FACTORS INFLUENCING SOLID WASTE MANAGEMENT IN THIKA SUB-COUNTY, KIAMBU COUNTY, KENYA

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A THESIS/PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PUBLIC HEALTH DEGREE IN EPIDEMIOLOGY AND DISEASE CONTROL OF

Mount Kenya University

04/01/2025

DECLARATION AND APPROVAL

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Declaration

This thesis/project is my original work and has never been presented for any academic award in any institution.

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DEDICATION

This study is devoted to my beloved daughter Mumbi, for the support. Above all, I dedicate this study to the Almighty God.

ACKNOWLEDGEMENTS

I exceptionally thank God for His kindness throughout my life. I acknowledge my esteemed supervisors, Dr. John Kariuki, the Dean School of Public Health, Mount Kenya University, and Dr. James Mwitari of Kenya Medical Research Institute, Centre for Respiratory Diseases Research for continuously correcting and guiding me throughout this study development. I appreciate for sparing your time to go through my work for corrections and guidance. More so, your encouragement has been of great motivation. My regard goes to the entire School of Public Health for the support accorded during my studies, examinations, and presentations and for ensuring a noble learning environment. Further acknowledgment goes to the County Government of Kiambu for allowing me to collect data for this study. I also appreciate everyone assisted in anyway and contributed to make this study possible. For these, I will remain grateful to all the above, and may God bless you mightily.

ABSTRACT

Solid waste is an issue that has attracted global attention as it has significant effects on public health. It is a global threat, and challenges associated with its management include; increased generation of solid waste associated with accelerated industrialization, urbanization, and urban poverty. The expansion in populace, development of economies, income variations, industrialization, and urbanization are all associated with the increase in the solid waste generation. The main objective of the study was the factors influencing solid waste management in Thika Sub-County. The objective of the study was to elucidate the factors influencing solid waste management in Thika Municipality. The study applied analytical cross-sectional, study design. The study location was Thika Municipality, Kiambu County in Central Kenya. The target population was 42,341 households who were either men or women (household heads) from Hospital, Kamenu, and Township Wards and Environmental officers from Thika Municipal Council. The sample size for the household was 396 households and 2 Municipal Council staff. A semi-structured questionnaire aided to gather quantitative data, while an interview guide was used to gather qualitative data. SPSS – Version 26 computer software facilitated data analysis. Fisher's exact test was used to determine the relationship between dependent and independent variables where variables with p- values of ≤ 0.05 were considered statistically significant. A qualitative data inductive approach was used; using research questions as a guide for data analysis. According to this research, majority 67.3% of this study participants were males, while 32.7% were females. The study respondents, 64.6% had secondary level of education. Food remains were 80.4% generated type of waste. In this study, participants 65.1% of the participants did not segregate waste while 34.1% segregated waste. The study further revealed that, 88.7% participants' practiced inappropriate SWM practices. There was a statistical association between respondents' level of education and SWM practices (*Fisher's exact p=0.017*). There was no statistical association between gender and solid waste management (X^2*0.603, df=1, p=0.437)*) as per the results. The research established that, socio- economic factors were significantly associated with solid waste practices in Thika Sub- county. The level of stakeholder engagement was high 56.6 % and improved solid waste management that was linked to better adoption of good SWM capabilities. The extent of the public taking part in Solid Waste Management was low in the study area. The study concluded that, socio- economic situation influenced solid waste management. Aspect like education level, area of residence, monthly income, and duration lived in the study area were associated to practices of SWM. The study recommends for promotion of tertiary education among the youths, as they seem to earn low income due to low level of education, community to be engaged as stakeholders in solid waste management, for appropriate management of waste among the community and special programs that would target the community to own solid waste management and hence participate and practice appropriate solid waste management.

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LIST OF ABBREVIATIONS AND ACRONYMS

CGK:	Government of Kiambu County
EMCA:	The Environmental Management and Coordination Act
GDP:	Gross Domestic Product
IETC	International Environmental Technology Center
ISWM:	Integrated Solid Waste Management
KNBS:	Kenya National Bureau of Statistics
MSW:	Municipal Solid Waste
NACOSTI:	National Commission for Science, Technology and Innovation.
NEMA:	National Environment Management Authority
PPS:	Probability Proportionate to Size
SPSS:	Statistical Program for Social Sciences
SWM:	Solid Waste Management
SW	Solid waste
UNEP:	United Nations Environment Programme
UN:	United Nations
U.S EPA	United States Environmental Protection Agency

CHAPTER ONE

INTRODUCTION

Chapter one is basically introduces us to the study. This section will highlight the background information guided by the variables of this research. This section additionally contains problem statement, objectives, significance, limitations and delimitations of the study, scope, and assumption of the study.

1.1 Background of the Study

Solid waste management (SWM) is a global menace. Challenges associated include increased generation of solid waste resulting from accelerated industrialization, urbanization, and urban poverty. The United Nations Environment Programme(UNEP, 2017) suggested that, cumulative capacity and the bulk of waste related with the current economy is posing a severe danger to the environments and public health. Globally, 2.01B tonnes of solid refuse are generated yearly, at the minimum of 33% of this refuse is not controlled in methods that are friendly to the environment. Globally, waste generation per individual on daily basis is about 0.74 Kg although it varies broadly, from 0.11 to 4.54Kgs. Even though only 16% of the global demographic is accounted for, big economies states generate nearly 34%or 683M tonnes, of the global waste, that anticipated to balloon with 3.40B tonnes by the year 2050. according to (*Kaza et al., 2018b*) Numerous municipalities are gradually experiencing challenges in SWM due to prompt sub-urbanization, lack of technical and economic capability or low policy urgency.

Suitable SWM is vital to protect surroundings and the public health (Rodrigo *et al.,* 2016) . SWM is a worldwide subject affecting everyone globally. Awareness deficiency and poor attitude by the

people regarding management of waste leads to substandard actions like cluttering up; open disposing and waste burning; substandard management of available waste yards (UNEP, 2020).

Solid waste is an issue that has attracted global attention as it has significant effects on human well-being and ecology (Mukherji *et al.,* 2016). This escalating issue is directly linked to societal behaviors surrounding production and consumption. SWM is a critical domain of research as the amount of waste grows and can be used as an instrument for Management of refuse to ensure public health safety (Ayilara *et al.,* 2020).

Additionally, 2.01 billion tons of MSW is produced yearly, where 33% is not treated in an environmentally secure method. Globally, daily per individual production of waste is about 0.74 kgs but mostly varies, from 0.11 to 4.54kgs. Global waste is anticipated to rise to 3.40B tones by 2050 (Bowan *et al.,* 2019).

Fast urban life , growth of population, and enhanced standards of living have been associated with rising generation of solid waste among industrialized nations (Zohoori & Ghani, 2017). Hence, waste management is a primary human need or a fundamental human right given that proper solid waste management matches other fundamental human rights associated with the clean water provision, inhabitable shelter, and consumable food to the entire society(UNEP, 2020).

Some statistics (Samwine *et al.,* 2017) indicate that 9.4B tonnes of generated waste by human beings globally in 2015. Further, the generation of waste production globally stands at 1.9B tonnes, 70 % of which is solid waste gets to the dumpsite, 19% is recycled, and 11% is to the recycling of energy (Fadhullah *et al.,* 2022). Bahrain is among the countries that have recorded high annual waste generation figures, with each person generating approximately 906.7 kilograms of waste per capita. Other contrives that have been associated with high annual waste generation include

Comoros with an estimation of 813.3 kilograms of waste per person, and Canada with an estimation of 777 kilograms of waste per person per capita (Samwine *et al.*, 2017).

According to available data (WorldBank, 2015) in developing nations higher than 90% of waste is usually discarded in unauthorized rubbish pits or burned openly, where these habits generate severe safety, environmental, and health problems. Managing waste poorly, aids as a breeding site for vectors of diseases, leads to change of climate via production of methane, and can consequently contribute to towns and cities crimes (Agamuthu & Fauziah, 2011).

A study in the East Coast of Malaysia (Fadhullah *et al.*, 2022) reported that, ineffective solid waste in the household has effects on public health, which can be biological, physical, psychological, non-communicable diseases and ergonomic health risks. Leachate from the solid waste contaminates the soil, waste and air that provide a breeding environment for biological vectors like rodents, flies and pests. They finally cause diseases such as cholera, dysentery, diarrhea, gastrointestinal infections, dengue fever bacterial infection, and respiratory problems. Pollution from the dumpsite may cause cancer and exposure to gases such as carbon dioxide, Sulphur, methane and nitrogen dioxide produced by the waste in the landfill is capable of causing bronchoconstriction and inflammation that can affect immunity. Hydrogen fluoride and hydrogen chloride leads to cough, chest tightness, and breathlessness if deposited in the respiratory system (Kouloughli & Kanfoud, 2017).

A report by (UNEP, 2020) estimated that, Africa produced 125 million tonnes of MSW in 2012, and forecasted to double by 2025. The report shows that, waste collection services in Africa are not adequate, where the average of collection rate is 55%. Africa generated waste, more than 90%

is usually dumped off in abandoned dumpsites and landfills, mostly related with open burning (Babayemi *et al.*, 2016).

There are 50 largest dumpsites globally, and 19 of them are in Africa, all in Sub- Saharan Africa. Approximately 70% to 80% of the Africa generated MSW can be renewed through recycling; however, only 4% of that is being recycled (Haregu *et al.*, 2016).

Poor management of solid waste effectively provide inhabitable cities. However, it has continued to challenge most developed countries with its budget occupying 20 – 50% of municipal budgets. It is additionally fundamental to take note that waste administration requires the involvement of diverse stakeholders and sustainable and socially supported systems and strategies (MS Ayilara, 2020).

The value of Solid Waste produced in Africa is approximately USD 8 billion yearly, but the openings are mainly not exploited (UNEP, 2020).Waste generation increase at a high rate and set burden on presented infrastructure. This result from little scope of services of collecting waste, viable SWM frameworks to enable separation, recycling, reduce, reuse, scarce resource allotments for SWM particularly investments on infrastructure, poor governance including conformity with and administration of present legal system and insufficient comprehensiveness and reliability of data on waste (Suleman, 2016).

(Z Abdullah, 2017) suggested that solid waste is a continuous hurdle for most African countries. Several municipalities appear to have scarce funds to manage solid waste. They divert their energies in collecting and land disposal of solid waste. Nevertheless, technology innovative methods have advanced globally, with industrialized countries leading in how solid waste is supposed to incorporate into viable advanced strategies of municipalities. The problem was precipitated by increased

urbanization efforts by most countries in the region, the poor performance of economies, and has hence been unavoidable. A study by (R Aldaco, 2020) identified several African biggest cities among them Nairobi, Lagos, Dar Salaam, Johannesburg, and Cairo as experiencing growth in populations associated with high migration levels resulting in high waste generation in the cities. (Mohee & Simelane, 2015) approximated that a substantial percentage of the population in Sub-Saharan Africa would migrate to urban centers by 2020. The prediction suggests that solid waste production would be high by approximately 1.0 kilogram per capita, with the normal per capita of SW creation being 0.7 kg/day in Zimbabwe, 1.0 kg/day in Tanzania, and Mauritius production rising from approximately 0.8 per capita to 1.1 kg per capita every day of blended city solid waste. The historical and political history of waste management in Africa is divergent (Mohee & Simelane, 2015). Studies by(Atta *et al.,* 2016) indicated that the annual production of SW in Nigeria ranged from 0.3 – 1.1 kg/individual/day accounted for in a few urban communities of the nation.

According to (UNEP, 2018) there are policies in African countries that direct methods of waste management, but there are several factors that restrain system of the waste management. These elements comprise shaky regulations, enforcement absence, negative attitudes, Poor mass sensitization, bribe, conflicts, lack of political stability, and poor state of services. Haphazard discarding of waste is common experienced in urban areas. This has raised the risk of flooding, diseases and environmental pollution. Organic waste disposal has led to the production of greenhouse gases, contributing to change of climate and percolate with the capabilities of polluting ground and surface water. Significant air pollution has been because to the open burning of the solid waste, affecting human health (Chen, 2020).

Strategies initiated to manage waste in East African countries do not differ from that of African and global nations. In Tanzania, the solid waste generated was approximately 1 kg/day per homestead; which is more than the usual standards for developing nations, which is between 0.4 to 0.6 kg/day per homestead (IETC, 2020). Less than 40% of the entire produced waste in the Dar es Salaam metropolitan was gathered and dumped off properly in appointed garbage areas. The outstanding 60% of the waste was burnt at the households, dumped in the drainage system, thrown by the roadside, sewerage, shorelines, buried or disposed of in open fields. This has been a cause to the production of methane, public health risks and floods (IETC, 2020).

The report by (Dianati *et al*., 2021) indicated inadequate capacities of the municipal authorities and lack of enough vehicles as challenges of waste collection in EAC. The pace of refuse production is more, and it challenges government capacity to manage waste and hence waste increases. Factors such as population growth, economic growth, urbanization, per capita income and general industrialization influence waste generation. It was evident that population growth in Kampala and EAC was a major factor influencing the generation of waste (Douti *et al.*, 2017). Burning polythene carrier bags in 2017 has significant effect in minimizing production of solid waste in Kenya. Nevertheless, Kenya generate approximately 22,000 tons of solid waste daily. This was deliberated from assumption that, averagely produces per capita refuse production of 0.5kgs per person per day, interpreting 8 million tonnes yearly, where 40% of this waste is produced in sub-urban regions. Known that urbanization increase by 10%, by 2030, Kenyan urban populace will generate about 5.5 million tonnes of waste annually. In Kenya, 10 million (34.8%) of the total population exist in the urban areas. As the rate of urbanization increase, waste management will cause more challenges in socio-economic, environment and institution if adequate measures not taken (Ministry Of Environment and Forestry, 2021).

In Kenya, only 40 % of the population main urbans get services of waste management. A lot towns lack garbage gathering system in poverty stricken and slum. There are uncontrolled waste dumpsites in all counties whereby effluent causes pollutions in waterways and underneath water. Waste burning in these dumpsites produces toxic air and poisonous fumes that pollutes the air (Miezah *et al.,* 2015). Waste is not segregated from the source; while the conventional waste collectors' recover the recyclable waste such as papers, metal, plastics and glass. As a result, only a fragment of entire recyclable waste is recovered from the dumpsites, where the conventional waste collectors are exposed to poisonous chemicals, burning waste, polluted air and pest that transmit diseases (Ministry of Environment and Forestry, 2021).

County government contract Private firms to collect solid waste, transport and dispose waste. This approach is inefficient because the private firms compete for high income residents neglecting low-income areas (Oribe-Garcia *et al.,* 2015). In high-income residents, waste collection is twice per week, middle-income resident once per week while in low-income residents waste is not collected (Lissah *et al.,* 2021). Private firms are in charge of both charges and collecting waste without structure to guide charges by private firms resulting to high charges that the majority of the population do not afford. Some of the involved private companies are accused of disposing of waste illegally in rivers, by roadsides, quarries and illegal dumpsites (Ministry Of Environment and Forestry, 2021).

There is Population growth and rapid urbanization in Kenya, where cities have attracted a huge population in slums and middle class. Increased affluence and urbanization has resulted to the heightening of waste generation and complicated waste streams, which contributed by the industrialization advancement of the Kenyan economy. Law and policies governing waste management has been in place, but the weak application and poor practices causes municipalities

overwhelmed by generated waste, consequently having effect on the public health and environment (NEMA, 2015). SWM has been a huge difficult in Kenya. The local authority did not give priority to the development of appropriate systems of waste treatment for years; therefore, the County Governments took over the same status leading to an unfortunate waste management state in the country(NEMA, 2015).

Most municipalities have incompetent systems of waste management. For example, survey carried out in Nairobi showed that 2400 tons of waste generated per day, and approximately 30-40 % of this was not piled up while less than 50 % of the population was attended. In Nakuru, it is projected that only 45% of 250 tons of the waste produced was gathered and discarded of at Giotto garbage, 18 % recycled, and the other gathered in the environment (NEMA, 2015). Statistics approximate Kenya's least waste production at 109.5 kilograms per person per annum and could be placed at similar levels with Ethiopia which produces 109.8 kilograms of waster per person per year, and Nepal which produces 115.7 kilograms of waste per person per annum(Asare *et al.,* 2020).

The Environmental Management and Coordination Act (EMCA) of 1999 was endorsed to respond to environmental challenges. The act defines individual obligations to people in shielding and improving nature. Every Kenyan resident ensured a perfect and solid condition, and the provisions look forth towards the protection of the environment for the present benefits in addition to the benefits of generations to come (Kaza *et al.,* 2018a). Similar sentiments are inscribed in the country's Vision 2030. Section 42 of the Kenyan constitution guarantees all Kenyan citizens the appropriate to a perfect and environmental condition, including the security of nature for the present and who and what is to come. Section 62 (9) emphasizes the importance of each person in cooperating with relevant stakeholders towards the conservation and protection of the environment (NEMA, 2015).

A report by (NEMA, 2015) indicated that, the massive urbanization process and growth of the human population in urban centers had challenged management of the refuse in the country. The report further illustrated that most of the country's cities and towns lacked competent waste accumulation and transfer frameworks (Rousta *et al.,* 2020). In Nairobi, half of the waste produced remains uncollected and half of the residents try not to approach waste management utilities. In Nakuru, 45% of SW generated assembled and dumped at separate dumpsites, only 18% was recovered, and the rest was heaped in the earth. Statistics by (NEMA, 2015) indicated that Thika town generated 140 tonnes of SW per day. Only 60% of the SW was collected, 30% recovered, and 40% remained uncollected as shown in appendix IV. The survey explores the attributes influencing SWM in Thika Sub-county, evaluating influence of social-economic status in solid waste management for waste generators, stakeholder's level, engagement and community practices in SWM in Thika Sub- County.

1.2 Statement of the Problem

The growing generation of solid waste is among major global issue. About 11.2 billion tons of solid waste are collected globally each year. The expanding capacity and difficulty of waste is related to modern economic activities and rapid urbanization present a serious threat to both environment and public health (Amugsi *et al*., 2020).

Inappropriate managed waste pollute the oceans, clogs drainage and leading to floods, illnesses transmission through vectors breeding and high respiratory complications via airborne particles from the burning of waste (Fudala-Ksiazek *et al.,* 2016).

In Kenya, rapid urbanization has been contributing to growth of generated waste. In 2016, waste generated was about 4 million tons per year, which may double by 2030 (Haregu *et al.,* 2016). In addition, according to (NEMA, 2015), approximately 80% of the transport facilities are out of

service or need major repairs, and hence have remained out of service. In Nakuru, 45% generated solid waste was dumped at particular dumpsites, just 18% is recorded, and the remaining heaped in the earth.

Kenya's population is progressively increasing, accompanied by the growing industrialization of its economy. While there are regulations in place for waste management, the lax enforcement of these laws has resulted public to struggle with excessive waste. This situation negatively affects both the environment and public health, contributing to issues such as blocked drains and sewerage, transmission of waterborne diseases such as typhoid, cholera, and diarrhea, a rise in upper respiratory illnesses from the open burning of waste, and the spread of malaria (NEMA, 2020).

