseases.

Table 4.4: Types of waste collection services

Methods waste collection service	Percentage
Scheduled collection days	15
On-call collection services	25
Door-to-door collection	42
Community collection points	16
Public waste bins	2

Source: Researcher (2025)

4.2.1.2 Frequency of wastes collections by the informal waste collectors

The frequency of waste collections in the households by the waste collectors varied. Waste collection in the households was least carried out 2-3 times in a week by the respondents (6 %). Daily and weekly waste collection are also less common among some households accounting for 9 % and 14 % respectively. Wastes were commonly collected was once a month as per 71 % of the respondents (**Table 4.5**).

The frequency of waste collection by the individual waste collectors in Kibera Slum was varying since it depended on factors for example; agreement between waste collectors and the residents, amount of waste generated by the households and availability of equipment and other resources for waste collection. In majority of the villages of Kibera Slum, wastes were not collected 2-3 times a week (6 %) and this was because individual waste collectors give priority to the areas, where there is higher demand and where the residents regularly pay for the services. Daily and weekly waste collections were also not popular in densely populated areas of the riparian areas of Ngong River where waste accumulated so rapidly. Weekly, waste collection was however more common in the frequency of waste collection. And this because in many scenarios, inconsistency in waste collections schedules results in accumulations of waste which contributes fully to the pollution of the Ngong River, as well as the health concern of the residents. Improvement in the frequency and reliability of waste collections, therefore is vital for sustainability of waste management in slums. A study

by Kitonyi, (2014) showed that, there is lack of regular waste collection in Kibera Slum villages. As a result, 90 % of the households near Ngong River are disposing their solid waste directly into Ngong River, resulting into high level of pollution. Therefore, the water in the river cannot support any domestic purposes such as washing, drinking etc as well as not supporting aquatic biodiversity.

Table 4.5: Frequency of waste collections

Frequency	Percentage
2-3 times a week	36
Weekly	24
Daily	29
Once a month	71

Source: Researcher (2025)

4.2.1.3 Types of household waste frequently collected

Organic wastes, and recyclable wastes were the commonest wastes collected from the household, as per 45 %, and 40 % of the respondents respectively. Electronic wastes collected accounted for 11 % of waste collected while hazardous waste and other wastes were the least collected represented by 3 % and 1 % respectively (**Table, 4.6**). In Kibera Slums, informal waste collectors were dealing with a variety of household waste, and the most collected and the most frequently collected waste were organic waste and recyclable materials. Organic waste contributed a significant portion because of large amount of perishable goods being consumed. Recyclable materials such as plastics waste, packaging materials were second most common waste collected due to reliance on packaged and disposable product. While electronic wastes were collected less frequently and were often salvaged by residents or informal waste recyclers for reselling. Hazardous wastes materials such as batteries (dry cell), chemical, medical waste, etc were not common because most of the residents were no longer using dry cell in their electronic, and there were no health centres, medical shops near riparian areas which could release the medical waste. The composition of household waste collected highlights the necessity for improvement of sorting within the household level, which enhances recycling efforts and reduces negative environmental impacts. The type of waste collected is in concurrence with Kamau, 2024, who asserted that in Kibera, waste collectors are mainly collecting households waste such as papers, plastic

bags, books, newspapers for recycling to tissue papers and other products. In addition, they even collect organic waste such as food scrap which are useful for making fertilizers. Glass bottles were also collected which were later fused with silica, calcium carbonate and sodium carbonate to produce new bottle thus saving energy.

Table 4.6: Types of household waste most frequently collected

Type	Percentage
Organic wastes (food scraps, yard waste, etc.)	45
Recyclable materials (plastic, glass, paper, Metal, etc.)	40
Electronic wastes (old electronics, batteries, etc.)	11
Hazardous wastes (batteries, chemicals, medical waste, etc.)	3
Other wastes	1

Source: Researcher (2025)

These research findings on the types of waste identified in Kibera Slums also was in line with the study undertaken by Nthambi, (2013) who also found out that vegetable remains (organic waste) were the largest waste category (32.13 %) generated by the households. And this was closely followed by recyclable materials such as plastic papers bags (31.2%). Wastes that were produced in lowest quantities were wood and scrap metal, which were 5.07 % and 5.2 % respectively.

4.2.1.4 Volume of waste collected per day

The volume of waste collected by the respondents from households were majorly less than 1 tonne according to 99 % of the respondents, this was considered small amount of waste compared to the residents living in Kibera Slum and especially near Ngong River. The rest of waste collected amounted to between 1-3 tonnes by only 1 % of the respondents. The volume of wastes collected daily by the informal waste collectors in Kibera depended on factors such as population density, the rate of waste generation, and the capacity of waste collectors. On an average informal waste's collectors in an area of their operation can handle several kilograms of waste every day and this depends on the size of their operation and method transporting waste after collection example use of handcart. And this accounts for volume of waste collected which is less than1 tonne according to 99 % respondents. Moreover, 1-3 tonnes of waste according to 1 % of the respondents was because high density areas of Kibera Slum within riparian area of Ngong River which generated a larger volume of waste specifically organic and

plastic materials as compare to lower density areas of slum within the riparian area. In spite of the efforts by the informal waste collectors, limitation due to infrastructure and availability of resources, there was uncontrol and accumulation of waste in the riparian areas which resulted in complete blockage of water in Ngong River.

This findings were consistent with research by Njoroge *et al.,* (2014) and Njagi, (2017), which showed that, the entire Kibera Slum generates more than 205 tonnes per day and a fraction of these waste were collected. As a result of uncontrolled dumping the uncollected waste ends up in rivers and streams such as Ngong Rivers which worsened the pollution situation. Apart from inadequate clean water, lack of proper sanitation, security challenges and undurable houses, one major challenge Kibera Slums were facing is the absence of solid waste management system and infrastructure.

4.2.2 Demand and Payment for Services

4.2.2.1 Demand for waste collection services in the area

The demand for waste collection services was high according to 53 % of those who the questionnaire was administered to. This was followed by 44 % who mentioned that, the demand for waste collection services was moderate, while according to very few respondents (3 %), the demand for waste collection services was very high (**Figure 4.1**). The higher demand for waste collections services according to 56 % of the respondents was because of dense population and inadequate waste management systems especially among the residents living along Ngong River. Informal waste collectors were being relied upon by the households to collect waste and prevents accumulations. The demand was higher in villages of Kibira Slum where generation rates was higher. However, majority of the households especially those living near Ngong River could not pay consistently for waste collection services because of extreme poverty. As a result of this, a gap was created, between the demand for waste collection and the ability to regularly access it. The higher demand, leads to straining in the capacity of individual informal waste collectors who are already facing logistical and infrastructural challenges in trying to effectively meet the demand for the households. The research by Zakaria *et al.,*(2024), is the same to the finding of this study. Zakaria *et al.,*(2024), revealed that waste collection services in Nairobi City County have a high demand and is attributed to the rapidly growing population for example in Kasarani Subcounty.

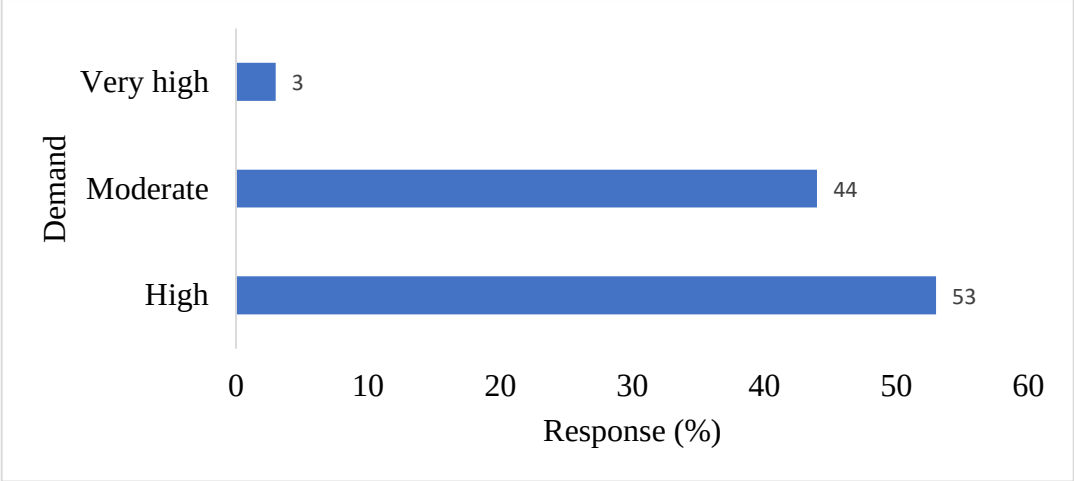

Figure 4.1: Demand for waste collection services in the area

Source: Researcher (2025)

4.2.2.2 Payment methods for waste collection services

Payment for waste collection services were done using method which included; pay-per-service, and monthly subscription, while in other situation no payments were done. Pay-per services was a popular payment method used by 45 % of the respondents while monthly subscription was the second popular method with 29 % of the respondents agreeing to using this method. The method where no payments were made after collections of waste was used, according to 26 % respondents (**Table 4.7**). Pay per service method of payment for waste collection services were popular because it was often preferred by households. The reason why the household preferred it, was because it's an informal method used by the waste collectors where it depends on a varying agreement with households. Due to poverty levels, negotiations in some instances could lead to reduction in amount charged to the level the households afford. Some households (29 %) preferred paying using monthly subscriptions, with ranging fees charged as per the volumed of waste collected per month. And this method was properly used by the households with some level of income and thus could afford it. In some cases, no payment was made and instead some barter arrangement took place such as exchange of recyclable materials for waste collections service, and this took place among the residents with extremely low income. Cash and mobile money services particularly Safaricom M-Pesa platform were used as convenient and secured method of payment by the residents to the waste collectors. In spite of these payment methods, affordability affects the frequency of waste collection services hence due to poverty

levels, majority of household near Ngong River resorts to freely dumped the waste inside the river.

The research findings is consistent with a study by Waweru & Kanda, (2012b) entitled **'**Municipal Solid Waste Management in Kenya: A Comparison of Middle Income and Slum Areas'. According to this study, residents of Kibera Slums were generally not ready to pay for the waste collection services due to various problems they are facing. The problems include poverty and thus they prioritise basic need for example food, hence other basic services like sanitation are relegated, since residents believed that government is supposed to freely offer it. The government should work with the local authorities in exploring the option of encouraging private sector to fully participate in solid waste management in slum areas. This will result in efficiency in service provision. The authorities should give incentives to informal waste collectors to make waste collections services cheap for very poor residents in slums. The potential that exists in waste management should be used in creating public private partnership with scavengers' groups and micro-enterprises and the public entities, which has been proven to be successful in other sectors such as water sector.

Table 4.7: Payment methods for waste collection services

Payment methods	Percentage
Pay-per-service	45
Monthly subscriptions	29
No payment	26

Source: Researcher (2025)

4.2.2.3 Cost of waste collection services

The cost of collecting waste from the households was varying according to various respondents. Most of the respondents (51 %) were charging between Kshs 21-30, while others were charging Kshs 20, Kshs 41-50 and Kshs 31-40, were 21 %, 10 % and 11 % correspondingly. Few respondents (7 %) charged Kshs 51 and above. And these charges were per single service offered, and variation depended on the amount of waste collected (**Table 4.8**). Waste collection services by the informal waste collectors in Kibera Slum were charged differently and was determined by factors such as volume of waste, frequency of waste collection and the areas where the waste collection service was being offered. Majority of the respondents were charging Kshs 21-30, even though

the price could be more, in villages of Kibera that are not so densely populated or more frequent collections especially residents living near Ngong River. Other cost charged by waste collectors were attributed to individual waste collectors offering discounted rates especially to larger households or long-term agreements. However, most of the residents, the cost especially Kshs. 51 and above was significantly high given majority of the households near Ngong River had very low income. The issue of affordability led to inconsistence in payment, hence gaps in service provisions. Majority of the households within Ngong River riparian area, resort to informal method of waste disposal, by disposing waste directly into the river, hence posing health risk and exacerbating the challenge of pollution of the river.

The finding of this research correlates with the report entitled ‘‘Solid Waste Management in Nairobi : A Situation Analysis’’ by UNEP, (2019). According to this report, sustainability in waste management can be achieved if waste collectors, company or authority in charge of waste management, are charging a reasonably affordable cost, that can be useful in meeting the capital, operational and the costs of maintenance. In most of the cases, waste collection fee should generally be based on the wealth status of the communities, ability to pay and their desired quality of services.

Table 4.8: Cost of waste collection services

Cost (Kshs)	Percentage
Kshs 21-30	51
Kshs 20	21
Kshs 31-40	10
Kshs 41-50	11
Kshs 51 and above	7

Source: Researcher (2025)

4.2.2.4 Satisfaction Level and Household Perception

Based on the responses from informal waste collectors, households exhibited varying attitudes toward the waste collection services provided. As shown in Table 4.19, the majority of households (54%) responded positively to the services, while 6% expressed a very positive response. About 30% of households were neutral, and 10% responded negatively. Overall, 60% of households showed a positive attitude, likely because they recognized the importance of proper waste disposal for health and environmental conservation. Many residents also appreciated the convenience of door-to-door waste

collection, especially given the limitations of formal waste management systems. The neutral responses (30%) may have been due to affordability challenges, leading some households to resort to illegal dumping. The 10% negative responses were likely linked to frustrations over irregular waste collection, inadequate service coverage, or high collection costs **(Table 4.9)**.

The report by Kloettschen *et al.,* (2024), shows some related findings with this study, by showing that informal waste collectors and their community have a bi-directional and interdependent relationship. Furthermore, based on that report, some of the residents interviewed and were living in the area of operations by the waste collectors, clearly stated that they love the waste collectors because of the work they are doing for them. A sense of belonging and motivation to work was created which help waste collectors to engage the community positively in collection of waste. The reports further showed, despite the health risk and nature of the work, majority of the informal waste collectors were enjoying their day-to-day work.

Table 4.9: Households respond to the waste collection services provided

Response	Percentage
Positive	54
Neutral	30
Negative	10
Very positive	6

Source: Researcher (2025)

Respondents furthermore, mentioned that households gave various feedbacks about their services of waste collections. These feedbacks were based on questions asked; timeliness of collection, professionalism of waste collectors, cleanliness and thoroughness, cost of services as well as other factors. Most of the respondents mentioned that the feedback given by the households were on timeliness in collection, professionalism of waste collectors and cleanliness and thoroughness as per 46 %, 20 %, and 17 % of the respondents correspondingly. These were followed by the cost of services as feedback according to 15 % of the respondents, while other feedback was not mentioned in prior category and this was according to 2 % of the respondents (**Table 4.10**). Most respondents (46 %) mentioned timeliness of waste collection as feedback

used by the households to rate their services. Timeline is an important factor since delays in collecting waste causes accumulation and worst sanitation situations thus frustrating the residents. A research by Kariuki *et al.*,(2019) shows that waste pickers spend average of 10 hours in waste picking and are usually punctual in collecting waste from households in Kenyan Slum. Professionalism was another factor considered by the households when rating the respondents, because households tend to appreciate waste collectors who are courteous, efficient and handling waste with care. Cleanliness was also important factor considered by the households, when giving feedback on waste collections. This was because, households expect waste collection to be carried out in a manner that does not spill or contaminates their neighbourhood. The cost of waste collection services, was mentioned by some respondents as the factors used by the households to rate their services. This is because cost of waste collection services is a significant challenge among majority of the households, since some of fee charged by waste collectors were usually perceived by the households as high, resulting inconsistency in payment and hence residents dumping waste directly into to the Ngong River. These results contradicts findings by Faye *et al.*,(2016) which revealed that only a few households (1%) were not paying for waste collection services in Korogocho Slum in Nairobi. Furthermore, the report shows households dumping the wastes in river were more common in Nairobi (28.7 %) as compare to Mombasa. In overall, the quality and affordability of waste collection services largely influence the households' satisfactions.

Table 4.10: Feedback from household about waste collection services

Feedbacks	**Percentage**
Timeliness of collection	46
Professionalism of waste collectors	20
Cleanliness and thoroughness	17
Cost of services	15
Others	2

Source: Researcher (2025)

4.2.2.5 Service Quality and Challenges

Informal waste collectors were facing several challenges which were affecting reliability of their waste collection services. These challenges were categorised as followed; lack of proper disposal facilities and, insufficient equipment or resources, inadequate waste separation by the households, inconsistent payment or support, poor road conditions or accessibility, health risk from hazardous waste, as well as other challenges. Based on the respondents, major challenges were lack of proper disposal facilities, inadequate waste separation by the households, inconsistent payment or support, and poor road conditions or accessibility, each accounting for 42 %, 17 %, and 15, % of the responses by the respondents while poor road conditions or accessibility accounted for 14 % of the response. The least of the challenges were; health risk from hazardous waste, and other challenges as mentioned by 7 % and 5 % of the respondents respectively (**Table 4.11**).

Lack of disposal facilities and insufficient equipment or resources was a major challenge hindering the ability of maintaining consistency in waste collection by the waste collectors. While lack of financial resources among the residents was contributing to irregular service since many residents could not afford the cost of waste collection hence reduced frequency of service. Failure by most households to separate waste resulted waste collectors spending a lot of time, sorting the wastes at the collection point, hence reducing time of collection. In addition, inconsistent payment discourages waste collectors from picking waste from the households. Poor road conditions make the households living near the river inaccessible and thus it was difficult to use equipment such as carts or vehicles to carry waste. Moreover, unpredictability of the weather condition for example heavy rain could resulted damaging of roads making waste collections more challenging. When all these challenges were combined it resulted in frequent gaps in service, leading to majority of the households near Ngong River, dumping waste directly into the river hence contributing to accumulation of waste in the river and sanitation related problems. Similarly, a study by Mburu, (2016) identified form of socio-economic exclusion among Kibera Slums and these were; poverty, service exclusion and labour market exclusion. These forms of exclusion were commonly caused by lack of stakeholder participation, lack of employment, high rate of crime, among others. Furthermore, the

study established the main challenges affecting waste collections to be inaccessible roads, absence of dumping ground, financial problems and many others.

