SOLID WASTE MANAGEMENT PRACTICES ON SUSTAINABILITY OF LIVELIHOOD PROJECTS IN PERI-URBAN SETTLEMENTS: A CASE OF EMBAKASI WEST SUB- COUNTY, NAIROBI COUNTY, KENYA.

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DECLARATION

This research project report is my original work and has not been presented to any other university for any award.

Signature ……  …… Date ……29th June 2023 …

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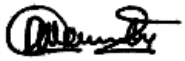

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ABBREVIATIONS AND ACRONYMS

ABRELPE	–	Brazilian Association of Public Cleaning and Waste Management
ANOVA	–	Analysis of Variance.
GHG	–	Greenhouse Gases
GOK	–	Government of Kenya.
ICM	–	Integrated Coastal Management
MSW	–	Municipal Solid Waste.
NACOSTI	–	National Commission for Science, Technology and Innovation
NEMA	–	National Environmental Management Authority in Kenya
SPSS	–	Statistical Package for Social Sciences
SWM	–	Solid Waste Management
UNEP	–	United Nations Environmental Programme
UNHABITAT	–	United Nations Human Settlements Programme
WASA	–	Water Supply and Sewerage Authority
CPCB	–	Central Pollution Control Board

ABSTRACT

Management of solid refuse has become a challenge due to the increased waste generation brought about by the rising levels of prosperity in industrialized cities and economies due to the volumes of the creation and use of products and services. The existing situation of inadequate waste management has been made worse by the local authorities' lack of institutional and technical capacity to handle trash. In the city, residents' indiscriminate dumping, failure to collect waste, and lack of waste segregation have all become normal. The study's goals were to ascertain the extent to which source reduction influences the sustainability of livelihood projects in peri-urban settlements in Nairobi County, Kenya; to ascertain the impact of recycling organic waste on the sustainability of livelihood projects in peri-urban settlements in Nairobi County, Kenya; and to ascertain the relationship between these two factors determining the degree to which waste volume affects the sustainability of livelihood projects in peri-urban settlements in Nairobi County, Kenya.. Lastly, the research aimed to evaluate the role of solid waste treatment in determining the sustainability of livelihood projects in this region. The research evaluated the hypotheses. The study focused on a target population comprising 3,847 people, which included 3,420 households, 12 administrators from the local Sub-County office in charge of trash management, 12 responders from department of environment and waste management, and 30 members from each of 13 randomly chosen youth groups. In this study, a sample of 349 participants was selected from the target population using simple random sampling. Data collection involved the use of surveys and an interview guide to gather respondents' perspectives. Pilot study conducted in Kamukunji Sub-County was similar to the research zone in terms of features. Data was analyzed through use of SPSS. Tables were used to present the studied data, interpretations were formed, The study found that source reduction $R=0.215$, $R2=0.46$, $=0.215$, $t=0.753$, $F(1,284) = 33.95$, $p<0.05$, recycling organic waste $R=0.130$, $R^2=0.170$, $\beta=0.130$, $t=17.336$, $F(_{1,284}) = 8.530$, $p<0.05$, volume of waste $R=0.491$, $R^2=0.241$, $\beta=0.491$, $t=1.149$, $F(_{1,284}) = 13.800$, $p<0.05$ solid waste treatment $R=0.619$, $R^2=0.383$, $\beta=0.619$, $t=0.112$, $F(_{1,284}) = 10.230$, $p<0.05$ affects the long-term viability of livelihood initiatives in Embakasi West Sub-County. The study gave discussions of findings and conclusions were made. The study further gave recommendations in relations to the findings and areas of further research suggested.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Lesser-developed countries have found challenges to manage solid waste especially owning to the fast-growing population and economic growth. Pradhan *et al.,* (2012) asserts that the increased industrialization together with economic development and population increase have fast-tracked the dynamics of urbanization in developing economies. Managing solid waste has developed into a challenge because of the increased waste generation brought about by the rising levels of prosperity in industrialized cities and economies due to the volumes of products and services produced and consumed (Salhofer *et al.*, 2008). In South Africa, the major provinces for instance Gauteng and Johannesburg are experiencing problems managing the solid waste disposal process, mostly owing to a shortage of landfill capacity (Bonolo, 2016). The ever-increasing bulging population has resulted to limited spaces available to hide solid waste and therefore littering and illegal dumping sites. Simelane. (2018), asserts that less than 50% of the solid trash generated in metropolitan areas is gathered across the continents from which about 95% of the waste is dumped at the dump sites rather than being contained or recycled. The informal settlements tend to struggle with consistent supply of water hence they resolve to depending on informal sources of water that are contaminated and unsafe for human consumption. The formal waste management levels in these places are very low to negligible levels (Mogelgaard, 2011). This clearly indicates that the generation of waste is unavoidable and therefore achieving environmentally safe and economically viable societies has become an area of concern.

Kenya's population has significantly increased as the levels of urbanization have also soared higher. The middle class and people who live in informal settlements have attracted significant populations to urban centers. The National Environmental Management Authority in Kenya, (NEMA, 2014), under Vision 2030 recognized the necessity of have a sustainable and efficient waste management system as the country moves towards industrialization by 2030. Under the guidance of the zero-waste principle whereby waste is considered as a resource which may be used to create wealth, possibilities for employment, and lessen environmental degradation. The authority strives to develop the 7R strategy Reducing, Rethinking, Recycling, Repairing and Refilling its waste.

Kilifi county for instance has integrated solid waste management into its livelihood sustainability program. The county has involved over 700 youth into the program. Kilifi Green Town environmental initiative engaged the community in distributing waste bins across the town as well as institutions around. This project created awareness within the county while letting the residents understand the different types of wastes and their disposal mechanisms. The county further provided waste disposal mechanisms. In the project, the group further distributed 100 waste bins to households, taught the locals how to sort rubbish as a tool to measure the project's success. Another example of sustainable livelihood project in solid waste is Dajopen waste management project in Kitale, Kenya. Dajopen Waste Management (DWM) is a community-based organization concerned with waste collection, disposal, collection and training of residents about the waste generated. The project started in 2007 and is continuing up to this date. Over 21,000 members have learnt how they dispose their solid waste and most have adopted on best practices of generating income from waste generated. Since 2007, training and solid waste awareness has helped the project to be sustainable. The income generated from these projects have been very sustainable to the project.

Strategies for solid refuse disposal and sustainability of livelihood projects are anchored on several theories. The theories include system theory as well as theory of change. Systems theory recognizes that solid waste management is dynamic and interconnected involving stakeholders, processes and environmental impacts. Managing waste cannot be a standalone activity in the larger system that involves waste generation, collection, transportation, treatment, disposal and recycling. Further, system theory recognizes that livelihood projects are intertwined with a larger socio-economic and environmental systems and applies the principles of holistic approach, participatory approach, resilience and multi-level analysis. Another theory that strongly that livelihood project incorporates with is theory of change. The scholar applies that there is need for comprehending the relationships among actions, results, consequences, and effects related to these areas. It is necessary to define a problem, determine the inputs and activities, outputs, outcomes, impacts, assumptions and risks as well as monitoring and evaluation in livelihood projects especially those based on waste management.

By generating income from waste, through compost manure people can grow food to generate for consumption. The residents also can create biogas and recover energy from the waste produced.

This sustains the livelihood of residents and consequently improves the livelihood of people. Having minimal waste also to the environment reduces the environmental gases and reduces climate change. The adverse health effects caused by waste through bacterial infections, dust, smell among others is greatly reduced is waste is properly handled and disposed. There are different factors that influence sustainability of livelihood projects in peri-urban settlements such as source reduction, recycling organic waste, volume of waste and solid waste treatment among others.

1.1.1 Solid Waste Management & Best Practices

As the world continues to grow so does the solid waste continues to increase. In 2015, the world was producing solid refuse of about 2 billion metric tons and experts estimate this number to by 2050, reach 3.4 billion metrics (kaza et. Al 2018). As noted earlier, most cities and local government face too many challenges when managing the waste. Understanding the best strategies for managing solid waste is essential since trash itself has detrimental consequences on human health, the environment, and our socioeconomic society.

Some of the challenges faced by the local government as well as the cities in disposing solid waste include limited financial resources and capacity. Most local authorities have limited capacity in funding infrastructure and operations associated with solid waste. Most that are responsible to manage solid waste struggle with financial expertise and upkeep of these facilities. Further, those supposed to handle solid waste have limited access to and technical knowledge to using equipment. If the equipment is not designed for local conditions, the waste handlers have limited knowledge and in the meantime the waste continues to increase. Solid waste management also faces the challenge of political turnover and less of planning and evaluation towards planning of managing this solid waste.

There are different ways in which one can incorporate best practices in the handling of solid waste. One of the best practices is turning solid waste into valuable resources. Such resources include; recyclables, biogas, compost manure as well as energy recovery. Another good practice towards solid waste management practice is applying the 3R strategies- Reuse, Recycle and Reduce the waste. Another good practice associated with solid waste is separating the waste into sections that are related; biodegradable and non-biodegradable.

1.1.2 Sustainability of Livelihoods Projects

Sustainable environmental management requires sustainable waste management as an essential since the improper solid waste disposal damages the environment and leads to human, animal and environmental hazards. Unissa and Rav (2012) posit that waste management comprises of collection, gathering, treatment and removal and disposal of waste items and substances. Human activity generates waste which consists of human activities gathered through domestic activities, agricultural, industrial, medical, natural and man-made disasters.

Management of waste has been an ever-present and unavoidable phenomenon since time immemorial. In Bangladesh, the practice of traditional waste management systems had been practiced since the early 1970s where the practice permitted garbage to be dumped and burned in the open without restriction, to be dumped in water, to be dumped in landfills, and to be dumped directly onto agricultural land in rural regions. In urban areas, Water Supply and Sewerage Authority (WASA) carried out house-to-house garbage collection, night tile waste collection, and solid waste collection using bullock carts. Since then, the country has moved from the traditional waste management systems to adopting modern approaches that entail resource management as opposed to waste management (BIGD, 2015).

According to Shams et al, (2017), organic waste recycling and composting was off-set in the mid-1980s. In order to be in compliance with the prevailing international and national legal policies regarding to waste and environmental management, commencement of a sanitary landfill with gas recovery for the remaining waste occurred in 2010. This was a major initiative aimed at managing waste sustainably. In the Philippines, research conducted by a multi-disciplinary group of researchers on the sustainability Coordinated Coastal Local residents' support for ICM projects depending on a range of variables, which include project activities acceptance, level of involvement in project design and implementation, adherence to regulations, number of economic benefits they receive, and how fairly those benefits are dispersed throughout the community.

Achieving sustainability of livelihood projects requires that all stakeholders are engaged in participating in waste management practices especially in informal settlements that performs a major part in providing services to urban poor as advanced by (Gutberlet et al., 2016).

Collaboration involves funding for equipment, storage, advertising of the collecting services, and removal of solid waste collected from the transfer stations or recycling facilities (Tirado-Soto & Zamberlan, 2013). Similarly, building capacities of municipal and local community-based organizations in-charge of waste collection, disposal and reduction.

1.1.3 Waste Management Policies

There are several waste management policies in Kenya that plays vital roles in formulating and implementing waste disposal policies and regulations. The policies are formulated by different bodies such as National Environmental Management Authority (NEMA) in the waste management sector. Waste management sector, overtime in Kenya, has been regulated by a legislation Act known as Environmental Management and Coordination Act (EMCA). The legislation establishes a legal structure for the management of waste and sets out different principles for the sustainable management of resources. Kenya has developed several solid waste management regulations which delineates principles for the collection and transportation, disposal and recycling solid waste. These regulations ensure that there is proper management of solid waste and minimal environmental pollution. The waste management strategies are developed at national, county and local levels.

1.1.4 Livelihood Projects in Peri-Urban Settlements of Embakasi West Sub- County

Livelihood projects in peri-urban settlements play major role in addressing solid refuse especially in generating income and ultimately improving the overall well-being of the people. Several livelihood projects have been incorporated in Embakasi West sub county which is a peri-urban settlement. Examples of such projects include; recycling center and compositing initiatives the community has established a community-based recycling center where they recycle plastic bottles, metal cans, papers among other wastes. This also includes waste from the houses-biodegradable waste. This also includes a compositing initiative that convert solid waste to nutrient rich compost that can be sold as manure. By setting up recycling center and involvement in compositing initiatives, this has enabled the community to get trainings and opened up some job opportunities for local residents involved in the waste collection and recycling process.