Waste management responsibility is primarily taken by county governments. However, these authorities have not given this task the attention it requires nor provided enough resources to effectively manage it. As a result, poor waste management practices have emerged, including haphazard littering, uncollected waste, and a lack of waste segregation nationally (NEMA,2020).

According to (Government of Nyeri, 2020), blockage of drainage resulted from unmanaged waste ultimately leads to polluting water and postures public health risks and results to environmental degradation.

In Nairobi, half of the waste produced remains uncollected and half of the residents try not to approach waste management utilities. In Nakuru, 45% of SW generated assembled and dumped at separate dumpsites, only 18% was recovered, and the rest was heaped in the environment (NEMA, 2015).

A report by (County Government of Kiambu, 2018) estimated garbage disposal within its town centers covered a small percentage of solid waste collection. Only 2.6 % of the total population had access to county waste disposal utilities, 0.7% used private companies, 29.1% used garbage pits, 29.6 % used farm gardens, 12.1% used public garbage heaps, and 25.9 % burned their solid waste. The statistics above indicate that the strategies adopted by most of the residents posed negative consequences for the environment and general wellbeing, and thus requiring the selection of successful waste management and disposal strategies by the county. Absence of legitimate solid waste gathering frameworks in the county force residents to adopt desperate measures such as burning solid waste and disposing it into public garbage hips because of the. Statistics by (NEMA, 2015) indicated that Thika town generated 140 tonnes of SW per day. Only 60% of the SW was collected, 30% recovered, and 40% remained uncollected, and hence highlighting the ineffective nature of SWM in the area. To make matters worse, the management of the collected waste was not satisfactory.

A study in Kiambu County by (Muiruri, 2018) reported that, the county's waste disposal systems were inefficient and had gaps, particularly in the household waste management system. Additionally, the county did not implement an integrated approach to SWM or treatment.

A study in Thika Sub- County by (Wanjau, 2016) reported that, county government is responsible for 24.1% of the total waste collection, while the remainder of the solid waste is either dumped indiscriminately or collected using skips. The study further reported that, awareness levels among households regarding solid waste reduction and segregation were found to be 41.4% and 41.9%, respectively.

The research surveys the factors affecting solid waste management in Thika Sub-county, evaluating influence of social-economic status in SWM for waste generators, level of stakeholders' engagement and community practices in solid waste management in Thika Sub- County.

1.3 Purpose of The Study

The aim of this study is to determine the factors influencing solid waste management in Thika Sub- county, Kenya.

1.4 Objectives of The Study

1.4.1 General Objective

To **assess the factors influencing solid waste management in Thika Sub- County, Kenya.**

1.4.2 Specific Objectives

The specific objectives of the study include:

1. To assess the waste management practices among waste generators in Thika Sub- County, Kenya.
2. To determine the influence of social-economic status in solid waste management for waste generators in Thika Sub- County, Kenya.
3. To evaluate the level of stakeholder involvement in the solid waste management in Thika Sub-County, Kenya.
4. To assess the existing community practice in managing solid waste within Thika Sub- County, Kenya.

1.5 Research Questions

The research questions of the study include:

1. What are the practices of solid waste management for waste generators in Thika Sub-County, Kenya?

2. What is the influence of social-economic status in solid waste management in Thika Sub-County, Kenya?
3. What is the extent of the stakeholder involvement in solid waste management in Thika Sub- County, Kenya?
4. What are the solid waste management practices in Thika Sub- County, Kenya?

1.6 Justification of the Study

The (County Government of Kiambu, 2017) recognized that solid waste management is an domain of interest within the County. Dumpsites positioned nearby water bodies pose a great threat to pollution. The community outlook on waste disposal is very inadequate as very few people take serious responsibility for their domestic waste. Kiambu County Government also has raised a concern that county landfills should be constructed to deal with solid waste disposal.

The industrious negligence of appropriate SWM raises an incredible worry with various individuals in question. The choice of the subject emerges from the dire need to adopt solutions in regions that have continued facing challenges associated with open dumpsites and failed solid waste management systems.

The choice of the study emerged from another study on SW production and characterization in Thika Municipality by (Mugo Ephantus et al., 2015) that concluded, The growth of industry and population in Thika Municipality has resulted to an rise in waste production, presenting a challenge for policymakers in managing this issue. As a result, it is crucial for the County government to have accurate information on how to effectively address the problems of Municipal Solid Waste (MSW) in Thika Sub- County.

1.7 Significance of the Study

The study will offer an added advantage to different partners including the county government of Kiambu, communities within Kiambu County, academicians, and future scientists. The discoveries of this investigation has incredible commitment in making the relevant institutions and the community aware of the aspects that would impact on the effective management of solid refuse. This research provides an overview to the Municipality of Thika Sub County, about the present status because of network routine in the solid waste administration, stakeholder engagement, and the socioeconomic variables influencing solid waste governance in this domain. The study is anticipated to form a yardstick for the interested researcher in the same or related study area. Besides adding to the current information concerning the study territory, the investigation provides academicians with literature to review and critique. Policymakers at the county and national as well as at regional level might find this study as a source of data and research evidence to make decisions on way to handle the menace of the administration of solid waste practices and making nature habitable.

1.8 Scope of the Study

1.8.1 Content Scope

The concept of this study was on SWM since inappropriate management of solid waste remains to affect the whole communities and cities pubic health; pollute indigenous water, air, and land resources.

1.8.2 Geographical Scope

This research was carried out in Sub county of Thika, which is situated in the Kiambu County in, Central Kenya. This Sub- County Covers Township Ward, Kamenu Ward, Gatuanyaga Ward,

Ngoliba Ward, and Hospital ward (County Government of Kiambu, 2018). Only 3 Wards was sampled in this study – Township Ward, Kamenu Ward, and Hospital Ward. Thika Sub-County was chosen as the appropriate study area due to the tremendous social and economic growth that the area has made the previous few years. Hence, the viability of examining the public health situation of waste management was essential.

1.8.3 Time Scope

Time from 2015 – 2021 was factored in the empirical analysis of the study concepts. This is due to the tremendous social, political, and economic changes that the county government of Thika has made towards SWM on the county.

1.9 Limitations of the study

The research faced several hurdles however, the scholar ensured that these challenges did not impact on the research. The research focuses solely on the factors influencing solid waste in Thika Sub-County, Kiambu County. As such, the findings may not fully represent general waste management practices. However, the insights gathered could be useful for informing similar studies.

The researcher also encountered the challenge of insecurity, as most of the data was gathered during the late evening hours when the household heads were available. However, local 'Nyumba Kumi' representatives, who were well-known to the community, accompanied the researcher for safety.

Cultural barrier was another limitation during this study, whereby in some communities only men are allowed to give the information on behalf of the other members or the researcher is required to as for permission to from the head of the family before collection of any information. The

researcher collected data from the head of the family, and always ask permission from those who lacked knowledge on waste management in that household.

1.10 Delimitations of the Study

Since the respondents had busy schedule, the researcher collected data at their convenient time such as evening hours after work and weekends for them to successfully fill the questionnaire therefore making this study a success. For easy and open identification, the researcher acquired introduction letter from the university and authorization letter from the County Government of Kiambu. This was to instill assurance to respondents to easily fill the questionnaire without fear in participating in the study hence making this study a success.

1.11 Assumptions of the Study

The study assumed that the research subjects gave important and honest reactions to the exploration questions. Additionally, the researcher assumed that the relevant stakeholders would adopt the findings and recommendations of the study.

1.12 Operational Definition of Keywords

Determinant: A factor definitively influences the nature or result of something.

Engagement: It is the extent to which individual feel passionate about something, is committed to the organization, and put discretionary effort into their work.

Household: it refers to an individual or a group of individuals residing in the one compound or habitat, partaking similar cooking plans, and reporting to the similar head of the household.

Household Head: it means the person who is accountable for the habitat who makes major decisions in the household daily, and who is responsible for counsel to all household members.

Practices: Involves the definite application or the implementation of ideas, beliefs, hypotheses, and methods related to a certain course of action.

Respondent/ Participant: This may be the residence leader or a different well-informed or accountable residence member.

Socio-economic: It is a branch of social sciences and economics that explores the interrelation between economic activities and social traits. Generally, the process involves an analysis of societies' progression, stagnation, or regression based on the nature of local, regional, or global economy.

Solid Waste: Solid waste can be described as any sludge, garbage or effluent from a sewer disposal establishment, or plant for air pollution regulation, and other disposed waste, coming from commercial, agricultural, mining and industrial processes, and from other practices of the community.

Stakeholder: it is an individual or a party with an interest in or investment in something, affected by, and cares about how it turns out.

Stakeholders Engagement: Involves processes and procedures adopted by organizations to involve people affected directly or indirectly by activities undertaken or decisions reached upon by the organizations. Stakeholders, in this case, may either oppose or support decisions and activities, or influence organizations within the community they operate in or hold relevant official positions that they can use to influence decisions.

CHAPTER TWO

LITERATURE REVIEW

This section served as the foundation for the development of the study. It discussed the pertinent empirical literature relating to determinants influencing effective SWM from a worldwide perspective to a territorial, and neighborhood perspective. The research gap identified the theoretical framework and literature relevant to management of waste highlighted, and the conceptual framework expounded on chapter contents.

2.1 Theoretical Review

This study discussed three theories namely the Waste management theory (WMT), waste management hierarchy Theory- 'Lansink's Ladder theory and the protection motive theory.

2.1.2 Waste Management Theory

This Theory was established by Keiski, Pongrácz and Phillips. The theory anticipated that management of waste is intended to avoid refuse from causing damages to environment and human health of the large public and enhance maximum utilization of resources (Muturi, 2021). The ideal waste Theory of Waste Management signifies an additional deep field description and it consists review, the practice upon waste, and an entire perspective of the management of refuse goal. The theory is founded on the projection that the management of waste is to avert refuse arousing risks to environment and hazards to the human beings. (Muturi, 2021). This theory develops from industrial ecology, which emphasizes on processes of design, manufacturing and firms products, based on product demand and relationship with the environment (Maleka *et al.*, 2017*)*.Additionally, waste reduction needs that manufacturer to compel and rise the percentage of

non- waste leaving the process(Fidelis *et al.,* 2020). Waste management theory purpose to boosting the resources conservation by utilizing management of waste and avoiding wastage of resources (Maleka *et al.,* 2017).

2.1.3 Waste Management Hierarchy Theory- 'Lansink's Ladder Theory

The waste hierarchy or 'Lansink's Ladder 'was discovered by a former Dutch politician as well as the father of the waste hierarchy theory Ad Lansink. The Ladder of Lansink/chain of command, instituted to be a standard to manage waste and clarify the five stages of waste administration: Prevention, Reuse, Sorting/Recycling, Incineration, and Landfilling/Disposal (Lansink, 2018) Presented is 'Lansink's Ladder' in a simple diagram showing the procedure for waste management options, with disposal at the bottom and prevention at the top(Lansink, 2018).

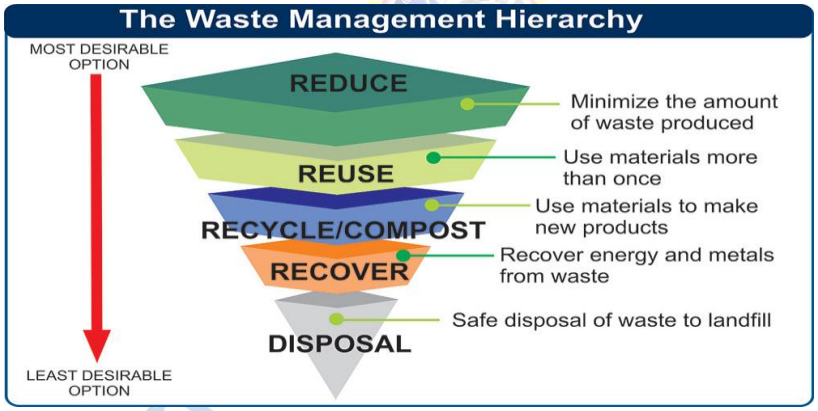


Figure 1: Hierarchy of Waste Management

Source: (Adipah & Kwame, 2018)

The 3R hierarch characterized by reduction, reuse, and recycling, is one of the highlyliked and applied systems of management of waste since it promotes environment-friendliness and sustainability (Lima *et al.,* 2018). The management of waste hierarchy has attracted the support of both national and international bodies and used as a procedure for ranking practices related to

the management of waste to achieve favorable environmental results (Prajapati *et al.,* 2021). The request of practices of management of waste is characterized from the most desirable to the least.

Reduction: Reduction is the first step in the management of waste, which characterized the minimization of the generation of any type of waste, also, is the hugest development in the waste organization chain of significance. The reduction of waste is mainly by treating the municipal waste with care at the household level, where the local authorities play an important part in the reduction of waste. Government achieves reduction by putting effort in different levels such as public education and media, to minimize household waste. (Upadhyaya, 2013).

Reuse: Reuse involves a procedure of making use of products for a second or third time as a means of depreciating their value. People re-use various things for long durations of time, and when there is awareness to re-use that certain items, materials, or products there are fewer transfer expenses and needs (Upadhyay & Mohan Rao, 2013).

Recycle: Recycling can likewise allude to the re-utilization or re-use of materials. The greater part of the materials is recyclable and substances to be reused stem up from the manufacturing and consumption of products. The remains that cannot be re-used get into the environment, can never be used as new raw materials but can serve as raw materials to a certain degree, for instance in the new goods production or applications as energy sources, depending on the products (Upadhyaya, 2013).

Energy Recovery: Energy is restored from waste using numerous existing technologies. The process involves the initial removal of re-usable waste followed by the retrieval of unrecyclable waste, mainly known as residual waste (Upadhyaya, 2013). Below is the process to retrieve energy from waste.

Disposal: Disposal involves setting up a process or system that treats waste materials. This may represent the gathering, transport, reusing, arranging, or processing of waste. Frameworks for waste management intend to control waste for reasons like dangers related to general wellbeing, ecological issues, or the general look of an area(Mihai & Ingrao, 2018).

The oldest and most common waste disposal method is dumping, and most of the developed nations dump more than 90% of their solid waste through the dumping method. The process involved carrying out studies on certain areas to dispose of the waste or create dumping sites (Galvão *et al*., 2023). These studies include determining the location's geographical orientation, groundwater system, ecology, and surrounding communities and inhabitants. The natural degradation of biological substances leads to the generation and release of gases and liquids that are odorless(Silverberg *et al*., 2021). Poor management of the landfill poses negative impacts to the surrounding through the contamination of the soil and groundwater, hence leading to deteriorated environmental hygiene. All waste cannot however be deposited in landfills. In such instances, this waste is treated using incineration, a complicated process with numerous reactions. Solid waste does not in any way burn even in the presence of oxygen (Upadhyaya, 2013).

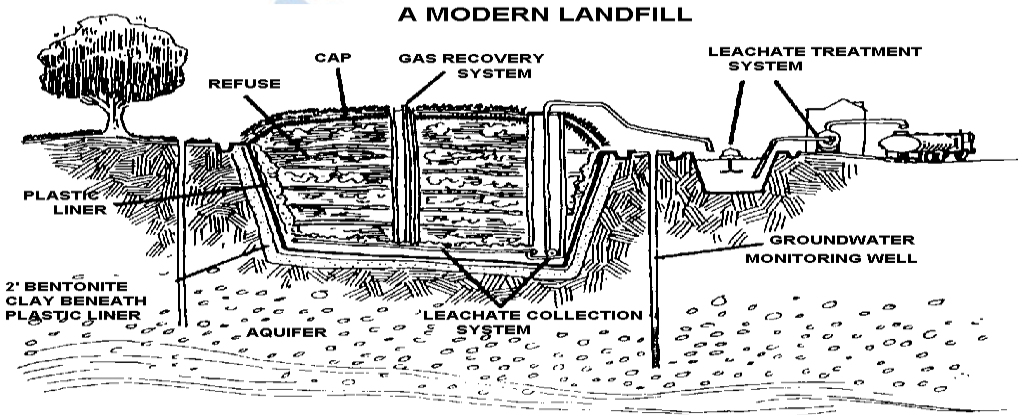


Figure 2: A modern Landfill

Source: Upadhyaya, 2013.

2.1.4 Protection Motive Theory (PMT)

The protection motive theory (PMT), which Rogers first proposed, is a conceptual framework that explains the variables influencing risk-avoidance behavior. As per PMT, individuals seek to participate in harm-lessening behaviors since they would like to protect themselves from risks such as change of climate, nuclear explosions, and natural calamities. People measure different dangers and benefits (Xiao *et al.,* 2017). Hinged on the risk finding and surviving evaluations a selection is undertaken. Individuals use the cognitive threat evaluation process to ascertain the threat depth. It contains 2 significant elements; a threat assessment taken critical and the certainty that the hazard would have negatively impact (Janmaimool, 2017).

The extent of gravity that an individual takes the looming harms to be termed as a menace's deemed severity. An individual's view of their prone to the dangers is considered in their deemed susceptibility. The reward impression or the benefits of present actions as viewed, is also added in the evolution of the threat (maintaining risky behaviors). Individuals might be motivated to adopt adjusted practices, such practicing environment friendly routines, due to the, reward, vulnerability , and severity (Abdel-Shafy & Mansour, 2018). A higher logic of seriousness and susceptibility has a likelihood of increasing incentive of people in engaging in an act of reducing risk, but a higher reward sense from current actions has a likelihood of reducing the conduct of lessening hazard (Piyapong Janmaimool, 2017).

Both reaction and self-efficacies are taken to be mechanisms of adaptation. A persons point of view of their ability to do activities is referred as self-efficacy.

Both self-efficacy and reaction efficacy are considered in the coping appraisal. An individual's opinion of their capacity to carry out the activities is termed as self-efficacy. The act of people

believing that the recommended risk cutting actions workable is known as 'response efficacy. 'The response cost, or what it would cost to carry out the advised behavior, is accounted in the coping appraisal process(Ávila *et al.,* 2017). Individuals may be demoralized from joining in suggested conducts by the greater cost of carrying out averting actions. The total of the self-efficacy and response efficacy evaluations decreases the expense of executing the suggested preventative behavior results in the surviving assessment. (Piyapong Janmaimool, 2017).

2.2 Empirical Review

2.2.1 Solid Waste Management Practices

Refuse is a worldwide problem and if not well addressed, refuse results in a harm to the surrounding and the people's health. It is an increasing problem connected to directly to how community manufactures and uses. Waste handling is one of the key efficacy services supporting 21st Century society, especially in cities and towns (Wilson *et al.,* 2015). Rise of population, fast urbanization, thriving economy, and the increase in standards of life have significantly boosted the amount of municipal production of solid effluent in unindustrialized nations (Zohoori & Ghani, 2017). In responding to effective SWM issues and rising environmental knowledge, community group have started participating in projects related to management of waste in Asian urbans (Greene & Tonjes, 2014).