Table 4.11: Main challenges affecting reliability of waste collection services

Challenges	Percentage
Lack of proper disposal facilities and insufficient equipment or resources	42
Inadequate waste separation by households	17
Inconsistent payment or support	15
Poor road conditions/accessibility	14
Health risks from hazardous waste	7
Others	5

Source: Researcher (2025)

4.2.2.6 Measures to improve the quality of household waste collection

Improvement in the quality of household waste collection services by the informal waste collectors in Kibera Slums in villages within the Ngong River, riparian area, call for combination of practical, community driven, and policy-level measures. Measures were suggested to the respondents on how the quality of the waste collection services in the households could be improved. The measures suggested were; carrying out more frequent collection services, better waste separation at the source, enhanced public awareness and education, improved infrastructure (e.g., trucks, bins), better compensation and support for waste collectors and other specified measures. Based on the respondents, measures which included; carrying out more frequent collection services, better waste separation at the source, enhanced public awareness and education, improved infrastructure (e.g., trucks, bins), better compensation and support for waste collectors, were the most popular measures the respondents agreed to, with 22 %, 20 %, 20 %, 19 %, and 15 % of the respondents correspondingly agreeing as these measures to be implemented to improve the quality of household's waste collection services. Only 4 % of the respondents agreed to other specified measures for improving quality of household waste collections services (**Table 4.12**). More frequent waste collections services were the popular measure as agreed by majority of the respondents because this could significantly enhance reliability and efficiency. To carry out frequent waste collection services, investment in better infrastructure such as

accessible roads and designated point for waste collection must be achieved. Better waste separation at the source and enhanced public awareness and education were second most popular measures according to the respondents. This was because, separating waste at the household level make it's easy for waste collectors to collect waste from many households, while public awareness and education on waste separation could improve collaboration between the residents and waste collectors, hence reduction in logistical challenges and increase in service reliability. Improvement of infrastructure such as trucks and waste bins, or provision of protective equipment results in improvement of their capacity in effectively handling waste. Better compensation in terms of amount paid to the waste collectors after service and support from local authorities, NGOs, or public private partnership moreover can boost their financial and technical resources. This ensures sustainability and consistency in waste management services. The finding of this study, were in line with the research conducted in Kibera by Rigasa *et al.*,(2016), which suggested that improvement on the quality of household waste collection among slums in Kenya need a combined approach. This approach is supposed to look at the issues of infrastructure, organization and the challenges of the community. For instance, investment in infrastructural projects for example roads and designated points for collection of waste, improves the efficiency of operation by waste collectors.

Table 4.12: Measures to improve the quality of household waste collection

Measures	Percentage
More frequent collection services	22
Better waste separation at the source	20
Enhanced public awareness and education	20
Improved infrastructure (e.g., trucks, bins)	19
Better compensation and support for waste collectors	15
Others	4

Source: Researcher (2025)

4.2.2.7 Waste recycling

Findings of this study, showed that only 35 % of the respondents, were involved in waste recycling while 65 % were not involved. Waste recycling by the informal waste collectors in Kibera Slum is generally low and not regular because of limitation in infrastructure and resources used for recycling. Majority of the waste collectors were primarily focusing on collecting and disposing waste. However, informal recycling practices were usually integrated in waste collectors' operations, specifically for high value items like plastics, metals and glasses, that were collected and sold to individuals or companies involved in recycling **(Plate 4.1)**. Moreover, the frequency of the respondents carrying out waste recycling activities varied. Some respondents (61 %), often participated while other respondents (22 %) were sometimes involved, and the rest of respondents (17 %) were always involved in waste recycling activities (**Table 4.13).** Most of the waste collectors involved in waste recycling often participated in the practice because of availability of waste recycling materials and the market demand for the recycling materials. While respondents who sometimes, carried out waste recycling was because, the households were rarely separating wastes, and this limited the opportunities for consistency in recycling. Improvement in frequency and efficiency of recycling requires awareness and education of households on separation of wastes, better accessibility to the recycling facilities and enhancing collaboration between informal waste collectors and recycling initiatives. A research by Mburu, (2016), which investigated solid waste recycling within the households in Kibera Slums found almost similar results with the findings of this study.

Table 4.13: Waste recycling

Frequency	Percentage
Often	61
Sometimes	22
Always	17

Source: Researcher (2025)

Plate 4.1: Informal waste collector searching for metals and other valuable materials for recycling from Ngong River

Source: Researcher (2025)

Various barriers hindered waste recycling activities and these were; being considered as inconvenience work, no access to recycling bin, lack of information, and other specified challenges. Based on the responses, barriers such as being considered as inconvenience work, no access to recycling bin, and lack of information were mentioned by 33 %, 33 % and 30 % of the respondents correspondingly. While other specified barriers were mentioned by only 4 % of the respondents (**Table 4.14**). Most respondents considered recycling practice as inconvenience work thus most of waste collectors were not involved in it. This is because of lack of infrastructure and equipment such as recycling bins for sorting and processing recyclable materials. In addition, failure of most households to separate waste makes the waste recycling practice difficult. Furthermore, the cost of establishing and maintaining a recycling

facility was often discouraging to small-scale waste collectors. Lack of information was because of low awareness and education about the importance of recycling, and this worsened the challenges of recycling since most of the residents were not motivated to separate waste at household level. Other barriers included; lack prioritizing recycling practice were due to informal nature of waste collection in Kibera Slums whereby waste collector focussed more on basically removal of waste. All these challenges combined became significant barriers to establish sustainable recycling system in Kibera Slum, which can lower the volume of waste being dump in Ngong River. The barriers in waste recycling practices found in this study were almost in accordance with the barriers which were identified by research carried out by Mburu, (2016). The research by Mburu, (2016) discovered that residents of Kibera Slum were economically challenged and excluded and therefore majority could not carry out waste recycling and hence could not manage their solid wastes sustainably.

Table 4.14: Barriers in recycling

Barriers	Percentage
Being considered as inconvenience work	33
No access to recycling bins	33
Lack of information	30
Other (please specify)	4

Source: Researcher (2025)

4.2.2.8 Waste sorting

Waste sorting was carried out by 15 % of the respondents while 85 % of the respondents did not sort wastes. Waste segregation was largely informal in Kibera Slum and majority of the waste collectors focussed on removal of mixed waste instead of sorting at the source. This was because of various factors among them lack of awareness among the residents. Waste sorting was carried out in different places which were; at collections points, at wastes processing facilities and at the source e.g. household. Majority of the wastes sorting was carried out at collection points according to 67 % of the respondents. It was then followed by waste sorting at waste processing facilities according to 32 % of the respondents. The least percentage of the respondents (1 %) mentioned the source e.g. households as the place where waste sorting was carried out (**Table 4.15**). Waste sorting at the collection points by the waste collectors was an

attempt to separate materials that were valuable for example plastics, metals and glasses but the process was often not efficient and labour intensive. Sorting at the waste processing facilities were not so common because of lack of proper waste facilities and infrastructure for proper segregation and recycling. While sorting at household level was the least practiced because, household level waste sorting was not promoted or while the waste collectors were not provided with the training and equipment for effective separation, which could have improved waste management and recycling efforts significantly within Kibera Slums.

Table 4.15: Place of waste segregation

Place	Percentage
At collection points	67
At waste processing facilities	32
At source e.g. household	1

Source: Researcher (2025)

4.2.3 Correlational analysis on household waste collection by service providers

The relationships among four key variables in household waste collection by service providers: (i) the amount charged for waste collection, (ii) household response, (iii) demand for waste collection, and (iv) perceived reliability of the service was investigated using Spearman's rank-order correlation (rho). Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity.

The amount charged for waste collection and the perceived reliability of the service showed a moderate positive correlation ($\rho = 0.305$, $p = 0.005$). This was a suggestion that, higher charges for waste collection could have been associated with more reliable service delivery. However, this did not suggest causation, as other external factors were possibly influencing reliability of service.

A weak but significant positive correlation was observed between households' response to waste collection services and the demand for these services ($\rho = 0.264$, $p = 0.016$). This revealed that, as household demand increases, their response to service providers (such as willingness to participate or provide feedback) was also improving. A weak but significant positive correlation was also observed between households' response and service reliability ($\rho = 0.258$, $p = 0.018$). This showed

that households responded more positively when the waste collection service were perceived as reliable, which is an indication of a relationship between service quality and customer engagement. No significant correlation was observed between the demand for waste collection services and the perceived reliability of the service ($\rho = 0.092$, $p = 0.408$). This implied that, demand essentially does not increase with reliability, perhaps as a result of factors for example accessibility, affordability, or habits of households on disposal of waste. The amount charged for waste collection and household response to services did not have a significant relationship ($\rho = 0.074$, $p = 0.504$). This was a suggestion that, cost alone did not significantly affect how households engage with waste collection services. And finally, amount charged and the demand for waste collection services did not show any correlation ($\rho = 0.045$, $p = 0.688$). This implied that demand was moderately stable regardless of price, suggesting that waste collection was a necessity rather than a price-sensitive service **(Table 4.16).**

''The research therefore, failed to reject the alternative hypothesis, that there is a significant relationship between the types and characteristics of household solid waste collection by service providers and the restoration of Ngong River.''

The reliability of the household waste collection by service providers, was useful in shaping the response of the households to this service, as indicated in the results. Higher charges for waste collection service were moderately connected to the improvement in the reliability of waste collection service, however, they did not significantly affect the demand or engagement of the households. Moreover, households demand and response were positively correlated and this highlighted the need of accessing quality waste collection service which drives stakeholder participation, and this useful in restoration of Ngong River.

Table 4.16: Spearman's Rank-Order Correlation Matrix

Variables	Waste Collection Charges	Household Response	Demand for Waste Collection	Reliability of Service
Waste Collection Charges	1.000	0.074 (*p = 0.504*)	0.045(*p = 0.688*)	**0.305** (**p = 0.005**)
Household Response	0.074	1.000	*0.264* (*p = 0.016*)	*0.258* (*p = 0.018*)
Demand for Waste Collection	0.045	*0.264* (*p = 0.016*)	1.000	0.092 (*p = 0.408*)
Reliability of Service	**0.305** (**p = 0.005**)	*0.258* (*p = 0.018*)	0.092 (*p = 0.408*)	1.000

Notes:

- **Significant correlations at the 0.01 level (2-tailed) are in bold**.
- *Significant correlations at the 0.05 level (2-tailed) are italicized.*

Source: Researcher (2025)

4.2.4 Spatial distribution of waste dumping sites in Kibera Slum villages and their environmental impact

The spatial distribution of waste dumping sites in Kibera Slum, as illustrated in **Figure 4.2**, is an indication of a strong relationship between locations of waste disposal and the distance to the Ngong River. Many dumping sites were grouped around villages such as, Kisumu Ndogo, Kambi Muru, and Mashimoni which were situated away from Ngong River banks. While only a few were located in Gatwekera, Raila, and Soweto West, with a dumping site located between Raila and Gathwekera very close to the river. This was a suggestion that many households located in riparian areas of Ngong River whom majority could not afford waste collection service by informal waste collectors prefer to dispose of waste directly into Ngong River instead of accumulating it within their living spaces, which were often congested. Also, due to the long distances to the dumping sites from their houses, as well as the lack of formal waste collection services and designated disposal sites and waste infrastructure. In addition, lack of stringent enforcement of environmental regulations permits the persistence of the practice. Perception by the residents was another factor, that the river is natural resource for carrying away waste hence reduction of burden of household's waste management. Dumping of waste into the river and at the river banks, however, blocks the flow of

river, hence vulnerability to floods as well as severely polluting the water through contamination, which consequently affects the health of users of the river.

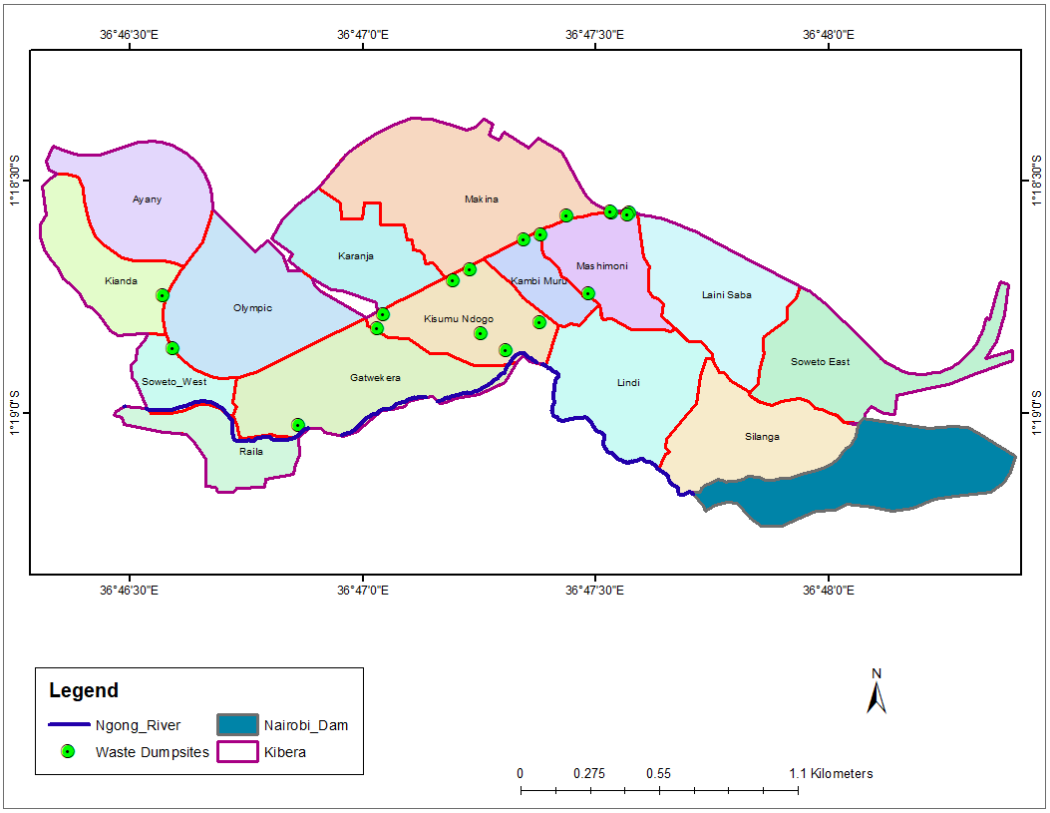

Figure 4.2: Spatial distribution of waste dumping sites in Kibera Slum villages

Source: Researcher (2025)

4.2.5 Stakeholder restoration strategies

The restoration programmes of Ngong River adopted various solid waste management strategies to reduce pollution and improve the river's ecological health. Community-based approaches such as household waste segregation, regular clean-up activities, and proper waste disposal were central to these efforts. Other strategies included installing labelled waste bins, establishing material recovery centres, promoting recycling and composting to enhance resource recovery, and enforcing strict regulations against illegal dumping through surveillance and fines. Collaboration among stakeholders, including public-private partnerships and informal waste collectors, also played a crucial role. Education and awareness campaigns further engaged communities, fostering collective responsibility for environmental conservation. According to respondents, key strategies implemented included waste segregation at source (32%),

recycling programs (22%), installation of waste bins (15%), community clean-ups (12%), partnerships with businesses (8%), awareness campaigns (5%), and other minor strategies (9%) such as constructing gabions and burning or drying collected waste. Overall, these initiatives contributed significantly to the sustainable restoration of Ngong River **(Figure 4.3).**

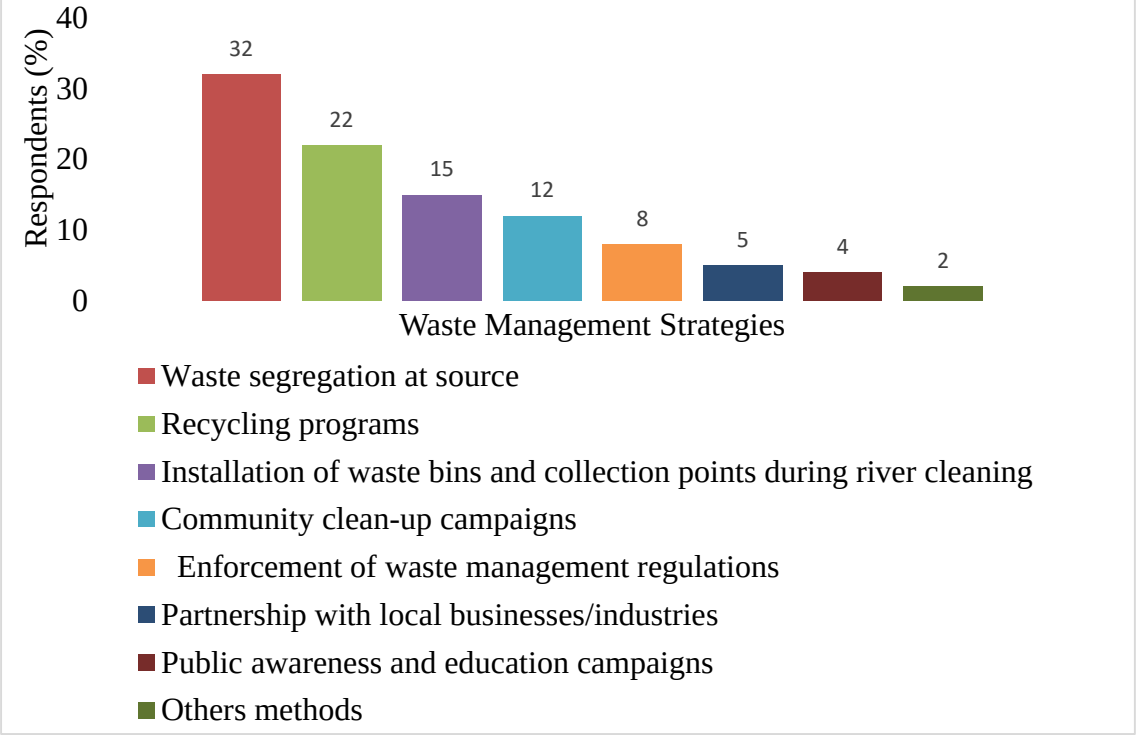

Figure 4.3: Solid waste management strategies used in restoration of Ngong River

Source: Researcher (2025)

4.2.5.1 Effectiveness of strategies in managing solid waste

The strategies implemented for solid waste management during restoration of Ngong River were slightly effective according to 48 % of the respondents, while based on 24 % of the respondents, the strategies were not effective. The strategies were however, effective, moderately effective and very effective based on 15 %, 8 %, and 6 % respondents correspondingly **(Table 4.17)**. The strategies employed were slightly effective and not effective according to 48 % and 24 % of the respondents because the effectiveness of these strategies hinges on its ability in addressing the root cause of pollution and key stakeholder engagements. While strategies were effective, moderately effective and very effective as per 29 % of the respondents cumulatively. And this is because, while the strategies are promising in overall, their effectiveness is hindered by a system of challenges such as lack of sufficient funds, efforts which are

fragmented as well as absence of well-planned involvement of stakeholders. Creating strong institutional frameworks, enhancement of community participation and adoption of integrated waste integrated approaches are vital in improvement of the outcome of these strategies. A study by Ochieng, (2016) entitled ‘‘Challenges and Possible Interventions for Effective Solid Waste Management in Ngomongo Village of Korogocho Informal Settlement, Nairobi County’’ had almost similar results and it established that SWM in Ngomomgo in overall was inadequate. And this was due to ineffectiveness in the strategies that were used for SWM leading to serious pollution of environment, and health implications due to spread of diseases. The study by Ochieng,(2016) therefore, recommended improvement of waste management strategies for example through sensitization of households on strategies such as waste segregation and material recovery for recycling.