Additionally, as a source of livelihood, the community has engaged in waste to energy production projects. It has provided solutions in energy biogas/waste incineration where non-recyclable waste

is converted into energy. In a bigger picture, this has helped some of the community members to offset their energy costs leading to a sustainable livelihood. Embakasi west sub-county through the help of relevant authorities have further had a project where they set a waste collection and segregation center. They create awareness and education campaigns on waste segregation that is from collection, sorting, processing and sold to recycling centers.

1.2 Statement of the Problem

The ratio of rural to urban and urban to rural migration, has translated to more waste generation and a myriad complexities of waste streams due to increased affluence. The municipal authorities have mandated waste management over time (Okot-Okumu, 2011). Most local governments have not given proper waste management system establishment a high priority, which has resulted in a minimal resources allocation for waste management. A study undertaken in Nairobi by UNHABITAT (2016) indicated that less than 50% of the population is served in terms of waste management whereas between 30 – 40% of the generated waste is not picked. The current bad state of waste management has been made worse by the local authorities' lack of institutional and technical capacity to handle waste. In the city, indiscriminate dumping, uncollected trash, and a lack of waste segregation among people have all grown common place. A study by Mugambi et al, (2017) undertaken in Meru on factors affecting household functional solid waste management adopting descriptive survey research design among a sample of 306 households observed that the predictor variables household solid garbage availability, kind of household solid garbage produced, awareness of the laws and policies governing solid waste management on waste management influence functional livelihoods is management of solid waste in Meru Town. The study however failed to address how sustainability of influenced by solid waste management practices. Although there are laws and procedures governing waste management, inadequate implementation and bad practices have caused towns and cities to become overrun by the trash created by their citizens, negatively harming public health and the environment. Scanty research has been conducted in developing countries on how source reduction, recycling organic waste, volume of waste and solid waste treatment influence sustainability of livelihoods projects in peri-urban settlements. This research therefore aims to address how solid waste management practices influence sustainability of livelihood projects in peri-urban settlements.

1.3 Objectives of the Study

In this research, the study's guiding principles and objectives were as follows:

i. To assess the degree to which source reduction influences the sustainability of livelihood projects in peri-urban settlements within Nairobi County, Kenya.
ii. To examine how recycling organic waste influence sustainability of livelihood projects in peri-urban settlements in Nairobi County, Kenya.
iii. To establish the extent at which the volume of waste influences sustainability of livelihood projects in peri-urban settlements in Nairobi County, Kenya.
iv. To evaluate the impact of solid waste treatment on the sustainability of livelihood projects in peri-urban settlements within Nairobi County, Kenya..

1.5 Value of the Study

Healthy societies are vital to economic development and prosperity. This study hopes to be significant to the major stakeholders engaged in management of solid waste; the National and county governments, private waste management organizations, donor agencies and locals involved in solid waste management since it will highlight the existing gaps in solid waste management that the relevant institutions need to address in bettering communities and urban areas especially in major cities where population is increasing daily. The study hopes to inform policy towards environmental management that is under the National Environmental Management Authority (NEMA). The study also hopes to be of significance to the field of management science and project planning in that the lessons learnt from this research might be shared across the multidiscipline for future project sustainability. In terms of gauging the sustainability of livelihoods in peri-urban areas and solid waste management, the study's conclusions may also be extrapolated to other counties. By addressing the knowledge gap in solid waste management techniques with regard to the sustainability of livelihoods in urban settlements, the study will contribute to the current knowledge base.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter integrates both theoretical and empirical reviews, organized around themes derived from the study's objectives. The following are the thematic areas: sustainability of livelihood projects, source reduction and sustainability of livelihood projects, recycling organic waste and sustaining livelihood initiatives, volume waste and sustainability of livelihood project, solid waste treatment and sustainability of livelihood projects, theoretical framework addressing two theories, conceptual framework demonstrating the connections between the factors and knowledge gaps.

2.2 Theoretical Framework

The current investigation into the impact of solid waste management practices on the sustainability of livelihood projects in peri-urban areas settlements was hinged on three theories; Actor-net theory, Systems theory and Theory of Change.

2.2.1 Actor-net Theory

Bruno Latour advanced actor network theory in the year 1997 and it is a sociological theory (Latour, 1997). The fundamental principle of action-net theory is the notion of the existence of a heterogeneous network in a given environment. The concept of the heterogeneous network, which has various components, is the fundamental tenet of actor-network theory. These components of the coextensive networks include both social and technical components, which ANT views as being inseparable. The theory posits that any actor – in this case including an individual, organization, equipment or object that could include both hardware and software is essential to a social network. As a result, a functioning actor network has the effect of bringing about societal order.

This theory connects to the study in that it describes the various solid waste management stakeholders., including the equipment used are significant to achieving conducive ecosystems to avoid collapse in the social order. Adherence to policies regarding waste management at the same time developing solutions to emerging issues propels societies to sustainability. In handling waste,

many actors come into play in terms of collection, disposal as well as recycling of waste. Different levels of policies, plans and procedures apply to every level of waste handling. Solid waste reduction and solid waste treatment include stakeholder engagement as well as the type of equipment/technology applied.

2.2.2 Systems Theory

The System Theory was advanced by Ludwig von Bertallanfy in 1968. The theory states that environment is itself a system comprising of sub-systems where one has to fully understand the functions of an entity. The entity should be viewed as a system having several parts that are interdependent. According to the theory, all systems share common patterns, behaviors, and features that may be studied and exploited to gain a better understanding of how complex phenomena behave. Phenomena can be viewed as a web of relationships between elements. The theory is significant to the study because key areas of consideration require that the various stakeholders create a sub-system hence recycling of organic waste, volume of waste, reduction of waste at the source and solid waste treatment require processes within environments.

2.2.3 Theory of Change

This theory, was put forth by Carol Weiss in 1995 and describes how change occurs by describing potential connections within an intervention. These consist of outputs, results, and shorter-, middle-, and long-term results. It is vital to identify changes in the process and map them out as a series of connected paths, each of which shows the desired results in a logical and sequential order. Similar to this, the Theory of Change highlights the important parties participating in the change processes, their roles in the process, and how the changes affect them. The theory relates to the focus of this study given the involvement of stakeholders' contribution to solid waste management and sustainability of livelihood projects in Nairobi County. A variable on extent of volume of waste can be linked to this theory as the volume of waste determines the output or results, either long or short term to the environment.

2.3 Determinants of Solid Waste Management Practices

There are wide range of determinants, socially, economically, environmental and policy-related factors that influence solid waste management. Factors such as waste reduction deeply influence solid waste management practices. Awareness and education among the community is an important factor as well as regulatory measures and designing of projects create a basis for solid waste management practices. In terms of recycling organic waste, involvement of technology and infrastructure, engaging the community and supportive polices play an essential role in waste management practices.

Another determinant in solid waste management is the amount of waste generated. Peri-urban settlements produce more waste due to high population density and consumption patterns. Similarly, solid waste treatment methods are another determinant of waste management practice. Presence of waste management infrastructure including collection systems, transfer stations, recycling facilities and waste treatment plants are crucial in solid waste treatment. In depth, the research has discussed some of these determinants.

2.4 Empirical Literature

2.4.1 Source Reduction and Sustainability of Livelihoods Projects

Source reduction refers to activities that entail covering of containers, discarding containers in safe places and cleaning outside environments. These behaviors can be many, complicated, and challenging for family members to carry out, much alone maintain (Anderson et al, 2015). Source reduction refers to lowering the amount or toxicity of waste at the source by altering the process that produces the materials; it also involves implementing reducing in the creation, production, sale, and usage of products and packaging. Other words like waste reduction, waste prevention, waste minimization, and pollution avoidance are also used to refer to source reduction (Modebe et al., 2011). Whereas many people and companies engage sometimes in waste reduction efforts, mandating communities would be exceedingly challenging. The choice of waste reduction must be handled at the level of each community, taking into consideration the circumstances or factors that encourage such action (Zerbock, 2003).

In Kenya, research carried out by Forsyth et al, (2020) in Kwale County on source reduction with an emphasis on mosquito ecology and community viewpoints insights for bettering household mosquito control in the coastal area of Kenya by performing an entomological survey utilizing a mixed approach methodology. This study is set out to explore household mosquito control habits and their behavioral variables as well as to identify prolific mosquito breeding environments in coastal Kenya. The study findings revealed that containers holding water contributed to about 55.2% of mosquito larvae whereas containers containing rainwater made up 95.8% of all immature mosquitos. Responses gathered from interviews showed that most households ranked sleeping under bed-nets as a main protection from mosquito's bites.

Globally, plastic pollution has become a major concern with the percentage of plastic waste reaching increasing and alarming levels alongside the dramatic increase of the production in manufacturing companies (Wilcox et al., 2015). The environment, and the ecology in specifically, are greatly impacted by the inappropriate disposal of old polypropylene bags, a type of plastic bag. It would take years for plastic bags to decompose and degrade, hence these items contribute greatly to contamination of the land, water, and air (Asmuni et al., 2015). Additionally, the waste generated during the polypropylene bag production procedures contributes significantly to environmental deterioration and is a quality-related issue that has recently been raised by the industries.

A qualitative research conducted by Muhammad et al, (2021), on the reduction of waste polypropylene bag manufacturing process observed that use of Six Sigma DMAIC technique leads to reduction of waste with regards to rejection of sacks in a polypropylene bag manufacturing process.. According to the research's findings, the average sack rejection rate was determined to be 2.8 percent, but when the DMAIC technique was used, that percentage dropped to 1.20 percent, a 50% reduction. If applied, the Six Sigma DMAIC technique - Define, Measure, Analyze, Improve, Control - approach leads in a 50% decrease in waste, allowing a manufacturing organization to significantly reduce expenses. The study came to the conclusion that implementing Six Sigma (6) DMAIC methodology increases the process efficiency of a polypropylene bag manufacturing facility. The method is only used in one local polypropylene bag manufacturing business, though. Even farther, the study found that, if implemented, the factors and levels found in the findings would result in a decrease in sack rejection in polypropylene bag manufacturing

facilities, which would have a major effect on both the economy and the environment due to a decrease in material waste and an increase in business productivity and profitability.

The empirically reviewed literature was delimited to focusing on plastic waste matter in retaining waste water as habitat for vector-diseases and manufacturing of polypropylene plastic using lean management practices. The current study seeks to test hypothesis on source reduction and sustainability of livelihood projects.

2.4.2 Recycling Organic Waste and Sustainability of Livelihood Projects

Numerous factors, including population expansion, changing lifestyles, and increased urbanization, have greatly influenced the production of enormous volumes of solid waste (Singh et al. 2011). In the modern day, the majority of waste produced is either dumped in landfills in affluent nations or open dumps in underdeveloped nations. These two practices use a lot of area and may have adverse effects on the environment and the health of local residents who live close to the dump sites.

The recovery and reprocessing of usable material that might otherwise end up in landfills and dumpsites is referred to as the process of recycling. These materials can be transformed into other valuable products that can be used as resources in manufacturing. Recycling of materials saves energy during manufacturing and requires a proportion of energy to produce an item as compared to manufacturing a similar product with materials from conception. Moreover, there is significant reduction of greenhouse gases across the several stages of the lifecycle of the product. The most common recyclable materials may include but not limited to paper, cardboard, glass, plastics, metals.

In India, urbanization and rapid population increase has exacerbated rapid ad increased production and consumption of plastic products which has also contributed to increased plastic waste (CPCB, 2015). According to PlastIndia (2015), the United States of America consumes the most plastic, closely followed by China, with India using an average of 11 kg, or approximately a tenth of what the US does. India's trajectory of plastic use and waste in the coming years and decades is predicted to go drastically upward due to the country's rapid urbanization and the forecasted high growth rates in terms of GDP. These statistics and projections clearly provide an indication that

urbanization has a significant influence on GDP thus increased manufacturing and population growth contribute to increased waste generation.