According to the research by (Fadhullah *et al.,* 2022), explored the handling of SW activities and residents' perception in the East Coast Malaysia. The study determined the aspects that contributed to practices of segregation among the participants. The findings indicated that practice of waste segregation was significant with the locality.

Study by (Maharjan *et al.,* 2019) researched on SWM hurdles and activities in the Nepal. Survey results indicated that municipalities practiced door- to- door system to gather solid refuse from homesteads with coordination with community and private sectors.

Research by (Teshome *et al.,* 2022) studied practices of SWM in Kebridehar City, Somali Provincial state, Ethiopia. Results showed there was high rate of refuse formed from urban households. Study reported that, participants who were not set out by municipality used informal sector and burned solid waste for disposal. They also disposed garbage in the valleys, in the streets, and open-air spaces polluting the environment.

Study by (Gospel Chimenma Dimkpa *et al.,* 2023) was conducted in Nigeria, assessed strategies of SWM in Elele Community, Ikwerre Local Government Area, Rivers State. The findings exposed that open spaces disposing was at 69.82% and was highly eminent dumping technique used in Elele and only 1.09 % of the community practiced Landfill technique. There was no adequate supply of top-closed compacted trucks 29.03%t to manage garbage collection with a safeguarding game plan. The respondents' recognition of non-selective dumping of a solid refuse in Elele was huge at 96.67%. The elements contributed were reported to be; absence of information on permitted ways of dumping of solid waste 38.55%, absence of participation by public 16.2% and government funds insufficiency at 14.78%.

Survey was conducted by (Iraguha *et al.,* 2022) assessed present practices of SWM, perceptions of the community, and participations in the Kigali City, Rwanda. The study reported ways applied for MSWM in Kigali City, where 88.72% refuse gathered at garbage sites at 35.5% is dressed and consumed as fertilizers, while 53.23%is piled up at the garbage site. A small amount of 7.2% is

burned without recovery of energy. Reuse and recycling only applied for a small amount of refuse. Additionally, study further reported that treatment of refuse has not yet been established in Kigali.

Although there are guidelines and regulation in Kenya about the management of waste, poor execution and dismal enactments have contributed to overwhelmed urban centers by their own refuse, subsequently impacting n environment and public health (NEMA, 2015). A research by (Mochache *et al.,* 2020) who studied management of solid waste among town market household; case of Embu, Kenya. The study indicated that, 37% of the homesteads disposed their solid refuse in open places, 32% combustion and 24% did a recycling. Approximately 8percent of the homesteads reused the solid refuse. The study reported that open waste dumping and burning were the highly popular homestead management of waste techniques. These ways were popular in homesteads in regions where collection of refuse was inaccessible by County Government of Embu or poor infrastructure, where some of the places had high slopes disadvantages refuse gathering trucks to access those areas. Nevertheless, these techniques are not effective causing harm to the environment and public health.

A research by (Mugo Ephantus *et al.,* 2015) studied a review on generation of solid refuse and its features in Thika Municipality of Kiambu County in Kenya. The produced waste comprised of food, paper, plastics and other organic waste. Every element had some recovery level. Some of the recyclable and reusable resources were being recovered, refuse from food had the biggest rate of recovery for 23 % and was utilized as feeds for animals, while soft plastics at 17% were bought by recyclers. Material recovery for composting and recycling was approximately at 10.12 tonnes or of everyday production, remaining 76.44 tonnes daily that can be turned into beneficial energy. The survey showed refuse in garbage pit can be utilized by turning it to energy hence a best solution for SWM.

2.2.2 Socio-Economic Determinants Influencing Effective Solid Waste Management

A research by (Abegaz *et al.* 2021), observed practices and limitations of homestead management of solid waste in Woldia Town, Northeastern Ethiopia. The study stated social economic factors to be key elements influences management of waste. The results revealed that level of education, status of occupation, income per month, and age were significant to solid waste management.

A study in Jimma town, Ethiopia, observed determinants of effective household solid waste management practices and showed that, the level of education, law implementation, willingness to pay, years of dwelling, sex, family size and monthly income were among the factors influenced management of solid waste (Megersa, 2018).

A research in Nigeria, Benin city, investigated determinants of solid waste production and disposal systems among neighborhoods. The study associated low education level, family size, income level and occupational status to poor solid waste management by (Onwuemele, 2015).

Study by (Mashau *et al.*, 2018) investigated the socio-economic factors impacted practices on household SWM in South African city. The study revealed that poverty and unemployment contributed to poor household solid waste disposal. Participants indicated they disposed of the refuse in the open veld because they could not afford the services of waste management from their local municipality. The study further revealed that, the local municipality was also not providing any service concerning household waste management. The study recommended provision for affordable, equitable, and sustainable household SWM services in rural communities.

Research by (Vieira & Matheus, 2017) examined the significance of social-economic components on "Municipal Solid Waste Generation" in the city of Sao Paulo, Brazil. The researchers also examined the relationships between the variables. The socioeconomic factors included the

population density of rural populations, population, education, income per capita, life expectancy, human development, and inequality.

A research by (Trang *et al.*, 2017), studied impacts of social-economic elements composition and production of household solid waste in the town of Thu Dau Mot, Vietnam. The results disclosed that, family size and income significantly influenced solid waste generation at 1%. Another variable such as the size of the household related with the household waste generation. However, the findings illustrated that households with more people generated a higher quantity of household solid waste every day, while other variables were at constant, attitudinal variable for the coefficient environment was significant statistically and positive. Additionally, the results indicated that families with higher revenue, which are higher, generated less quantity of organic waste daily, but the plastic generation, Polyethylene terephthalate, and paper was seemingly increasing.

Research by (Noufal *et al.*, 2020), analyzed the household solid waste production determinants and composition in Homs City, Syria. Pearson's coefficient values found there is relationship between generation of household waste and monthly income, size of the household, and household head age.

Study by (Mochache *et al.*, 2020), investigated market town household SWW: a case study of Embu, Kenya. The survey aimed to unveil the elements that influenced choice for SWM ways in households. The research exposed that education level, income and availability of collection services as major factors influenced methods of solid waste management. Descriptive analysis showed that, 50% of casuals with low but regular income did not prioritize waste collection services, while 7.5% of permanently employed with higher regular income paid for waste collection services.

Research by (Naftal Omonywa Mecheo, 2022), studied about components affecting the production of domestic solid refuse in residing areas in Kisii town. The study stated the key elements that influenced quantity of daily generated solid waste in the households included household size according to 86% respondents and monthly income 4.3%.

2.2.3 Stakeholders Engagement Influence in Solid Waste Management

Stakeholders' engagement involves creating links with communities, concerned groups and other impacted entities to achieve backing for waste management policies, SWM plan and service matters. Stakeholders partnership influences operational SWM system, environment protection and promotion of healthy inhabitant (Kotei *et al.*, 2020).

Poor and inadequate stakeholder involvement has been among the factors leading to poor solid waste management. It is vital to engage people to recognize their needs and the best solution for their needs, including SWM (Besen *et al.*, 2014). According to research where public is involved in the process of SWM, individuals are likely to cooperate and know the appropriate measures to be set up an environment to make sure a clean environment is reserved (Ghinea *et al.*, 2016*)*. Furthermore, engaging the necessary stakeholders ensure appropriate and adequate resources are set up to make sure the necessary measures to enable appropriate management of solid waste. In a study done in China, appropriate and adequate stakeholder involvement was found to be a factor causing good SWM practices and this was linked to the individuals in the society giving priority to the most produced type of waste in society (Chhay *et al.*, 2018*)*. Same results were also noted in a survey done in Brazil where adequate engagement of the necessary stakeholders was found to enhance the appropriate management of solid waste (Rebehy *et al.*, 2023). In 2017, the Brazil, generation of Urban Solid Waste was at 78.4M tonnes; out of that 71.6 million tons was collected, and 6.9 million tons did not have proper disposal, adding up a range of 91.2 % of the nation.

Drawing from all collected SW in 2017, 59.1 % were recorded, and increased with 3% as compared to 2016. Nonetheless, the balance of 40.9%, were dumped in unsuitable locations like dumpsites or garbage without environmental protection system, creating public health risks, and all this hazard was related to poor engagement of the community and other stakeholders in solid waste management process (Penteado & Castro, 2021).

Study by (Nthambi *et al.,* 2013) observed the determinants of households' choices on solid waste administration alternatives in Kibra slum, Kenya. Results indicated that organizational elements such as arrangements in contracts, 2006 regulation of waste management, returns of disposal, proximity to the main road, and schooling duration, size of the family, and slum/sack garden ownership, network based, network-based reusing practice; transfer returns, and waste isolation clarify the family's decision of managing solid waste. Consequently, the survey recommended powerful poorest guidelines of waste management, approaches of community based management of refuse, informal refuse recyclers support, privatization of services of refuse management, and establishment of compost manure market among cities and towns and semi urban farmers (Shahbaz *et al.,* 2022).

(Malii & Mugambi, 2015) examined the risk determinants in SWM projects, in Mombasa, Kenya. The study presented that, there were well placed regulations and measures to handle disposing solid waste in the county. Nevertheless, from different case groups the suggestion was that, though the county had proper legal systems, for handling refuses basically, comprising solid waste, there were less implementations, leading to public health risks to the County residents, solid waste workers, and the citizens. On contrary, political weight was additionally found to undertake a major part in preventing suitable and fitting controlling of these programs (Oswald *et al.*, 2016).

A study by (Ng'ang'a, 2022), explored the success of stakeholder inclusion and SWM in Mombasa County in Kenya. The study evaluated stakeholders' involvement through public private partnership, and results showed from the community that involvement of stakeholders' resolve problems of SWM and encourage change of behavior among youth. Results further exposed that, lack of goodwill between government, private investors and the general public made it impossible to solve challenges in solid waste management. Study insisted on community participation to be important in ensuring effective solid waste management and healthy environment. Research by (Ogutu *et al.*, 2020), studied collaborations for manageable urbans as alternatives for bettering SWM in the City of Nairobi. There is advantages in application of policy partnership in solid waste management that included; improved economy, jobs creation, reduced pollution and viable solid waste management.

2.2.4 Existing Community Practices

A study in the East Coast of Malaysia by (Fadhulla, *et al.*, 2022) reported that, ineffective solid waste in the household had effects on public health, such as biological, physical, psychological, non- communicable diseases and ergonomics health risks. Filters from the solid waste pollutes the soil, waste and air that offers a breeding environment for biological vectors like rodents, flies and pests (Grazhdani, 2016). They finally cause diseases such as cholera, dysentery, diarrhea, gastrointestinal infections, dengue fever bacterial infection and respiratory problems. Pollution from the dumpsite may cause cancer and exposure to gases such as carbon dioxide, Sulphur, methane and nitrogen dioxide produced by the waste in the landfill is capable of causing bronchoconstriction and inflammation that can affect immunity (Welivita *et al.*, 2015). Hydrogen fluoride and hydrogen chloride leads to cough, chest tightness and breathlessness if deposited in the respiratory system. Empirical result of a study in Thailand by (Vassanadumrongdee &

Kittipongvises, 2018) presented that, waste segregation from the source was significantly affected by previous behavior on regular source segregation, presence of waste segregation system and knowledge on risks caused by waste. *(*Ferreira *et al.,* 2015) analyses the packing system of waste management in Belgium. The authors used a binary logistic regression model that covered variables including frequency of waste allocation, household characteristics, and provision of cycling services. Poor solid waste management at the society level remained to be a public health concern. Poor disposal of solid waste by community members pose a big threat to the surrounding biodiversity and hence there is a need to educate community members on how to appropriately manage all type of solid waste in the appropriate manner (Lazo & Gasparatos, 2022). In a study conducted in Cameroon, good community practices on solid waste management were found to have profound benefits on the surrounding and improved wellbeing of the community (Albrecht et al., 2022). Appropriate waste segregation and recycling are important in conquering waste challenges, attaining a rounded economy, civilizing public health, and sustaining environment. Therefore, it is key to realize what encourages community to segregate generated waste to implement accurate planning and policy development *(*Adu-Gyamfi *et al.*, 2023a).

Study by (Mukui, 2013) determined the problems that hinder SWM among households in urban Nyeri, Kenya. The survey results indicated that about 26.2% of households carry out the methods correctly in SWM, the household separation percentage of solid wastes which was practiced was about 24.6% and the remaining 74.6% was as a result of the long distance to the nearest chamber, social style, and carelessness. The proper method of solid waste management proposed were compost pits for household disposal, self-provided bins to store, and the utilized trash chamber. (Kinyua et al., 2016) studied the social-cultural factors influencing SWM among households in a

Kenyan informal settlement. Findings from the study showed those poor SWM behaviors, poor information of proper SW disposal, and a negative attitude on appropriate WM.

2.3 Other Studies

The study by (Onwuemele, 2015) analyzed the factors determining the generation and SWM in Benin City. The amount of waste produced including solid waste transfer techniques among family units was an impression of differences in socio-economic characteristics of the populace. The survey called for the polishing of socio-economic factors of homesteads and neighborhoods in the plan and usage of a solid waste transfer framework.

An investigation by (World Bank, 2018) observed that in the EU, associations of municipalities are typically strong proponents of local needs and key counterparts to the central government on issues of waste management. Important decisions in the sector are rare without key stakeholders consulted and their endorsement secured. Other stakeholders are equally important for the process of negotiating complex implementation schemes requiring the consent of industries, national governments, and municipalities. A similar study in Makassar City by (World Bank, 2018) expressed that, the participation of the community was essential to the achievement of waste administration at the local level. It has powerful relevancy and correlation concerning the limitedness of government in providing infrastructure for supporting waste management.

A study that was done in Utah by (Mcallister, 2015) analyzed attributes affecting SWM in the third world countries and identified some of the key hurdles that influenced solid waste systems to be policy, infrastructure, and culture. The study called for mediation in education, policy restructuring, and infrastructure update to upgrading SWM in the communities of the developing world. Mass sensitization, financing, competence, implements, facilities and provide other lacking

necessities to improve SWM sustainability in the developing nations. According to a survey by, (Teshome *et al.*, 2021) concluded that, deficit of sanitary landfills, resulted to disposing solid waste into unauthorized open space leading to environment pollution. inadequate institutional framework, deficiency of skilled labor, finances and infrastructure are among main challenges in municipal council. Hence, Partnerships of local government, community, non-governmental organizations, learning institutions and business communities are essential to facilitate effective solid waste management practices.

2.4 Critical Review

A survey by (Riquelme *et al.*, 2016) reviewed the significance of social-economic factors on the "Municipal SW Generation" in the city of Sao Paulo, Brazil. The researchers also examined the links between social aspects and municipal solid waste generation. The socioeconomic factors identified included: rural population, density, population, education (undergraduate and high school), income per capita, life expectancy, human development, and inequality. Whereas the study identified inequality and income per capita as the primary drivers, the study did not address age, accessibility to dumping sites, and household sizes as socio-economic factors relevant to viable practices of SWM. A survey by (Raab *et al.,* 2021) only examined the effect of social-economic factors composition and household solid waste yielding. The survey was done in Guatemala City, which is situated in Central America. Hence, the study would not be relevant to the current context because Kenya is a state in sub-Saharan Africa with unique socio-economic characters that would not match Guatemala City.

Reviewed African-based studies failed to identify the accessibility of dumping sites as a socio-economic determinant to effective solid waste management. For example, (Serge Kubanza & Simatele, 2019) revealed that poverty and unemployment contributed to poor household solid

waste disposal in a South African city. Participants indicated they disposed of refuse in the open because they could not afford the services of waste management from their local municipality. It was revealed that, the local municipality was also not providing any service concerning household waste management. Whereas the study addressed several socio-economic determinants and community factors, the study did not effectively address the effects posed by stakeholder engagement critically. (Moruf *et al.*, 2020) findings indicated that waste generation composed in the Ibadan reflected the variation of social-economic to the individual. Other factors of social-economic comprise age, occupation, education, income, and building types that had a great influence on dispersal methods in the Ibadan metropolis.

Reviewed Kenyan studies were anchored on identifying correct household solid waste management methods. A survey by (Kinyua *et al*., 2016), studied the social-cultural aspects connected to the SWM among families residing in informal settlements. The survey showed those poor SWM behaviors, poor information of proper SW discarding, and a dismissive point of view on appropriate SWM. Empirical analysis by (Naftal Omonywa Mecheo, 2022) proved that there existed positive SWM practices in Kenya through separation of SW was practiced while lack of proper disposal resulted from indiscretion, the style of socialization, and long partitions to the nearest garbage chamber. Several Kenyan studies linked socio-economic determinants, existing practices in the community, and stakeholder engagement with effective solid waste management practices.

2.5 Conceptual Framework

This study insinuates that socioeconomic variables influence powerful SWM. The arrows demonstrate the interrelationships between variables of the study. The moderation of solid refuse

in the study was by organizational factors like proper government policies, county by- laws and availability of infrastructure on SWM.