Table 4.17: Effectiveness of strategies in managing solid waste

Responses	Percentage of respondents
Slightly Effective	48
Not Effective	24
Effective	15
Moderately Effective	8
Very Effective	6

Source: Researcher (2025)

4.2.5.2 Household disposal of solid waste

Residents who lived within the riparian area of Ngong River, were disposing solid wastes in different ways. The methods used were; dumping inside the river, regular garbage pickup, yard waste pick-up, use of recycle bin and other specified methods of disposal. Majority of the residents (80 %) were dumping waste inside the river while 6 % were using regular pick-ups by waste collectors as a method in disposing solid wastes from their households. While other disposal methods, yard waste pick-up and recycle bin were used as per 6 %,1 %,2 %, of the respondents respectively (**Figure 4.4)**. Other disposal methods, mentioned by 6 % of the respondents were for example, burning of wastes within their compounds or at the river bank, disposing in dumping sites and many others. The reasons why majority of the residents are opting to dispose wastes directly into the river is as a result of insufficient waste management services, challenges which are of socio-economic in nature as well as behavioural factors.

Absence of adequate waste collection services, limits the residents hence conveniently dumping the wastes inside the river. Kibera Slum is overcrowded with high rate of poverty and therefore majority of the residents cannot afford to pay even for cheapest waste collection service. Overcrowding in the slum makes it impossible for the county government department in charge of collection of solid waste to carry out its work and to enforce regulations to stop dumping waste into the river. The proximity of houses to the river further exacerbates the situation since it makes the residents to easily access the river as their dumping site. These results coincide with the statement by Kilei, (2024) who asserted that, failure of consistency in waste collection services and designation of dumping sites has resulted in serious pollution of the Nairobi Rivers specifically by residents living in riparian areas. Most of the wastes dumped inside the water from the households are majorly made up of materials that cannot be recycled which include diapers, and many other materials. Several residents living in riparian areas of Ngong River in Kibera Slums cannot afford wastes collection services and therefore have limited options as the Nairobi City County have always failed to collect wastes in their areas and hence resorting to disposing them inside the river.

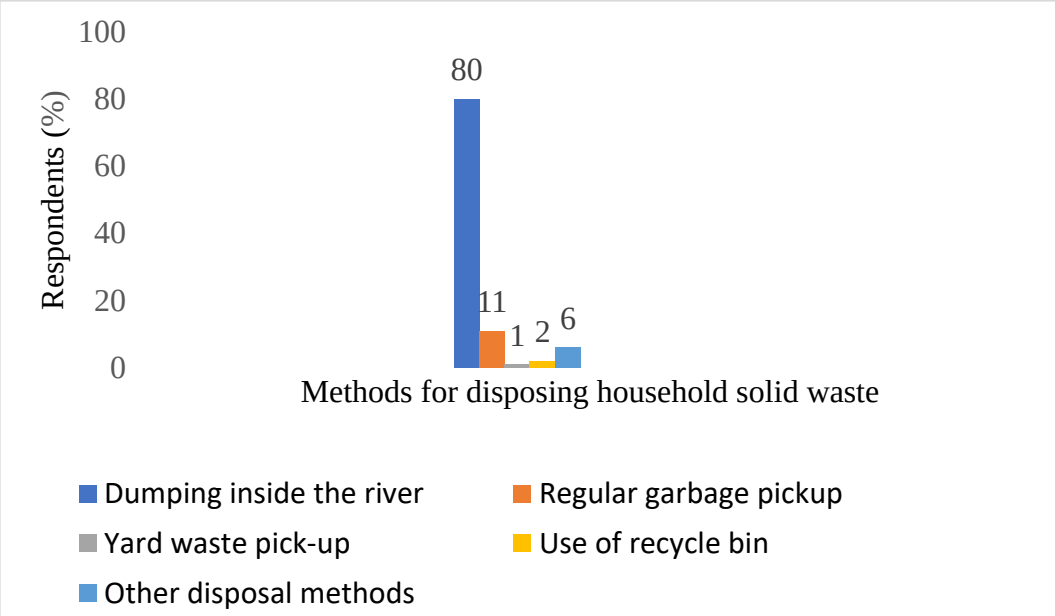

Figure 4.4: Methods for disposing household wastes

Source: Researcher (2025)

Furthermore, these methods used to dispose solid waste poses challenges according to 57 % of the respondents while 43 % of respondents disagreed that the methods for disposing solid waste poses challenges. The challenges that were mentioned include; spread of diseases, insects and rodents, pollution of environment, blocking of water

flow resulting in flooding during rainy season, accumulation of waste in the river overflows and enters the houses and many other challenges. The significant number of residents in Kibera do not perceive their action of dumping waste into the river to cause challenges because they have not realized the link between dumping of waste into the river and challenges such as diseases. This has been contributed by lack of environmental awareness, normalizing unsanitary practices, poverty, lack of alternatives, insufficient health communication, desensitization and structural challenges. These factors suggest the need for targeted community education programs, better infrastructure for waste management, and inclusive policies which effectively addresses the problem of waste pollution and diseases in the Kibera slum.

4.2.5.3 The common type of solid waste produced by the households near the river

Types of waste that are commonly produced in the households within the riparian area in the six villages where the research was carried out were majorly organic waste which include food scraps, yard waste etc. This was according to 50 % of the respondents interviewed. Recyclable waste for example paper, plastics, metals glasses etc, were second most populous wastes generated in the households and this was according to the 40 % respondents of the total respondents whom the questionnaires were administered. Non-recyclable waste such as general trash, bulky waste for example furniture, and appliances, hazardous waste including batteries, chemical, electronic waste, etc as well as other waste contributed to an equivalent of 4 %, 3 %, 2 % and 1 % of the respondents correspondingly **(Figure 4.5)**. The major types of waste that were commonly produced and dumped into the river were majorly household wastes such as food scraps. As a result of insufficient waste management system, failure to enforce environmental regulations, little public awareness on effects on dumping wastes on rivers ecosystem, such type of wastes is primarily dumped by the households into the river. High poverty levels significantly contribute to many households not to afford waste disposal services. And this is exacerbated by the fact that, households in informal settlements close to the river are lacking accessibility to a well-planned waste collection service. The finding is in accordance to Alukwe, (2015) who asserted that informal settlements within the riparian area of Nairobi Rivers, Basin totally lacks waste collections services and thus solid waste from households are directly dumped into river.

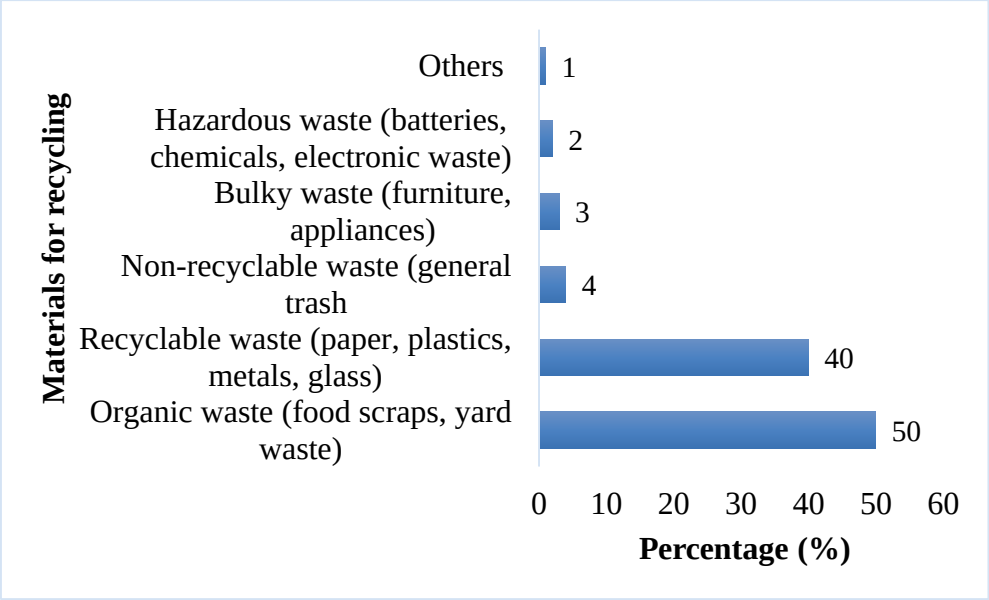

Figure 4.5: The common type of wastes produced by the households near Ngong River

Source: Researcher (2025)

4.2.5.4 Household segregation of solid waste

Most of the households near Ngong River did not carry out the segregation of solid waste at the household level and this was shown by 77 % of the respondents. Only 23 % of the households were, segregating the waste at the source through waste separation process. Majority of the households did not segregate solid because of many reasons. The major reason for not segregating waste is low awareness and education level concerning the advantages of segregating waste and its usefulness in conserving the environment. In addition, lack of sufficient infrastructure for example separate collection bins does not encourage this practice. Majority of the residents give priority to the survival needs over the concerns of the environment as a result of economic hardships. Moreover, in informal settlements such as Kibira Slums, enforcement of regulation are limited and waste management systems are not organized hence creating barriers to the adoption of segregation practices.

These findings correlates with the findings by Kanja, (2020) which showed that wastes from households in informal settlements such as Kibera are biodegradable and not adequately managed with majority of the waste being disposed in sites such as river without segregation.

4.2.5.5 Recycling practices by the households

Recycling activities are taking place within the vicinity of the households for example waste collectors are involved in removing metals for recycling from Ngong River. In addition, households are selling waste that are recyclable such as paper, plastics, glasses and metal to the waste collectors who move from house to house. This was proven by 85 % of the respondents who agreed that recycling activities is taking place in the area. Recycling activities or programmes are not taking place according to 15 % of the respondents, who said they have not seen any recycling activities in the area. Most of the Kibera Villages residents living near Ngong River are engaging in recycling of waste because it is a way of sustaining themselves economically. This is common due to low income earned by the households and waste recycling is an important source of livelihood. In addition, less opportunities for formal employment in informal settlements pushes the residents to seek for other ways to earn income and waste recycling is an easy option. Other concerns, such as environmental and resource conservations are not the motivations for recycling but economic issues primarily drive the practice. This relates to the statements by Africa Water Journalist, (Mwendwa, 2017) on article entitle ‘‘Kenya: Turning Kibera’s Garbage into Gold’’ who asserted that through garbage recycling, Kibera Slum which is the biggest and poorest slum in Africa has become a hub of economic empowerment.

4.2.5.6 Barriers in recycling

According to the respondents there are a number of challenges which limit the recycling activities. Based on the 76 % of the respondents, absence of recycling bins is the main barrier to the recycling activities. This was closely followed by the inconvenience as the barrier since the recycling activity is considered dirty work by the most residents as mentioned by 9 % respondents. Lack of information is also one of major challenge as mentioned by 11 % of respondents while 4 % respondents mentioned other barriers such as limited accessibility to the reliable markets or buyers for the recycle materials as well as social factors (**Figure, 4.6**).

Barriers affecting recycling activities by majority of the residents within the Ngong River riparian area is a complicated issue. The major problem is unavailability of recycling bins (76 %) which was hindering recycling efforts by limiting the residents from separating and storing the recyclable materials. This is attributed to the economic

constraints and poverty levels among the residents. Some residents consider waste recycling activities as dirty work, while there is also lack of information on importance of waste recycling activities among some residents. These can be due to insufficient awareness and knowledge of waste recycling methods that were effective and their benefits. Social factors affecting recycling activities include absence of community planning and little enforcement of policies on waste management which exacerbates the challenges.

A study by Nthambi, (2013) which assessed the economy of the household's options in solid waste management in Kibera Slum mentioned that households that have been enlightened through awareness programme on benefits of reducing wastes through recycling activities are likely to participate in recycling activities and faces less unsurmountable challenges. Furthermore, the results from that research showed that, participation of the community in communal waste recycling, increases household's perception on recycling and decreases the possible challenges affecting the recycling activities by more than 6 %.

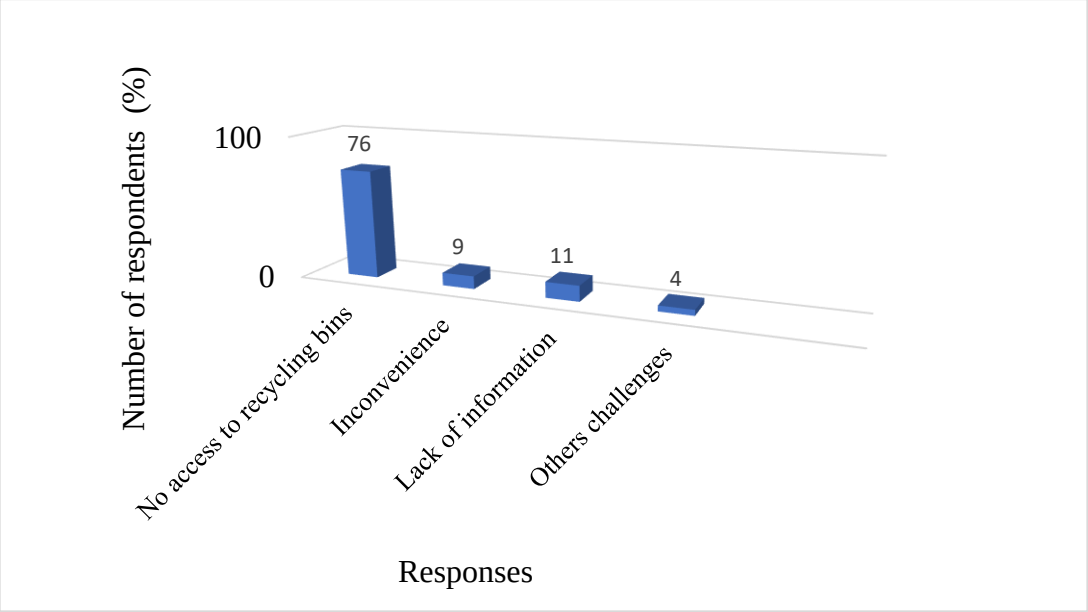

Figure 4.6: Barriers to recycling activities

Source: Researcher (2025)

4.2.5.7 Implementation and community involvement

Solid waste management strategies were implemented differently during river cleaning according to respondents. Based on 44 % of the respondents, strategies used in solid waste management in restoration of Ngong River were slightly well implemented,

while according to 31 %, these strategies were not well implemented at all. Furthermore, solid waste management strategies implementations were implemented well, very well and moderately well as per 14 %, 7 % and 4 % of the respondents correspondingly **(Figure 4.7)**. The level of implementations of these strategies varied with majority of respondent (75 %) agreeing that the implementations slightly well or not well caried out. This is because the implementations of these strategies were affected by factors such as how community were engaged, enforcement of waste management policies and development of necessary infrastructure during river clean up. Furthermore, other factors affecting implementations of these strategies include awareness creation by the government in collaboration with local residents' other stakeholders such as NGOs prior to cleaning day which possibly was not effectively caried out. A research by Joshua, (2023), in role of communication in restoration of water resources with the specific focus of Nairobi River, revealed that public awareness is useful in achieving positive change of attitude of the public towards waste management in restoration of Nairobi River. Moreover, for this change to be effective, economic incentives which are informative and prohibitive is supposed to be included while setting awareness program at mass media level. The study recommends adoption of multi-stakeholder approach for solid waste management strategies to be effectively implemented during restoration of Nairobi River.