Recycling of polyethylene terephthalate (PET) is higher in India (90%) as compared to other countries such as Japan (72%), 48% across Europe and about 31% in the US (National Chemical Laboratory Pune, 2017). Despite the fact that India's rate of plastic recycling is substantially greater than the global average of 15%, there is still a sizeable quantity of plastic garbage that cannot be recycled owing to the mixing of different waste streams. This waste is either dumped on the ground or causes groundwater to get contaminated or drain and sewage systems to become clogged.

In Cameroun, the City of Yaunde has been compounded by domestic waste management which has been a major challenge with an estimated daily production of 1200 tons (HYSACAM 2017) and a typical daily specific production of 0.62 kg per capita. (Ngnikam et al. 2017. In an experiment-based investigation conducted by Ginette et al. (2021) concerning efficient organic waste recycling for sustainable tropical agriculture utilizing vermicomposting technology, it was observed that the temperature within the pre-composting stage reached a peak of 54.3°C, a suitable level for the elimination of potential pathogens. Furthermore, the pH values ranged from 9.44 to 8.53, gradually approaching neutrality by the end of the vermicomposting process. Vermicompost was found to be non-phytotoxic and rich in nutrients, according to the study's findings. Therefore, in the context of Cameroon, vermicomposting may be used to convert organic waste into organic fertilizer suited for sustainable agriculture.

Several studies on waste segregation, for instance Johnson et al., (2013) suggest that effective hospital waste management is aided by waste segregation. Similar to this, Rajkamal et al. (2014) assert that waste segregation can result in improved energy recovery, which will advance the recycling process (Stoeva & Alriksson, 2017). Matsumo (2011) suggests that strong adherence to good waste segregation regulations is necessary for this to be successful. It is clear that trash separation greatly facilitates effective waste management.

In many of the third world countries, waste management practices are not adequately implemented since waste segregation has not been effectively adopted and so, much of the waste ends up being mixed-up (Agbefe et al., 2019). The failure to segregate at the source has been a major challenge

resulting in inefficiency in waste collection and waste recycling process. Review of literature by Kumar et al, (2017) shows that recovery of waste and reuse in addition can generate direct economic benefits and enhance and enable the protection of public health and environment. Moreover, with effectively laid down recycling programs where all recyclables are taken into considerations, the reduction in volumes of waste would be very significant (Saphores et al., 2012).

In a case study conducted by Kihila et al. (2021) in Dar es Salaam, Tanzania, focusing on waste segregation and the potential for recycling, the researchers employed waste measurements, household surveys, and interview guides to assess the prospects for RRR (Reuse, Reduce, and Recycle) and the underlying factors connected to community perspectives and strategies for improving waste management. The study found that the waste generation rate was 0.53 kg per capita per day, with food waste accounting for over 60% of the total weight of waste. Additionally, the survey revealed that recycling and reuse of plastic, electrical, and metallic materials were predominantly carried out through informal means. This was demonstrated by the fact that these wastes were sold in a chain from households to garbage collectors to recycling facilities, and then to industry.

The literature reviewed was based on past empirical studies that generally relate to the variable under study. The current study seeks to examine how recycling organic waste influence sustainability of livelihood projects in Nairobi County.

2.4.3 Volume of waste and Sustainability of Livelihood Projects

According to Austin (2019), human beings are generating a large amount of trash, which they barely have the mechanism to handle the waste generated. Most of the plastic waste that is produced is filling the oceans as well as landfills. Austin provides further clarification by citing a study conducted in 2017, which revealed that during that year, a total of 6.3 billion metric tons of plastic waste was generated, but only 9% of it was recycled in the United States.

In many low-income environments, such as the steadily urbanizing Kenyan context, solid waste management is a problem of growing significance. One such location is Kisumu County, where daily garbage generation is projected to be 500t, yet below half of it is consistently gathered. The open incineration of solid waste and the natural decomposition of waste materials represent notable

contributors to greenhouse gas (GHG) emissions and the release of harmful air pollutants, which can have detrimental effects on public health. In many Kenyan municipalities, municipal solid waste (MSW) is disposed of in both regulated and unregulated settings, including uncontrolled open dumpsites. This practice poses environmental and health hazards to urban populations, as highlighted by the United Nations Environment Programme (UNEP) in 2018.

There are several ways in which the amount of waste produced can affect the sustainability of livelihoods. First, climate change. How we dispose solid waste is distressing. Researchers have shown that about v40% of the world's trash is burned through landfills and this poses a huge risk to the atmosphere as well as people who thrive is such atmospheres. Heating up the solid waste generates gases such as carbon dioxide too which is a greenhouse gas that is causing climate change by heating up the environment.

Throughout the SWM service chain, greenhouse gas (GHG) emissions take place at several levels. Waste collection and transportation fleets are outdated in many African cities, which results in greater GHG emissions (Friedrich and Trois, 2011). Additionally, because open dumpsites without gas gathering equipment are so common, methane is released as organic waste decomposes (Friedrich and Trois, 2011). The more the solid waste produced the higher the level of methane gas produced. Nevertheless, this gas can be utilized as a substitute and for the more over 50% of SSA homes who cook with kerosene and biomass, a clean source of energy is needed. (Lambe et al., 2015; Morrissey, 2017). Kerosene and biomass fuels have both been linked to high levels of indoor air pollution, which could be harmful to users' and their families' health (WHO, 2021).

The Dandora Waste-to-Energy Plant, a 40 MW bio power project in Nairobi County, Kenya, is now going through the approval process. The project will likely cost more than $197 million and is owned by KenGen. In this project, the combustion process will be used to liberate the feed's stored energy. Refuse, a type of municipal solid waste, will serve as the project's feedstock. The project is expected to start in 2023 and be completed in a single phase. The project is also anticipated to begin commercial operations in 2024. (Global Data, 2021).

Less than ten years remain until the SDGs' 2030 deadline, which includes SDG 7 on affordable and accessible clean energy, therefore African governments and other regions where biomass is a

common source of that can be a substitute clean fuels for homes. By looking into how a proposed waste-to-biogas effort might be used to generate cooking energy, cut GHG emissions, improve air quality, and have a positive impact on health outcomes.

MSW has become a pressing issue in Kenya due to rapid urbanization, changing consumption patterns, and inadequate environmental management. This is evident from the frequent overflowing dumpsites in urban areas, which pose risks to both the environment and public health, as pointed out by Awuor et al. in 2019. Kisumu, like many other cities in developing regions, grapples with the challenge of an overflowing dumpsite and the associated environmental and health hazards resulting from improper MSW disposal, as discussed by Sibanda et al. in 2017. According to data obtained from local stakeholders in the region, Kisumu County generates approximately 500 tons of solid waste per day. However, only around 40% of this waste is collected for disposal in the city's designated open landfill.

Dianati et al. (2021) conducted a system dynamics research and scenario analysis concerning residential solid waste management in Kisumu, Kenya. Their study aimed to investigate the anticipated impacts of two initiatives: the waste-to-biogas program and the regulatory prohibition of open burning of waste in landfills, with a focus on their effects on greenhouse gas (GHG) emissions and particulate matter emissions. The research utilized a modeled system dynamics approach. The findings indicated that combining these two measures could potentially generate more than 1.1 million tons of clean biogas. Additionally, there would be cumulative reductions in GHG emissions, with the largest portion (42 percent) of these reductions attributed to the use of clean biogas to replace traditional, polluting fuels in household cooking. The findings of this study were noteworthy since it pointed out the potential quantification of waste-to-biogas and the significant implications to the health and environment of residents and the ecosystem in Kisumu.

In China, a study by Mian Hu et al. (2021) on thermochemical alteration of waste as a source of energy and resources addresses the technological difficulties and future implications of environmental contamination. According to a study utilizing thermochemical conversion with an experimental approach, thermochemical technologies are considered favorable methods for sewage sludge management. They have the potential to recover energy and resources, substantially reduce volume, and effectively eliminate pathogens. As per the study findings, bio-crude derived

from hydrothermal liquefaction (HTL) of sewage sludge can serve as a viable alternative to fossil fuels..

The three empirical reviewed studies demonstrated the application of true experimental designs hence they did little or no effort in their approaches to apply triangulation. Basing on the adoption of mixed method research, the current study seeks to triangulate the research instruments to enhance multiple realities from the different methods of triangulation. The study will also seek to evaluate the degree at which volume of waste affects sustainability of livelihood initiatives.

2.4.4 Solid Waste Treatment and Sustainability of Livelihood Projects

Waste treatment is the physical, mechanical, biological, and thermal processing of waste in order to remove any harmful substances that, if released, might have a negative influence on the environment.

Kenya's Ministry of Environment and Forestry's policy on sustainable waste management strives to create the required legal framework so that Kenya may successfully address its waste problem through the adoption of a waste hierarchy and circular economy. The policy's provisions outline the processing actions intended to lessen or stop the production of waste and encourage the reuse of materials (MEF, 2019). The policy also promotes efficient and inexpensive garbage collection in all neighborhoods, where waste should be segregated at the source and collected in accordance with established schedules for dry and wet waste.

In the majority of emerging nations, Municipal Solid Waste (MWS) management has evolved to an enormous ecological as well as environmental phenomenon especially in urban areas (Sinha & Enayetullah, 2002). Advanced economies have been able to safely handle and dispose of the huge amounts of municipal solid waste they generate. This is so because these countries are economically and technologically advanced. They have achieved advanced technological capabilities, demonstrated by their utilization of recycling, anaerobic degradation, incineration, pyrolysis, and other methods. As indicated by Challcharoenwattana and Pharino (2015), any remaining residues are deposited in modern sanitary landfills. Additionally, these developed nations are working harder to create new technology that will enable them to recycle and reclaim all of the locked precious materials from MSW (Suthar et al., 2016).

The case for developing nations is different. Harir, Kasim, & Ishiyaku (2015) posit that the daily produced municipal solid trash is typically disposed of through crude dumping combined with uncontrolled partial treatment for materials, fertilizers, and energy recovery. In Bangladesh, a developing economy comprising of upwards of 522 urban centers generates tons of thousands in municipal solid waste (Yasin, Mumtaz, Hussain, & Rahman, 2013). The present condition of solid waste management, treatment, and disposal systems is inadequate. This can be linked to a lack of investment in research and insufficient data collection pertaining to the prevalent challenges associated with municipal solid waste management systems, as highlighted by Wilson et al. in 2012.

Kharat et al. (2016) conducted a study centered on employing the Delphi and Analytic Hierarchy Process (AHP) approach to choose environmentally sustainable technologies for managing municipal solid waste in Mumbai, India. The research utilized experimental techniques based on the Analytic Hierarchy Process (AHP) and Delphi procedures to establish a model for assessing the most suitable treatment and disposal methods. According to the study's outcomes, composting organic waste not only produces revenue but also reduces the volume of waste sent to landfills.

Abel et al. (2017) conducted a research project to investigate the factors influencing the composition of solid waste generated in the Obafemi Awolowo University Teaching Hospital Complex in Ile-Ife, Nigeria. To collect data for their study, they measured waste production in the hospital's wards and clinics over a three-month period, seven days a week. The researchers gathered both primary and secondary data. According to their findings, general garbage constituted 0.273 percent and 0.727 percent of the total waste, respectively. The investigation also discovered that each resident produced roughly 6 kg of waste each day in the wards. The assessment came to the conclusion that the OAUTHC's waste storage practices and materials were not up to par with WHO requirements.

The review of empirical literature revealed that solid waste treatment especially from healthcare waste in developing countries was not treated after disposal. The current study seeks to assess the degree that solid waste treatment influence sustainability of livelihood projects in peri-urban settlements in Nairobi County, Kenya.

2.5 Summary of Empirical Literature and Knowledge Gaps

The Table 2.1 presents the discrepancy between the known and the unknown after in depth literature review. This gap will enable discussion of the results later in the study.