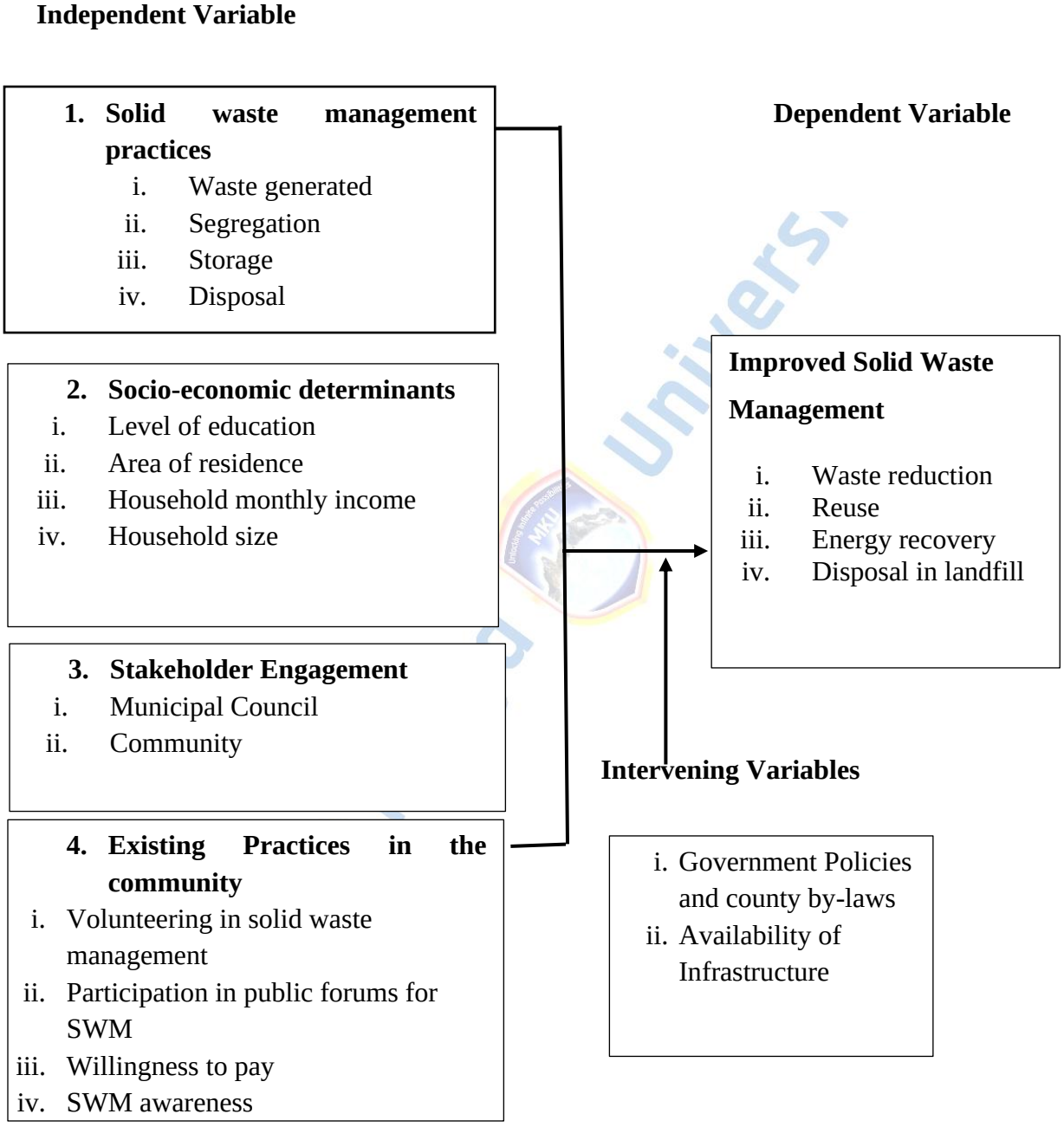


Figure 3:Conceptual framework

Source: Researcher, 2019

2.5.1 Summary of Conceptual Review

The study developed a conceptual framework to depict the interactions between independent and dependent variables. There are factors that are measured i.e. solid waste management practices, socio-economic determinants, stakeholder engagement and existing practices in the community (independent variables). These factors are manipulated to observe their effect on improved solid waste management (dependent variable). The observed change is considered the cause or reason for observed effect (outcome). Factors (intervening variables) that ensure implementation of improved solid waste management, where the government can implement a range of policies and by-laws. Policies and by-laws should be designed to regulate waste disposal, restrict harmful practices, facilitate transportation and development of modern landfills. Infrastructure that supports waste recovery, reuse, and recycling include treatment processes, sharing networks, reverse logistics, and marketplaces. This type of infrastructure facilitates resource recovery and near-zero waste strategies, enabling the collection and sorting of materials for reuse, repair, refurbishment, and recycling. Additionally, infrastructure for waste-to-energy enables the recovery of embedded energy from residual materials that cannot be reused or recycled. Although waste-to-energy isn't technically considered "circular" since it deals with end-of-life materials, it plays a significant role in addressing waste and pollution. It can also help countries reduce their dependence on landfills as they transition toward a circular economy.

CHAPTER THREE

RESEARCH METHODOLOGY

This segment puts bare the procedures applied in carrying out this research. In particular, it describes the research design, target population, techniques for sampling, instruments for data collection, and data analysis methods. The chapter also explains the ethical considerations that the researcher adhered to while conducting the study.

3.1 Study Design

The research had a mixed approach characterized by analytical cross-sectional research design. Cross-sectional research design is type of observational study design that greatly helps to measure results and exposures in the study respondents and similarly, without influencing the results. Hence, formulate knowledge and solutions regarding the present problem. Cross- sectional study design was suitable because the research aimed to observe, describe, and document factors influence solid waste management practices as they naturally occur, to offer an explanatory perspective without altering results.(Ranganathan, 2019).

Analytical or inferential studies establishes a relationship between an outcome and exposure. They are moreover categorized as interventional or observational studies. In observational surveys, there is no need of researcher intervention. The researcher basically observes results in various groups of respondents who, for some intentions, have or have not been susceptible to a certain risk factor. Instances of observational research are like cross-sectional study design.

Analytical research design describes the relationship between study variables without manipulating them. The design reflects the relationship stability and/ or direction between two variables, which can be either positive or negative (Ranganathan, 2019).

3.2 Study Variables

Variables in this study are divided into three i.e. independent, intervening and independent variables. Independent variables included SWM practices, social- economic determinants, stakeholders' engagement and existing practices in the community. Policies by- law and facilities was interviewing variables between independent and dependent variables. The dependent variable was improved solid waste management. this had several indicators i.e. waste reduction, reuse, energy recovery and disposal in landfill. Fischer's exact was carried out to determine the association between the above variables.

3.3 Location of the Study

Thika town is situated at 01°03′S 37°05′E and lying on the A2 street 40km in Nairobi Northeast, close to the intersection of the Thika and Chania Rivers (City Government of Kiambu, 2015). The main economic activities include industries and agricultural processing, particularly in horticulture, coffee and pineapple. This makes the areas suitable for this study due to the industries and agricultural activities that generates waste and hence the need to select it as a study site. The study's locale is Thika Sub-County, which is sited in the County of Kiambu, in Central Kenya. The Sub- County has five Wards – Township, Kamenu, Hospital, Makongeni, and Ngoliba Gatuanyaga Wards (County Government of Kiambu, 2018). The latest population and housing census of Kenya evaluated the number of inhabitants in the region to 264,261 residing in 88,989 households (Kenya National Bureau of Statistics, 2019)

3.4 Target Population

The target population was 42,341 households and 2 employees of the Municipal Council of Thika. As per last country census, the total population of the Thika sub-county was 264,261 with 88,989

households (Kenya National Bureau of Statistics, 2019) Table 1 illustrates the target population distribution among respective wards.

Table 1: Target population

County Ward	Sub-location	No. of Households
Township Ward	Starehe	30,486
Kamenu Ward	Kamenu	6,688
Hospital Ward	Kimathi	5,167
Total		42,341

Source: Kenya National Bureau of Statistics (2019)

3.5 Sample Design

3.5.1 Sample Size Determination

Yamane's (1967) formula determined the sample size.

$$n = \frac{N}{1 + N(e)^2}$$

Where: **n** is the sample size; **N** is the population size and **e** is the error tolerance.

Therefore, using Yamane (1967) Formula, the sample size will be:

$$n = \frac{42341}{1+42341(0.05)^2} = 396.2$$

n= 396 households.

n= no. of samples

N= total population

e = error margin

Table 2 illustrates the distribution of the sample size in each ward (strata).

Table 2: Sample population frame

Stratum	No. of Households	Formula	Sample Size
Starehe Sub-location	6,668	n = (6,668 / 42321) * 396	= 62.4
Kamenu Sub-location	30,486	n = (30,486 / 42321) * 396	= 285.1
Kimathi Sub-location	5,167	n = (5,167 /42321) * 396	= 48.3
Municipal council of Thika staff			2
Total	42321		398

Source: Kenya Bureau of Statistics, 2019

The sample population was 396 households and 2 employees of the Municipal Council of Thika to bring the total sample size to 398.

3.6 Inclusion Criteria

Residents of Thika Sub- County, household heads 18 years and above, Participants who consented and Environment officer Kiambu County.

3.7 Exclusion Criteria

Children below 18 years, Participants who did not consent to the study and household heads who lacked knowledge on solid waste management in that household.

3.8 Sampling Procedures and Techniques

Cluster sampling was used to group the 5 Wards in Thika Sub- County; Township Ward, Hospital Ward, Kamenu Ward, Ngoliba Ward, and Gatuanyaga Ward. Purposive sampling facilitated to select three Wards; Township, Hospital, and Kamenu Ward based on population size. Stratified random sampling aided to sub-divide these Wards into Sub-locations, where only one Sub-location per Ward was selected by purposive sampling. In this case, the study selected those Sub-locations with a small portion of households. Simple Random sampling facilitated to choose the households where every third house was sampled. This avoided bias in the study. The key informant were purposively sampled since only the in-charge in Municipal Council of Environment Department were included in the study.

3.9 Data Collection Methods and Procedures

Both quantitative and qualitative data gathering approaches were applied in this study. The questionnaire sourced quantitative data, where the respondents filled them voluntarily, while the interview guide was utilized to source qualitative information from the Environment Officers as the key informants. This aided the researcher in recording respondent responses and opinions relayed to the survey.

3.10 Data Collection Tools and Instruments

3.10.1 Questionnaire

A structured questionnaire was the primary tool for collecting qualitative data. The research tool contained questions in a pre-arranged order and gave respondents options to provide their responses. The questionnaire had closed-ended and open-ended queries. Closed-ended question offered the respondents' options to tick the correct responses based on Likert scales while open-

ended questions complement the closed-ended ones by having respondents provide their opinions in writing for their responses.

3.10.2 Interview Guide

An interview guide documented information from the selected municipal council staff members to collect quantitative data. An interview guide comprised a set of questions asked to record in-depth information, opinions, and feelings of respondents regarding the study variables.

3.11 Data Collection Procedure

The researcher collected both qualitative and quantitative data. Quantitative data was gathered by use of researcher administering semi-structured questionnaire, while qualitative data was collected using a Key Informant Interview Guide. A semi-structured questionnaire (Appendix II) was generated from the in-depth literature reviewed, while KI interview guide in Appendix III, had in-depth semi-structured open-ended questions for the key informants to answer. Both quantitative and qualitative data collection instruments were translated into Kiswahili for easy understanding amongst those who did not understand.

Objective 1: To assess the solid waste management practices for waste generators

Information on solid waste management practices was gathered using a pre-tested semi-structured questionnaire in Appendix II. This section will cover information type of waste generated, waste segregation, waste storage and waste disposal. The researcher visited the randomly selected households and briefed the participants to comprehend the study purpose and ensured them privacy. the consented respondents were given questionnaire, where questions were read by the researcher, and the responses of the participants were recorded. Key informant interview was used to assess waste segregation, 3R hierarchy practice, waste recovery practice and waste collection.

The researcher applied descriptive analysis and bivariate relationship between solid waste management practices among respondents and social- economic status.

Objective 2: To determine the influence of social-economic status in solid waste management for waste generators

Information on the influence of social-economic status in solid waste management was gathered by a pretests of semi-structured questionnaire which included, a question on gender, level of education, area of residence, living duration, monthly income, and question on household size. The researcher visited the randomly selected households and briefed the participants comprehend the study purpose and ensured them privacy. the consented respondents were given questionnaire, where questions were read by the researcher, and the answers of the participants were documented. The researcher applied the researcher applied descriptive analysis and bivariate relationship between variables. The researcher applied descriptive analysis and bivariate relationship between social- economic status and solid waste management practices among respondents.

Objective 3: To evaluate the level of stakeholders' involvement in SWM

Information on level of stakeholders' engagement in solid waste management was collected using a pre-tested semi-structured questionnaire which included, a question on rating municipal council in SWM, enforcement of by-laws on SWM, encouraged to participate in SWM by the municipal council and question on rewards by municipal council for participating in SWM. The researcher visited the randomly selected households and briefed the participants to comprehend the purpose of the research and ensured them privacy. the consented respondents were given questionnaire, where questions were read by the researcher, and the responses of the participants were recorded. Key informant interview was used to assess public sensitization by City Council and the dumpsite

present in Kiambu County. The researcher applied descriptive analysis and bivariate associations between the level of stakeholder engagement and solid waste management practices.

Objective 4: To assess the existing community practices in SWM.

Information on the existing society practices in SWM was gathered by employing pretested semi-structured questionnaire which included, a question on extent of general public taking part in Solid Waste Management, voluntary in SWM, participating in public participation forums of SWM, willingness to pay and involvement in awareness of SWM. The researcher toured the randomly chose households and briefed the participants to comprehend the research purpose and ensured them privacy. The consented respondents were given questionnaire, where questions were read by the researcher, and the responses of the participants were recorded. Key informant interview was applied review factors that affected SWM in the study domain, community attitude towards SWM. The researcher applied descriptive analysis.

3.12 Administration of Data Collection Tools

The study first obtained permit to carry out research from Mount Kenya University Ethical Review Committee and School of Postgraduate to gather information in the field. The researcher was cleared to execute data collection to public by obtaining research licence from NACOSTI. Thereafter, the researcher contacted Kiambu County Government for approval to do data collection in the County and in the designated location of the research. Introduction of the researcher and the information regarding the study followed, and then participants were offered a consent form to read and sign before being recruited to participate in the study. Participants who duly completed the consent form and handed it back to the researcher were hired to take part in the study, and those who never signed the forms were omitted from the study. Those taking part

in the study were reassured that that the data provided for study purpose solely, and their confidentiality was paramount to the research.

3.13 Validity and Reliability

3.13.1 Validity

Content and construct validity was assured by warranting that the content in both the questionnaire and interview guide match with the research objectives as well as the theoretical underpinnings of the study. Researcher administered semi-structured questionnaire among the participants in a nearby sub- location. The pre- testing of data instrument eliminated uncertainties and ensured the validity of the data collection tool. The pilot study involved 39 participants, which was 10% of the sample size. Researcher presented key informant interview guide to public health officer in Government of Kiambu County for peer view of the formulated questions. The tool improved depending on the respondents. The experts in the field including supervisors and public health officer in Kiambu County established content validity on both tools. Lastly, during the proposal defense, the research tools were reviewed and corrected.

3.13.2 Reliability

The pre-test of semi- structured questionnaire was in Maguguni Sub- location among 39 respondents. Interview guide was piloted to 4 public health officers in Kiambu County. Subjected to the same respondents were subjected to the same tool after 7 days to assess if the participants gave similar response. The study applied the Cronbach's Alpha (α) reliability coefficient in SPSS statistics to establish the reliability of the research questionnaire. The collected data was entered in SPSS version 26, to check the internal consistency of the questionnaire using Cronbach's Alpha where the value was 0.73. This indicated that the tool was reliable. High coefficient figures that

were close to 1.0 showed high rates of internal consistency and hence, the instrument was reliable (Taherdoost, 2018). Key informant interview guide had open-ended questions, where notes were taken, then analysed using INVIVO version 11 where themes corresponded in both tools, confirming the reliability of the tool.

3.14 Data Analysis and Presentation

Questionnaire were sorted first and those with errors were put aside. The qualitative data was cleaned using excel spreadsheet to avoid outliers/ extreme values, unreadable data, incomplete cases duplicate entries and inconsistencies. Cleaned data was then exported from excel to statistical package deal for social sciences (SPSS) Version 26 computer software for analysis. Data coding was done in SPSS through assigning variables numbers based on their categories and data transformation. Since all variables were transformed into categories, frequencies and percentages were applied in descriptive statistics. Fisher's exact tests as bivariate review was carried out to assess the link between dependent and independent parameters at 95pecent confidence interval, and variables with p- values of ≤ 0.05 were concluded to be significant. Qualitative data was analyzed by thematic approach from the interview guide. The interview guide was uploaded into a Microsoft Word document for cleaning. The documents were imported and uploaded for transcription. Narratives were then uploaded into INVIVO version 11 from Microsoft Word for coding and categorized according to excerpts associated to them. Auto coding was done based on research questions, and each research question was coded as main themes (parent code) and then emerging variables under each research question was coded as sub- themes (child theme). Similar responses under each sub- themes were identified and coded as grandchild code. Later themes, sub-themes, and grandchild codes were generated, and triangulation followed where data was presented using verbatim quotes.

Table 3: Summary of the data analysis technique.

Objectives	Independent variables	Dependent variable	Data analysis technique
Solid waste management practices for waste generators.	• Waste segregation • Storage of solid waste • Disposal of Refuse	Solid waste management	• Descriptive analysis.
Influence of Socioeconomic Status on Solid Waste Management.	• Level of education • Area of residence • Household monthly income • Household size	Solid waste management	• Descriptive analysis (Frequency, percentage) • Bivariate analysis (Fisher's Exact test)
Stakeholder Engagement in SWM	• Municipal Council • Contribution of Community	Solid waste management	• Descriptive analysis (Frequency, percentage) • Bivariate analysis (Fisher's Exact test)
Community Practices Influencing Solid Waste Management	• SWM volunteerism • Participation in public forums for SWM • Readiness to pay • SWM awareness	Solid waste management	• Frequency • Percentage

3.15 Data Management

Raw data was under a locked cabinet to ensure security. Memory-stick saved soft copy of the data set, and only accessible to the researcher and supervisors. Only supervisors and the researcher accessed data related to the study.

3.16 Ethical Considerations

Researcher considered numerous ethical when conducting the study. To begin with, the researcher ensured that there was maintenance of respect and confidentiality when handling the respondents. Data acquired from the study was confidential and used for educational purposes only. Participation was merely voluntary without force or coercion to participants in the study. The nature of the research was relayed to the respondents prior to accepting to engage into the study. A consent form provided indicated that participation in the study would be free of coercion, and participants were free to stop participation any time. In addition, the study did not collect personal data that could in one way or the other link the respondents to the study. Data collection was commenced after obtaining clearance from Mount Kenya University Ethical Clearance Committee (ERC) and study permit from National Council for Science Technology and Innovation (NACOSTI). The scholar searched authority to interact with people from County Government of Kiambu.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSIONS

4.0 Introduction

The chapter describes the findings of the study in Thika Sub-County, which involved 396 participants. Participants who consented were 396 from Kamenu Ward, Township Ward, and Hospital Ward in Thika Sub- County. The only 2 Municipal Officers in the Department of Environment Thika Sub-County were interviewed as key informants in the study, therefore rate of reply was 100 percent.

4.1 Socio-Demographic Characteristics

This section provides the social profile features of the study respondents recruited in this survey. As illustrated in table 4 in this research most (67.3%) of the study participants were males while close to three-quarters (32.7%) of the study participants were females. Regarding the research respondents' age, more than half (54.5%) of the study respondents were aged 26-35, this was closely (25.6%) followed by 36-45while only a few (9.1%) of the study respondents were aged above 46 years. Concerning education, majority (64.6%) of the study participants had attained a secondary education level and this could be linked to the presence of free primary and secondary education in Kenya. Only a few (2%) of the study participants had a doctorate level of education. From this study, the majority (71.9%) of the study participants were residing in the Kamenu ward while only a few (12.3%)were residents of the hospital ward. Concerning the period of residence in the selected research zones, the majority (55.8%) of the study respondents reported to have lived for 6-10 years while only a few (4.3%) of the participants of the survey reported having dwelled in the research area for less than a year. Concerning household income level, the majority (66.3%) of the study respondents reported earning more than 11000-30000 Kshs while only a few (0.3%)

of the study participants reported earning less than 10000. Finally concerning household size majority (97.7%) of the study participants divulged owning a size of family of fewer than 4 four members while only a few (2.3prcent) of the study participants opened to own a size of family of -10 members.