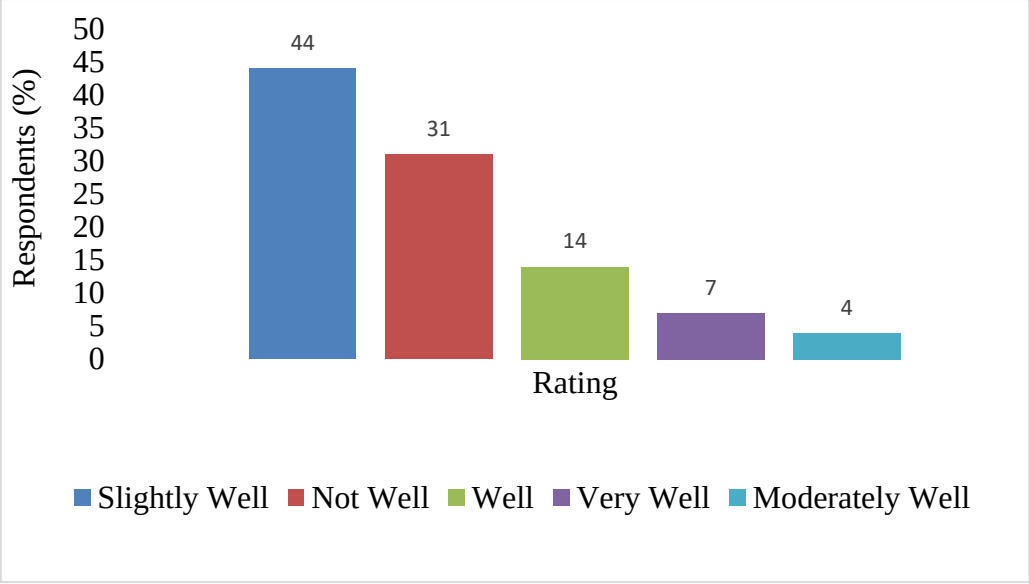

Figure 4.7: Implementation solid waste management strategies in restoration of Ngong River

Source: Researcher (2025)

4.2.5.8 Community involvement in implementation of solid waste management strategies

Involvement of community in solid waste management can be a useful catalyst in the river restoration because it offers a sense of feeling of ownership and self-esteem for the restoration project. It can results into generation of income from practices such as waste recycling(UN-Habitat, 2013). In solid waste management strategies, and its implementation, the level of involvement by the local community is crucial for the success of the entire river restoration programme. 66% of the respondents, mentioned that the residents were not involved at all in these solid waste management strategies in restoration of Ngong River that were previously stated. The community involvement was slightly according to 18 %, just involved according to 7 % and moderately involved and very involved as per 5 % and 2 % respondents respectively as per the **Table 4.18**. The involvement of the community in river cleaning was minimal with only 34 % of the residents being involved while 66 % of the residents were not involved. Residents living in Kibera Slum near Ngong River were less involved because of many factors. One of the major factors was nepotism which determined the people employed to during river clean-up activities. According to the explanation given by the respondents, majority of the residents felt they were no part of cleaning process, because employment, leadership roles or participation opportunities were unfairly given to people who were not even the residents of Kibera Slum. Resentment and disillusion were created as a result of this favouritism.

Table 4.18: Community involvement in implementation of solid waste management strategies

Community involvement	Percentage
Not Involved	66
Slightly Involved	18
Involved	8
Moderately Involved	6
Very Involved	2

Source: Researcher (2025)

4.2.5.9 Method used to involve the households

Methods used to involve some of the households in the implementation of solid waste management strategies during the restoration of Ngong River were; volunteer programmes, community meetings and workshops, door to door awareness drives, educational campaigns in schools and social media and other communication channels.

Based on the data obtain from the study area, volunteer programs were mentioned by 35 % of the respondents, community meetings and workshops mentioned by 24 % of the respondents, door to door awareness drives were mentioned by 16 % of respondents, educational campaigns in schools according to 14 % of the respondents, social media and other communication channels as per 11 % of the respondents **(Table 4.19)**.

Some of the residents who were selected to be part of solid waste management aimed at restoration of Ngong River were actively involved in the cleaning of the river. And therefore, majority opted to be part of the cleaning initiative by volunteering directly or through their various CBOs and they were paid some little amount of money as appreciation apart from being given meals such as lunch. Through community meetings and workshops some residents were trained on segregation and recycling of wastes and their benefits which aimed at ensuring sustainable management of waste. Local leaders as well as environmental groups were involved in raising awareness on proper methods of waste disposal by going from door to door of some few households living close to the river. Education campaigns in schools around the Ngong River were used by some NGOs to involved the pupils and teachers, who will otherwise pass the information to their respective families. Some of the CBOs were using social media like, Facebook, WhatsApp, Telegram and X, formerly Twitter, to communicate to the residents and respective groups regarding cleaning initiatives. Other communication channels that were used by these groups of CBOs, NGOs and government and its institutions include; mass media such as local radio stations, newspaper etc.

Table 4.19: Method used to involve the households

Methods	**Percentage** (%)
Volunteer programs	35
Community meetings and workshops	24
Door-to-door awareness drives	16
Educational campaigns in schools	14
Social media and other communication channels	11

Source: Researcher (2025)

4.2.6.0 Household's response to the solid waste management initiatives

Households' heads reacted differently in regards to the initiatives on solid waste management that were used in restorations of Ngong River. Majority of the respondents (33 %) were neutral regarding these initiatives on solid waste management. Positive

and negative responses were from 30 %, and 28 % of the respondents respectively. While according to 8 % and 1 % of respondents' solid waste management initiatives implemented were very negative and very positive correspondingly (**Figure 4.8**). The response by the households to the solid waste management implemented during Ngong River Clean-up, was with mixed level of engagement. Most respondents were neutral because they were not actively participating in the river clean-up activities, segregation of the waste, community campaigns or any other strategies used. The ones who responded negative had a very minimal participation probably as a result of not being aware or the perception of being inconvenienced. Positive responses were also significance because of positive effects of educational campaigns that were carried out especially to those residents directly impacted by river's degradation. While very negative responses by the household heads was as a result of households not participating at all and also strategies not being effective due to inadequate infrastructure for example waste collection point and limitation to long-term adherence to the solid waste management strategies. However, the very positive (1 %) was because of the visible desire among some of the households and therefore, the responses show the importance of consistency in awareness campaign and infrastructural support by the relevant authorities.

The responses were similar to the initiatives by two NGOs namely SDI Kenya and Muungano Wa Wanavijiji, which were involved in data collection with the aim of developing a plan to solve the issue of household solid waste disposal along Mathare River. The data collected showed not only did the residents of Mathare 4B along Mathare River faced numerous challenges due to poor management of solid waste but also the entire Mathare Slums. A well-structured plan was then developed which offered a solution through, voluntary door to door waste collection, creating awareness on proper waste disposal methods, and cleaning of Mathare River. To stop the littering, waste bins were placed along the river, which keeps the river clean from solid wastes and reduces the spread of sanitary diseases as well as improving living conditions (Ouma, 2024).

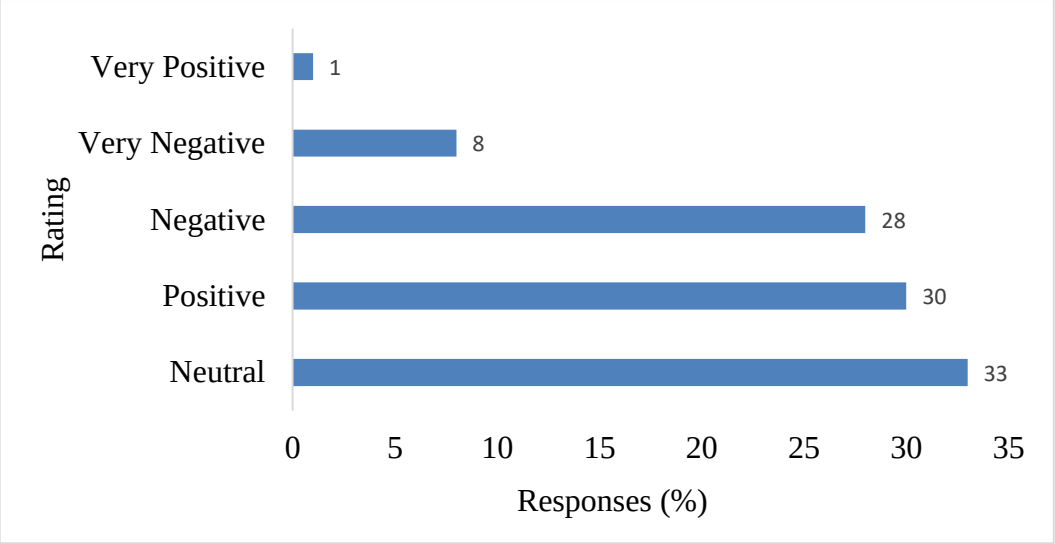

Figure 4.8: Household's response to the solid waste management initiatives

Source: Researcher (2025)

4.2.6.1 Impact of solid waste management on river restorations

Solid waste management strategies have impacted the river's cleanliness in different ways. Solid waste management strategies improved the river's cleanliness according to 36 % of the respondents while it significantly improved according to 1 % of the respondents. The river's cleanliness significantly deteriorated as per 19 % of the respondents. While according to 30 % of the respondents there was just little deterioration in river's cleanliness as a result of solid waste management initiatives. No change was observed on the river's cleanliness as a result of solid waste management according to 14 % of respondents (**Figure 4.9**).

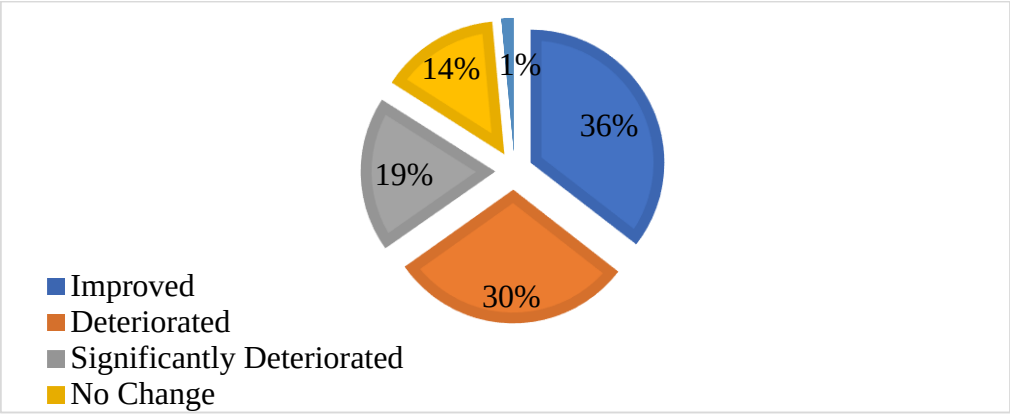

Figure 4.9: Impact of solid waste management on the river's cleanliness

Source: Researcher (2025)

Management of solid waste and its impact on river's cleanliness had almost equal responses by the respondents who mentioned that there was improvement (36 %) and those who said that river cleanliness had just deteriorated a little (30 %). The reason for these responses was because, solid waste management restoration strategies that were implemented during the cleaning of Ngong had mixed impacts of negative and positive. The cleaning initiatives resulted in the improvement of the immediate environmental condition of the river through reduction of wastes but did not prevent the further pollution of the river. Furthermore, a sense of shared responsibility was fostered through community clean-up campaigns, which encourage adoptions of better waste disposal practices by the residents and these was shown by 1 % of the respondent who said there was a significant improvement. However, significant deterioration of river's cleanliness was witnessed according to 19 % of the respondents because of lack of long-term positive impact as a result of insufficient infrastructure and inconsistency in community's participation. While 14 % of the respondents who mentioned that there was no change in rivers cleanliness was as a result of temporary improvement and waste dumping recurring and absence of sustainable waste management systems resulting in restoration efforts that were not fully sustainable **(Plate 4.2)**. A study by Mburu, (2016) which investigated the relationship between socio-economic exclusion and practices in waste management based among the communities in Kibera Slum was in line with these responses on impact solid waste management in river's cleanliness. The result of that study revealed extreme poverty, service exclusion such as waste collection and sewerage and labour market exclusion in Kibera Slum. These exclusions were resulting from inadequate participation, lack of employment, low wages, high crime rate and tribalism. Moreover, the research identified the major problems associated with solid waste management to be; inaccessibility of the roads, insufficient recycling activities, dumping of wastes at the river or water ways as well as financial challenges.

Plate 4.2: Ngong River that has been heavily polluted by solid waste and sewage

Source: Researcher (2025)

4.2.6.2 Changes in the biodiversity of the river ecosystem since the implementation of solid waste management strategies

Changes in the biodiversity of the river were observed by the residents in various ways while implementing river restoration strategies on solid waste management. According to 35 % of respondents, biodiversity of the river increased after solid waste management strategies were implemented. Alternatively, based on 33 % of the respondents, there was a decreased in the biodiversity after implementation of solid waste management restoration strategies. In addition, 19 % of respondents indicated that, a significant decrease was observed in biodiversity of the river. No change and a significant increase in biodiversity were mentioned by 12 % and 1 % of respondents respectively **(Figure 4.10)**. The increased in biodiversity of the river as mentioned by 35 % of the respondents after solid waste management strategies were implemented during the cleaning of Ngong River was a result of positive changes, although the challenges are still there. The decrease in wastes that are visible and other pollutants resulted in improvement of water quality, which had a positive effect on the river's aquatic life. Furthermore, according to the respondents during the cleaning period, some few species

of fish such as mud fish became available. However, the decrease and significant decrease in the river's biodiversity according to 33 % and 19 % of the respondents, was because the river is still faced with the challenge of solid waste accumulation due continual dumping by the residents and limitation of waste management infrastructure. No change was observed according to 12 % of the respondents because, the improvement of rivers biodiversity was gradual after cleaning of the river and changes were little to be noticed by some residents. While 1 % of the respondents who said that there was significant increase in the biodiversity of the river, was because the waste management strategies implemented during cleaning contributed partial restoration of biodiversity of the river during that time of cleaning, and some of the residents very optimistic of the full recovery of the river's ecosystem depending on the continued efforts in effective management of waste and ensuring long-term environmental protection.

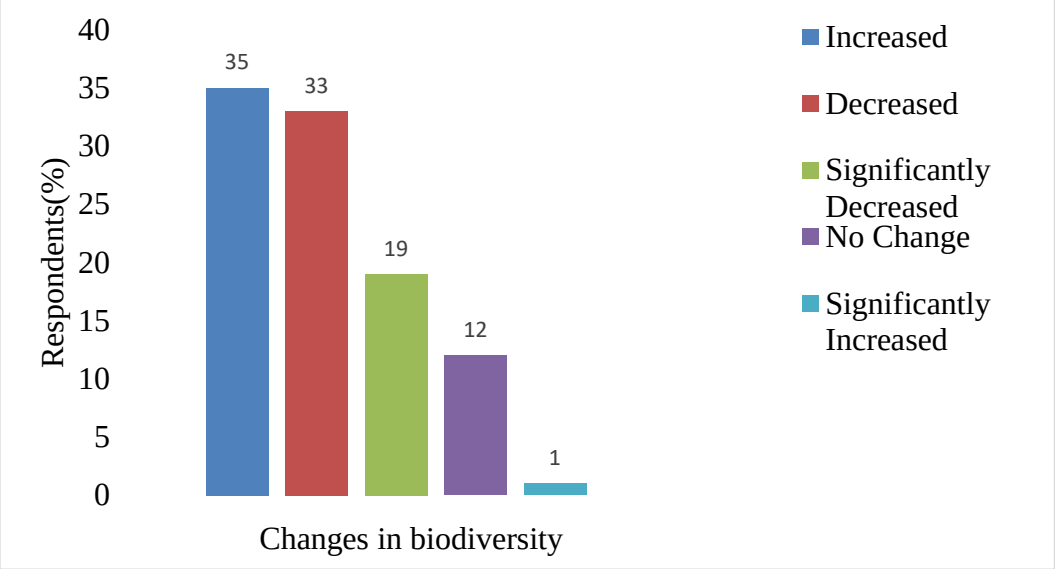

Figure 4.10: Changes in the biodiversity of the river after cleaning

Source: Researcher (2025)

Research by Kienja (2017) showed that between 2006 and 2009, there was a progress made by the government through landscaping and beautifying the riparian area of the Nairobi Rivers. Controlling of solid waste entering the rivers were achieved through replanting of indigenous trees and fauna along the riverbanks which increased biodiversity of the river. However, the residents living along the rivers, destroyed a lot of these trees and there was no replacement and this compromised the biodiversity of the rivers as well as its biological health. The study recommends constant replanting of

indigenous trees and fauna, enforcing of regulations to control further deforestations in order to restore these rivers.

4.2.7 Regulatory measures

4.2.7.1 Particular regulations on solid waste disposal or recycling

Based on the 51 % of the respondents, regulations on solid waste disposal and recycling exist within their community. Alternatively, 49 % respondents disagreed of the existence of regulations governing waste disposal and waste recycling. Moreover, in terms of the level of awareness on these regulations related to managing solid waste in their community, 52 % of the respondents said they were not familiar, while 48 % were familiar with the existence of these regulations. In terms of effectiveness of this regulation in managing solid waste, these regulations were not effective as indicated by the 67 % of the respondents, and slightly effective and effective as indicated by 32 % and 1 % of the respondents respectively. Most respondents were not compliant with these regulations (62 %) while 38 % of the respondents were complying. Awareness programs and initiatives on regulations on solid waste in the community have never been carried out as per 52 % respondents, while according to 48 % of the respondents, agreed that awareness programs and initiative have been carried out before.