Table 2. 1: Matrix Knowledge Gap

Variable	**Author (year)**	**Title of the study**	**Methodology adopted**	**Findings of the study**	**Knowledge Gaps**	**Focus of Current study**
Source Reduction	Forsyth et al, (2020)	Source reduction with a purpose focusing on mosquito ecology and community perspectives.	Entomological survey employing a mixed method design.	Containers holding water contributed to about 55.2% of mosquito larvae while containers filled with rainwater held 95.8% of all immature mosquitoes.	Focus was given on reduction of waste containers that retain rain water to reduce vector-borne diseases for instance malaria	The current study seeks to test hypothesis on source reduction and sustainability of livelihood projects.
	Muhammad et al, (2021)	The reduction of waste in the polypropylene bag manufacturing process was achieved through the application of the Six Sigma DMAIC technique.	Case Study applying	The average sack rejection rate was determined to be 2.8 percent, which was decreased to 1.20 percent when the DMAIC approach was used. Sack rejection rate is lowered by 50% as a result.	The research focused on manufacturing of polypropylene plastic using lean management practices	Focus will be given to correlation analysis between the predictor and the response variable

Recycling Organic Waste	Ginette et al, (2021)	Effective organic waste recycling through vermicomposting technology for sustainable agriculture in tropics	Experimental design	Vermicomposting can be used to turn organic waste into organic fertilizer suited for sustainable agriculture because it exhibits non-phytotoxicity and is rich in nutrients.	The study design was purely experimental and did not involve interview with the local stakeholders.	The current study seeks to conduct mixed method design applying both quantitative and qualitative approaches.
	Kihila et al, (2021),	Waste segregation and potential for recycling	Interview guides, surveys and waste measurements	Waste generation rate was 0.53 kg/Cap. Day with food waste as the main type of waste aggregating more than 60% of the waste weight.	Focus of the research was on waste segregation	Study seeks to examine how recycling organic waste influence sustainability of livelihood projects
Volume of Waste	Dianati et al, (2021)	A system dynamics-based scenario analysis of residential solid waste management in Kisumu, Kenya	True experimental design	Combination of the two interventions resulted to the largest production of biogas (42%) replacing unclean fuels.	The study having adopted experimental approach applying two interventions failed to triangulate.	Basing on the adoption of mixed method research, the study will triangulate the research instruments

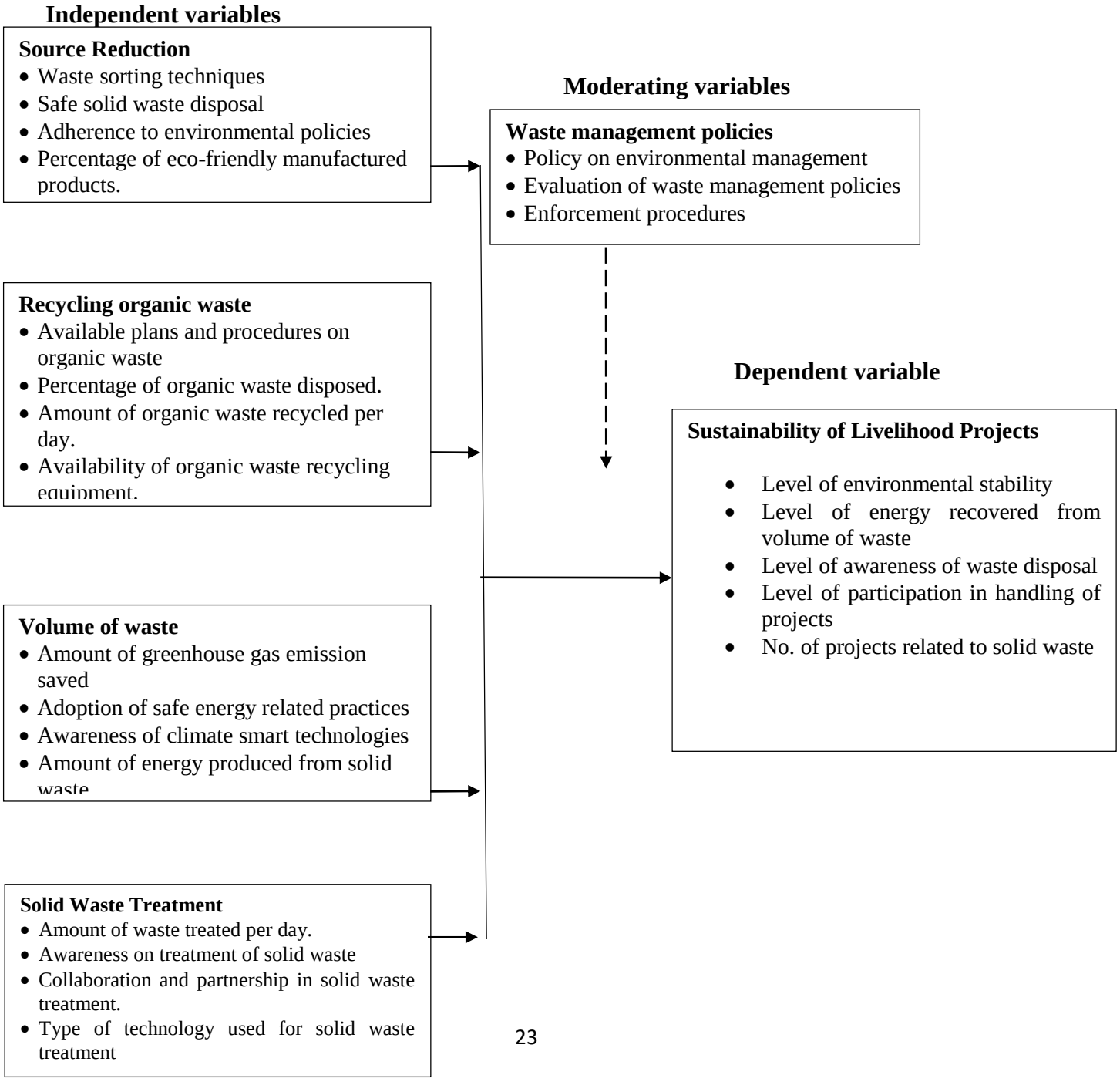
	Mian Hu et al, (2021)	Thermochemical conversion of sewage sludge for energy and resource recovery.	Thermochemical experiment approach	The ability of thermochemical technologies to recover energy and resources, significantly reduce and eliminate pathogens, and manage sewage sludge puts them at the forefront of the industry.	The research was a true experiment involving several tests and experiments for instance pyrolysis, incineration	The study will focus on determining the degree to which energy recovery impacts the sustainability of livelihood projects.
Solid Waste Treatment	Kharat et al, (2016)	The application of Delphi and AHP method in environmentally conscious solid waste treatment and disposal technology selection	Experimental approaches based on Delphi and Analytic Hierarchy Process (AHP) techniques	Organic garbage is composted, which decreases the quantity of waste dumped in landfills and yields compost that eventually brings in money.	The research solely focused on treatment of compost organic waste and used true experimental approaches to arrive at conclusions.	The study will answer the research question: To what extent does solid waste treatment influence sustainability of livelihood projects in peri-urban settlements ?

	Abel et al, (2017)	Determinants of hospital solid waste composition of Obafemi Awolowo University Teaching Hospital Complex in Ile-Ife.	Data collection methods follows that the research gathered both primary and secondary data	General waste contributed to proportions of 0.273 and 0.727 respectively. The study also found out that the per capita waste generated in the wards amounted to nearly 6 kilograms per day.	The study only focused on hospital solid waste composition failing to address solid waste in general.	The current research will address general solid waste treatment in peri-urban

2.6 Conceptual Framework

Figure 1 depicts the conceptual framework, which serves as a visual representation of the study..

Figure 1: Conceptual Framework on influence of solid waste management practices on sustainability of livelihood projects in peri-urban settlements.



2.7 Research Hypotheses

The study examined the following research hypotheses;

1. **H_0:** The study found that there is no statistically significant relationship between source reduction and the sustainability of livelihood projects in peri-urban settlements.
2. **H_0:** The research did not find a significant relationship between recycling organic waste and the sustainability of livelihood projects in peri-urban settlements.
3. **H_0:** No significant correlation exists between the quantity of waste and the sustainability of livelihood projects in peri-urban communities.
4. **H_0:** No significant correlation was found between solid waste treatment and the sustainability of livelihood projects in peri-urban settlements.

2.10 Summary of Literature Review

Literature study covered both empirical and theoretical reviews. Theoretical literature was reviewed to demonstrate the application of three studies employed to hinge the current study on; Actor-net theory, systems theory and theory of change. Source reduction, also known as mean source waste immunization and prevention, or pollution prevention, aims to reduce the volume or toxicity at the source of the waste by altering the process that produces the materials; this involves combining sale, manufacture, design, purchase, and usage of products and packaging (Modebe et al., 2011).

Recycling refers to the recovery and reprocessing of usable material that might otherwise end up in landfills and dumpsites. The solid waste materials can be transformed into other useful products that can be used as resources in manufacturing. This process of waste transformation saves energy during manufacturing and requires a proportion of energy to produce an item as compared to manufacturing a similar product with materials from conception.

Energy recovery, commonly referred to as waste-to-energy, involves the conversion of non-recyclable waste materials into usable heat, power, or fuel. Other processes used in the procedure include anaerobic digestion, combustion, gasification, pyrolysis, landfill gas recovery, and gasification.

In their exploration of an experimental approach for conducting scenario analysis based on system dynamics in the context of residential solid waste management within Kisumu County, Dianati et al. (2021) note that combining the two interventions could produce more than 1.1 million tons of clean biogas while reducing greenhouse gas emissions. Table 2.1 provides an overview of the literature as well as the gaps that have been found.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

In this section, the research design was elaborated upon, the target audience was defined, and the sample size was determined, along with the chosen sampling techniques. The chapter also delved into the pilot test to ensure the reliability and validity of the research instrument. Data capture procedures were comprehensively outlined, and analysis methods were discussed. The chapter concluded with the operationalization of variables and considerations related to ethics.

3.2 Research Design

This research acquired a descriptive survey research design as indicated by Burns and Grove, (2010). The research design refers to the methods, procedures and techniques or structures that are applied to undertake a study. The study's design was deemed appropriate since it involves the collection and comparison of data from the designated population at a particular point in time. The design places a strong emphasis on information gathering through the distribution of questionnaires to a sample of people since doing so will enable the researcher to produce quantitative and descriptive data for the purpose of assessing the variables. In order to gather data for the design's quantitative and qualitative approaches, questionnaires, interviewing protocols, and focus group discussions will be used. This design is preferred by the study because it aims to guarantee accurate description of phenomena and reduce bias during data gathering (Kothari, 2003).

3.3 Target Population

The research's aimed population, consisting of 3,847 individuals, was chosen among a pool of 12 potential respondents in the department of environment and waste management, 13 registered youth groups each having 30 members involved in waste management practices, 3,420 households and 25 administrators from the local Sub-County office in charge of waste management. (Department of Environment, 2021; Kenya Populace and Housing Census, 2019). The distribution of the required group is indicated as below.

Table 3. 1: Target Population

Category	Target population	Percentage (%)
Department of Environment and Waste Management	12	0.3
13 registered Youth Groups	390	10.3
Households	3420	88.9
Local County administrators	25	0.6
Total	**3847**	**100.0**

The term "population," as described by Singh (2006), is also commonly known as the "universe." Within this methodology section, "population" refers to the constituents of a specific group. It is of paramount importance for a researcher to meticulously define the scope of their study and highlight its distinct characteristics before selecting a sample of research participants, as emphasized by Singh (2006). Once research encompasses all the elements within a real or hypothetical group of individuals, objects, or occurrences, from which the study seeks to draw generalizations based on its findings, this group is referred to as the intended population, as defined by Borg and Gall (1989). It is this demographic that is being investigated in the survey, and it is from this population that the survey's key conclusions have been derived, as indicated by Levy and Lemeshow (2008).

3.4 Sample Size and Sampling Procedure

Sample is defined as a subset of entire group that a researcher chooses to represent entire population (Creswell, 2014). The sampling size and the methods for sampling as detailed in the below sections.