Table 4:Socio-demographic and Economic Characteristics

Gender	**Freq.**	**Percent**
Male	268	67.3
Female	130	32.7
Total	398	100
Age	**Freq.**	**Percent**
26-35	217	54.5
36-45	102	25.6
18- 25	43	10.8
Above 46	36	9.1
Total	398	100
Level of education	**Freq.**	**Percent**
Secondary School	257	64.6
Undergraduate Degree	101	25.4
Primary School	18	4.5
Postgraduate Degree	14	3.5
Doctorate Degree	8	2.0
Total	398	100
Area of residence	**Freq.**	**Percent**
Kamenu ward	286	71.9
Township Ward	63	15.8
Hospital Ward	49	12.3
Total	398	100
How long have you been a residence in your current ward	**Freq.**	**Percent**
6 – 10 years	222	55.8
2 – 5 years	113	28.4
More than 10 years	46	11.6
Less than 1 year	17	4.3
Total	398	100
Household's monthly income (K.sh)	**Freq.**	**Percent**
11,000Kshs – 30,000	264	66.3

31,000Kshs – 50,000	92	23.1
51,000Kshs – 100,000	39	9.8
More than 100,000	2	0.5
Less than 10,000	1	0.3
Total	398	100
Household's size	**Freq.**	**Percent**
Less than 4	389	97.7
5 – 10	9	2.3
Total	398	100

Source: Researcher, 2023

4.2 Solid Waste Management Practices among Study Participants.

4.2.1 Types of Wastes generated in Households

Table 5 displays the various types of waste generated by households of study participants in the study area. Food remains were the most (80.4%) generated kind of waste in this study and the rest 19.6% of waste were cans, clothes, electronics, plastics, and papers as reported by the study participants, this could be linked to food commodities being the most produced and consumed product hence a higher percentage of waste generation from food products.

Table 5: Type of generated waste

Type of waste generated	Freq.	Percent
Food remains	320	80.4
Cans, clothes, electronics, plastics, and papers	78	19.6
Total	398	100

Source: Researcher, 2023

4.2.2 : Waste Management practices

Table 6 illustrates wastage management activities that respondents adopted at their household. A significant proportion of study participants 65.1% did not segregate waste while more than a quarter (34.1%) of the study participants reported practicing waste segregation, 89.2% temporarily stored solid waste in their house before disposal while only a few (10.8%) of the study participants

reported not to temporary store solid waste in the house. Disposal of solid waste was inappropriately done by 56.5% while the rest, 43.5% appropriately disposed of solid waste.

Table 6: Waste management activities adopted at the household level

Waste Segregation	**Freq.**	**Percent**
No	259	65.1
Yes	139	34.1
Total	398	100
Temporary solid waste storage in the house	**Freq.**	**Percent**
Yes	355	89.2
No	43	10.8
Total	398	100
Disposal of Solid Waste	**Freq.**	**Percent**
Inappropriate	225	56.5
Appropriate	173	43.5
Total	398	100

Source: Researcher, 2023

Low segregation of waste was linked to one of the key informants interview and averred that "*waste segregation was mostly done by waste-pickers at the time of collection". "Segregation of waste is so low at the household level, "The segregation of solid waste was done by waste pickers."* (Environment Officer, 2021, KI 1).

The study assumed that, the respondents temporarily stored waste since waste collection was not done frequently, the key informant noted that,

"Municipal Council collected solid waste daily from the markets only." (Environment Officer, KI 1).

Private garbage collectors collected solid waste once in a week at the household level, as was reported in the key informant interview,

"Private garbage collectors were engaged in collecting solid waste and disposed it at Kang'oki dumpsite for entire Kiambu County" (Environment Officer, KI 1,2).

4.2.3 : Solid Waste Management Index.

Table 7 illustrates the overall SWM practices index among study participants generated by combining practices in Table 4.5. The overall waste management practices were dichotomous inappropriate and inappropriate. A household is said to have appropriate solid waste management practices if they segregated waste, temporarily stored waste, and if they disposed of waste as required by solid waste disposal standards. It was evident that from Table 6, 88.7% of study participants' solid waste management practices were adjudged to be inappropriate. Only 11 % practiced appropriate SWM practices.

Table 7: Solid Waste Management Index among study participants

Solid Waste Management Practices	**Freq.**	**Percent**
Appropriate	45	11.3
Inappropriate	353	88.7
Total	398	100

Source: Researcher, 2023

Appropriate solid waste management was not implemented at the household level. This was as a result from lack of 3R hierarchy of waste management as it was claimed by a key informant,

"Municipal Council does not practice 3R hierarchy of waste management. The reduction was done by the refuse pickers at the dumping site, Recycling is practiced by businesspeople by manufacturing, and reuse was not clear if it was practiced" (Environment Officer, KI, 1).

The inappropriate solid waste management was also linked to poor enforcement of by-laws on waste management at household level as the respondents reported.

The municipal council did not practice energy recovery. Instead, *"Waste recovery was practiced by farmers via collecting organic waste from the markets to feed their animals"* (Environment Officer, KI, 2)

4.3 Influence of Socio-economic Status on SWM Practices in Thika sub-county.

Table 8 shows the bivariate analysis of respondents' socio-economic position and practices of SWM. Regarding the educational level, close to half (48.9%) of the survey participants who reported handling SWM appropriately had acquired a secondary education level while only a few (2.2%) of the respondents who reported handling SWM appropriately had attained a doctorate level of education. During the bivariate analysis, there was a statistical link between respondents' level of education and solid waste management practices (*Fisher's exact p=0.017*). Those who have a high level of education are probable to manage their solid refuse appropriately as compared to their fellow counterparts. These findings were in harmony with two other studies done in Spain where the level of education was discovered to affect the level of SWM *(*Knickmeyer, 2020; *Macklin et al., 2023)*. However, this was contrary to a study done in Ghana which was contrary to these findings *(Adu-Gyamfi et al., 2023b*). Regarding gender, more than half (62.2%) of the male gender reported appropriately handling solid waste management while more than a quarter (37.8%) of the female gender reported appropriately handling solid waste management. Results disclosed that, no statistical link between gender and solid waste management (X^2*0.603, df=1, p=0.437)*). These findings were in agreement with two other studies in Uganda and Ghana (Gumisiriza & Kugonza, 2020; *Katusiimeh et al., 2012*). However, another study in Nigeria, revealed that females were highly probable to exercise better solid waste management practices in comparison to males and this could be linked to the female gender being more hygienic in kitchen matters as compared to their fellow counterparts (*Adzawla et al., 2019*).

Regarding area of residence, in this study close to half (48.9%) of the respondents of the research who noted handling solid waste appropriately lived in the township ward while only a few (11.1%) of the research participants who recorded that handling solid waste appropriately lived in the hospital ward. According to Fisher's exact, there was a statistical connection between area of residence and solid waste management ($X^2=42.26$, $df=2$, $p=0.0001$). The possible reason for this could be linked to, despite majority the study respondents' willingness to pay for solid waste management, they could not afford since majority had low monthly income. These research outcomes were in accordance with a survey conducted in India where the area of residence was found to influence solid waste management (Kulkarni & Anantharama, 2020). However, this was contrary to a survey carried out in Tanzania which did not find any connection between the area of residence and SWM (*Nyampundu et al., 2020*).

In regard to the effect of duration lived in the research area, three quarter (33.3%) of the survey respondent who not appropriately handling SWM had dwelled in the study area for 2-5 years while only a few (11.1%) of the research participants who indicated to handle solid waste appropriately reported to dwell in the study area for less than a year. When the chi-square test for independence was done there was a statistical link between duration lived in the study area and solid waste management ($X^2=8.96$, $df=3$, $p=0.030$). The possible reason for this could be linked to the study respondents putting more effort to preserve the environment they dwell in for better health and environmental outcome. The results were in accord with two other studies carried out in Malawi (*Holm et al., 2021*; Yesaya & Tilley, 2021). However, this was contrary to a study done in Nepal which found no association between the two parameters (*Behera et al., 2020)*.

Regarding monthly income level, close to half (46.7%) of the study respondents who earned between 11,000-30,000 Ksh reported handling sold waste management appropriately while only a

few (15.6%) of the study respondents who reported earning 51,000 Ksh above handled solid waste appropriately. When the chi-square test for independence was done there was a statistical connection between level of income and solid waste management (*Fisher's Exact p=0.044*). Studies have reported better level of income has been linked to good solid waste management practices. These findings were in agreement with two other studies done in Ethiopia where the level of income was found to influence solid waste management (*Dika et al., 2019;* Tassie & Endalew, 2020). These findings were opposing to a similar survey in Ethiopia which did not find any link between the level of income and appropriate solid waste management *(Kebede et al., 2021*). Finally, regarding household size, all (100%) households that had a household size of less than 4 members had appropriate SWM while the majority (97.5%) of the households which were reported to handle solid waste management inappropriately had less than 4 household members. The Fisher's Exact test revealed that, there was no statistical association between household size and solid waste management (*Fisher's Exact p=0.606*). These findings were contrary to a study done in Ethiopia where a bigger household size was found to influence appropriate solid waste management, the bigger the size of the family the larger the amount of refuse produced hence poor SWM (*Abegaz et al., 2021*). It was contrary to two other studies done in Ethiopia and Kenya which found an association between solid waste management and household size (Dianati *et al.,* 2021; Lema *et al.*, 2019).

Table 8:Influence of Socio-economic Status on SWM Practices

Gender	**Appropriate**	**Inappropriate**	**Total**
Male	28(62.2)	240(68.0)	***0.6034(1), p=0.437)***
Female	17(37.8)	113(32.0)	
Level of education	**Appropriate**	**Inappropriate**	
Primary School	0(0.0)	18(5.1)	***Fisher's Exact test p=0.017***
Secondary School	22(48.9)	235(66.6)	
Undergraduate Degree	19(42.2)	82(23.2)	

Postgraduate Degree	3(6.7)	11(3.1)	
Doctorate Degree	1(2.2)	7(2.0)	
Area of residence	**Appropriate**	**Inappropriate**	
Township Ward	22(48.9)	41(11.6)	***42.26(2), p=0.0001***
Hospital Ward	5(11.1)	44(12.5)	
Kamenu ward	18(40.0)	268(75.9)	
Duration lived in current ward	Appropriate	Inappropriate	
Less than 1 year	5(11.1)	12(3.4)	***8.96(3), p=0.030***
2 – 5 years	15(33.3)	98(27.8)	
6 – 10 years	18(40)	204(58)	
More than 10 years	7(15.6)	39(11.1)	
monthly income (K.sh)	**Appropriate**	**Inappropriate**	
Less than 10,000 K	0(0.0)	1(0.3)	***Fisher's Exact p=0.044***
11,000 – 30,000	21(46.7)	243(68.8)	
31,000 – 50,000	17(37.8)	75(21.3)	
51,000Kshs – 100,0	7(15.6)	32(9.1)	
More than 100,000	0(0)	2(0.6)	
Household 'size	**Appropriate**	**Inappropriate**	
Less than 4	45(100.0)	344(97.5)	***Fisher's Exact p=0.606***
2. 5 – 10	0(0.0)	9(2.6)	

Source: Researcher, 2023

4.4 Stakeholder Engagement in Solid Waste Management

Table 9 illustrates the degree to which Municipality as a key stakeholder is engaged SWM in the research area. From the respondent's point of view, 52.5% of study participants rated the Municipal council's effort in managing solid waste as good, and 47.5% gave a poor rating. Regarding enactment of SWM by-laws, a significant proportion 87.4% held the opinion that enforcement of by-laws was poor. The study participants, 77% attested that they were not encouraged to participate, and a majority (95.7%) acknowledged that they were not rewarded by the municipality for participating in solid waste management activities.

Table 9:Stakeholder Engagements in Solid Waste Management

Rating Municipal Council in SWM	Freq.	Percent
Poor	189	47.5
Good	209	52.5

Total	398	100
Enforcement of by-laws on SWM		
Poor	348	87.4
Good	50	12.6
Total	398	100
Encouraged to participate in SWM by the Municipal Council.	Freq.	Percent
No	307	77.1
Yes	91	22.9
Total	398	100
Rewarded by Municipal Council for Participating in SWM	Freq.	Percent
Yes	17	4.3
No	381	95.7
Total	398	100

Source: Researcher, 2023

4.4.1 : Level of Stakeholder Engagement

A dichotomous composite index based on the findings in Table 9 was generated and illustrated in Table 10 where 56.6% of study participants opined that the municipality as the key stakeholder engaged them in solid waste management while 43.4% felt that the level of engagement was low.

Table 10: Level of Stakeholder Engagement

level of stakeholder engagement	Freq.	Percent
High	163	56.6
Low	125	43.4
Total	288	100

Source: Researcher, 2023

To improve engagement one key informant underscored the role of public sensitization

"Public sensitization in waste management, dust bin donation in tangible points, funding, waste collection, and participation in cleaning activities" (Environment Officer, KI 1).

In the interviews, it was not noted that the county shared only one dumpsite and there was a need for transfer stations

"All Wards share Kang'oki dumping site, although it was suggested to have transfer stations per Ward, and has not been achieved" (Environment

4.4.2 **Bivariate Associations between the Level of Stakeholder Engagement and Solid Waste Management Practices**.

Regarding the level of stakeholder engagement, the majority of the research respondents reported that appropriately handling solid waste management had a high level of stakeholder engagement while only a few of the research participants who reported handling solid waste appropriately reported a low level of stakeholder engagement. When the Fisher's Exact test was done there was a statistically positive relationship between the extent of stakeholder engagement and solid waste management practices χ^2 (*15.98(1), p=0.0001.* a high level of stakeholder engagement has been found to enhance better solid waste management and this can be connected to better adoption of good SWM capabilities. These research results were in consistent with two different research done in Ethiopia (*Hirpe et al., 2021*; Mussa & Suryabhagavan, 2019). However, another study done in Sri Lanka was contrary to these results as it found no association between the level of stakeholder engagement and solid waste management (*Saja et al., 2021*).

Table 11: Bivariate Associations between the Level of Stakeholder Engagement and Practices

level of stakeholder engagement	Appropriate	Inappropriate	
Low	7(15.9)	118(48.4)	*15.98(2), p=0.0001*
High	37(84.1)	126(51.6)	

Source: Researcher, 2023

The qualitative analysis further revealed that strategic options for improving solid waste management in Thika Sub-County included, the *"Creation of transfer stations in every Ward, provision of incinerators, allocating more funding to SWM, material recovery facilities, provision of environmental education, and enhancing public-private partnership"*

"Engagement of private garbage collectors by Municipal Council and recovery of organic waste by livestock farmers from the markets" (Environment Officer, KI 1, 2).

Other stakeholders of solid waste management in Kiambu County according to a key informant interview included the "*business community, private garbage collectors, and UN-Habitat"* (Environment Officer, KI 1, 2).

Key informant interview reported, "*Other stakeholders of solid waste management in Kiambu County included the business community, they gave donations and created public awareness in waste management. Private garbage collectors collected a bigger percentage of waste in households and disposed of it at the dumping site. UN-Habitat funded and assisted the County in planning for waste management"* (Environment Officer, KI 1, 2). Further reports showed that the *"Influence of the business community had a small effect in waste management, especially at the household level but a very large effect in markets and CBD"* (Environment Officer KI 1, 2). The further report showed that the *"Influence of business community had a small effect in waste management especially in the household level but a very large effect in markets and CBD"* (Environment Officer KI 1, 2).

4.5 Community Practices Influencing Solid Waste Management

Table 12 illustrates community practices in SWM in their corresponding study zones. Most respondents (80.65%) in this study reported not having ever volunteered in Solid waste management clean up- activities, while only a few (19.4%) of the study respondents affirmed to have volunteered in SWM clean-up activities in the designated wards. Concerning participation in county public engagement forums for SWM, the majority of the study participants (91.2%) had never participated in any public participation forums on solid waste management while only a few (8.8%) of the research participants reported having taken part in the public participation forums

for managing refuse. Regarding readiness to recompense higher for bettered solid waste management, a significant proportion (78.6%) were ready to remunerate more for enhanced services for solid waste management while (21.4%) of the research were not prepared to pay more for improved services concerning SWM. Finally, concerning being involved in sensitization of SWM close to three quarters (72.1%) of the study respondents reported being involved while only a few (27.9%) of the study participants reported not being involved in Awareness of Solid Waste Management.

Table 12: Community Practices in Solid Waste Management

Ever volunteered in Solid Waste Management cleanup activities in the ward	Freq.	Percent
Yes	77	19.35
No	321	80.65
Total	398	100
Participated in County public participation forums on Solid Waste Management	Freq.	Percent
No	362	91.2
Yes	35	8.8
Total	397	100.0
Willingness to pay for Improved Solid Waste Management		
Yes	313	78.6
No	85	21.4
Total	398	100
Ever been involved in Awareness of Solid Waste Management	**Freq.**	**Percent**
No	287	72.1
Yes	111	27.9
Total	398	100

Source: Researcher, 2023

One of the key informants notes that *"The Factors that affected solid waste management in Thika Sub-County was scarce waste collection machinery, working tools were shared among workers and insufficient manpower since there were only 2. So much resources are needed and can be*

availed if county residents voice their concerns in budgeting forums prepared by the county assembly" (Environment Officer, KI 1).

"*There* was *scarce waste collection machinery*" (Environment Officer, KI 1). Further reports showed that the "*Municipal Council had 1 backhoe tractor and 2 skip loaders used in solid waste management"* (Environment Officer, KI 1, 2).

Key informant findings reveal that "*Behavior change is required among residents to take that, waste is not waste but gold"* (Environment Officer, KI 2).

4.6 Extent of Community Participation in Solid Waste Management

Based on the outcomes in the table 12, public taking part was adjudged to be low (80.65%). Only 19.35% averred that community participation was high and shown in table 13.

Table 13: Extent of Community Participation in Solid Waste Management

Community Participation in SWM	Freq.	Percent
High	77	19.35
Low	321	80.65
Total	398	100

Source: Researcher, 2023

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

Chapter five summarizes the results of the study, conclusions drawn from the study, and recommendations to improve SWM in Sub-county of Thika, Kiambu County, Kenya. The chapter also includes the areas suggested for further research.

5.1 Summary of Findings

Males 67.3% were the majority participants while females 32.7% were the minority participants in this study. Among the participants, those aged between 25-35 years were the majority 54.5%, and those above 46 years were the minority 9.1% in this study. Food remains (80.4%) was the biggest kind of solid waste produced in households. The research revealed that in waste management practices adopted at the household level, a significant proportion of study participants 65.1% did not segregate waste, and 89.2% temporarily stored solid waste in their houses before disposal. Disposal of solid waste was inappropriately done by 56.5% while the rest, 43.5% appropriately disposed of solid waste.

Solid Waste Management Index among study participants showed that the majority 88.7% of study participants were adjudged to practice inappropriate solid waste management and only 11 % practiced appropriate SWM practices.

5.1.1 Assess the solid waste management practices for waste generators.

Food remains were the most (80.4%) generated kind of waste in this study and the rest 19.6% of waste were cans, clothes, electronics, plastics, and papers as reported by the study participants, this could be linked to food commodities being the most produced and consumed product hence a

higher percentage of waste generation from food products. A significant proportion of study participants 65.1% did not segregate waste while only 34.1% of the study participants reported practicing waste segregation, 89.2% temporarily stored solid waste in their house before disposal. A household is said to have appropriate solid waste management practices if they segregated waste, temporarily stored waste, and if they disposed of waste as required by solid waste disposal standards. It was evident that, 88.7% of study participants' solid waste management practices were adjudged to be inappropriate. Only 11 % practiced appropriate solid waste management practices.