Most respondents (51 %) were not cognizant of the existence of regulations on solid waste management, and disposal and this was because after solid waste management strategies were implemented during cleaning of Ngong River, there was some awareness programmes on regulations relating to waste disposal. In addition, 48 % of the respondents who were familiar with the regulations was attributed to educational campaigns and community outreach programme which were significant in informing the local residents regarding local laws on waste management and the environmental consequences of disposing waste improperly. Regulations were not effective according to 67 % of the respondents because, even though some residents have knowledge on the regulations, awareness is still uneven across different communities in the slum. And these is shown by 52 % of the respondents who said that awareness programmes have never been carried out in their community. This was due to challenges which include low level of literacy, limitation in accessing information, and a lack of consistency in enforcement which have hindered full compliance. Furthermore, while awareness has improved more efforts are required in ensuring broader understanding and consistency in adherence to the waste management regulations.

In line with these efforts, Nairobi Rivers Commission was established on December, 2022 with an aim of reclaiming Nairobi Rivers, which include Ngong River. The commission is using a collaborative approach in waste management with other stakeholders such as NEMA and Nairobi City County responsible for enforcing regulations in order to achieved the shared goal of restoring the Nairobi Rivers (Restoring the Nairobi River Corridor – KIPPRA, 2024).

4.2.8 Solid waste management by Nairobi City County Government

Most respondents (52 %) were very dissatisfied, with the services of the local authorities specifically the Nairobi City County Government in collection and disposal of waste. While 36 % of the respondents were just dissatisfied. Only 10 % and 2 % were satisfied and very satisfied respectively with how the solid waste were being managed by the Nairobi City County Government (**Table 4.20**). Most of the respondents (52 %) were very dissatisfied with how the county government, were handling the issue of solid waste management due to several reasons. One of the major reasons was inconsistent in waste collection services, where garbage is left uncollected for a longer period of time resulting in illegal dumping in and near the river. Additionally, there is a lack of proper waste segregation and recycling infrastructure, which further exacerbates the problem. The absence of clear enforcement of waste disposal regulations and penalties for illegal dumping has contributed to a sense of negligence among residents. Many feel that the county government has not adequately addressed the growing waste management challenges, leaving communities to cope with the impacts resulting from poor waste management, including the pollution of the Ngong River.

A report by AWSB, & NCWSC (2015) on Nairobi Rivers Basin Rehabilitation and Restoration Program revealed that management of waste in slum areas such as Kibera is a serious and difficult problem which Nairobi City County cannot easily handled it. The findings further revealed that, the problem of solid waste dumping along the rivers and open spaces is common in slum areas. Even though in the past there have been some interventions to stop these illegal dumping, these interventions have not been substantive enough to stop solid waste pollutions in the Nairobi Rivers basin.

Table 4.20: Solid waste management by the local authorities

Response	Percentage
Very dissatisfied	52
Dissatisfied	36
Satisfied	10
Very Satisfied	2

Source: Researcher (2025)

4.2.9 Regression analysis on effectiveness of solid waste management strategies used in restoration of Ngong River

The strategies used in solid waste management in restoration of Ngong River were further examined using ordinal regression analysis. Solid waste management strategies and effectiveness of those strategies in the management of solid waste were assessed in terms of their relationship and the findings were presented in tables and interpreted.

Table 4.21 (a), shows Model Fitting Information, which indicates significant improvement in the final model over the intercept-only model as demonstrated by the value of the chi-square of 87.007(df=18, p<0.001). This gives a suggestion of the predictor variables contributions to the explanation on variation of dependant variable (effectiveness of solid waste management strategies.

Table 4.21 (a): Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig. (p-value)
Intercept Only	309.845	-	-	-
Final Model	222.838	87.007	18	**0.000**

Source: Researcher (2025)

Table 4.21 (b) shows the Goodness-of-Fit statistics which illustrates a Pearson chi-square of 502.899 (p < 0.001), suggesting that the model probably was perfect fit for the data. The deviance statistic (182.424, p=1.000) shows a model fit that is acceptable. Since the reliability of deviance test is high in large samples, the model therefore is considered to be having a reasonable fit.

Table 4.21(b): Goodness-of-Fit

Test	Chi-Square	df	Sig. (p-value)
Pearson	502.899	298	**0.000**
Deviance	182.424	298	**1.000**

Source: Researcher (2025)

The Pseudo R- square (Model Performance) value indicates how variance in the dependent variable is well explained by the model. The Nagelkerke value of 0.500 is a suggestion of an explanation of approximately 50 % of the variation by the model of the effectiveness of solid waste management strategies, that is a moderate effect size. McFadden $R^2 = 0.236$ is a suggestion of explanatory power that is moderate **(Table 4.21 (c)**.

Table 4.21 (c): Pseudo R-Square

Pseudo R-Square Method	Value
Cox & Snell	0.465
Nagelkerke	0.500
McFadden	0.236

Source: Researcher (2025)

Parameter Estimates (Predictor Effects) in **Table 4.21 (d)** shows regression coefficient for the independent variables and how each independent variable affects the effectiveness of solid waste management strategies. The threshold is representing the cut-off points between the categories of effectiveness. The lower categories with the significant negative coefficient (such as (e.g., -8.130 for "Not Effective," $p < 0.001$) reveals that the higher levels of effectiveness are less likely unless higher values of predictor variables are present.

Table 4.21 (d): Parameter Estimates

Predictor	Estimate (B)	Std. Error	Wald	df	Sig. (p-value)	Exp(B) (Odds Ratio)
Waste segregation at source	-1.485	1.161	1.635	1	0.201	0.226
Recycling programs	-1.532	1.310	1.366	1	0.242	0.216
Installation of waste bins	-3.134	1.340	5.468	1	0.019	**0.044**
Community clean-up campaigns	-1.421	1.306	1.184	1	0.277	0.241
Public awareness campaigns	**-20.494**	**0.000**	**.**	1	.	**0.000**
Community involvement	-1.235	0.834	2.196	1	0.138	0.291

Source: Researcher (2025)

The model therefore revealed that the effectiveness of solid waste management strategies is significantly influenced by the type of the strategies (waste segregation at the source, recycling programs, installation of waste bins, community clean-up campaigns, public awareness campaigns, and community involvement) that were implemented. Furthermore, they are also affected by the way they are executed. The role of community involvement and the frequency of recycling were less influential in predicting effectiveness rating. In overall the model fit practically well in explaining 50 % of the variance in effectiveness of solid waste management strategies. Some independent variables were however, having stronger impact than others.

‘‘*The research therefore, failed to reject the alternative hypothesis, that a significant relationship existed between the effectiveness of strategies used in solid waste management and the restoration of the Ngong River’’.*

Almost similar results were obtained by a study by Kanja, (2020) on organic solid waste management in Nairobi City County. Inferential statistics were used in that study, which included estimation and hypothesis testing in further assessment of organic solid waste management strategies such as stakeholders’ involvement. The findings showed that, there was low to moderate involvement among majority of the stakeholders. The study recommended more collaboration between government and private institution in addressing the challenge.

4.3 Effectiveness of stakeholder roles in solid waste management in restoration of Ngong River

4.3.1 Roles and responsibilities in solid waste management in restoration of Ngong River

4.3.1.1 Primary roles of organizations and government agencies in solid waste management in restoration of Ngong River

Governments, and its agencies, various institutions and organizations involved in solid waste management in restoration of Ngong River had different roles based on respondents and these roles were; public awareness and education (36%), recycling and waste processing (14%), waste collection and transportation (31 %), policy formulation (5 %) and regulation, enforcement of waste management laws (5 %) and other specified roles such as housing and settlement (9 %) (**Table 4.22**). Majority of the institutions were involved in waste collection and transportation (31 %) and public awareness and education (36 %). The basic roles in solid waste management in the restoration of Ngong River was establishing and implementing waste management systems that were effective and thus minimization of environmental degradation and the promotion of river restoration. Some of the CBOs and the NGOs were involved in waste recycling and processing (14 %) and these organizations were focusing on collection of waste, recycling as well as disposing the waste to prevent river pollution. In addition, these CBOs were engaging and empowering the local community on solid waste management and this was done through awareness campaigns, educative programmes and capacity building which intend to foster responsibility in waste management. Furthermore, this was clarified during an interview with an official from a CBO, who asserted that;

> *"We are involved in community awareness, waste collection, and advocacy for better waste management practices. We also carry out clean-up activities along the Ngong River and we are working closely with youth and women's groups in creating income-generating activities from waste recycling."*
>
> KII 1, Programme Officer,
> Quality Smile Restores,
> Olympic, Kibera Slum (CBO),
> (2025).

Policy formulation (5 %) and regulation, enforcement of wastes management laws (5 %) was majorly carried out by the few stakeholders and these were specifically the Nairobi City County and the national government particularly through NEMA. They collaborate with other government agencies, as well as NGOs, CBO and private entities in enforcing policies and regulations on waste management.

This findings concurred with the research by Joshua,(2023) entitled ‘’Role of Communication in the Conservation and Restoration of Water Resources in the Face of a Changing Climate: a Case Study of the Nairobi River in Nairobi City County, Kenya. The study’s findings by Joshua,(2023) affirmed that public education and awareness were useful in achieving transformation of the attitude of the public attitudes and perception on waste disposal in saving Nairobi River. Furthermore, the rules and regulations on environment and governance of water resources must resonates with the public. The findings of this study projected the necessity of adopting a multi-stakeholder approach to conserve the Nairobi River.

Table 4.22: Primary role of the institutions in solid waste management

Role	Percent (%)
Public awareness and education	36
Recycling and waste processing	14
Waste collection and transportation	31
Policy formulation and regulation	5
Enforcement of waste management laws	5
Others	9
Total	100

Source: Researcher (2025)

4.3.1.2 Strategies and policies implemented for solid waste management

Different strategies were being used by various stakeholders in solid waste management. Smart waste collection technique was being used as a strategy according to 14 % of the respondents. The rest of the respondents each mentioned different strategies applied by their institutions in the management of the solid waste. Among these strategies were; empowerment of residents in Kibera Slums through better ways of managing waste, provision of waste collections bags to the households near the river, integrated solid waste management (ISWM) strategy,

public-private partnerships (PPP) for waste collection and many others. Among the commonly applied policies particularly mentioned by the respondents from the county government and the government agencies included; Nairobi City County Solid Waste Management Act (2015) and National Solid Waste Management Strategy Solid Waste Management Act (2022). Strategies and policies were implemented with an aim of managing solid waste management in Kibera Slums and in the restoration of Ngong River with a particular focus on promotion of sustainability in waste and compliance of regulations. The major policies addressed segregation of waste at the source thus mandating households and businesses to carry out separation of recyclable, organic and non-recyclable waste. Nairobi City County and others stakeholders have endeavoured to implement strategies which include establishing designated points for collecting waste, and partnering with licensed service providers in waste collection. These strategies and policies collectively were useful in solid waste reduction, enhancement of ecosystem's health and promotion of sustainability of the urban development. However, these strategies and policies were not fully implemented in riparian area of Ngong River hence the river remains heavily polluted(Athi Water Services Board, 2015).

4.3.1.3 Frequency of waste Collection near Ngong River

Waste collections in Kibera Slums and in areas near Ngong River were being conducted at a different interval according to the respondents whom their institutions were involved. The respondents whom their institutions were involved in collections of solid wastes were 74 % of the total respondents whom the institutional questionnaires were administered to, while the rest were not involved in the collection of the waste. Majority of the organizations which are involved in restoring Ngong River, were typically conducting waste collections as per the pre-established schedules which ensured consistency and efficiency in the management of waste. Waste collections frequency mostly depends on rate generation of waste, population density, within the riparian area, and the resource availability in the organization.

According to the majority of respondents (32 %) solid waste collections were carried out weekly, and on monthly according to 18 % of the respondents. Waste collections were carried based on the demand according to the 14 % of the respondents while wastes were being collected daily and bi weekly as per 5 % of the respondents

respectively. However, substantial number of respondents (26 %) did not know the frequency of waste collections (**Table 4.23**). Waste collections were carried out weekly according to 32 % of the respondents because, Kibera Slums and riparian areas near Ngong River are densely populated, and not easily accessible due to poor road network system and overcrowding of houses hence residents dumped waste directly into the river. A considerable number of the respondents (26 %) were not aware of the frequency of waste collection because waste collections were randomly done and were usually supplemented by community led waste collection initiatives or emergency response measures during heavy rain or floods which worsens the disposal of waste into the river.

The findings of this study coincide with the research by Villa *et al.*,(2024) on social impact resulting from closure of Ngong dumpsite. The closure of Ngong dumpsite in 2018, resulted in reduction in frequency of waste collection in Kibera Slums by different actors hence increasing solid waste pollution in the slum and pollution of Ngong River. The alternative dumpsite like Dandora are very far and only few actors such as Nairobi City County can transport waste using tracks, however their services to Kibera Slums were limited due to the vast areas of operation within the county.

Table 4.24: Frequency of waste collections

Frequency	Percentage
Weekly	32
Monthly	18
On demand	14
Daily	5
Bi-weekly	5
Unknown	26
Total	100

Source: Researcher (2025)

4.3.1.4: Collaboration of stakeholders in solid waste management

Institutions that were involved in restoration of Ngong River were collaborating with different stakeholders in ensuring integrated and sustainable approach to solid waste management was achieved. These stakeholders were Nairobi County Government, government bodies such as NEMA, private organizations like NGOs and CBOs, private waste companies among many others. The collaboration entailed regular stakeholder meetings in order to align the goals, share resources and to develop a cohesive action

plan. Government agencies were responsible for provision of policy guidelines and enforcement mechanism, while private organizations contributed their expertise in waste collection, recycling and disposal technologies (Odha & Mbataru, 2024). Various form of collaboration such as regular meetings, joint projects, and funding partnerships was used. Each of these forms of collaborations were being used more than once by various organizations and government institutions as shown by the feedback from the respondents whom the institutional questionnaires were administered. The most popular form of collaboration was through joint projects (50 %), and were then followed by funding partnerships (27 %) and through regular meetings (18 %). While the instances where there was no collaboration were rare only accounting for 5 % (**Table 4.25**). Moreover, various forms of stakeholders' collaboration as well as challenges faced in those collaborations were further explained by a respondent from a CBO.

> *"There are collaborations with various stakeholders, but they are not well-structured. There is lack of regular platform for every stakeholder to coordinate their efforts effectively. Stakeholder meetings and community engagement forums are occasional and lacking follow-up and implementation strategies. Moreover, there are funding conflicts, whereby many stakeholders are competing for limited resources. Some stakeholders are blaming one another rather than working together."*
>
> KII 1, Programme Officer, Quality Smile Restores, Olympic, Kibera Slum (CBO), (2025).

Table 4.25: Stakeholders collaboration in solid waste management

Form of collaboration	**Percent** (%)
Regular meetings	18
Joint projects	50
Funding partnerships	27
No collaboration	5
Total	100

Source: Researcher (2025)

4.3.1.5 Key resources in solid waste management in Kibera Slum

Key resources were provided by various stakeholders such as government and its entities, CBOs, NGOs and private companies and were useful in solid waste management process. These key resources were; technical resources, capacity building and trainings, as well as human resources and logistics. Capacity building and trainings (36 %), technical resources (32 %) and human resources (27 %) were the most common key resources. However, logistics (5 %) were the least among the key resources provided (**Table 4.26**). Capacity building and trainings, technical resources and human resources were the common key resources provided because NGOs and CBOs are the usual contributors and their contributions fosters public participation and awareness. Private companies in waste management were the one usually providing logistical support such as transportation and recycling solution. Private companies generally have an aim of making profits, hence cannot offer a lot of free services, and this explains less logistical support (5 %). A research by Ochieng, (2016) on effectiveness of roles of stakeholders in solid waste management in Korogocho Slum in Nairobi reveals almost the similar results. In this research, majority of the stakeholders in solid waste management were lacking sufficient key resources to effectively carry out their work. This has resulted in poor disposal of waste, erratic system of waste collection and private waste collectors charging exorbitant fee.

Table 4.26: Key resources in SWM in Kibera Slum

Key resources	**Percent** (%)
Technical resources	32
Capacity building and trainings	36
Human resources	27
Logistics	5
Total	100

Source: Researcher (2025)

4.3.2 Effectiveness of Stakeholders roles in solid waste management

4.3.2.1 Rating of the effectiveness of Nairobi City County's role in safe disposal of waste

The effectiveness of the role of Nairobi City County in ensuring safe disposal of waste collected in all areas of Kibera Slums including riparian areas of Ngong River was rated on a scale of 1-5. According to the results obtained from the institutional questionnaires administered to the various respondents, Nairobi City County Government was ineffective in their role of collecting and disposing solid waste from Kibera Slums according to 65 % of the respondents and very ineffective based on 10 % of the respondents. While 15 % of the respondents were neutral on the effectiveness of the roles of county in disposing collected waste. According to only 5 % of the respondents, the county was very effective and effective respectively in disposing solid waste collected from Kibera Slum (**Table 4.27**). Majority of the respondents (75%) mentioned that Nairobi City County was ineffective ensuring safe disposal of solid waste collected. Even though, the Nairobi City County Government had established infrastructure for example designated dumpsites the challenge arises due lack of consistent and safe disposal practices. Efforts to regulate waste management were hampered by insufficient enforcement, constraints of the resources and logistical challenges which resulted in illegal dumping and landfill that were poorly managed. The respondents (5%) who mentioned that, the county government were effective and very effectively respectively was possibly because they have witnessed collaboration of the county government with other stakeholders and community sensitizations programmes on wastes management which were initiated. However, these programmes and collaborations usually lack scale and funding required for the widespread impact.

Improvement in effectiveness of ensuring safe disposal of solid waste collected, Nairobi City County should ensure waste management laws are strictly enforced especially in riparian areas of Ngong River. The current role of the County Government shows some potential but is supposed to be strengthened in order to fully support the restoration of Ngong River. The report by Urban Links Africa (ULA, (2021) shows some level consistency with this particular findings of this study and it asserts that Nairobi is facing a serious challenges relating to management of the solid waste majorly due to the ineffectiveness of the authorities in handling the waste. Furthermore, the issue of ineffectiveness is due to current system of collection and disposal leading to negative social, economic and environmental outcomes.