3.4.1 Sample Size

Using Cochran's technique, 349 respondents from the study's target population were selected as the sample(1977). Sample consists of a relatively small segment of a larger population, chosen

with the assumption that it mirrors the characteristics of the entire population (Cooper and Schindler, 2014).To determine the sample size, the research adopted Cochran's formula (1977)

$$n_0 = \frac{Z^2 pq}{e^2}$$

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

$$n_0 = \frac{(1.96)(1.96)(0.5)(0.5)}{(0.05)(0.05)}$$

$$n = \frac{384}{1 + \frac{384-1}{3847}}$$

n= 349.23

3.4.2 Sampling Procedures

Based on the Cochran formula (1977) of sample size determination, the sample size of 349 will be derived from a group of 3,847 respondents. The study population is stratified and will use proportionate stratified random1sampling technique1where each strata1will be divided by the total population and multiplied by the obtained sample size. The formula used to calculate the number of respondents per stratum was as follows: ns = p/P * S; where 'ns' represents the desired strata sample size, 'p' stands for the population within each stratum in the heterogeneous distribution, 'P' represents the total population, and 'S' signifies the overall sample size. Table 3.2 provides a

breakdown of the methodology used to determine each sample size. It offers a detailed explanation of how each sample size was arrived at..

Table 3. 2: Sample Size

Category	**Target population**	**Proportion**	**Sample Size**
Department of Environment and Waste Management	12	0.003	1
13 registered Youth Groups	390	0.101	35
Households	3420	0.889	310
Local County administrators	25	0.006	2
Total	**3847**	**100.0**	**349**

3.5 Research Instruments

The data collection instrument comprises of a survey questionnaire and interview guides. The questionnaire will be administered to the 349 respondents. Interview guides will be applied to gather qualitative data from a total of 10 in-depth interviews will be conducted with the following respondent groups; a representative from the department of environment and waste management, a youth leader from the youth groups and focus group discussions will be held with key members of the household preferably ‘nyumba kumi leaders’ who understand the dynamics of community policing and management.

The quantitative survey instrument utilized a Likert Scale to assess participants' opinions and perceptions regarding the sustainability of livelihood projects in Embakasi West Sub-County. This approach was chosen because it allows for the aggregation of responses, generating meaningful quantitative data for closed-ended questions. The 5-point Likert scale was structured as follows: 5 – Strongly Agree; 4 – Agree; 3 – Neutral; 2 – Disagree; and 1 – Strongly Disagree. The questionnaire comprised multiple sections: Section A collected socio-demographic information

from the respondents, while Section B focused on inquiries related to solid waste management practices, specifically addressing the response variable of the sustainability of livelihood projects.

The interview guide sought specific information on project management constraints and implementation of infrastructure to collect in-depth qualitative data through direct contact with the participants and probing for more information to add meaning and clarity to the collected data. Kothari (2004) implies that utilization of in-depth is a suitable method as it is flexible due to the ability to rephrase questions as needed to gather more insights from respondents and probing to get more information or clarification. The focus group discussion guide will also include open-ended inquiries based on the variables.

3.5.1 Pilot Testing of Research Instruments

The research took into account pretesting 10 percent of the 349 participants, which is the sample size, and 35 instruments were secured for the test pilot. As indicated by Mugenda & Mugenda (2003), pilot research with a sample size of 10% is sufficient because pretesting reveals problems prior to the start of actual data collecting. Pretesting of the instrument will be issued to 5 youth leaders from the youth groups, 25 households in Kamukunji Sub-County since this area has alike features as the study area (Mugenda and Mugenda, 2003). Pre-test targets youth group leadership, households, county administrators and one individual from the department of environment and waste management. Pilot testing aims to improve face validity and validate the accuracy and dependability of the research tools. According to Joppe (2009), a pilot study is a trial run performed prior to primary study, primarily to test the tool beforehand and identify any potential problems.

3.5.2 Validity of Research Instruments

In accordance with Mugenda and Mugenda's definition in 2003, validity pertains to the accuracy and meaningfulness of the inferences drawn from a study. In this research, both content and construct validity will be pursued. To establish content validity, expert opinions will be sought from a researcher who possesses a comprehensive understanding of and the ability to critically assess the variables under investigation. Academic supervisors, acknowledged as experts in the field of research instrument validation, will be consulted for this purpose. As noted by Wambugu, Nyonje, and Nduge (2015), content validity ensures a logical assessment of whether an instrument

covers what it is intended to cover or not. On construct validity, this will be determined by how the statements in the instrument have been designed. It is concerned with how straightforward or complicated the questions are written in the instrument. The extent that an instrument captures the variable it was intended to capture is known as construct validity.

3.5.3 Reliability of Research Instruments

To confirm the instrument's reliability, the study employed the split-half approach. This involved dividing the instrument into two equal parts, which were then administered simultaneously to a single group of respondents. The correlation between the results from the two halves of the test was examined. Subsequently, the internal consistency of the instrument was assessed by computing correlation coefficients between the two data sets using Cronbach's Alpha in SPSS. This is done to determine whether specific scale items measure the same construct or not. To determine credibility, an instrument will have high correlation indicating that a respondent would report equally well on both halves of the questions. Creswell (2014) suggests that an accurate research tool should have an alpha value for the correlation coefficient of at least 0.7.

3.6 Data Collection Procedures

Investigator created introduction letter, provided to respondents throughout the data gathering process. Similar to that, the investigator also asked the University of Nairobi for a letter authorizing them to undertake research. After that, they proceeded to obtain a permit from the NACOSTI. These records allowed the researcher to: was able to travel to the research area and properly present the research to the department of environment at the county headquarters as well as the administrators and community waste management administrators in the Embakasi West Sub-County. Instruction in using the research instruments was provided to the research assistants who were hired. The respondents received self-administered questionnaires, which they had approximately two weeks to complete. In order to gather qualitative data, the research assistants interviewed respondents.

3.7 Data Analysis Techniques

After the data collection process, the raw data pertaining to the variables underwent data processing. The data were then analyzed using SPSS version 28.0, which provided both descriptive and inferential statistics. Descriptive statistics included calculations of the mean and standard deviation. To present the data effectively, tables with frequency distributions were used. The parametric analysis employed inferential statistics. Regression was used to calculate the explanatory variable's effect on the response variable and evaluate the correlation's strength. The researcher utilized a content analysis technique to examine interview field notes in order to address qualitative analysis. The recorded responses were used to identify important themes, which were then given notes and codes.

3.7.1 Hypothesis Testing

The relationship between both the independent and dependent variables was assessed using a regression model. Table 3.3 outlines how the study's hypotheses will be tested.

Table 3. 3: Hypotheses Testing

Objective	Hypotheses	Model for testing Hypothesis	Results Interpretation
i. To determine the extent to which source reduction influence sustainability of livelihoods projects in peri-urban settlements.	i. **H_0:** There is no significant relationship between source reduction and sustainability of livelihood projects in peri-urban settlements.	$y= \alpha+\beta_1X_1+e$ y= Sustainability of livelihood projects in peri-urban settlements. β_0= constant, β_1= beta coefficient, X_1= Source reduction e= error term	p< 0.05 reject H_01> accept otherwise
ii. To examine how recycling organic waste influence sustainability of livelihood projects in peri-urban settlements.	ii. **H_0:** There is no significant relationship between recycling organic waste and sustainability of livelihood projects in peri-urban settlements.	$y= \alpha +\beta_2X_2+e$ y= Sustainability of livelihood projects in peri-urban settlements β_0= constant, β_2= beta coefficient, X_2= Recycling organic waste e= error term	p <0.05 reject H_02> accept otherwise
iii. To establish the extent to which energy recovery influence sustainability of livelihood projects in peri-urban settlements.	iii. **H_0:** There is no significant relationship between energy recovery and sustainability of livelihood projects in peri-urban settlements.	$y= \alpha +\beta_3X_3+e$ y= Sustainability of livelihood projects in peri-urban settlements. β_0= constant, β_3= beta coefficient, X_3= Energy recovery e= error term	p-value <0.05 reject H_03> accept otherwise
iv. To assess the extent to which solid waste treatment influence sustainability of livelihood projects in peri-urban settlements.	iv. **H_0:** There is no significant relationship between solid waste treatment and sustainability of livelihood projects in peri-urban settlements.	$y= \alpha +\beta_4X_4+e$ y= Sustainability of livelihood projects in peri-urban settlements. β_0= constant, β_4= beta coefficient, X_4= Solid waste treatment e= error term	p-value <0.05 reject H_04>accept otherwise

3.8 Ethical Considerations

The study ensured that the respondents were guaranteed full privacy, confidentiality and anonymity. The responses were used in aggregate form only, and we're not linked to specific respondents, or used for other purposes other than that for this study. Necessary research approvals were obtained to ensure that the study followed the laid down procedures and principles of ethical research. The collection of data commenced once the proposal was accepted. Various permissions were sort from different agencies – NACOSTI, MoE etc. Transmittal letters were advanced to the MoE offices with Embakasi Sub-County with the facilitation from University of Nairobi. The same letters were also forwarded to the various institutional heads within Embakasi Sub-County, Nairobi County.

3.9 Operationalization Table of Variables

Operationalization is the process of translating abstract concepts or variables into measurable and quantifiable terms, often involving the assignment of numerical values or other symbols to facilitate research and data collection. According to Sekaran (2006), operationalization identifies variables in a way that makes it possible to measure those variables. The study operationalized the variables in terms of objective, variable, indicators, the research instruments employed, measurement scale, type of analysis and tool of analysis as indicated in the Table 3.4.

Table 3. 4: Operationalization Table of Variables

Objectives	Variable	Indicator	Research Instrument	Measurement Scale	Type of analysis	Tools of Analysis
i. To determine the extent to which source reduction influence sustainability of livelihoods projects in peri-urban settlements.	Source Reduction		Questionnaire Interview Guide	Interval	Descriptive Analysis Inferential Analysis	Frequencies, Percentages, Mean, SD, Pearson Product Moment Correlation. Simple linear regression, ANOVA, F-test
ii. To examine how recycling organic waste influence sustainability of livelihood projects in peri-urban settlements.	Recycling organic waste		Questionnaire Interview Guide	Interval	Descriptive Analysis	Frequencies, Percentages, Mean, SD, Pearson Product Moment Correlation. Simple linear regression, ANOVA, F-test

					Inferential Analysis	
ii.	To establish the extent to which influence sustainability of livelihood projects in peri-urban settlements.	Volume of waste	Questionnaire Interview Guide	Interval	Descriptive Analysis Inferential Analysis	Frequencies, Percentages, Mean, SD, Pearson Product Moment Correlation. Simple linear regression, ANOVA, F-test
iv.	To assess the extent to which solid waste treatment influence sustainability of livelihood projects in peri-urban settlements.	Solid Waste treatment	Questionnaire Interview Guide	Interval	Descriptive Analysis Inferential Analysis	Frequencies, Percentages, Mean, SD, Pearson Product Moment Correlation. Simple linear regression, ANOVA, F-test
v.	Sustainability of livelihood projects in peri-urban settlements.		Questionnaire Interview Guide	Interval	Descriptive Analysis	Frequencies, Percentages, Mean, SD, Pearson Product Moment Correlation.

Inferential Analysis	Simple linear regression, ANOVA, F-test

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

4.1 Introduction

A summary of the research findings and discussion that were compared to its goals are presented in this chapter. The subjects covered include the percentage of completed questionnaires, the respondents' demographics, the viability of livelihood programs in peri-urban settlements in Nairobi, Kenya, source reduction, organic waste recycling, trash volume, and solid waste treatment in Nairobi County.

4.2 Questionnaire Return Rate

Sample of 349 respondents, 280 completed questionnaires, was taken from the target population. The outcomes of the questionnaires are exhibited in Table 4.1

Table 4. 1: Questionnaire Return Rate

Responses	Frequency	Percentage
Returned Responses	285	80.2
Non-Responses	64	19.8
Total	**349**	**100.0**

The questionnaire return rate, standing at 80.2%, was considered sufficient for data analysis, in accordance with the guideline provided by Mugenda and Mugenda (2003), which suggests that a return rate of 70% and above is deemed appropriate to proceed with data analysis.