5.1.2 Influence of social economic status in SWM for waste generators.

The respondents' socio-economic status had a statistically significant association with practices of SWM. Respondents' level of education was linked with Solid waste management practices (*Fisher's exact p=0.017*). There was a statistically positive variation between study participants' income level and solid waste management practices (*Fisher's exact p=0.004)*. This was also noted in the following parameters Area of residence (X^2*=42.26, df=2, p=0.0001*), duration lived in the study area management (X^2*=8.96, df=3, p=0.030*), income (*Fisher's Exact p=0.044*). However, Gender (X^2*0.603, df=1, p=0.437)*) and household size were not statistically connected practices of SWM (*Fisher's exact p=0.606).*

5.1.3 The level of stakeholders' engagement in solid waste management.

The study also estimated the level to which Municipality as a key stakeholder is engaged in SWM in the study area. From the respondents' perspective, 52.5% of survey respondents rated the Municipal council's effort in managing solid waste as good, and 47.5% gave a poor rating. The majority of the study participants 56.6% opined that the municipality as the key stakeholder engaged them in solid waste management while 43.4% felt that the level of engagement was low.

There was a statistically positive link between the level of stakeholder engagement and solid waste management practices χ^2 (*15.98(1), p=0.0001*)**.**

5.1.4 Community Practices Influencing Solid Waste Management.

According to the study, most respondents 80.65% in this study reported not having ever volunteered in Solid waste management clean up- activities. Also, 90.2% have never participated in any public participation forums on solid waste management but a significant proportion of 78.6 % were ready to remunerate higher for improved services for solid waste management. As per the results, community participation was declared to be below 80.65 %. Only 19.35% affirmed that community participation was high.

5.2 Conclusion

The study concluded that, remains of food was the most produced type of trash in the study area. A significant proportion of study participants did not segregate waste therefore; majority of study participants were pronounced to exercise inappropriate SWM.

The study concluded that, socio- economic situation influenced solid waste management. Aspect like education level, area of residence, monthly income, and duration lived in the study area were associated to practices of SWM, hence the variables positively influenced solid waste management in the study area. Household size and gender did not affect solid waste management in this research.

In conclusion, the level of stakeholders' engagement influenced solid waste management, municipal council being among the key stakeholder in solid waste management in the study area. The solid waste management stakeholders included business community, private garbage collectors, and UN-Habitat. There was a statistically positive connection between the extent of

stakeholder engagement and solid waste management practices χ^2 (*15.98(1), p=0.0001*. The level of stakeholder engagement was high 56.6 % and improved solid waste management that was linked to greater adoption of good SWM capabilities.

In conclusion, participation of the general public in SWM was low in the study area. Majority of the participants never volunteered in public clean- up activities and have never participated in public participation forums for solid waste management. The researcher linked the results to low public contribution in solid waste management.

5.3 Recommendations

The study recommends Government to implement solid waste segregation from the household level, that can be enhanced by provision of colour coded bins or liners, creating public awareness through public education and development of policies for solid waste management.

The study recommends for promotion of appropriate solid waste management by the government among young people especially in tertiary levels. This is supported by this study, since the respondents with high level of education were more likely to significantly influence appropriate solid waste management.

The study endorses that, community to actively engaged in solid waste management. This is because, as stakeholder in SWM there was low community participation in solid waste management and majority in the community did not participate in County- public forums for SWM.

The study recommends for special programs in Thika Sub-County that would target the community to voluntarily take part in solid waste management to enhance appropriate solid waste management in the public.

Suggestions for Further Study

1. This study was restricted to 3 selected Wards in Thika Sub- County, similar studies can be done in other Sub-Counties, so as to create basis for contrast of the findings obtained from different Sub- Counties in Kenya.
2. Researcher recommends further study on factors influencing industrial waste management in Thika Sub- County.

REFERENCES

Abdel-Shafy, H. I., & Mansour, M. S. M. (2018). Solid waste issue: Sources, composition, disposal, recycling, and valorization. *Egyptian Journal of Petroleum*, *27*(4), 1275–1290. https://doi.org/10.1016/J.EJPE.2018.07.003

Abegaz, S. B., Molla, K. A., & Ali, S. E. (2021). Practices and Challenges of Household Solid Waste Management in Woldia Town, Northeastern Ethiopia. *Journal of Health and Pollution*, *11*(30), 1–12. https://doi.org/10.5696/2156-9614-11.30.210605/465829

Adipah, S., & Kwame, O. N. (2018). A Novel Introduction of Municipal Solid Waste Management. *Journal of Environmental Science and Public Health*, *3*(2), 147–157. http://www.fotunejournals.com/a-novel-introduction-of-municipal-solid-waste-management.html

Adu-Gyamfi, G., Asamoah, A. N., Nketiah, E., Obuobi, B., Adjei, M., Cudjoe, D., & Zhu, B. (2023a). Reducing waste management challenges: Empirical assessment of waste sorting intention among corporate employees in Ghana. *Journal of Retailing and Consumer Services*, *72*. https://doi.org/10.1016/j.jretconser.2023.103261

Adu-Gyamfi, G., Asamoah, A. N., Nketiah, E., Obuobi, B., Adjei, M., Cudjoe, D., & Zhu, B. (2023b). Reducing waste management challenges: Empirical assessment of waste sorting intention among corporate employees in Ghana. *Journal of Retailing and Consumer Services*, *72*. https://doi.org/10.1016/J.JRETCONSER.2023.103261

Adzawla, W., Tahidu, A., Mustapha, S., & Azumah, S. B. (2019). Do socioeconomic factors influence households' solid waste disposal systems? Evidence from Ghana. *Waste Management and Research*, *37*(1_suppl), 51–57.

https://doi.org/10.1177/0734242X18817717

Agamuthu, P., & Fauziah, S. H. (2011). Challenges and issues in moving towards sustainable landfilling in a transitory country - Malaysia. *Waste Management and Research*, *29*(1), 13–19. https://doi.org/10.1177/0734242X10383080

Albrecht, E., Nkem, A. M. A., Ernest, E., Albrecht, E., Nkem, A. M. A., & Ernest, E. (2022). The Legal Aspect of Waste Management in Cameroon with Focus on the Buea Municipality. *Journal of Geoscience and Environment Protection*, *10*(8), 9–23. https://doi.org/10.4236/GEP.2022.108002

Amugsi, D. A., Mwangi, J. N., Haregu, T. N., Aboderin, I., Muindi, K., & Mberu, B. U. (2020). Solid Waste Management Policies in Kenya: The Silence on the Plight of Women and Children. *The Journal of Solid Waste Technology and Management*, *46*(1), 87–96. https://doi.org/10.5276/jswtm/2020.87

Asare, W., Oduro-Kwarteng, S., Donkor, E. A., & Rockson, M. A. D. (2020). Recovery of Municipal Solid Waste Recyclables under Different Incentive Schemes in Tamale, Ghana. *Sustainability 2020, Vol. 12, Page 9869*, *12*(23), 9869. https://doi.org/10.3390/SU12239869

Atta, A. Y., Aminu, M. A. Y., Yusuf, N., Gano, Z. S., Ahmed, O. U., & Fasanya, O. O. (2016). Potentials of Waste to Energy in Nigeria. *Journal of Applied Sciences Research, Pages*(2), 1–6. http://creativecommons.org/licenses/by/4.0/

Ávila, C., Cedano, K., & Martínez, M. (2017). Sustainability analysis of waste to energy strategies for municipal solid waste treatment. *International Journal of Environmental Sustainability*, *13*(2), 1–14. https://doi.org/10.18848/2325-1077/CGP/V13I02/1-14

Ayilara, M. S., Olanrewaju, O. S., Babalola, O. O., & Odeyemi, O. (2020). Waste management

through composting: Challenges and potentials. *Sustainability (Switzerland)*, *12*(11). https://doi.org/10.3390/SU12114456

Babayemi, J. O., Ogundiran, M. B., & Osibanjo, O. (2016). Overview of Environmental Hazards and Health Effects of Pollution in Developing Countries: A Case Study of Nigeria. *Environmental Quality Management*, *26*(1), 51–71. https://doi.org/10.1002/TQEM.21480

Behera, B., Rahut, D. B., & Sethi, N. (2020). Analysis of household access to drinking water, sanitation, and waste disposal services in urban areas of Nepal. *Utilities Policy*, *62*, 100996. https://doi.org/10.1016/J.JUP.2019.100996

Besen, G. R., Ribeiro, H., Gunther, W. M. R., & Jacobi, P. R. (2014). Coleta seletiva na região metropolitana de São Paulo: impactos da Política Nacional de Resíduos Sólidos. *Revista Ambiente & Sociedade*, *17*(3), 259–278. https://doi.org/10.1590/s1414-753x2014000300015

Bowan, P. A., Kayaga, S., Cotton, A., & Fisher, J. (2019). Municipal Solid Waste Disposal Operational Performance in Wa Municipality, Ghana. *Journal of Health & Pollution*, *9*(23). https://doi.org/10.5696/2156-9614-9.23.190903

Chhay, L., Reyad, M. A. H., Suy, R., Islam, M. R., & Mian, M. M. (2018). Municipal solid waste generation in China: influencing factor analysis and multi-model forecasting. *Journal of Material Cycles and Waste Management*, *20*(3), 1761–1770. https://doi.org/10.1007/S10163-018-0743-4/METRICS

County Government of Kiambu. (2018). *Water Resources*. Www.kiambu.go.ke; County government of Kiambu. https://dev.kiambu.go.ke/water-resources/#

County Government of Kiambu. (2017). *Environment and Climate Change*. Www.kiambu.go.ke; Government of Kiambu County. https://dev.kiambu.go.ke/environment-and-climate-change/

Dianati, K., Schäfer, L., Milner, J., Gómez-Sanabria, A., Gitau, H., Hale, J., Langmaack, H., Kiesewetter, G., Muindi, K., Mberu, B., Zimmermann, N., Michie, S., Wilkinson, P., & Davies, M. (2021). A system dynamics-based scenario analysis of residential solid waste management in Kisumu, Kenya. *Science of The Total Environment*, *777*, 146200. https://doi.org/10.1016/J.SCITOTENV.2021.146200

Dika, G., Nemie, A., & Birhane, E. (2019). Household's Willingness to Pay for Improved Solid Waste Management in Gulelle Sub City, Addis Ababa. *Energy and Environmental Engineering*, *6*(1), 1–7. https://doi.org/10.13189/eee.2019.060101

Douti, N., Abanyie, S., & Ampofo, S. (2017). Solid Waste Management Challenges in Urban Areas of Ghana: A Case Study of Bawku Municipality. *Int J Geosci*, *08*.

Fadhullah, W., Imran, N. I. N., Ismail, S. N. S., Jaafar, M. H., & Abdullah, H. (2022). Household solid waste management practices and perceptions among residents in the East Coast of Malaysia. *BMC Public Health*, *22*(1), 1–20. https://doi.org/10.1186/S12889-021-12274-7/TABLES/6

Ferreira, S., Cabral, M., De Jaeger, S., Da Cruz, N. F., Simões, P., & Marques, R. C. (2015). Life cycle assessment and valuation of the packaging waste recycling system in Belgium. *Journal of Material Cycles and Waste Management*, *19*(1), 144–154. https://doi.org/10.1007/s10163-015-0383-x

Fidelis, R., Marco-Ferreira, A., Antunes, L. C., & Komatsu, A. K. (2020). Socio-productive inclusion of scavengers in municipal solid waste management in Brazil: Practices, paradigms and future prospects. *Resources, Conservation and Recycling*, *154*, 104594. https://doi.org/10.1016/J.RESCONREC.2019.104594

Flannelly, L. T., Flannelly, K. J., & Jankowski, K. R. B. (2014). Independent, dependent, and other variables in healthcare and chaplaincy research. *Journal of Health Care Chaplaincy*, *20*(4), 161–170. https://doi.org/10.1080/08854726.2014.959374

Fudala-Ksiazek, S., Pierpaoli, M., Kulbat, E., & Luczkiewicz, A. (2016). A modern solid waste management strategy - the generation of new by-products. *Waste Management*, *49*, 516–529. https://doi.org/10.1016/J.WASMAN.2016.01.022

Galvão, N., Alves, I. R. F. S., & Bassin, J. P. (2023). Municipal solid waste management in Brazil: overview and trade-offs between different treatment technologies. *Waste Management and Resource Recycling in the Developing World*, 755–772. https://doi.org/10.1016/B978-0-323-90463-6.00031-2

Ghinea, C., Drăgoi, E. N., Comăniţă, E. D., Gavrilescu, M., Câmpean, T., Curteanu, S., & Gavrilescu, M. (2016). Forecasting municipal solid waste generation using prognostic tools and regression analysis. *J Environ Manage*, *182*, 80–93. https://doi.org/10.1016/j.jenvman.2016.07.026

Gospel Chimenma Dimkpa, Ins Dozie, John Nwolim Paul, Kiaka Nwikasi, Joyce Chisa Obia, Amaka Azubuike Ogba, Confidence Waribo Ihua, Sogbeye Tonye George, & Opuda, S. (2023). Assessment of Solid Waste Management Strategies in Elele Community, Ikwerre Local Government Area, Rivers State, Nigeria. *Saudi Journal of Medical and Pharmaceutical Sciences*, *9*(04), 258–269. https://doi.org/10.36348/sjmps.2023.v09i04.009

Grazhdani, D. (2016). Assessing the variables affecting on the rate of solid waste generation and recycling: An empirical analysis in Prespa Park. *Waste Management*, *48*, 3–13.

https://doi.org/10.1016/j.wasman.2015.09.028

Greene, K. L., & Tonjes, D. J. (2014). Quantitative assessments of municipal waste management systems: Using different indicators to compare and rank programs in New York State. *Waste Management*, *34*(4), 825–836. https://doi.org/10.1016/j.wasman.2013.12.02

Gumisiriza, P., & Kugonza, S. (2020). Corruption and Solid Waste Management in Mbarara Municipality, Uganda. *Journal of Environmental and Public Health, 2020*. https://doi.org/10.1155/2020/4754780

Haregu, T. N., Ziraba, A. K., & Mberu, B. (2016). Integration of Solid Waste Management Policies in Kenya: Analysis of coherence, gaps and overlaps. *African Population Studies*, *32*(2). https://doi.org/10.11564/30-2-889

Hirpe, L., Yeom, C., Del Consuelo Hernández Berriel, M., Lobo, A., De Cortázar, G., Lorena, A., & García, E. (2021). Municipal Solid Waste Management Policies, Practices, and Challenges in Ethiopia: A Systematic Review. *Sustainability 2021, Vol. 13, Page 11241*, *13*(20), 11241. https://doi.org/10.3390/SU132011241

Holm, R. H., Chunga, B. A., Mallory, A., Hutchings, P., & Parker, A. (2021). A Qualitative Study of NIMBYism for Waste in Smaller Urban Areas of a Low-Income Country, Mzuzu, Malawi. *Environmental Health Insights*, *15*. https://doi.org/10.1177/1178630220984147

IETC. (2020). *National Solid Waste Management Strategy for United Republic of Tanzania. International Environmental Technology Centre.* https://www.unep.org/ietc/resources/policy-and-strategy/national-solid-waste-management-strategy-united-republic-tanzania

Iraguha, F., Handono Ramelan, A., & Setyono, P. (2022). Assessment of current solid waste management practices, community perceptions, and contributions in the City of Kigali, Rwanda. *IOP Conference Series: Earth and Environmental Science*, *1016*(1), 012056. https://doi.org/10.1088/1755-1315/1016/1/012056

Janmaimool, P. (2017). Application of Protection Motivation Theory to Investigate Sustainable Waste Management Behaviors. *Sustainability 2017, Vol. 9, Page 1079*, *9*(7), 1079. https://doi.org/10.3390/SU9071079

Katusiimeh, M. W., Mol, A. P. J., & Burger, K. (2012). The operations and effectiveness of public and private provision of solid waste collection services in Kampala. *Habitat International*, *36*(2), 247–252. https://doi.org/10.1016/J.HABITATINT.2011.10.002

Kaza, S., Yao, L. C., Bhada-Tata, P., & Van Woerden, F. (2018a). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. https://doi.org/10.1596/978-1-4648-1329-0

Kaza, S., Yao, L. C., Bhada-Tata, P., & Van Woerden, F. (2018b). What a Waste 2.0. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. https://doi.org/10.1596/978-1-4648-1329-0

Kebede, Y. S., Alene, M. M., & Endalemaw, N. T. (2021). Urban landfill investigation for managing the negative impact of solid waste on environment using geospatial technique. A case study of Assosa town, Ethiopia. *Environmental Challenges*, *4*, 100103. https://doi.org/10.1016/J.ENVC.2021.100103

Kinyua, L., Pertet, A. M., Ph, D., & Ogwayo, I. O. (2016). Social- Cultural Factors Associated with Household Solid Waste Management in a Kenyan Informal Settlement. *IOSR Journal*

of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), *10*(10), 63–68. https://doi.org/10.9790/2402-1010026368

Knickmeyer, D. (2020). Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *Journal of Cleaner Production*, *245*, 118605. https://doi.org/10.1016/J.JCLEPRO.2019.118605

Kouloughli, S., & Kanfoud, S. (2017). Municipal Solid Waste Management in Constantine, Algeria. *Journal of Geoscience and Environment Protection*, *05*(01), 85–93. https://doi.org/10.4236/GEP.2017.51006

Kotei, P., Annang, T., & Yirenya-Tawiah, D. (2020). Stakeholder Participation for Sustainable Solid Waste Management in Ga West Municipality, Accra – Ghana. *American Journal of Environment Studies*, *3*(1), 44–60. https://doi.org/10.47672/ajes.611

Kulkarni, B. N., & Anantharama, V. (2020). Repercussions of COVID-19 pandemic on municipal solid waste management: Challenges and opportunities. *Science of The Total Environment*, *743*, 140693. https://doi.org/10.1016/J.SCITOTENV.2020.140693

Lansink, A. (2018). Challenging Changes – Connecting Waste Hierarchy and Circular Economy. *Https://Doi.Org/10.1177/0734242X18795600*, *36*(10), 872. https://doi.org/10.1177/0734242X18795600

Lazo, D. P. L., & Gasparatos, A. (2022). Factors influencing household-level positive and negative solid waste management practices in rapidly urbanizing cities: insights from Santa Cruz de la Sierra, Bolivia. *Environmental Research: Infrastructure and Sustainability*, *2*(1), 015002. https://doi.org/10.1088/2634-4505/AC44DA

Lema, G., Mesfun, M. G., Eshete, A., & Abdeta, G. (2019). Assessment of status of solid waste

management in Asella town, Ethiopia. *BMC Public Health*, *19*(1). https://doi.org/10.1186/S12889-019-7551-1

Lima, P. D. M., Colvero, D. A., Gomes, A. P., Wenzel, H., Schalch, V., & Cimpan, C. (2018). Environmental assessment of existing and alternative options for management of municipal solid waste in Brazil. *Waste Management*, *78*, 857–870. https://doi.org/10.1016/j.wasman.2018.07.007

Lissah, S. Y., Ayanore, M. A., Krugu, J. K., Aberese-Ako, M., & Ruiter, R. A. C. (2021). Managing urban solid waste in Ghana: Perspectives and experiences of municipal waste company managers and supervisors in an urban municipality. *PLOS ONE*, *16*(3), e0248392. https://doi.org/10.1371/JOURNAL.PONE.0248392

Macklin, J., Curtis, J., & Smith, L. (2023). Interdisciplinary, systematic review found influences on household recycling behaviour are many and multifaceted, requiring a multi-level approach. *Resources, Conservation and Recycling Advances*, *18*. https://doi.org/10.1016/j.rcradv.2023.200152

Maharjan, A., Khatri, S. B., Thapa, L., Pant, R. R., Pathak, P., Bhatta, Y. R., Rijal, K., & Bishwakarma, K. (2019). Solid Waste Management: Challenges and Practices in the Nepalese Context. *Himalayan Biodiversity*, *7*(2382-5200), 6–18. https://doi.org/10.3126/hebids.v7i1.40185

Maleka, T. G., Nyirenda, G., & Fakoya, M. B. (2017). The Relationship between Waste Management Expenditure and Waste Reduction Targets on Selected JSE Companies. *Sustainability 2017, Vol. 9, Page 1528*, *9*(9), 1528. https://doi.org/10.3390/SU9091528

Malii, J. M., & Mugambi, F. (2015). Determinants of Risk in Solid Waste Management Projects,

in Kenya (A Case of Solid Waste Management Projects in Mombasa County). *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, *24*(4), 83–109. https://www.gssrr.org/index.php/JournalOfBasicAndApplied/article/view/4706

Mashau, N. S., Mandiwana, C., & Akinsola, H. A. (2018). Socio-Economic Factors Influencing Household Solid Waste Management Practices at a Rural Village in South Africa 74. *International Journal of Management and Applied Science*, *4*(2), 2394–7926. http://iraj.in

Mcallister, J. (2015). Factors Influencing Solid-Waste Management in the Developing World. *All Graduate Plan B and Other Reports*. https://doi.org/10.26076/2c24-5944.