Table 4.27: Rating of the effectiveness of Nairobi City County's in safe disposal of waste collected

Rating	**Percent** (%)
Very Ineffective	10
Ineffective	65
Neutral	15
Effective	5
Very effective	5
Total	100

Source: Researcher (2025)

4.3.2.2 Assessment of cost-effectiveness of transportation of waste by the County Government

On a scale of 1-5 the cost effectiveness of transportation of waste managed by Nairobi City County in Kibera Slums was rated as being; very cost effective, cost effective, neutral, not cost effective, and very inefficient. The cost-effectiveness in transportation of the waste by the Nairobi City County was rated as being not cost-effective and very inefficient as by 43 % and 32 % of those interviewed respectively. Cost effectiveness was rated as neutral (15 %) while according to 5 % of the respondents, transportation of waste by the Nairobi City County was cost effective and very cost effective each correspondingly (**Table 4.28**). According to majority of the respondents (75 %) the cost effectiveness of transportation of waste managed by the county was rated as being not cost-effective and very inefficient. Even though, the county has been making effort in improving waste transportation system which include partnering with private waste

collectors and deploying trucks, insufficient maintenance of vehicle and limited coverage negatively affects the cost effectiveness. Increased costs of operations together with waste collection schedules which were not regular resulted into illegal dumping of waste in Kibera Slum, which complicates further restoration of Ngong River (Odha & Mbataru, 2024). Furthermore, the absence of investment in modern truck for waste collection which consume less fuel and are efficient, increases the expenses while delivering poor results. And this, explains the reason for very few respondents (5 %) who rated cost effectiveness of transportation of waste managed by Nairobi City County in Kibera Slum as being effective and very effective respectively. Improvement in the cost-effectiveness requires the county government to utilize innovations which include GPS-enabled route optimization, public private partnership which are useful in expanding transportation capacity. In addition, community-based hubs for waste collections should be used to reduce transit distances. Financial sustainability effort of transporting waste will significantly be enhanced if these inefficiencies are addressed and hence support restoration of the river (Kindiga, 2017).

Table 4.28: Assessment of cost-effectiveness of transportation of waste by the County Government

Rating	**Percent** (%)
Very cost effective	5
Cost-effective	5
Neutral	15
Not cost-effective	43
Very inefficient	32
Total	100

Source: Researcher (2025)

4.3.2.3 Effectiveness of the National Government in providing legislative support for solid waste management

The national government efforts in providing legislative support to the solid waste management was assessed. And according to the responses, 64 % of the respondents were neutral on whether the national government was effective or not effective in providing legislative support on solid waste management, while 32 % of the respondents, said that the government was not effective, while the least percentage

respondents (4 %) perceived that, the national government was effective in providing solid waste management (**Table 4.29**). Majority of the respondents (64 %) were neutral regarding the national government in provision of legislative support which relates to the restoration of Ngong River because the government has been moderately effective. Policies for example the Environmental Management and Coordination Act (EMCA) and the waste management regulations provided a robust avenue, which addresses the issue of solid waste such as collections, disposal and recycling. Roles of various stakeholders were established by these laws, as well as setting standards in the management of waste and promotion of sustainable practices**.** The Sustainable Waste Management Act 2022 seeks for provision of sustainable management of waste. For a long period of time, waste management issue has been the responsibility of the county council, and it thus it was not addressed at the national level. The Act therefore, addresses the systemic issues that have plagued for a long time the collection and separation of waste in addition to recyclability and reuse of the waste materials in a sustainable way. The respondents (32 %) who said that the government was not effective, was probably because the enforcement of these regulations has been a challenge because of insufficient resources, poor coordination between national and the county government as well as inadequate mechanism of monitoring. In addition, the 4 % of the respondents who said the government was effective in legislative support was possibly because of laws and initiatives which ban plastic bag and circular economy promotion. Moreover according to Odha, (2024), full implementations of ban of plastic were however hindered by gaps in public awareness and development of infrastructure. Supporting legislative enforcement and provision of sufficient funding and improvement of intergovernmental collaboration are vital for enhancement of government effectiveness which support restoration of Ngong River.

Table 4.29: Effectiveness of national government in providing legislative support for solid waste management

Ratings	Percentage
Not effective	32
Neutral	64
Effective	4

Source: Researcher (2025)

4.3.2.4 Major challenges faced by organizations its role in solid waste management

The private organizations as well as government and its entities were facing myriads of challenges in executing its roles of solid waste managements in relation to restoration of Ngong River. The major challenges as mentioned by 95 % of the respondents were; insufficient funding and resources, inadequate infrastructure, rapid urbanization and population growth, lack of public awareness and engagement in solid waste management, limited enforcement of regulations, and full dependence of informal waste collectors and these were the main challenges apart from many other challenges faced by organizations and government institutions in solid waste sector. In addition, an interview with official from a CBO highlighted the major challenges faced in SWM.

> *"While efforts have been made, the river remains heavily polluted. Waste collection services are not consistent, and there is persistent waste dumping into the river. Lack of very strict enforcement of laws and improvement in waste management infrastructure, is worsening the state of the pollution of Ngong River."*
>
> KII 1, Programme Officer, Quality Smile Restores, Olympic, Kibera Slum (CBO), (2025).

According to Odha & Mbataru,(2024), Ngong River restoration faces challenges in solid waste management due to insufficient funds, poor enforcement of waste management legislation, lack of public understanding, logistical issues, and fragmented stakeholder collaboration. Urbanization and population growth also increases garbage output, necessitating a multifaceted strategy including increased funding, robust policy enforcement, public education, and enhanced stakeholder engagement.

4.3.3 Stakeholder Collaboration and Public Participation

4.3.3.1 Strategies used in raising awareness on solid waste management and river restoration

Different strategies were used by the CBOs, NGOs and government and its agencies in raising awareness on solid waste management and river restorations. Among the methods used were; workshops and training, public campaigns, social media and online outreach, collaborations with local leaders and other specified methods. Majority of the stakeholders in solid waste management in restoration of Ngong River were using workshops and training methods as per 54 % of the respondents as well as public campaign according to 27 % of the respondents. Social media and online outreach, collaboration with local leaders and other methods were being used, according to 9 %, 5 % and 5 % of the respondents correspondingly **(Figure 4.11)**.

Workshops and trainings were popular methods according to 54 % of the respondents because, NGOs and CBOs were usually organizing workshops, community forums and door to door outreach programmes. These were useful in engaging the residents directly and hence provision of practical knowledge on segregation of waste, recycling and best disposal practices. Public campaigns were the second most popular method because it was mostly used by government agencies in educating the public on waste disposal and the impact of pollution on river. While social media and online outreach such as radio station and mobile apps were being used as a means to other methods such as public campaign and they were useful in reaching wider audience.

Almost similar results were found by a study by Joshua,(2023) on the role of communication in restoration of Nairobi Rivers which recommends engagement with the local community. Engagement with local community give a priority for stakeholder collaboration and awareness campaign which is important component of communication. Strategies such as workshops and trainings and social media are useful in empowering the local community with knowledge and sense of ownership of the Nairobi Rivers Basin.

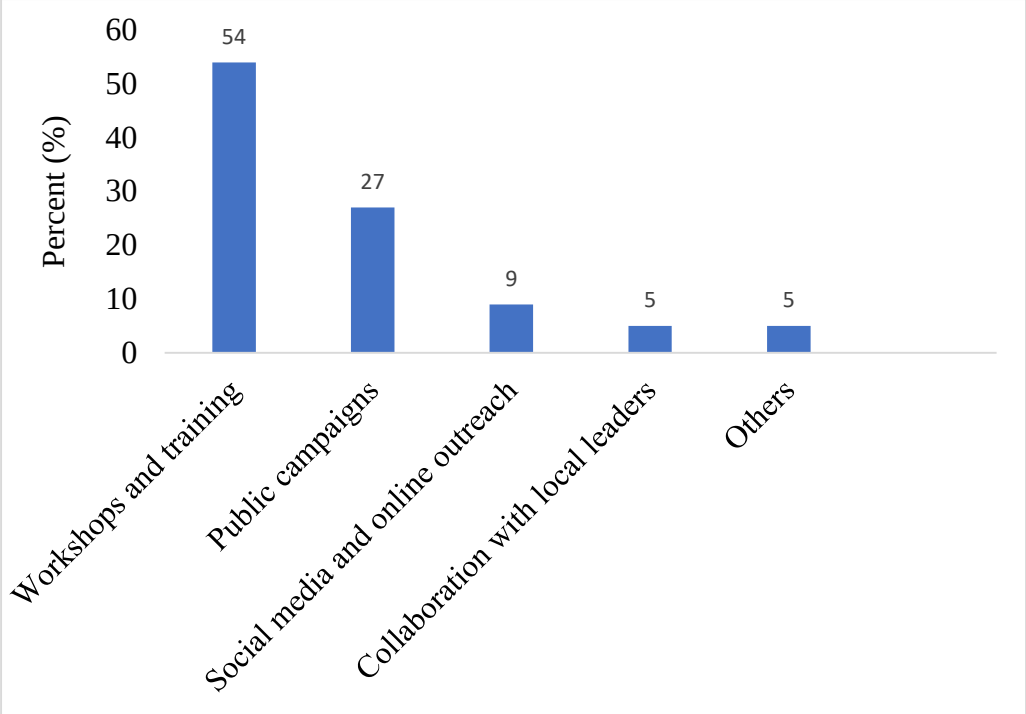

Figure 4.11: strategies used in raising awareness on solid waste management and river restoration

Source: Researcher (2025)

4.3.3.2 Creation of linkages between various stakeholders for solid waste management activities

Success in creation of linkages between various stakeholders in solid waste management such as government, and its institutions, NGOs, CBOs and the local community during restoration of Ngong River was ranked as very successful, successful, neutral, unsuccessful and very successful. Majority of respondents (54 %) were neutral while those 22 % and 9 % of the respondents ranked the creation of linkages were successful and very successful respectively. The rest of the respondents ranked the creation of linkages as unsuccessful and very unsuccessful as by 10 % and 5 % of the respondents respectively (**Table 4.30**).

The reason why majority of the respondents (54 %) were neutral in their response was because, most of the stakeholders such as government, NGOs and CBOs were moderately successful in creating linkages for solid waste management in relation to Ngong River restoration. However, the creation of linkages was successful and very successful as per 22 % and 9 % of the respondents respectively. And this could be due to government responsibility in creation of linkages through regulatory framework and

policy support. NGOs and CBOs are bridging the gap by engaging with the local communities, creating awareness and ensuring communities participates actively in solid waste management initiatives. Furthermore, NGOs and CBOs are involved in facilitation of dialogue and collaboration by use of multi-stakeholder forums, joint clean-up event and initiatives for resource sharing. However, there are challenges to ensure these linkages remains productive and sustainable. And this probably explained the reason for the respondents who ranked creation of linkages as being unsuccessful (10 %) and very unsuccessful (5 %).

Lack of coordination, with divided efforts and less communication between stakeholders are among the challenges in river restorations projects. In spite of these challenges, the ongoing efforts of creating more linkages especially by the government through improvement of partnership, joint projects, shared consultations, and shared objectives gradually improves collective impact in management of solid wastes in restoration of Ngong River (Ngatia *et al.*,2023).

Table 4.30: Creation of linkages between various stakeholders for solid waste management activities

Ratings	Percent
Very successful	9
Successful	22
Neutral	54
Unsuccessful	10
Very unsuccessful	5
Total	100

Source: Researcher (2025)

4.3.3.3 Participation in multi-stakeholder meetings or forums on solid waste management

Most of the stakeholders participated occasionally(annually) on multi-stakeholder meetings or forums on SWM in relation to the restoration of Ngong River and this was according to 50 % of the respondents. While participation was regularly (monthly or quarterly) as per 41 % of the respondents. However, stakeholder's participation on multi-stakeholder meetings or forums on SWM were rare according to 9 % of the

respondents (**Figure 4.12**).

Stakeholders were typically participating in multi-stakeholder's meetings or forums on solid waste management in relation to the restoration of Ngong River occasionally and regularly. And this depends on urgency and the scale of the ongoing activities. These meetings were the avenues for the discussion of the progress, to address challenges and align strategies among the stakeholders. Furthermore, they allow information sharing on waste management practices, policy update and the community engagement efforts. Frequency of these stakeholders' participation vary but regular engagement ensures every stakeholder were aligned in their efforts. Moreover, they can adapt their approaches as per new development or emerging challenges in relation to river's restoration (Sobowale, 2019).

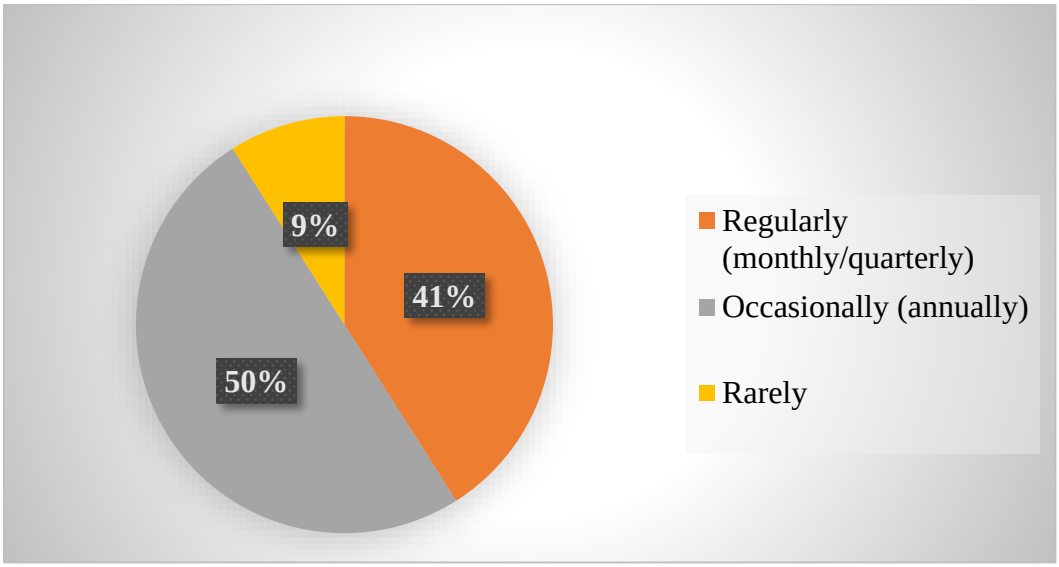

Figure 4.12: Participation in multi-stakeholder meetings or forums on solid waste management

Source: Researcher (2025)

4.3.3.4 Level of involvement of local communities in solid waste management activities near Ngong River

According to the 72 % of the respondents from various government, NGOs, and CBOs, local communities were fully involved in SWM activities near Ngong River through community consultations and clean-ups programmes. Involvement of local communities in SWM activities near Ngong River was partially carried out according

to 22 % of the respondents. However, based on 1 % of the respondents, local communities were not involved at all in SWM activities near Ngong River (**Figure 4.13**). This was further explained in an interview by the key informant.

> *"There is an increase in involvement by the local community, however many people are still dumping waste into the river because of lack of sufficient awareness. Younger people are more involved than older generations. More people are involved because of incentives and recycling businesses opportunities which generate income."*
>
> KII 2, Village elder of Gatwekera Village, (2025).

Different organizations and government and its agencies involved local communities significantly to some extend in solid waste management in restoration of Ngong River as evident by 72 % of the respondents. However, this is contrasting to the previous findings of this study, where majority of communities at Kibera Slums near Ngong River area were not involved. This was attributed to factors such as corruption nepotism and other factors by the leadership local community level despite these organizations endeavouring to involve the local communities.

Involvement of community is deemed to be a cornerstone of initiatives since local community performs a crucial role in the successful waste management efforts. Involvement of communities is often carried out using awareness campaigns, trainings and workshops that were educative to the residents concerning proper waste management practices. Additionally, direct involvement of local communities in activities such as clean-up drives, and waste collection to control pollution of the river was witnessed(Joshua,2023). Certain organization or government and its agencies can set up community-based waste management committee for ensuring local ownership and accountability. This encourages sustainability of waste management practices at the grassroot level. Collaborative efforts with the leaders of the community are useful in ensuring that the waste management solutions are culturally correct and accepted by many. This approach which is inclusive is important in fostering a sense of shared responsibility as well as empowering communities in taking active role in the restoration of the polluted rivers (Mbithi, 2018).

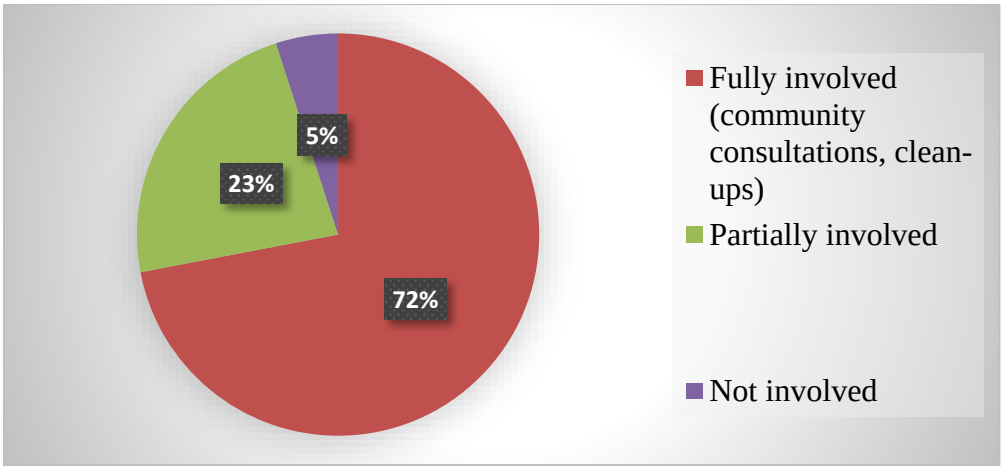

Figure 4.13: Level of involvement of local communities in solid waste management activities near Ngong River

Source: Researcher (2025)

4.3.3.5 Role of the local community in the restoration of Ngong River

The role of the local communities in solid waste management in river restoration programme is very crucial in achieving its' success. This can be achieved by the local communities taking ownership of their environment and through active participation in sustainable waste practices(Odha & Mbataru, 2024). All the respondents gave varying opinions but were all in agreement that, the local communities have a significant role in restoration of Ngong River through better waste management.