4.3 Demographic Characteristics of Respondents

This study sorted the respondents in order to establish their demographic makeup. Figure 4.2 illustrates the demographic features based on age, gender, highest degree of education, and years lived in Embakasi West.

Table 4. 2: Demographic Characteristics of the Respondents

Variable	Frequency	Percentage	Cumulative Frequency
Gender			
Male	119	41.8	119
Female	166	58.2	285
Total	**285**	**100.0**	
Age Bracket			
Below 25 years	14	4.9	14
26 – 35 years	131	46.0	145
36 – 45 years	83	29.1	228
46 – 55 years	45	15.8	273
Above 55 years	12	4.2	285
Total	**285**	**100.0**	
Highest level of Education			
Diploma	67	23.5	67
Degree	192	67.4	259
Master	17	6.0	276
PhD	9	3.2	285
Total	**285**	**100.0**	
Years Lived in Embakasi			
1	12	4.2	12
2	103	36.1	115
3	85	29.8	200
4	74	29.8	274
5	11	3.9	285
Total	**285**	**100.0**	

Table 4.2 reveals that in terms of gender distribution, 41.8% of the respondents were male, while 58.2% of the respondents were female. This implies that a majority of the participants in the study, which focused on the influence of solid waste management practices on the sustainability of livelihood projects in Embakasi West, were female.

On age, the findings display that the participants that have been underneath 25 years of age were 14 (4.9%), 26 to 35 years were represented by 131 respondents, which become 46%, eighty-three respondents had been aged 36 to 45 years and this become represented by 29.1%, 45 respondents with a percent of 15.8% represented respondents of age bracket 46-55 years old and the respondents that have been above 55 years have been 12 represented by a percentage of 4.2%. This indicates that the majority of the participants fell within the age range of 26 to 35 years old.

Based on the distribution of respondents by their highest degree of education, the majority held a degree, which accounted for 192 respondents (67.4%). Additionally, 67 respondents (23.5%) had earned a diploma, 17 (6.0%) held a master's degree, and 9 (3.2%) had obtained a doctorate. The consequences demonstrated that as schooling ranges rise, there are fewer responses. It shows that the respondents' expertise in strong waste management techniques in “relation to the sustainability of livelihood initiatives turned into pretty low.

4.4 Sustainability of Livelihood Projects

Regarding the dependent variable, the study aimed to gather responses regarding the sustainability of livelihood projects in Embakasi West. The survey employed a 5-point Likert scale for statements, where 5 indicated "Strongly Agreed," 4 represented "Agree," 3 signified "Neutral," 2 denoted "Disagree," and 1 stood for "Strongly Disagreed." The findings are presented in Table 4.3.

Table 4. 3: Sustainability of Livelihood Projects

Statements	**5**	**4**	**3**	**2**	**1**		**Mean**	**SDV**
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**n**		
1. Sustainability of livelihood projects brings about environmental stability	11 (3.9)	208 (73.0)	50 (17.5)	11 (3.9)	5 (1.8)	285	3.14	1.201
2. There is high level of energy recovered from solid waste in this community	5 (1.8)	217 (76.1)	47 (16.5)	10 (3.5)	6 (2.1)	285	3.62	1.242
3. Most of the residents are aware of livelihood projects in the community	12 (4.2)	225 (78.9)	32 (11.2)	10 (3.5)	6 (2.1)	285	3.30	1.114
4. Improper waste disposal leads to livelihood deterioration	20 (7.0)	208 (73.0)	34 (11.9)	13 (4.6)	10 (3.5)	285	3.55	1.160
5. Local government is active on collection and disposal of solid waste	31 (10.9)	193 (67.7)	41 (14.4)	16 (5.6)	4 (1.4)	285	3.28	1.268
Composite Mean							**3.38**	**1.197**

The analysis results for the sustainability of livelihood programs in Nairobi County are presented in Table 4.3. The researcher computed the composite mean and standard deviation, then compared them to the mean of each statement derived from the response variable indicators. If the line-item mean was lower than the composite mean, it indicated a negative effect on the variable. Conversely, when the line-item standard deviation was lower than the composite standard deviation, it suggested conflicting opinions regarding the statement.

For the first claim that sustainable livelihood projects can promote environmental stability, the findings are as follows: 11 respondents (3.9%) strongly agreed, 208 (73.0%) agreed, 50 (17.5%) were neutral, 11 (3.9%) disagreed, and 5 (1.8%) strongly disagreed. The resulting mean score was 3.14, which is below the composite mean, and the obtained standard deviation was 1.201, which is higher than the composite standard deviation. These findings indicate that 73.0% of respondents agreed with the statement.

Regarding statement number 2, "There is high energy recovered in solid waste," the study collected responses. With a mean of 3.62 and a standard deviation of 1.242, the results indicate that 5 respondents (1.8%) strongly agreed, 217 (76.1%) agreed, 47 (16.5%) were neutral, 10 (3.5%) disagreed, and 6 (2.1%) strongly disagreed. Comparing these results to the composite mean of 3.38, it suggests that there was a consensus on the high level of energy recovered in solid waste. The statement's positive impact on the variable is evident as its mean is higher than the composite mean, with 76.1% of respondents agreeing with it.

Statement number three, that most of the residents are aware of livelihood projects in the community, yielded the following results: 12(4.2%) strongly agreed, 225(78.9%) agreed, 32 respondents (11.2%) were neutral, 10 (3.5%) disagreed, and 6 (2.1%) strongly disagreed. The mean score for this statement was 3.30, with a standard deviation of 1.114. The mean score of 3.30 was slightly higher than the composite mean, suggesting that the statement had a marginally negative impact on the variable, which was 1.114 points lower than the composite mean. Divergent views on the variable were expressed in this statement.

The results of the fourth line-item statement demonstrated that improper waste disposal leads to livelihood deterioration contributed positively to the variable. The mean for the line items was 3.55, and the standard deviation was 1.160. Despite these statistics, it is evident that 73% of respondents agreed with the statement. Specifically, 20 respondents (7.0%) strongly agreed, 208 (73.0%) agreed, 34 (11.9%) were neutral, 13 (4.6%) disagreed, and 10 (3.5%) strongly disagreed. This implies that the majority of respondents believed that the statement held significance in influencing the sustainability of livelihood programs.

The findings regarding the fifth statement aimed to assess the activity of local governments in solid waste collection and disposal. The results indicate that 31 respondents (10.9%) strongly agreed, 193 (67.7%) agreed, 41 (14.4%) were neutral, 16 (5.6%) disagreed, and 4 (1.4%) strongly disagreed. The statement had a mean score of 3.28 and a standard deviation of 1.268. These findings suggest that, according to the respondents, local governments were actively involved in solid waste collection and disposal, despite the difference between the composite mean and the line item mean.

4.5 Source Reduction and Sustainability of Livelihood Projects

The study's primary objective, which is to determine the extent to which source reduction affects the sustainability of livelihood programs in peri-urban areas of Nairobi County, is introduced through this theme. To achieve this, respondents were asked to indicate their level of agreement or disagreement with the statement on a Likert scale ranging from 1 to 5, where 1 represented "strongly disagree" (SD), 2 denoted "disagree," 3 indicated "neutral," 4 signified "agree," and 5 corresponded to "strongly agree" (SA). The results are presented in Table 4.4.

Table 4. 4 Source Reduction and Sustainability of Livelihood Projects

Statement	**5**	**4**	**3**	**2**	**1**		**Mean**	**SDV**
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**n**		
1. We have reusable methods of solid waste disposal	15 (5.3)	214 (75.1)	29 (10.2)	18 (6.3)	9 (3.2)	285	1.04	1.448
2. We have trainings on how to dispose waste as well as reusing waste where necessary	16 (6.3)	202 (70.9)	57 (20.0)	6 (2.1)	2 (0.7)	285	1.05	0.183
3. Environmental policies are strictly followed by waste handlers	4 (1.4)	173 (60.7)	67 (23.5)	26 (9.1)	15 (5.3)	285	1.04	0.140
4. Most of the residents practice waste minimization	12 (4.2)	162 (56.8)	72 (25.3)	28 (9.8)	11 (3.9)	285	1.03	0.128
Composite Mean							**1.04**	**0.475**

Statement 1 concerning the variable "source reduction" produced the following descriptive results: 15 respondents (5.3%) strongly agreed, 214 (75.1%) agreed, 29 (10.2%) were neutral, 18 (6.3%) disagreed, and 9 (3.2%) strongly disagreed regarding the existence of numerous waste sorting techniques in solid waste treatment. This statement had a mean score of 1.04 and a standard deviation of 1.448. The data indicates that the line item contributes positively to the predictor variable, as compared to the composite mean of 1.04, and is supported by 75.1% of the respondents.

The data collected for the second statement, "Are there trainings on how to dispose of waste as well as reuse waste when necessary?" showed that 16 respondents (6.3%) strongly agreed, 202 (70.9%) agreed, 57 (20.0%) were neutral, 6 (2.1%) disagreed, and 2 (0.7%) strongly disagreed. The statement had a mean score of 1.05 and a standard deviation of 0.183. This suggests that, according to 70.9% of respondents, the statement has a positive impact on the variable.

On the third claim—asking trash handlers if they carefully adhere to environmental regulations—the findings were as follows: a mean and standard deviation of 1.04 and 0.140, respectively, showed that 4 respondents (1.4%) strongly agreed, 173 (60.7%) agreed, 67 (23.5%) were neutral, 26 (9.1%) disagreed, and 15 (5.3%) strongly disagreed. These results indicate that the statement has a positive impact on the variable. Notably, the mean of 1.04 for the statement matches the composite mean.

The fourth statement regarding the variable aimed to determine if local residents minimize waste. The data showed that 56.8% of respondents agreed, 72.3% were neutral, 28.8% disagreed, and 11 (3.9%) strongly disagreed. The corresponding means were 1.03, and the standard deviation was 0.128. This suggests that the statement had a negative impact on the variable in comparison to the composite mean (1.04).

4.5.1 Correlation Analysis between Source Reduction and Sustainability of Livelihood projects

The researcher employed Pearson Correlation Coefficient to analyze the relationship between source reduction and the sustainability of livelihood projects. This allowed for the assessment of the type and strength of the connection between source reduction and the sustainability of livelihood projects. The correlation results are presented in Table 4.5.

Table 4. 5: Correlation Analysis between Source Reduction and Sustainability of Livelihood Projects

Variable		**Source Reduction**	**Sustainability of Livelihood Projects**
Source Reduction	Pearson Correlation	1	0.215**
	Sig. (2-Tailed)		0.000
	N	285	285
Sustainability of Livelihood Projects	Pearson Correlation	0.215**	1
	Sig. (2-Tailed)	0.000	
	N	285	285

**. Correlation is significant at the 0.05 level (2-tailed)

The correlation results in Table 4.5, which examined the relationship between source reduction and the sustainability of livelihood projects, indicated a weak positive correlation of 0.215. This suggests a significant association, with a p-value of 0.000, which is lower than the significance level of 0.05. These findings imply that source reduction indeed influences the sustainability of livelihood projects.

4.5.2 Regression Analysis of Source Reduction and Sustainability of Livelihood projects

The connection between source reduction and the sustainability of livelihood projects was analyzed through regression analysis. In line with the study's second objective, a basic linear regression model was employed to assess the hypothesis.

1. **H_0**: Source reduction has no significant influence on sustainability of livelihood projects

H_1: Source reduction has a significant influence on sustainability of livelihood projects

The first hypothesis was evaluated using the following model:

$y = \alpha + \beta 1X1 + e$

Where:

- y = sustainability of livelihood projects
- α = constant
- $\beta 1$ = beta coefficient
- X1 = source reduction
- e = error term

Table 4. 6: ANOVA for Source Reduction and Sustainability of livelihood projects

Factor	Sum of Squares	Df	Mean Square	F	Sig.
Regression	0.316	1	0.079	33.95	0.000
Residual	6.512	284	0.023		
Total	**6.828**	**285**			

a. Dependent Variable: sustainability of livelihood projects

b. Predictors: (Constant) source reduction

The regression model in Table 4.6 was assessed for goodness of fit through an analysis of variance. The F-significance value, which was 0.000, was found to be less than 0.05 ($p < 0.05$). Moreover, with an F (1, 284) value of 33.95, which greatly exceeded the critical F-value of 3.86, it is evident that the F-ratio was statistically significant. This indicates the significance and importance of the model.