Megersa, N. (2018). Determinants of Effective Household Solid Waste Management Practices in Jimma Town, Ethiopia. *International Journal of Advanced Research*, *6*(4), 242–256. https://doi.org/10.21474/IJAR01/6851

Miezah, K., Obiri-Danso, K., Kádár, Z., Fei-Baffoe, B., & Mensah, M. Y. (2015). Municipal solid waste characterization and quantification as a measure towards effective waste management in Ghana. *Waste Management*, *46*, 15–27. https://doi.org/10.1016/j.wasman.2015.09.009

Mihai, F. C., & Ingrao, C. (2018). Assessment of biowaste losses through unsound waste management practices in rural areas and the role of home composting. *Journal of Cleaner Production*, *172*, 1631–1638. https://doi.org/10.1016/J.JCLEPRO.2016.10.163

Ministry Of Environment and Forestry. (2021). *Republic Of Kenya Ministry Of Environment and Forestry February 2021 National Sustainable Waste Management Policy*. http://www.environment.go.ke/wp-content/uploads/2021/04/FINAL-National-Waste-Policy-Feb-20211.pdf

Mochache, M., Yegon, R., & Wakindiki, I. I. C. (2020). Market town household solid waste management: a case study of Embu, Kenya. *Journal of Applied Sciences and Environmental Management*, *24*(1), 105. https://doi.org/10.4314/jasem.v24i1.15

Moruf, A. A., Oluwasinaayomi, F. K., & Mubarak, O. L. (2020). Public-Private Partnership (PPP) in residential solid waste management in Ibadan: Challenges and opportunities. *Journal of Geography and Regional Planning*, *13*(1), 30–40. https://doi.org/10.5897/jgrp2019.0721

MS Ayilara, O. O. O. B. O. O. (2020). Waste Management through Composting. *Challenges Potent Sustain*, *12*, *4456*, 10.3390/su12114456.

Mugo Ephantus, Kinyua Robert, & Njogu Paul. (2015). An Analysis of Solid Waste Generation and Characterization in Thika Municipality of Kiambu County, Kenya. *Journal of Environmental Science and Engineering B*, *4*(4). https://doi.org/10.17265/2162-5263/2015.04.005

Muiruri, P. W. (2018). *Assessment of Strategic Solid Waste Management: A Case of Selected Markets in Kiambu County* [Thesis]. http://erepo.usiu.ac.ke/11732/3616

Mukherji, S. B., Sekiyama, M., Mino, T., & Chaturvedi, B. (2016). Resident Knowledge and Willingness to Engage in Waste Management in Delhi. *India Sustain*, *8*(10), 1065. https://doi.org/10.3390/su8101065

Mukui, S. (2013). Factors Influencing Household Solid Waste Management in Urban Nyeri Municipality. *Ethiopian Journal of Environmental Studies and Management*, *6*(3), 280–285. https://doi.org/10.4314/ejesm.v6i3.8

Muturi, E. (2021). Influence of Stakeholders Participation and Management of Solid Waste Disposal. A Critical Literature Review. *Journal of Environment*, *1*(1), 14–29. https://doi.org/10.47941/je.619

Mussa, A., & Suryabhagavan, K. V. (2019). Solid waste dumping site selection using GIS-based multi-criteria spatial modeling: a case study in Logia town, Afar region, Ethiopia. *Https://Doi.Org/10.1080/24749508.2019.1703311*, *5*(3), 186–198. https://doi.org/10.1080/24749508.2019.1703311

Naftal Omonywa Mecheo. (2022). Factors influencing generation of domestic solid wastes in Kisii Town, Kenya. *International Journal of Scientific Research Updates*, *4*(1), 322–328. https://doi.org/10.53430/ijsru.2022.4.1.0057

NEMA. (2015). *the National Solid Waste Management Strategy National Environment Management Authority the National Solid Waste Management Strategy*. http://meas.nema.go.ke/pops/download/National-Solid-Waste-Management-Strategy-_2.pdf

NEMA. (2020). *Kenya Waste Management Guidelines (developed for petroleum sector)*. Www.nema.go.ke; National Environment Management Authority. https://www.nema.go.ke/images/Docs/Selelah_OilandGas/Waste%20Management%20Guidelines%20for%20O&G%20sector

Ng'ang'a, P. (2022). Effectiveness of Stakeholders Involvement and Solid Waste Management in Mombasa County Kenya. *International Academic Journal of Economics and Finance (IAJEF) | International Academic Journal of Economics and Finance*, *3*(7), 127–142. https://iajournals.org/articles/iajef_v3_i7_127_142.pdf

Nimita Jebaranjitham, J., Selvan Christyraj, J. D., Prasannan, A., Rajagopalan, K., Chelladurai, K. S., & Gnanaraja, J. K. J. S. (2022). Current scenario of solid waste management

techniques and challenges in Covid-19 – A review. *Heliyon*, *8*(7), e09855. https://doi.org/10.1016/J.HELIYON.2022.E09855

Noufal, M., Yuanyuan, L., Maalla, Z., & Adipah, S. (2020). Determinants of Household Solid Waste Generation and Composition in Homs City, Syria. *Journal of Environmental and Public Health*, *2020*. https://doi.org/10.1155/2020/7460356

Nyampundu, K., Mwegoha, W. J. S., & Millanzi, W. C. (2020). Sustainable solid waste management Measures in Tanzania: An exploratory descriptive case study among vendors at Majengo market in Dodoma City. *BMC Public Health*, *20*(1), 1–16. https://doi.org/10.1186/S12889-020-08670-0/TABLES/6

Nyeri, C. G. of. (2020). *Nyeri Municipality Solid Waste Management Plan.* https://www.nyeri.go.ke/wp-content/uploads/2021/01/Nyeri-Municipal-Solid-Waste-Plan.Pdf

Ogutu, F. A., Kimata, D. M., & Kweyu, R. M. (2020). Partnerships for sustainable cities as options for improving solid waste management in Nairobi city. *Waste Management & Research: The Journal for a Sustainable Circular Economy*, *39*(1), 25–31. https://doi.org/10.1177/0734242x20967735

Onwuemele, A. (2015). Determinants of Solid Waste Generation and Disposal Systems Among Neighborhoods in Benin City. *International Journal of Social Sciences and Humanities Review*, *5*(2). https://www.ijsshr.com/journal/index.php/IJSSHR/article/view/109/94

Oribe-Garcia, I., Kamara-Esteban, O., Martin, C., Macarulla-Arenaza, A. M., & Alonso-Vicario, A. (2015). Identification of influencing municipal characteristics regarding household waste generation and their forecasting ability in Biscay. *Waste Manag*, *39*, 26–34.

https://doi.org/10.1016/j.wasman.2015.02.017

Oswald, W. E., Stewart, A. E. P., Flanders, W. D., Kramer, M. R., Endeshaw, T., Zerihun, M., Melaku, B., Sata, E., Gessesse, D., Teferi, T., Tadesse, Z., Guadie, B., King, J. D., Emerson, P. M., Callahan, E. K., Moe, C. L., & Clasen, T. F. (2016). Prediction of low community sanitation coverage using environmental and sociodemographic factors in Amhara Region, Ethiopia. *American Journal of Tropical Medicine and Hygiene*, *95*(3), 709–719. https://doi.org/10.4269/ajtmh.15-0895

Penteado, C. S. G., & Castro, M. A. S. de. (2021). Covid-19 effects on municipal solid waste management: What can effectively be done in the Brazilian scenario? *Resources, Conservation, and Recycling*, *164*, 105152. https://doi.org/10.1016/J.RESCONREC.2020.105152

Prajapati, K. K., Yadav, M., Singh, R. M., Parikh, P., Pareek, N., & Vivekanand, V. (2021). An overview of municipal solid waste management in Jaipur city, India - Current status, challenges and recommendations. *Renewable and Sustainable Energy Reviews*, *152*. https://doi.org/10.1016/j.rser.2021.111703

Ranganathan, P. (2019). Understanding Research Study Designs. *Indian Journal of Critical Care Medicine*, *23*(S4). https://doi.org/10.5005/jp-journals-10071-23314

R Aldaco, D. H. J. L. M. M. J. R.-S. J. C. R. K. P. V.-R. A. B. L. B.-B. (2020). Food waste management during the COVID-19 outbreak: a holistic climate, economic and nutritional approach. *Sci Total Environ*, *742*, 140524.

Raab, K., Tolotti, G., & Wagner, R. (2021). Challenges in Solid Waste Management: Insights Into the Disposal Behavior of Suburban Consumers in Guatemala City. *Frontiers in*

Sustainable Cities, *3*, 65. https://doi.org/10.3389/FRSC.2021.683576/BIBTEX

Rebehy, P. C. P. W., Salgado Junior, A. P., Ometto, A. R., Espinoza, D. de F., Rossi, E., & Novi, J. C. (2023). Municipal solid waste management (MSWM) in Brazil: Drivers and best practices towards to circular economy based on European Union and BSI. *Journal of Cleaner Production*, *401*, 136591. https://doi.org/10.1016/J.JCLEPRO.2023.136591

Riquelme, R., Méndez, P., & Smith, I. (2016). *Solid Waste Management in the Caribbean: Proceedings from the Caribbean Solid Waste Conference*. Inter-American Development Bank.

Rousta, K., Zisen, L., & Hellwig, C. (2020). Household waste sorting participation in developing countries—A meta-analysis. *Recycling*, *5*(1). https://doi.org/10.3390/RECYCLING5010006

Saja, A. M. A., Zimar, A. M. Z., & Junaideen, S. M. (2021). Municipal Solid Waste Management Practices and Challenges in the Southeastern Coastal Cities of Sri Lanka. *Sustainability 2021, Vol. 13, Page 4556*, *13*(8), 4556. https://doi.org/10.3390/SU13084556

Samwine, T., Wu, P., Xu, L., Shen, Y., Appiah, E., Yaoqi, W., & Wang, Y. (2017). Challenges and Prospects of Solid Waste Management in Ghana. *Http://Www.Sciencepublishinggroup.Com*,*5*(4),96.https://doi.org/10.11648/J.IJEMA.20170504.11

Serge Kubanza, N., & Simatele, M. D. (2019). Sustainable solid waste management in developing countries: a study of institutional strengthening for solid waste management in Johannesburg, South Africa. *Journal of Environmental Planning and Management*, 1–14. https://doi.org/10.1080/09640568.2019.1576510

Shahbaz, P., ul Haq, S., Abbas, A., Samie, A., Boz, I., Bagadeem, S., Yu, Z., & Li, Z. (2022).

Food, Energy, and Water Nexus at Household Level: Do Sustainable Household Consumption Practices Promote Cleaner Environment. *International Journal of Environmental Research and Public Health*, *19*(19). https://doi.org/10.3390/ijerph191912945

Silverberg, E. L., Sterling, T. W., Williams, T. H., Castro, G., de la Vega, P. R., & Barengo, N. C. (2021). The Association between Social Determinants of Health and Self-Reported Diabetic Retinopathy: An Exploratory Analysis. *International Journal of Environmental Research and Public Health 2021, Vol. 18, Page 792*, *18*(2), 792. https://doi.org/10.3390/IJERPH18020792

Suleman, Y. (2016). Solid Waste Disposal and Community Health Implications in Ghana: Evidence from Sawaba, Asokore Mampong Municipal Assembly. *Journal of Civil & Environmental Engineering*, *05*(06). https://doi.org/10.4172/2165-784X.1000202

T Chen, S. Z. Z. Y. (2020). Adoption of solid organic waste composting products: A critical review. *J Clean Prod*, *272*, 122712.

Taherdoost, H. (2018). Validity and Reliability of the Research Instrument; How to Test the Validation of a Questionnaire/Survey in a Research. *SSRN Electronic Journal*, *January 2016*. https://doi.org/10.2139/ssrn.3205040

Tassie, K., & Endalew, B. (2020). Willingness to pay for improved solid waste management services and associated factors among urban households: One and one half bounded contingent valuation study in Bahir Dar city, Ethiopia. *Http://Www.Editorialmanager.Com/Cogentenv*, *6*(1). https://doi.org/10.1080/23311843.2020.1807275

Teshome, Y. M., Habtu, N. G., Molla, M. B., & Ulsido, M. D. (2021). Municipal Solid Waste Management Practice in Yirgalem Town, Sidam Region, Ethiopia. *Research Square*. https://doi.org/10.21203/rs.3.rs-923133/v1

Teshome, Z. T., Ayele, Z. T., & Abib, M. I. (2022). Assessment of solid waste management practices in Kebridehar city Somali regional state, Ethiopia. *Heliyon*, *8*(9), e10451. https://doi.org/10.1016/j.heliyon.2022.e10451

Trang, P. T. T., Dong, H. Q., Toan, D. Q., Hanh, N. T. X., & Thu, N. T. (2017). The Effects of Socio-economic Factors on Household Solid Waste Generation and Composition: A Case Study in Thu Dau Mot, Vietnam. *Energy Procedia*, *107*(September 2016), 253–258. https://doi.org/10.1016/j.egypro.2016.12.144

UNEP. (2017). *Solid waste management. UNEP - UN Environment Programme.* https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/solid-waste-management

UNEP. (2018). *AfricA Waste Management Outlook. United Nations Environment Programme.* https://wedocs.unep.org/bitstream/handle/20.500.11822/25514/Africa_WMO.pdf

UNEP. (2020). *Integrated Waste Management in Africa: Focus on Circularity - SWITCH Africa Green.*

Upadhyay, R., & Mohan Rao, L. J. (2013). An outlook on chlorogenic acids-occurrence, chemistry, technology, and biological activities. *Critical Reviews in Food Science and Nutrition*, *53*(9), 968–984. https://doi.org/10.1080/10408398.2011.576319

Vassanadumrongdee, S., & Kittipongvises, S. (2018). Factors influencing source separation

intention and willingness to pay for improving waste management in Bangkok, Thailand. *Sustainable Environment Research*, *28*(2), 90–99. https://doi.org/10.1016/j.serj.2017.11.003

Vieira, V. H. A. de M., & Matheus, D. R. (2017). The impact of socioeconomic factors on municipal solid waste generation in São Paulo, Brazil. *Waste Management & Research : The Journal of the International Solid Wastes and Public Cleansing Association, ISWA*, *36*(1), 79–85. https://doi.org/10.1177/0734242X17744039

Welivita, I., Wattage, P., & Gunawardena, P. (2015). Review of household solid waste charges for developing countries - A focus on quantity-based charge methods. *Waste Management*, *46*, 637–645.

Wilson, D. C., Rodic, L., Cowing, M. J., Velis, C. A., Whiteman, A. D., Scheinberg, A., Vilches, R., Masterson, D., Stretz, J., & Oelz, B. (2015). "Wasteaware" benchmark indicators for integrated sustainable waste management in cities. *Waste Management*, *35*, 329–342. https://doi.org/10.1016/j.wasman.2014.10.006.

WorldBank. (2015). *The world bank annual report*. https://reliefweb.int/report/world/world-bank-annual-report-2015

World Bank. (2018). Municipal Solid Waste Management. *IOSR journals*, 1-162.

Xiao, L., Zhang, G., Zhu, Y., & Lin, T. (2017). Promoting public participation in household waste management: A survey based method and case study in Xiamen city, China. *Journal of Cleaner Production*, *144*, 313–322. https://doi.org/10.1016/J.JCLEPRO.2017.01.022

Yesaya, M., & Tilley, E. (2021). Sludge bomb: The impending sludge emptying and treatment crisis in Blantyre, Malawi. *Journal of Environmental Management*, *277*, 111474. https://doi.org/10.1016/J.JENVMAN.2020.111474

Z Abdullah, M. S. K. I. (2017). Survey of Household Solid Waste Management and Waste Minimization in Malaysia: Awareness, Issues and Practices. *International Journal of Environmental & Agriculture Research (IJOEAR)*, *3*(12), 38–48.

Zohoori, M., & Ghani, A. (2017a). Municipal Solid Waste Management Challenges and Problems for Cities in Low-Income and Developing Countries. *International Journal of Science and Engineering Applications*, *6*(2), 039–048. https://doi.org/10.7753/IJSEA0602.1002

Zohoori, M., & Ghani, A. (2017b). Municipal Solid Waste Management Challenges and Problems for Cities in Low-Income and Developing Countries. *International Journal of Science and Engineering Applications*, *6*(2), 039–048. https://doi.org/10.7753/ijsea0602.1002

APPENDICES

Appendix i: Consent form

My name is Margaret Munyua; I am a postgraduate student at Mount Kenya University, School of Public Health. I am researching to determine the determinants influencing effective solid waste management in "Thika Sub- County, Kiambu County, Kenya". You have been selected to participate in this study. The information you will provide will be used only for academic purposes and will be treated with utmost confidence

Procedures to be followed

Participation in this study will require that you fill in a questionnaire. You have the right to refuse participation in this study. Please remember that participation in this study is voluntary. You may ask questions related to the study at any time. You may refuse to respond to any questions and you may stop an interview at any time.