> *"We teach the communities in Kibera Slum on waste disposal, as well as organizing river clean-ups activities, and facilitating collaboration with NGOs and government agencies in managing solid waste. Our role also includes youth mobilization for waste collection and reporting illegal dumping to authorities."*
>
> KII 2, Village elder, Gatwekera Village, (2025).

Communities can contribute through adoption of proper waste segregation at the household level, proper disposal of recyclable and non-recyclable and reduction in the amount of waste entering the river. Communities can plan clean-up activities regularly, monitor the disposal of wastes and the dumping site as well as working together with

authorities locally in maintaining riverbanks and its surrounding clean. Moreover, residents can be ambassadors for the reduction of waste through offering education to other residents on the impacts of environment due to poor waste management. Communities can create community-based waste management groups which are useful in supporting waste collection, recycling and recycling which reduces the burden on the municipal systems(Mandela, 2020).

Eventually, local communities' active engagement and leadership in waste management are crucial in creation of the lasting, sustainable solutions for restoration of a polluted river. And this ensures a long-term health of the ecosystem and the well-being of the people living close to the river(Jenkins *et al*., 2021).

4.3.4 Impact of solid waste management on the Restoration of Ngong River

4.3.4.1 Impacts of different organizations on reduction of solid waste pollution

The impact of organizations and governments and its agencies involved in the restoration of Ngong River on their activities which aimed at reducing waste pollution was moderate, according to most of the respondents (40 %). However, based on 31 % and 5 % of the respondents, there was a high impact and very high impact respectively on reduction of waste by the organizations as well as with the governments and its agencies involved in restorations of Ngong River. While there was low impact according to 18 % of the respondents and there was no impact according to 6 % of the respondents (**Table 4.31**).

The impact of activities of governments and its agencies as well as NGOs, CBOs and other stakeholders on reducing waste pollution was moderate. This is because, some of these stakeholders have endeavour to raise awareness, implement waste collection programs and engage the local communities which possibly is the reason according to 40 % of the respondents. Even though, a significant impact has been made on reduction of wastes by regular clean-up activities, initiatives for segregation of waste, and educational campaigns. And this could be the reason for high and very high impact as per 31 % and 5 % of the respondents. However, the challenge remains on ensuring widespread participation, which could be the reason for 1ow impact according to 18 % of the respondents. The impact of these activities was restricted by constraint of resources, insufficient enforcement of regulations on management of waste as well as

poor coordination among the stakeholders.

The findings of this study were further supported by information in a magazine by an NGO, named Mazingira Yetu, which undertook restorations projects in Ngong River. In this magazine entitled ‘‘River Ngong Restoration & Sanitation Works (Kibera)’’, the editor Irungu, (2022), clearly showed that the level of pollution in Ngong River needs a sustained and a collaborative efforts. The reason for this is because, one-off initiatives or limited intervention cannot yield a long-term result. Thus, while the organization may contribute positively, an approach that is more integrated, focus greater on enforcement, develop infrastructure and empower community is require in the reduction of wastes and restoration of the health of Ngong River.

Table 4.31: Impacts of reducing waste pollution in Ngong River

Rating	Percent
Very high impact	5
High impact	31
Moderate impact	40
Low impact	18
No impact	6
Total	100

Source: Researcher (2025)

4.3.4.2 Outcomes as a result of solid waste management efforts near Ngong River

Significant outcomes have been observed as a result of SWM near Ngong River by various organizations such as NGOs, CBOs, and government and its agencies. This was further explained by the key informant. The outcomes were; increase in recycling activities, improvement in the community health, reduction in illegal dumping and other specified outcomes. Increasing recycling activities was the major outcome and this was according to 47 % of the respondents, which was then followed by the reduction in illegal dumping, improvement in water quality and no significant change according to 14 % of the respondents each correspondingly. Based on 7 % of the respondents, there was improvement in the health of the community. The remaining respondents (4 %) gave other specified outcomes such as creation of job opportunities among the youths in the local communities through solid waste collections among other many other outcomes (**Figure 4.14**).

"Some progress has been made, in restoration of Ngong River however, dumping of solid waste illegally into the river remains a big challenge. In addition, waste collection services are not reliable, and this makes it to maintain cleanliness."

KII 3, Project Officer, Mazingira Yetu, (NGO) (2025).

Increasing recycling activities (47 %) was the common outcome because of the enhancement of recycling efforts by awareness campaigns and waste segregation practices that were introduced resulting in more residents and waste collectors being involved in recycling initiatives. In addition, improvement in waste management practices have resulted in reduction in illegal dumping, and improvement of water quality. Moreover, this has improved community's health through reduction in the spread of waterborne diseases, as well as respiratory problems related to burning of waste. However, there was no significant change, which is in line with the responses given by residents in other objective of this study. Though there was improvement as previously mentioned, still significant overall change is lacking in the long-term restoration on Ngong River. This was due to the persistent challenges such as insufficient infrastructure, inconsistency in the enforcement of waste management policies and community involvement which was limited. Holistic efforts are required in achieving a more sustainable and widespread improvement in the management of waste and restoration of the river.

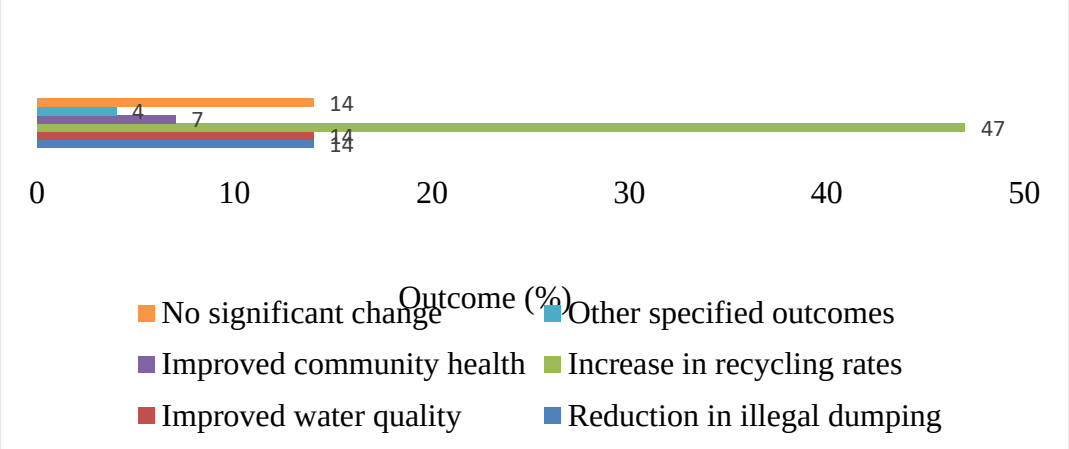

Figure 4.14: Outcomes as a result of solid waste management efforts near Ngong River

Source: Researcher (2025)

A research conducted by Odha, (2024) on prevention and control of pollution of Ngong River aligns with the results obtained in this study. The study suggests a multidimensional approach, with consideration of the outcome of restorations which are not only reducing pollutant level through ways such as reduction in illegal dumping, and improvement of water quality. But also, improvement in the general health of river's ecosystem. An example, is exploration which entails, evaluating availability of biodiversity and riparian areas which have been restored.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents a summary of the major findings of the study, the conclusions drawn from these findings, and the recommendations based on the conclusions. Additionally, it outlines actionable recommendations derived from the study results. Finally, the chapter suggests areas for further study and research based on the gaps identified during the study.

5.2 Summary of findings

The study assessed waste collection methods, frequency, types, and challenges faced by informal waste collectors along Ngong River's riparian areas in Kibera Slum. Door-to-door collection was the most common method (42%), followed by on-call services (25%) and community points (16%). Waste was mostly collected 2–3 times a week (36%) or daily (29%), though irregular collection led to accumulation, especially during rainy seasons. Organic (45%) and recyclable waste (40%) dominated household waste, while electronic (11%) and hazardous waste (3%) were minimal. Although demand for waste services was high (53%), affordability issues led many households to dump waste into the river. Payments were mainly pay-per-service (45%) or monthly (29%). Informal waste collectors faced major challenges, including lack of disposal facilities (42%), irregular payments (15%), and poor road access (14%), resulting in unreliable waste collection and worsening river pollution.

The study found that several solid waste management strategies such as waste segregation, clean-up campaigns, recycling, installation of waste bins, regulatory enforcement, awareness programs, and stakeholder collaboration were used in restoring Ngong River. However, their effectiveness was limited, with 48% of respondents rating them slightly effective and 24% ineffective, largely due to poor coordination, inadequate funding, and weak implementation. Most households (80%) still disposed of waste directly into the river because of poverty, poor infrastructure, and lack of collection services. Recycling efforts were mainly economically rather than environmentally driven and faced low participation and poor incentives. Community involvement was low (66%) due to corruption, nepotism, and exclusion. Although minor improvements in cleanliness and biodiversity were noted, weak regulation, rapid

informal settlement growth, and inconsistent waste collection continue to hinder sustainable restoration, leaving the river heavily polluted.

The study assessed the effectiveness of roles of different stakeholders such as county government, government agencies, NGOs, and CBOs, involved in solid waste management with an aim of restoring Ngong River. It was established that public awareness (36%) and waste collection and transportation (31%) were the key roles, while recycling (14%) and policy enforcement (10%) were less prioritized. Strategies like integrated SWM, public-private partnerships, and provision of waste collection bags were implemented but were subverted by poor enforcement, incomplete implementation, and inconsistent collection of waste in the riparian areas of Ngong River in Kibera Slum, resulting in illegal dumping of waste into the river. In spite of the fact that, joint projects (50%) and funding partnerships (27%) were major forms of collaborations among stakeholders, these efforts were hindered by lack of enough resources, poor coordination, and political interference. Nairobi City County Government was rated ineffective (75%) because of very limited waste collection and disposal services, weak enforcement of waste regulations logistical challenges and many waste management related challenges. Despite modest improvements, these challenges significantly limited the effectiveness of stakeholder's roles in solid waste management in restoration of Ngong River hence pollution of the river remained a big problem.

5.3 Conclusion

The study shows that stakeholder participation has an imperative role in solid waste management and restoration of Ngong River though gaps have significantly persisted which are undermining its effectiveness. Whereas implementation of different solid waste management strategies which include, community clean-up campaigns, waste segregation, recycling initiatives, and regulatory measures, etc, have been done. However, their impacts have not been realized fully, because of weak enforcement, insufficient public participation and as well lack or poor infrastructure, among others. Waste segregation is not popular among the households and not well practiced because of public awareness which is lacking, as well as inadequacy of the equipment and facilities for sorting. Clean-up campaigns are sporadically carried out and lacking a long-term sustainability. Waste bins and collection points specifically were very

insufficient within the households located at the riparian areas of Ngong River, resulting in continuous dumping of waste into the river. Recycling initiatives were not well developed due to lack of economic incentives and weak support of the policy. Moreover, the households solid waste collection by service providers such as informal waste collectors and Nairobi City County Government was negatively affected by some factors. High demand, inconsistent service delivery, high operational costs, and negative public perceptions due to unreliable collection schedules were among these factors. Stakeholders such as county government, government agencies involved in restorations of Ngong River were facing challenges which negatively affects the effectiveness of their roles. For instance, collection and disposal of waste by the county government and some private agencies were unreliable or in some cases totally lacking in riparian areas of Ngong River in Kibera Slum. Advocacy and awareness campaigns were not effectively carried out and thus failing to significantly achieve behavioural change in practices relating to waste disposal. In addition, weak enforcement of policies supports illegal dumping into the river. Failure to address these essential issues, restoration of Ngong River will always be challenging and moreover, this exacerbates degradation of environment and health risk of the residents in Nairobi City County and its surroundings.

5.4 Recommendation

Improvement of solid waste management and support of restoration of Ngong River, in general requires a holistic and a well-coordinated approach that is driven by stakeholders themselves. The approach is supposed to strength enforcement of policies, improve the infrastructure of waste management, enhances collaboration among various stakeholders as well as ensuring sufficient funding for sustainable solid waste management practices. Based on these findings therefore, the recommendations below were suggested:

1. Waste segregation at household and business levels should be enforced through laws such as EMCA (2015) and the Waste Management Act (2006) to ensure proper separation of biodegradable, recyclable, and non-recyclable waste. NEMA, Nairobi City County, and NGOs should strengthen public awareness and education campaigns to inform residents about the importance and methods

of segregation, fostering positive attitudes and responsible waste disposal practices.

2. Community clean-up campaigns should be institutionalized as continuous, well-organized programs supported by local authorities and private sector actors to ensure adequate resources and active public participation. Additionally, Nairobi City County and NGOs should extend the installation of waste bins and collection points to residential areas along the Ngong River in Kibera Slum, strategically positioning them to improve accessibility and reduce illegal dumping
3. Recycling initiatives, reported by 22% of respondents, should be expanded through financial incentives for both small- and large-scale recyclers. Partnerships between private waste management companies and informal collectors need to be strengthened, while recycling should be integrated into national and county waste management policies. Additionally, the government and NGOs such as UNEP should allocate more funding for recycling facilities, community-led programs, and waste treatment plants, and offer financial incentives to businesses investing in sustainable waste solutions to encourage private sector participation.
4. Household solid waste collection services including scheduled, on-call, door-to-door, and community-based methods should be enhanced to improve efficiency and reliability. Since 75% of respondents found Nairobi City County's services ineffective, the County should ensure consistent waste collection, particularly in underserved riparian areas along Ngong River. Moreover, introducing more public-private partnerships or subsidies to reduce or waive collection fees would enable greater participation by private and informal waste collectors, ensuring affordable and inclusive waste management for low-income households.
5. Stakeholder roles in waste management should be clearly defined by the government to prevent overlaps and enhance efficiency and accountability, particularly in law enforcement by Nairobi City County and NEMA. The County should ensure reliable, safe, and cost-effective waste collection and disposal. Efforts by NGOs, CBOs, and private entities in restoring Ngong River should be supported by all stakeholders, including the government and local communities. Strengthening linkages and holding regular multi-stakeholder

forums among agencies such as NEMA, WARMA, Nairobi City County, NGOs, and communities would foster dialogue, knowledge sharing, and coordinated actions for sustainable waste management.

6. To ensure the long-term restoration of Ngong River, the government should strengthen policy regulation, enforcement, and funding through the Ministry of Environment and related ministries. These ministries should collaborate with agencies like NEMA, WARMA, and Nairobi City County. Existing waste management policies, such as the Nairobi City County Solid Waste Management Act (2015), should be reviewed to incorporate modern waste treatment technologies and best practices. Enforcement should be enhanced by increasing environmental inspectors, imposing stricter penalties for non-compliance, and using technologies like surveillance cameras and mobile reporting apps.

5.5 Suggestion for Further Research

From the findings of this study further research can be carried out on the limited effectiveness of solid waste management strategies and stakeholder participation in the restoration of Ngong River.

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APPENDICES

Appendix I: Research Tools

Kenyatta University
Department of Spatial and Environmental Planning
Master of Environmental Planning and Management

Questionnaire for the waste collectors

I am a master's student in the Department of Spatial and Environmental Planning at the School of Engineering and Architecture, Kenyatta University. I am conducting research entitled ''Roles of stakeholder participation in solid waste management in restoration of Ngong River, in Nairobi City County, Kenya''. I am kindly requesting for your insights on the following questions. The data collected on this survey will be kept confidential and is entirely for academic use sand will not be diverted for any purpose or person.

Instruction: *Tick, or write your suitable response.*

Objective 1: To evaluate the types and characteristics of household solid waste in Ngong River and stakeholder restoration strategies.

Section A: Background Information

1. Age:
2. Gender: Male Female
3. How long have you been working as a waste collector?
    - Less than 1 year
    - 1-3 years
    - 4-6 years
    - More than 6 years
4. Which area(s) do you primarily serve for waste collection?
5. Are you affiliated with a waste collection company or do you work independently?
    - Affiliated with a company
    - Work independently
    - Other (please specify)

Section B: Types and Characteristics of Household Waste

6. How often is household solid waste collected?

- Daily

- Bi-weekly

- Weekly

- Bi-monthly

- Monthly

7. What methods are used for household solid waste collection? (Select all that apply)
   - Door-to-door collection

   - Community collection points

   - Public waste bins

   - Scheduled collection days

   - On-call collection services

   - Others (please specify)

8. What types of household waste do you most frequently collect? (Check all that apply)

    - Organic waste (food scraps, yard waste)
    - Recyclable materials (plastic, glass, paper, metal)
    - Hazardous waste (batteries, chemicals, medical waste)
    - Electronic waste (old electronics, batteries)
    - Other (please specify)

9. How would you describe the volume of waste you collect on a typical day?

    - Small (less than 1 ton)
    - Medium (1-3 tons)
    - Large (more than 3 tons)

10. Do you observe any seasonal variation in the types or amount of waste collected?

    - Yes (please explain)
    - No

11.What percentage of the waste you collect is improperly sorted?