Table 4. 7: Model Summary for Source Reduction and Sustainability of Livelihood Projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.215[a]	0.46	0.33	0.153

a. Source reduction, constant predictors

The study findings, as presented in Table 4.7, provide an explanation of the proportion of the total variability of the model that can be attributed to the predictor variable. Source reduction contributes to 46.0% of the changes in the dependent sustainability of livelihood initiatives, according to the R Square, which is reported as 0.46. This means that 54% of the variance was caused by other factors that were not taken into consideration in this model. According to the study's findings, source reduction significantly affects the viability of livelihood programs.

Table 4. 8: Coefficients of Source Reduction and Sustainability of livelihood projects

	Un-standardized Coefficients		**Standardized Coefficients**	**T**	**Sig.**
Variables	**B**	**Std. Error**	**Beta**		
(Constant)	1.232	0.111		11.105	0.000
Source Reduction	0.010	0.014	0.460	0.753	0.000

a. Dependent Variable: sustainability of livelihood projects

According to the findings in Table 4.8, a unit increase in source reduction led to a 46% rise in the fluctuations in the sustainability of livelihood initiatives, with a standardized beta value of 0.460. At p0.05, the overall model was suitable for predicting the sustainability of livelihood programs

and source reduction. Sustainability of livelihood initiatives = 1.232+0.460 (Source Reduction) + e; t = 0.753; p 0.05; would be the regression model.

The study's conclusions showed that source reduction significantly affects the viability of livelihood projects. As a result, the study's null hypothesis was rejected. The findings of the current study on the first variable source reduction (R^2 =0.460) explains 46% of the variations in sustainability of livelihood projects.

The researcher further conducted some interview questions to the key informants, and one of the waste handlers had this to say*; We have a team that conducts trainings once a month to the residents on different types of waste and how to reuse what can be reused. We recognize different waste management systems set by the NEMA and practice them on waste disposal. We always encourage the residents to minimize their waste production.*

4.6: Recycling Organic Waste and Sustainability of Livelihood Projects

In order to better understand how recycling of organic waste affects the sustainability of livelihood programs, the second variable of the study was used. To achieve this, respondents were asked to assess their level of agreement or disagreement with the statement using a Likert scale ranging from 1 to 5, where 1 represented "strongly disagree" (SD), 2 indicated "disagree," 3 represented "neutral," 4 indicated "agree," and 5 represented "strongly agree" (SA). The results are presented in Table 4.9.

Table 4. 9: Recycling Organic Waste and Sustainability of Livelihood Projects

Statement	**5**	**4**	**3**	**2**	**1**		**Mean**	**SDV**
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**			
1. There are plans and procedure on organic waste that I am aware of	6 (2.1)	150 (52.6)	79 (27.7)	43 (15.1)	7 (2.5)	285	1.08	0.242
2. I can confidently quantify the percentage of organic waste disposed	18 (6.3)	150 (52.6)	69 (24.2)	36 (12.6)	12 (4.2)	285	1.03	0.369
3. I am aware of organic waste recycled per day	10	167	73	29	6	285	1.01	0.063

	(3.5)	(58.6)	(25.6)	(10.2)	(2.1)			
4. I know several equipment used by local government to recycle waste	10	168	84	13	10	285	1.02	1.112
	(3.5)	(58.9)	(29.5)	(4.6)	(3.5)			
Composite Mean							**1.04**	**0.447**

The first statement on the second variable gathered data on the citizens' knowledge of the policies and practices around organic waste. The findings, with a mean of 1.08 and a standard deviation of 0.242, are as follows: 6 (2.1%) strongly agreed, 150 (52.6%) agreed, 79 (27.7%) were neutral, 43 (15.1%) disagreed, and 7 (2.5%) strongly disagreed regarding the statement. The data indicate that the statement has a positive influence on the variable "recycling of organic waste" compared to the composite mean of 1.04. This comparison is based on the composite mean (M=1.04) and the line item mean (M=1.08).

The second statement focused on accurately estimating the percentage of discharged organic waste. According to the study's findings, 18 participants (6.3% strongly agreed), 150 participants (52.6% agreed), 69 participants (24.2% were neutral), 36 participants (12.6% disagreed), and 12 participants (4.6% severely disagreed), with a mean of 1.03 and standard deviation of 0.369. This indicates that the statement has a negative impact on the variable and warrants further investigation.

The third statement inquired whether the local residents were aware that organic waste was recycled daily. The data revealed that 10 (3.5%) strongly agreed, 167 (58.6%) agreed, 73 (25.6%) were neutral, 29 (10.2%) disagreed, and 6 (2.1%) strongly disagreed, resulting in a mean of 1.01 and a standard deviation of 0.063. These results indicate that the statement has a negative impact on the variable. Therefore, it suggests that the daily recycling of waste should be reevaluated.

The study investigated whether local residents were aware of the machinery the government uses for waste recycling. The results, with a mean of 1.02 and a standard deviation of 0.112, showed that 10 (3.5%) strongly agreed, 168 (58.9%) agreed, 84 (29.5%) were neutral, 13 (4.6%) disagreed, and 10 (3.5%) strongly disagreed. Although the standard deviation suggests converging perspectives on the statement, it should be examined in relation to the composite mean (1.04), as the mean of the line item is lower than the composite mean.

4.6.1 Correlation Analysis between Recycling Organic Waste and Sustainability of livelihood Projects

The Pearson Correlation Coefficient was used by the researcher to analyze the association between recycling organic waste and the sustainability of livelihood programs. This makes it possible to determine the nature and direction of the connection between organic waste recycling and the sustainability of livelihood programs. The results of the correlation are shown in Table 4.10.

Table 4. 10: Correlation Analysis between Recycling Organic Waste and Sustainability of Livelihood Projects

Variable		**Recycling Organic Waste**	**Sustainability of Livelihood Projects**
Recycling Organic Waste	Pearson Correlation	1	0.170**
	Sig. (2-Tailed)		0.000
	n	285	285
Sustainability of livelihood projects	Pearson Correlation	0.170**	1
	Sig. (2-Tailed)	0.000	
	n	285	285

**. The 0.05 level of significance for correlation (2-tailed)

The findings regarding the relationship between recycling organic waste and the sustainability of livelihood projects are presented in Table 4.10. The results indicated a weak positive correlation of 0.170 between recycling organic waste and the sustainability of livelihood projects, indicating a significant relationship with a p-value of 0.000, which is below the test's significance threshold of 0.05. This suggests that recycling organic waste does have an impact on the sustainability of livelihood projects.

4.5.2 Regression Analysis of Recycling Organic Waste and Sustainability of livelihood Projects

Regression analysis was employed to investigate the relationship between recycling organic waste and the sustainability of livelihood projects, in line with the study's second objective. To achieve this objective, a simple linear regression model was utilized to test the hypothesis.

2. **H_0:** Recycling organic waste has no significant influence of sustainability of livelihood projects.

H_1: Recycling organic waste has a significant influence of sustainability of livelihood projects

The second hypothesis was examined using the following model:

$$y = \alpha + \beta 1X1 + e$$

Where:

- y = sustainability of livelihood projects
- α = constant
- $\beta 2$ = beta coefficient
- X2 = Recycling Organic Waste
- e = error term

Table 4. 11: ANOVA for Recycling Organic Waste and Sustainability of Livelihood Projects

Factor	Sum of Squares	Df	Mean Square	F	Sig.
Regression	0.047	1	0.012	8.530	0.000
Residual	3.896	284	0.014		
Total	**3.944**	**285**			

a. Dependent Variable: sustainability of livelihood projects.

b. Predictors: (Constant) recycling organic waste

Regression model presented in Table 4.11 was assessed for goodness of fit using analysis of variance. The F-significance value of 0.000 was found to be less than 0.05 ($p < 0.05$). The F-ratio was significant, with a value of $F(1, 284) = 8.530$, which was significantly higher than the critical F value of 3.86. This indicates the model's significance.

Table 4. 12: Model Summary for Recycling Organic Waste and Sustainability of Livelihood Projects Table 4.12

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.130[a]	0.170	0.002	**0.1180**

a. Predictors (Constant), recycling organic waste

The study's findings, which are presented in Table 4.12, explain how much of the model's total variability can be attributed to the predictor variable. The dependent variable sustainability of livelihood projects is dependent on 17% of the variations, according to the R Square, which is provided as 0.170. According to the study, recycling organic waste affects the viability of livelihood enterprises.

Table 4. 13: Coefficients of Recycling Organic Waste and Sustainability of Livelihood Projects

	Un-standardized Coefficients		Standardized Coefficients	T	Sig.
Variables	**B**	**Std. Error**	**Beta**		
(Constant)	0.962	0.056		1.227	0.001
Recycling Organic Waste	0.110	0.008	0.170	17.336	0.000

a. Dependent Variable: sustainability of livelihood projects

According to the findings in Table 4.13, the standardized beta value was 0.170, meaning that every unit more organic waste was recycled, the variances in the sustainability of livelihood initiatives increased by 17%. Given the recycling of organic waste, the overall model was suitable to estimate the sustainability of livelihood initiatives at 0.05. Below was the regression model that was created: Sustainability of livelihood projects = 0.962+0.170 (recycling of organic waste) + e; t = 17.336; $p<0.05$.

The study concluded that recycling organic waste significantly influences the sustainability of livelihood projects, leading to the rejection of the null hypothesis. The findings from this study, which have an R-squared value of 0.170, suggest that the predictor variable, recycling of organic waste, can explain approximately 17% of the variations in the response variable, which is the sustainability of livelihood projects in Nairobi County.

The research further did a qualitative analysis on the second variable, and the key informants gave the following response; *There is a specific producer we follow when collecting waste. We have to get license from the County government as well as address where we will take the waste. Once at the site, we sort waste into reusable and non-reusable. Any organic waste, we gather it together and have it gone through the process of decomposition and we can generate energy as well as manure for cropping.*

4.7 Volume of Waste and Sustainability of Livelihood Projects

The third variable investigated the impact of trash volume in Nairobi County on the sustainability of livelihood projects. Respondents were asked to express their level of agreement or disagreement

with a statement on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The results are presented in Table 4.14**.**

Table 4. 14: Volume of Waste and Sustainability of Livelihood Projects

Statement	**5**	**4**	**3**	**2**	**1**		**Mean**	**SDV**
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**N**		
1.I have adopted a safe energy practice in relation to solid waste	42 (14.7)	77 (27.0)	80 (28.1)	58 (20.4)	28 (9.8)	285	1.02	0.127
2.I am aware of greenhouse gas emission and mitigate its effects	11 (3.9)	160 (56.1)	80 (28.1)	29 (10.2)	5 (1.8)	285	1.01	0.155
3.I am aware of climate smart technologies	21 (7.4)	146 (51.2)	64 (22.5)	44 (15.4)	10 (3.5)	285	1.02	0.117
4.I understand there is significant amount of energy produced by solid waste	20 (7.0)	168 (58.9)	56 (19.6)	28 (9.8)	13 (4.6)	285	1.02	0.199
Composite Mean							**1.01**	**0.150**

The first statement under the third variable aimed to determine whether all participants had adopted safe energy practices related to solid waste. The results indicated that 42 (14.7%) strongly agreed, 77 (27%) agreed, 80 (28.1%) were neutral, 58 (20.4%) disagreed, and 28 (9.8%) strongly disagreed with this statement. The statement had a mean of 1.02 and a standard deviation of 0.127. In comparison to the composite mean (1.01), the statement had a higher mean, suggesting a positive impact on the variable related to the amount of waste in solid waste (1.02). The second statement assessed participants' awareness of greenhouse gas emissions and their impacts. The results showed that 11 (3.9%) strongly agreed, 160 (56.1%) agreed, 80 (28.1%) were neutral, 29 (10.2%) disagreed, and 5 (1.8%) strongly disagreed. The statement had a mean of 1.01 and a standard deviation of 0.155. Comparing the statement's mean to the composite mean (1.01), it appears that the volume of garbage contributes positively to the variable.