Risks

There are no risks whatsoever for participating in this study.

Benefits

If you participate in this study you will help stakeholders in the public health sector with the socio-economic challenges linked to effective solid waste management and therefore reduce the risks associated with inefficient waste management.

Confidentiality

You will fill the questionnaire on your own and your name will not be recorded on the questionnaire. The questionnaire will also be kept safe and everything will be kept private

Contact information

If you have any questions you may contact **Dr. Kariuki 0722495458** and **Dr. Mwitari 0721743502** or **Mount Kenya University Ethical Review Committee Secretariat** on **Provide contact**.

Participant's statement

The above information on my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study will be entirely voluntary. I understand that my records will be kept private and that I can stop participation at any time.

Signature: _____

Date: _____

Researcher statement

I, the undersigned, have explained to the volunteer in a language s/he understands the procedures to be followed in the study and the benefits involved.

Name of the interviewer: _____

Signature: _____

Date: _____

Appendix ii: Research questionnaire for household representatives

Section A: Demographic information (please tick where appropriate)

1. Gender of the respondent

   Male ☐ Female ☐

2. Age of the respondent

   Below 25yrs ☐ 26-35 yrs ☐ 36 - 45yrs ☐ Above 46 yrs ☐

3. Area of residence

   Township Ward ☐

   Kamenu Ward ☐

   Hospital Ward ☐

4. For how long have you been a residence in your current ward?

   Less than 1 year ☐

   2 – 5 years ☐

   6 – 10 years ☐

   More than 10 years ☐

Section B: Solid waste management

1. What are the types of refuse generated in this house?

   Food Remains ☐

   Perfume cans ☐

   Cloth ☐

   Electronics ☐

   Plastics ☐

   Goods Papers ☐

   Others (Please Specify) …….

2. Do you segregate waste in your house?

   Yes ☐ No ☐ Not Sure ☐

3. Do you have a temporary solid waste storage in your house?

Yes ☐ No ☐ Not Sure ☐

If "YES" what kind of storage is it?

.....

4. What means do you use to dispose of the solid wastes of your household?
   a. Throw it on an open space, in sewerage or on street ☐
   b. Digging a hole around the house and burn it ☐
   c. Disposing on the backyards of the house ☐
   d. Throw it in to the nearby drainage ☐

   Others, please specify_____

5. Is there any organization or company that collects solid wastes via door-to-door system in your ward?

   Yes ☐ No ☐ Not Sure ☐

6. If "YES" how frequent are the solid waste collected per week?'

   Once in a Week ☐
   Twice in a Week ☐
   Every day ☐

7. How much does that organization charge you for collecting solid waste?

   Less than 50kshs ☐
   51khs – 100kshs ☐
   101kshs – 200kshs ☐
   More than 200kshs ☐

Social- Economic Factors Influencing Solid Waste Management

8. Kindly indicate the extent you agree with the following statements on a scale of 1 to 5. **NB: 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly agree**

Statement	**1**	**2**	**3**	**4**	**5**
Your income level can enable you to effectively manage solid waste					
There are designated dump sites in this area					
Dump sites in your ward are accessible to the residents					

Residents in this area are committed to ensure appropriate waste management					
Small households are likely to manage their solid waste more effectively than the large households					
Your ward have enough facilities for garbage disposal for community use					
You appreciate paying for waste management					

9. Level of education of the respondent

Primary School ☐
Secondary School ☐
Undergraduate Degree ☐
Postgraduate Degree ☐
Doctorate Degree ☐

10. What is your household's monthly income?

Less than 10,000 Kshs ☐
11,000Kshs – 30,000Kshs ☐
31,000Kshs – 50,000Kshs ☐
51,000Kshs – 100,000Kshs ☐
More than 100,000Kshs ☐

11. What is your household's size (including yourself)?

Less than 4 ☐
5 – 10 ☐
More than 10 ☐

Community Factors Influencing Effective Solid Waste Management

12. Kindly indicate the extent you agree with the following statements on a scale of 1 to 5. **NB:**

1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly agree

Statement	**1**	**2**	**3**	**4**	**5**
Solid waste collection in my ward is done consistently					

The company/organization responsible for collecting garbage provides people with disposal bags for storage of waste until the next pick up					
The company/organization responsible for collective solid waste emphasizes on segregation of waste (decaying and non-decaying) by residents before collection.					
The transportation mode used by the solid waste collection company is effective and adequate as per the needs of the residents and population in your ward.					
The residents in this area are well educated on effective solid waste management in the area					

Stakeholder Engagement Factors Influencing Effective Solid Waste Management

13. Kindly indicate the extent you agree with the following statements on a scale of 1 to 5. **NB: 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly agree**

Statement	**1**	**2**	**3**	**4**	**5**
The County government have been effectively managing solid waste in this area					

14. How do you evaluate the efforts made so far by the municipality of the town to provide effective solid waste management services?

    Very Good ☐
    Good ☐
    Fair ☐
    Poor ☐
    Very Poor ☐

15. In your opinion what is the level of community participation in solid waste management in Thika Sub County?

    Very low level ☐
    Low level ☐
    Moderate level ☐
    High level ☐
    Very high level ☐
    I don't know ☐

16. Does Municipal Council encourage you to participate in solid waste management?

Yes ☐ No ☐ Not Sure ☐

17. Does the Municipal Council reward you for participating in solid waste management?

Yes ☐ No ☐ Not Sure ☐

18. Does enforcement of county by-laws influence solid waste management in urban centers?

Yes ☐ No ☐ Not Sure ☐

19. What is the influence of the enforcement of county by-laws on solid waste management and environmental preservation in Thika sub county, Kiambu County?

Very Large Effect ☐

Great Effect ☐

Moderate Effect ☐

Small Effect ☐

Thank you for your cooperation

Appendix iii: Interview guide for municipal council staff members

1. What are the steps used in effective Solid Waste Management in Thika Sub- County?
    a. ……
    b. ……
    c. ……
    d. ……
    e. ……
    f. ……

2. Where does Municipal Council dispose solid waste in Thika Sub- County?
    a. ……
    b. …….
    c. …….
    d. ……

3. How Does Municipal Council treat solid waste for disposal?

4. How does Municipal Council manage solid waste in the disposal area?

5. How often does Municipal Council collect waste in Thika Sub- County?

6. How many vehicles does the Municipal council have for solid waste management?

7. Has Municipal Council provided dumping sites in Thika Sub County?

    If "Yes", how many per Ward?
    a. Kamenu Ward …….

b. Hospital Ward …….
c. Thika Township Ward …….
d. Ngoliba Ward …….
e. Gatuanyaga Ward …….

8. How much does Municipal Council Charge for solid waste collection?

9. Does Municipal Council practice the 3R hierarchy of waste management i.e. Reduction of waste, Reuse, and Recycling?

10. Does Municipal Council recover energy from solid waste?

11. If "yes" how is that energy utilized?

12. What are some of the factors affecting effective Solid Waste Management in Thika Sub-County?

13. What are some of the strategic options available for SWM improvement?

14. What are the common solid waste management practices in the Thika Sub- County, particularly at the household level?

15. Who are other stakeholders of solid waste management in Kiambu County?

16. How do the stakeholders influence solid waste management in Thika Sub County?

17. Does public and private partnership influence solid waste management in urban centers? If "YES", how?

18. What is the influence of public and private partnerships on solid waste management practices in Thika Sub County?

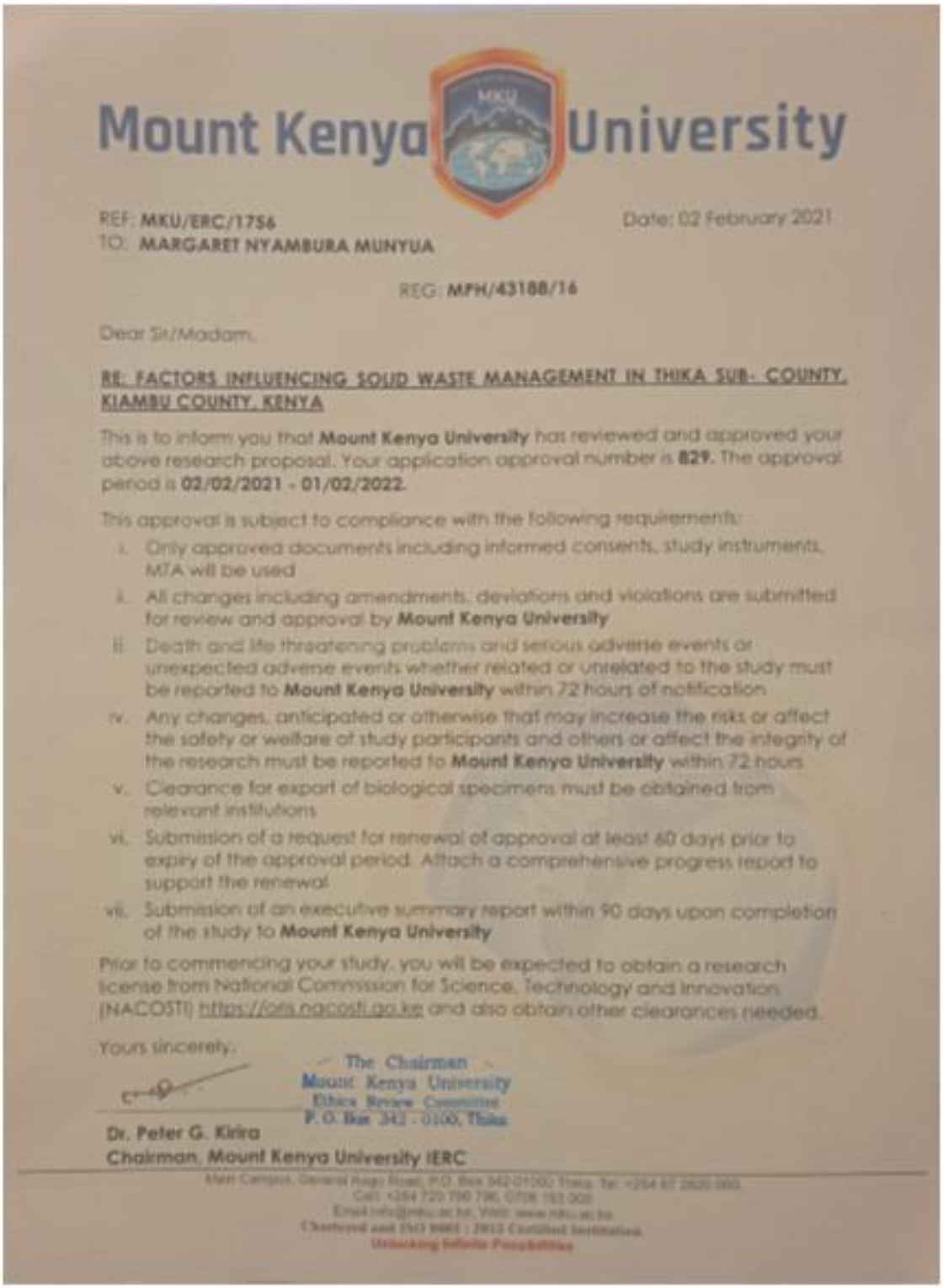
    Very Large Effect ☐
    Great Effect ☐
    Moderate Effect ☐
    Small Effect ☐

19. Does the business community influence solid waste management in urban centers? If "Yes", how?

20. What is the influence of the business community on solid waste management cost in Thika Sub County?

    Very Large Effect ☐
    Great Effect ☐
    Moderate Effect ☐
    Small Effect ☐
    No effect ☐

Appendix iv: ERC Clearance



Mount Kenya University

REF: **MKU/ERC/1756** Date: 02 February 2021
TO: **MARGARET NYAMBURA MUNYUA**

REG: **MPH/43188/16**

Dear Sir/Madam,

RE: FACTORS INFLUENCING SOLID WASTE MANAGEMENT IN THIKA SUB- COUNTY, KIAMBU COUNTY, KENYA

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **829.** The approval period is **02/02/2021 - 01/02/2022.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Dr. Peter G. Kiria
Chairman, Mount Kenya University IERC

Appendix v: Introduction Letter

Mount Kenya University

SCHOOL OF POSTGRADUATE STUDIES

MPH/43188/2016

24th February, 2021

The Director, Research Coordination Division
National Commission for Science, Technology & Innovation
Utalii House, 8th & 9th Floor
P.O Box 30623- 00100
NAIROBI

Dear Sir/Madam,

RE: MARGARET NYAMBURA MUNYUA – REGISTRATION NO: MPH/43188/2016

The purpose of this letter is to introduce the above named student who is pursuing **Master of Public Health** in the Department of **Epidemiology and Biostatistics** in the School of **Public Health.**

The title of her research is *"Factors Influencing Solid Waste management in Thika Sub-County, Kiambu County, Kenya."*

She has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data for her research between **February and April 2021.**

Any assistance accorded to her will be highly appreciated.

Thank you.

Mount Kenya University
P.O. Box 342-01000, THIKA
Office of the Director
Postgraduate Studies

Dr. Samuel M. Karenga, Ph.D.
Director, Graduate Studies
Enc.

Appendix vi: NACOSTI Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **805820**

Date of Issue: **19/March/2021**

RESEARCH LICENSE

This is to Certify that Ms.. Margaret Nyambura Munyua of Mount Kenya University, has been licensed to conduct research in Kiambu on the topic: FACTORS INFLUENCING SOLID WASTE MANAGEMENT IN THIKA SUB- COUNTY, KIAMBU COUNTY, KENYA for the period ending : 19/March/2022.

License No: **NACOSTI/P/21/9458**

805820

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.

Appendix vii: Field Entry Authorization

COUNTY GOVERNMENT OF KIAMBU

[illegible]

[illegible]

Tel: [illegible] Email: [illegible] Website: [illegible] Twitter: [illegible]

KCG/ED/11/VOL.1/91

22nd March, 2021

Margaret N. Munyua
Masters Student
MOUNT KENYA UNIVERSITY

RE: AUTHORITY TO CONDUCT RESEARCH IN KIAMBU COUNTY ON "FACTORS INFLUENCING SOLID WASTE MANAGEMENT IN THIKA SUB COUNTY, KENYA"

This is in reference to your request to conduct research in the County Government of Kiambu on " Factors Influencing Solid Waste Management in Thika Sub County, Kenya" dated 2nd March, 2021.

This is to let you know that you have been allowed to conduct the research under the guidance of the Chief Officer, Department of Water, Environment, Energy and Natural Resources.

Kindly ensure you give a copy of your research findings to this office after completion of your research.

Benson M. Mbari
FOR: COUNTY SECRETARY& HEAD OF PUBLIC SERVICE

CC: Chief Officer, Department of Water, Environment, Energy and Natural Resources

22 MAR 2021

Appendix viii: Turnitin Report

FACTORS INFLUENCING SOLID WASTE MANAGEMENT IN THIKA SUB- COUNTY, KIAMBU COUNTY, KENYA

by Margaret Munyua

Submission date: 03-Apr-2025 02:08PM (UTC+0300)
Submission ID: 2624777208
File name: UPDATED_FINAL_THESIS_FOR_MPH_DEGREE_2_.docx (808.78K)
Word count: 23275
Character count: 137390

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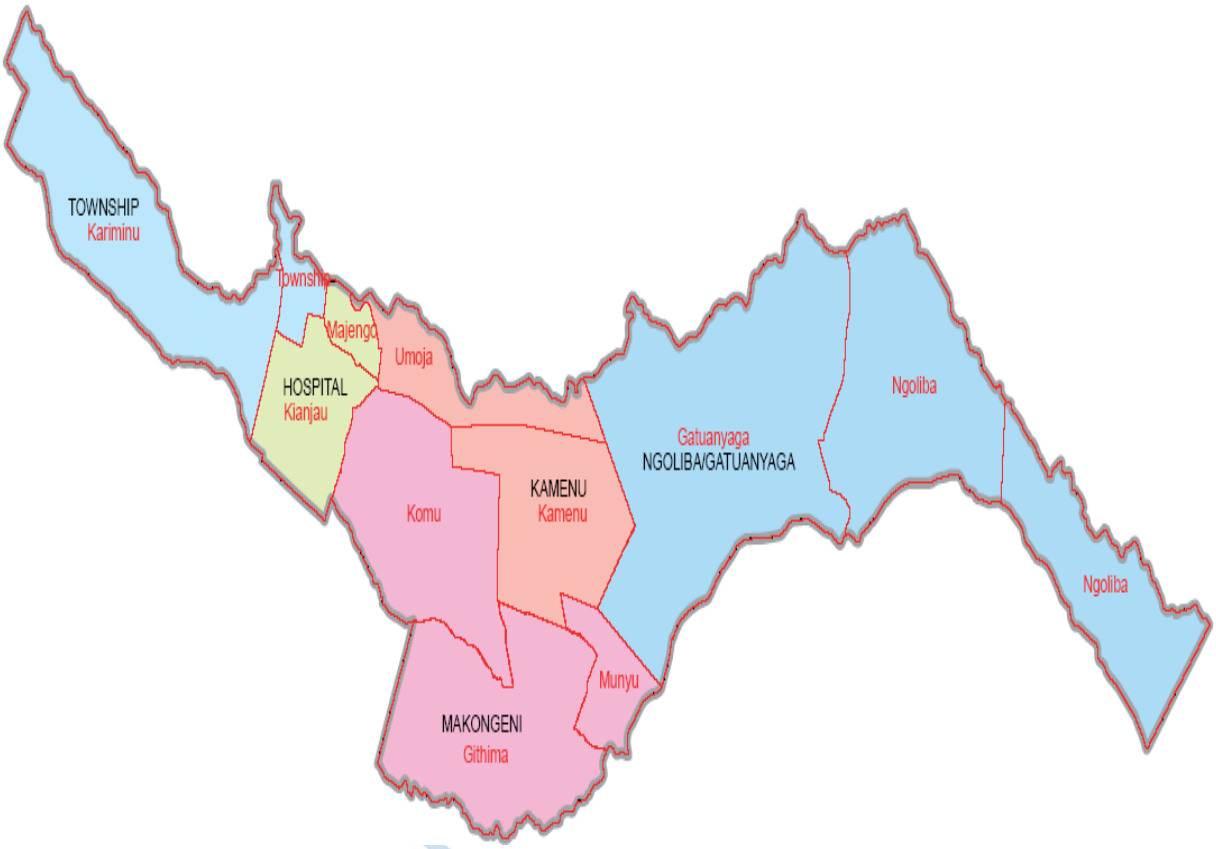
Appendix ix: Thika Sub County Map



Appendix x: Status of Wastes Generation, Collection and Recovery in Major Towns

Name of Town	Estimated waste generated (Tons/day)	% Waste collected	% Waste Recovery	% Waste Unaccounted for	% Uncollected waste
Nairobi	2400	80%	45%	35%	20%
Nakuru	250	45%	18%	27%	37%
Thika	**140**	**60%**	**30%**	**30%**	**40%**
Mombasa	2200	65%	40%	25%	35%
Eldoret	600	55%	15%	40%	45%

Source: (NEMA, 2015)