    - 0-25%
    - 26-50%
    - 51-75%

- 76-100%

Section C: Demand and Payment for Services

12. How would you describe the demand for waste collection services in your area?
    - Very high
    - High
    - Moderate
    - Low
    - Very low

13. How do households pay for waste collection services?

    - Monthly subscription
    - Pay-per-service
    - Government or community-funded
    - No payment
    - Other (please specify)

14. Is the payment for services timely and sufficient?

    - Yes, always
    - Yes, sometimes
    - No (please explain)

Section D: Reliability and Efficiency of Services

15. How reliable do you believe your waste collection service is?
    Very reliable
    Reliable
    Somewhat reliable
    Unreliable
    Very unreliable

16. What factors affect the reliability of waste collection services? (Check all that apply)
    Weather conditions
    Availability of equipment
    Access to collection points
    Traffic and road conditions
    Other (please specify)

17. How efficient do you find the current waste collection process?
    Very efficient
    Efficient
    Somewhat efficient
    Inefficient
    Very inefficient

18. What improvements could be made to enhance the efficiency of waste collection?

Section E: Satisfaction Level and Household Perception

19. How satisfied are you with the overall waste collection system in your area?
    - Very satisfied
    - Satisfied
    - Neutral
    - Dissatisfied
    - Very dissatisfied

20. How do households generally perceive the waste collection services you provide?
    - Very positive
    - Positive
    - Neutral
    - Negative
    - Very negative

21. What feedback do you receive from households about waste collection services? (Check all that apply)
    - Timeliness of collection
    - Cleanliness and thoroughness
    - Professionalism of collectors
    - Cost of services
    - Other (please specify)

Section F: Service Quality and Challenges

22. What are the main challenges you face in providing waste collection services? (Check all that apply)
    - Inadequate waste separation by households
    - Lack of proper disposal facilities
    - Insufficient equipment or resources
    - Health risks from hazardous waste
    - Inconsistent payment or support
    - Poor road conditions/accessibility
    - Other (please specify)

23. What measures do you think could improve the quality of household waste collection?
    - Better waste separation at the source
    - More frequent collection services
    - Improved infrastructure (e.g., trucks, bins)
    - Enhanced public awareness and education
    - Better compensation and support for waste collectors
    - Other (please specify)

24. How do you think improving waste collection services could contribute to the restoration of Ngong River?
25. Any other comments or suggestions:

Questionnaire for the household

Section 1: General Information

1. Name of the River Restoration Project:…….....
2. Location (Village/Town, District, Country):……
3.Respondent's Name and Contact Information:……..
4. Role in the Project (e.g., project manager, community member, local government official, NGO representative)…….

Section 2: Solid Waste Management Strategies

5. Which solid waste management strategies were implemented in the river restoration project? (Select all that apply)

-Waste segregation at source ☐

- Community clean-up campaigns ☐
- Installation of waste bins and collection points ☐
- Recycling programs ☐
- Composting ☐
- Public awareness and education campaigns ☐
- Enforcement of waste management regulations ☐
- Partnership with local businesses/industries ☐
- Others (please specify): …….

6. How effective were these strategies in managing solid waste?

- Very Effective

- Effective

- Moderately Effective

- Slightly Effective

- Not Effective

Section 3: Implementation and Community Involvement

7. How well were the solid waste management strategies implemented?
   - Very Well

   - Well

   - Moderately Well

   - Slightly Well

   - Not Well

8. How involved was the local community in the implementation of these strategies?
   - Very Involved

   - Involved

   - Moderately Involved

   - Slightly Involved

   - Not Involved

9. What methods were used to involve the community? (Select all that apply)
   - Community meetings and workshops

   - Educational campaigns in schools

- Door-to-door awareness drives

- Volunteer programs

- Social media and other communication channels

- Others (please specify): ……

10. How would you rate the community's response to the solid waste management initiatives?

- Very Positive

- Positive

- Neutral

- Negative

- Very Negative

Section 4: Impact on River Restoration

11. How has the solid waste management affected the cleanliness of the river?

- Significantly Improved

- Improved

- No Change

- Deteriorated

- Significantly Deteriorated

12. How has the biodiversity of the river ecosystem changed since the implementation of solid waste management strategies?

- Significantly Increased

- Increased

- No Change

- Decreased

- Significantly Decreased

13. What positive outcomes have you observed as a result of solid waste management in river restoration?

i.……
ii……
iii……

14. What negative outcomes, if any, have you observed?
i.……
ii……
iii……

Section 5: Sustainability and Challenges
14. What measures are in place to ensure the sustainability of the solid waste management strategies?

- Continuous community education
- Regular monitoring and evaluation

- Strong waste management policies and enforcement

- Partnerships with local businesses and organizations

- Ongoing funding and resources
- Others (please specify): ……

15. What challenges have been encountered in implementing and sustaining solid waste management strategies?
i.……
ii……
iii……
……
16. How can these challenges be addressed in future projects?
i.……
ii……
iii……

Section 6: Recommendations and Comments

17. What recommendations do you have for improving solid waste management in river restoration projects?

i..……

ii……

iii……

18. Any additional comments or observations?

i..……

ii……

iii……

Institutional Questionnaire

Objective: To assess the effectiveness of the stakeholders' roles in solid waste management in restoration of Ngong River

Section A: General Information

1. Please indicate your affiliation:
   - ☐ Nairobi City County
   - ☐ NGO
   - ☐ CBO
   - ☐ Private sector
   - ☐ National Government
2. What is your specific role in the organization?

3. How long have you been working in the waste management sector?
   - ☐ Less than 1 year
   - ☐ 1-3 years
   - ☐ 4-6 years
   - ☐ More than 6 years

Section B: Roles and Responsibilities in SWM

4. What is your organization's primary role in solid waste management? (Please check all that apply):
   - ☐ Waste collection and transportation
   - ☐ Recycling and waste processing
   - ☐ Public awareness and education
   - ☐ Policy formulation and regulation
   - ☐ Enforcement of waste management laws
   - ☐ Other (please specify)

5. What policies or strategies has your organization implemented to contribute to solid waste management? (Please list or describe briefly)

6. How often does your organization conduct waste collection in the areas near Ngong River?
   - ☐ Daily
   - ☐ Weekly
   - ☐ Bi-weekly
   - ☐ Monthly
   - ☐ On demand
   - ☐ Yearly
7. How does your organization collaborate with other stakeholders in SWM?
   - ☐ Joint projects
   - ☐ Regular meetings
   - ☐ Funding partnerships
   - ☐ No collaboration
   - ☐ Other (please specify)
8. What key resources does your organization bring into SWM in Nairobi?
   - ☐ Technical resources
   - ☐ Human resources
   - ☐ Capacity building and trainings
   - ☐ Logistics
   - ☐ Other (please specify)

Section C: Effectiveness of Stakeholders in SWM

9. On a scale of 1-5, how would you rate the effectiveness of Nairobi City County's role in ensuring safe disposal of waste collected?
   1. Very effective
   2. Effective
   3. Neutral
   4. Ineffective
   5. Very ineffective

10. On a scale of 1-5, how would you assess the cost-effectiveness of transportation of waste managed by the County Government?
    1. Very cost-effective
    2. Cost-effective
    3. Neutral
    4. Not cost-effective
    5. Very inefficient

11. In your opinion, how effective has the National Government been in providing legislative support for SWM? (open ended)

- ☐ Effective
- ☐ Neutral
- ☐ Not effective

12. What are the major challenges faced by your organization in executing its role in SWM?

……
……
……

13. What incentives or support does your organization receive to improve its SWM activities?

- ☐ Financial grants
- ☐ Training and capacity building
- ☐ Policy support
- ☐ Public recognition/awards
- ☐ Other (please specify)

Section D: Stakeholder Collaboration and Public Participation

14. What methods does your organization use to raise awareness about SWM and river restoration?

- ☐ Workshops and training
- ☐ Public campaigns
- ☐ Social media and online outreach
- ☐ Collaboration with local leaders
- ☐ Other (please specify)

15. How successful is your organization in creating linkages between various stakeholders (government, private sector, community) for SWM activities?

- ☐ Very successful
- ☐ Successful
- ☐ Neutral
- ☐ Unsuccessful
- ☐ Very unsuccessful

16. How frequently does your organization participate in multi-stakeholder meetings or forums on SWM?

- ☐ Regularly (monthly/quarterly)
- ☐ Occasionally (annually)
- ☐ Rarely
- ☐ Never

17. To what extent does your organization involve local communities in SWM activities near Ngong River?

- ☐ Fully involved (community consultations, clean-ups)
- ☐ Partially involved

- Not involved

18. In your opinion, what role should local communities play in restoring Ngong River through better waste management?

Section E: Impact of SWM on the Restoration of Ngong River

19. How would you rate the impact of your organization's activities on the reduction of waste pollution in Ngong River?

- Very high impact
- High impact
- Moderate impact
- Low impact
- No impact

20. Which of the following outcomes have you observed as a result of SWM efforts near Ngong River? (Please check all that apply)

- Reduction in illegal dumping
- Improved water quality
- Increase in recycling rates
- Improved community health
- No significant change
- Other (please specify)

21. What additional measures do you think are necessary to fully restore Ngong River from a waste management perspective?

Section F: Recommendations

22. What recommendations would you make to improve the role of each of the

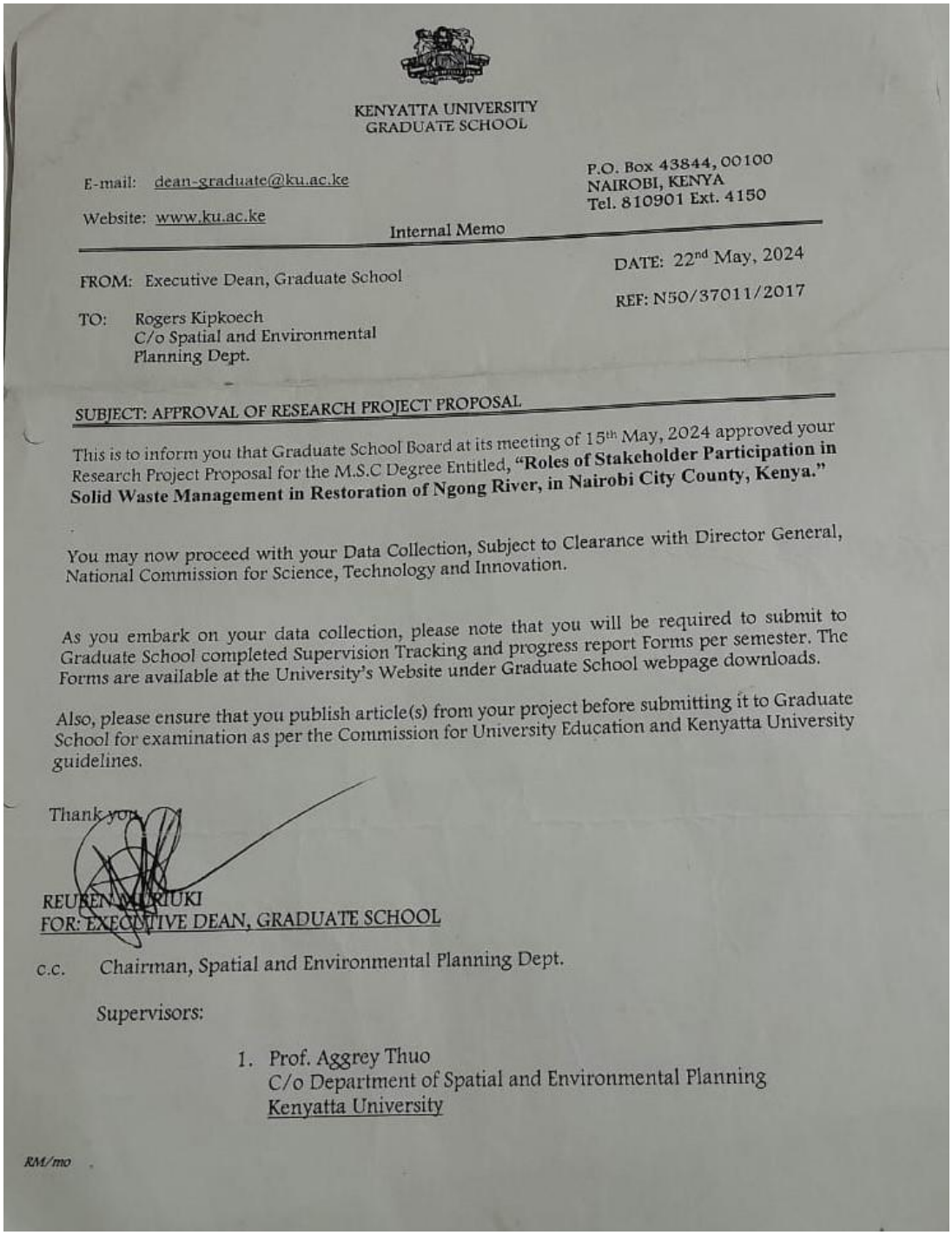
23. What are your suggestions for enhancing coordination and collaboration among the various stakeholders in SWM?

24. Please provide any additional comments or suggestions regarding SWM and the restoration of Ngong River.

Appendix II: Budget for the Research

ITEM	Cost
Printing, photocopy and binding	5,000
Data collection and travel expenses	40,000
Miscellaneous	5000
TOTAL	50,000

Appendix III: Research Authorizations



KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 810901 Ext. 4150

Internal Memo

FROM: Executive Dean, Graduate School

DATE: 22nd May, 2024

REF: N50/37011/2017

TO: Rogers Kipkoech
C/o Spatial and Environmental
Planning Dept.

SUBJECT: APPROVAL OF RESEARCH PROJECT PROPOSAL

This is to inform you that Graduate School Board at its meeting of 15th May, 2024 approved your Research Project Proposal for the M.S.C Degree Entitled, **"Roles of Stakeholder Participation in Solid Waste Management in Restoration of Ngong River, in Nairobi City County, Kenya."**

You may now proceed with your Data Collection, Subject to Clearance with Director General, National Commission for Science, Technology and Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and progress report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

Also, please ensure that you publish article(s) from your project before submitting it to Graduate School for examination as per the Commission for University Education and Kenyatta University guidelines.

Thank you.

REUBEN MURIUKI
FOR: EXECUTIVE DEAN, GRADUATE SCHOOL

c.c. Chairman, Spatial and Environmental Planning Dept.

Supervisors:

1. Prof. Aggrey Thuo
   C/o Department of Spatial and Environmental Planning
   Kenyatta University

RM/mo

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke

Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: N50/37011/2017

DATE: 22nd May, 2024

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR ROGERS KIPKOECH – REG. NO. N50/37011/2017

I write to introduce Rogers Kipkoech who is a Postgraduate Student of this University. The student is registered for M.S.C. degree programme in the Department of Spatial and Environmental Planning.

Rogers intends to conduct research for a M.S.C. Project Proposal entitled, **"Roles of Stakeholder Participation in Solid Waste Management in Restoration of Ngong River, in Nairobi City County, Kenya."**

Any assistance given will be highly appreciated.

Yours faithfully,

PROF. ELIUD NJAGI
EXECUTIVE DEAN, GRADUATE SCHOOL

RM/mo

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 474007

Date of Issue: 18/July/2024

RESEARCH LICENSE

This is to Certify that Mr.. Rogers Kipkoech of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: Roles of Stakeholder Participation in Solid Waste Management in Restoration of Ngong River, in Nairobi City County, Kenya for the period ending : 18/July/2025.

License No: NACOSTI/P/24/37754

474007

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.

See overleaf for conditions

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
    i. Endanger national security
    ii. Adversely affect the lives of Kenyans
    iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
    iv. Result in exploitation of intellectual property rights of communities in Kenya
    v. Adversely affect the environment
    vi. Adversely affect the rights of communities
    vii. Endanger public safety and national cohesion
    viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020 4007000, 0713788787, 0735404245
E-mail: dg@nacosti.go.ke
Website: www.nacosti.go.ke

OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND NATIONAL ADMINISTRATION
STATE DAPARTMENT FOR INTERNAL SECURITY AND NATIONAL ADMINISTRATION

Telegrams: .....
Telephone: Nairobi 316845/ 341666
When replying please quote

COUNTY COMMISSIONER
NAIROBI COUNTY
P.O. Box 30124- 00100
NAIROBI

REF: ED 10/6 VOL.XXIX (161)

7th August, 2024

Rodgers Kipkoech
KENYATTA UNIVERSITY

RE: RESEARCH AUTHORIZATION

Your letter dated 6th August, 2024 refers.

This office has no objection and authority is hereby granted to conduct research on the topic **"Roles of Stakeholder Participation in Solid Waste Management in Restoration of Ngong River"** in Nairobi, Kenya for the period ending 18th July, 2025.

DAVID S. WANYONYI
COUNTY COMMISSIONER
NAIROBI COUNTY

Copy to: Deputy County Commissioner
KIBERA SUBCOUNTY

OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND NATIONAL ADMINISTRATION
STATE DEPARTMENT FOR INTERNAL SECURITY AND NATIONAL ADMINISTRATION

Telegram.....
Telephone:
dcckibra@gmail.com

DEPUTY COUNTY COMMISSIONER
KIBRA SUB-COUNTY
P.O. Box 30124-00100
NAIROBI

Ref: KBR/ED/10/9/VOL. II (32)

Date: 9th August ,2024

All Assistant County Commissioners
Kibra Sub-county

RE: RESEARCH AUTHORIZATION

I would like to inform you that authority has been granted to Rodgers Kipkoech of Kenyatta University to conduct research on **"Roles of Stakeholder Participation in Solid Waste Management in Restoration of Ngong River"** in Kibra Sub-County for a period ending 18th July 2025 on condition that the laid down guidelines are strictly adhered to.

Please, give them all the necessary assistance that they may require.

DEPUTY COUNTY COMMISSIONER
09 AUG 2024
KIBRA SUB-COUNTY

ALEX MBUTE
For: DEPUTY COUNTY COMMISSIONER
KIBRA SUB-COUNTY

Cc: **Rodgers Kipkoech**
Kenyatta University