In the third statement, participants were asked about their knowledge of climate-smart technologies. The survey results showed that 21 (7.4%) strongly agreed, 146 (51.2%) agreed, 64

(22.5%) were neutral, 44 (15.4%) disagreed, and 10 (3.5%) strongly disagreed with this statement. The statement had a mean of 1.02 and a standard deviation of 0.117. These results suggest that the statement had a positive impact on the variable related to fluctuating waste volume. This conclusion is drawn by comparing the composite mean (M=4.01) to the line item mean (M=1.02).

According to the descriptive findings from Table 4.14, 20 participants (7.0%) strongly agreed with the fourth statement, 168 participants (58.9%) agreed, 56 participants (19.6%) were neutral, 28 participants (9.8%) disagreed, and 13 participants (4.6%) strongly disagreed. They also show that participants understand that solid waste produces a significant amount of energy. These results indicate that 65.9% of the respondents accepted the statement. Furthermore, the line-item mean was higher than the composite item means, suggesting that the statement had a positive impact on the variable related to fluctuating waste volume.

Table 4. 15: Correlation for Volume of Waste and Sustainability of Livelihood Projects

Variable		**Volume of Waste**	**Sustainability of Livelihood Projects**
Volume of Waste	Pearson Correlation	1	0.241**
	Sig. (2-Tailed)		0.000
	N	285	285
Sustainability of Livelihood Projects	Pearson Correlation	0.241**	1
	Sig. (2-Tailed)	0.000	
	N	285	285

**. Correlation is significant at the 0.05 level (2-tailed)

The results from Table 4.15, which explores the relationship between waste volume and livelihood projects, indicate a statistically significant link between trash volume and livelihood projects. The p-value of 0.000 is less than the alpha value of 0.05. Additionally, the results reveal a moderate positive correlation of 0.241 between the explanatory variable (volume of waste) and the

dependent variable (sustainability of livelihood projects). This suggests that the volume of waste does indeed influence the sustainability of livelihood projects.

4.7.2 Regression Analysis for Volume of Waste and Sustainability of Livelihood Projects

To fulfill the demands of the third goal of this research, a simple linear regression model was used to assess the third hypothesis.

3.**H_0:** Volume of waste has no significant influence on sustainability of livelihood projects.

H_1: Volume of waste has a significant influence on sustainability of livelihood projects.

The third hypothesis was tested using the following model:

\[y = \alpha + \beta_3X_3 + e\]

Where:

- \(y\) = Sustainability of Livelihood Projects

- \(\alpha\) = Constant

- \(\beta_3\) = Beta Coefficient

- \(X_3\) = Volume of Waste

- \(e\) = Error Term

Table 4. 16: ANOVA for Volume of Waste and Sustainability of Livelihood Projects

Factor	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Regression	0.114	1	0.028	13.800	0.001
Residual	5.760	284	0.021		
Total	**5.874**	**285**			

a. Dependent Variable: Sustainability of Livelihood Projects.

b. Predictors: (Constant) Volume of waste

The goodness of fit for the regression model presented in Table 4.16 was assessed using analysis of variance. The F-significance value, which was determined to be 0.000, was found to be less than 0.05 ($p < 0.05$). The F-ratio was substantial, with a result of $F(1, 284) = 13.800$, significantly exceeding the critical threshold of F=3.86. This indicates the model's significance and strength in explaining the variation in the data.

Table 4. 17: Model Summary for Volume of Waste and Sustainability of Livelihood Projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.491[a]	0.241	0.005	0.0143

a. Predictors (Constant), volume of waste

The study's findings, which are presented in Table 4.17, explain how much of the model's total variability can be attributed to the predictor variable. The R Square value of 0.241 indicates that waste volume contributes by 24.1% to the sustainability of livelihood programs. The study came to the conclusion that waste volume has a considerable positive impact on the viability of livelihood enterprises.

Table 4. 18: Coefficients of Volume of Waste and Sustainability of Livelihood Projects

	Un-standardized Coefficients		Standardized Coefficients	T	Sig.
Variables	**B**	**Std. Error**	**Beta**		
(Constant)	1.149	0.065		17.820	0.000
	0.008	0.007	0.241	1.846	0.000

a. Dependent Variable: Sustainability of Livelihood Projects

According to the findings in Table 4.18, a unit increase in waste volume led to a 24.1% rise in the fluctuations in the sustainability of livelihood initiatives, with a standardized beta value of 0.241.

At $p<0.05$, the overall model was suitable for predicting the sustainability of livelihood projects given the volume of waste. Here is how the regression model might look;

Sustainability of livelihood projects = 1.149+0.241 (Volume of waste) + e; t = 1.846; $p<0.05$.

The study's findings concluded that the alternative hypothesis was accepted, and the null hypothesis was rejected.

This demonstrates volume of waste had influence on sustainability of livelihood projects.

The study further analyzed responses from key informants. The waste manager had this to say;

There is a lot of waste production from the residents and we are putting efforts to train them on how to recycle waste as well as where they can reuse and we believe that this will significantly reduce the volume of waste. High volume of waste is leading to high production of energy; it could be positive but handling the volume of waste is a bit hectic. We have started a campaign for residents to adopt safe energy practices and climate smart technologies. We also create awareness on greenhouse gases and effects on them.

4.8 Solid Waste Treatment and Sustainability of Livelihood Projects

The study's fourth variable was to evaluate how solid waste management affects the long-term viability of livelihood programs in Nairobi County. To do this, the respondents were asked to rate the statement's level of agreement or disagreement on a Likert scale of 1 to 5, with 1 denoting "strongly disagree" (SD), 2 "disagree," 3 "neutral," 4 "agree," and 5 denoting "strongly agree" (SA). The Table 4.19 findings are displayed.

Table 4. 19: Solid Waste Treatment and Sustainability of Livelihood Projects

Statement	**5**	**4**	**3**	**2**	**1**		**Mean**	**SDV**
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**N**		
1.I am aware of solid waste treatment mechanisms	4 (1.4)	222 (77.9)	43 (15.1)	15 (5.3)	1 (0.4)	285	1.00	0.207

2. There is collaboration and partnership in solid waste treatment	11 (3.9)	220 (77.2)	33 (11.6)	11 (3.9)	10 (3.5)	285	1.02	0.245
3. There are modern technologies applied in handling of solid waste	15 (5.3)	208 (73.0)	32 (11.2)	17 (6.0)	13 (4.6)	285	1.01	0.188
Composite Mean							**1.01**	**0.203**

In the last variable research, statement number 1 tried to determine whether respondents were aware of the processes used to treat solid waste. The results in Table 4.19 indicate that, with a mean and standard deviation of 1.00 and 0.207, respectively, 4 (1.4%) strongly agreed, 222 (77.9%) agreed, 43 (15.1%) were neutral, 15 (5.3%) disagreed, and 1 (0.4%) strongly disagreed. This suggests that the line item for this variable has a slightly negative impact on the predictor variable when compared to the composite mean (1.01).

Statement number 2, which pertains to collaboration and partnership in solid waste treatment, had a mean of 1.02 and a standard deviation of 0.245. Among the respondents, 11 (3.9%) strongly agreed, 220 (77.2%) agreed, 33 (11.6%) were neutral, 11 (3.9%) disagreed, and 10 (3.5%) strongly disagreed with this statement. This suggests that the line item for this variable has a generally positive impact on the predictor variable when compared to the composite mean (1.01). The fact that 81.1% of respondents supported the statement suggests that it both contributes positively to the variable and influences the predictor variable.

The third statement received 17 (6.0%) disagree and 13 (4.6%) strongly disagree responses from the participants. The statement had a mean of 1.01 and a standard deviation of 0.188. This suggests that the line item for this variable has a generally negative impact on the predictor variable when compared to the composite mean (1.02). Also, 208 (73.0%) agreed, 32 (11.2%) were neutral about the statement. Compared to the average mean of 1.01, the line item positively affects the predictor variable.4.8.1 Correlation Analysis on Solid Waste Treatment and Sustainability of Livelihood Projects

Using Pearson Correlation Coefficient, the researcher tried to ascertain the connection involving solid waste treatment and the viability of livelihood programs. The strength and direction that the connection has involving solid waste treatment and the durability of livelihood projects are established as a result. The correlation findings are presented in Table 4.20.

Table 4. 20: Correlation Analysis on Solid Waste Treatment and Sustainability of Livelihood Projects

Variable		**Solid Waste Treatment**	**Sustainability of Livelihood Projects**
Solid Waste Treatment	Pearson Correlation	1	0.383**
	Sig. (2-Tailed)		0.001
	N	285	285
Sustainability of Livelihood Projects	Pearson Correlation	0.383**	1
	Sig. (2-Tailed)	0.001	
	N	285	285

**. The 0.05 level of significance for correlation (2-tailed)

The findings of the link among both solid waste treatment and the sustainability of livelihood programs are shown in Table 4.20. The results showed that solid waste treatment and the sustainability of livelihood programs have a somewhat good correlation of 0.383. With a p-value of 0.001, which is lower than the predetermined significance level of 0.05, the result also indicates a significant correlation. This suggests that the sustainability of livelihood programs is influenced by the management of solid waste.

4.8.2 Regression Analysis for Solid Waste Treatment and Sustainability of Livelihood Projects

To fulfill the requirements of the study's fourth aim, The fourth hypothesis was examined through the application of a simple linear regression model.

4. H_0: Treatment of solid waste has no significant influence on sustainability of livelihood projects.

H_1: Treatment of solid waste has significant influence on sustainability of livelihood projects.

The following model was used to test the fourth hypothesis;

$y= \alpha+\beta_4X_4+e$

Where;

y= sustainability of livelihood projects;

α= constant,

β_2= beta coefficient,

X_2= solid waste treatment and;

e= error term

Table 4. 21: ANOVA for Solid Waste Treatment and Sustainability of Livelihood Projects

Factor	Sum of Squares	Df	Mean Square	F	Sig.
Regression	0.063	1	0.21	10.230	0.001
Residual	5.810	284	0.21		
Total	**5.874**	**285**			

a. Dependent Variable: sustainability of livelihood projects.

b. Predictors: (Constant) solid waste treatment

The regression model presented in Table 4.21 was assessed for goodness of fit using analysis of variance. The F-significance value of 0.000 was found to be less than 0.05 ($p < 0.05$). The F-ratio was substantial, and it significantly exceeded the critical value of F=3.86, with F (1, 285) = 10.230. This indicates the model's significance and its ability to explain the variation in the data.

Table 4. 22: Model Summary for Solid Waste Treatment and Sustainability of Livelihood projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.619[a]	0.383	0.111	0.1441

a. Predictors (Constant), solid waste treatment

The findings of the study, as presented in Table 4.22, illustrate the proportion of the total variability in the model that can be attributed to the predictor variable, which is solid waste treatment. The R-squared (R2) value of 0.383 indicates that solid waste treatment explains approximately 38.3% of the variance in the dependent variable, the sustainability of livelihood projects. This means that other factors not considered in this model account for the remaining 61.7% of the variance. In conclusion, the study found that solid waste treatment has a significant positive impact on the sustainability of livelihood projects.

Table 4. 23: Coefficients of Solid Waste Treatment and Sustainability of Livelihood Projects

	Un-standardized Coefficients		Standardized Coefficients	T	Sig.
Variables	**B**	**Std. Error**	**Beta**		
(Constant)	0.112	0.085		0.174	0.000
	0.003	0.015	0.383	13.063	0.001

a. Dependent Variable: sustainability of livelihood projects

According to Table 4.23's findings, a unit increase in solid waste treatment led to a 38.3% rise in the fluctuations in the sustainability of livelihood projects, with a standardized beta value of 0.383. With solid waste treatment, the model as a whole demonstrated accuracy in predicting the sustainability of livelihood programs at $p=0.001<0.05$. Here is how the regression model might look; Sustainability of livelihood projects = 0.112+0.383 (Solid waste treatment) + e; $t = 13.063$; $p<0.05$.

As a result, the results showed that the alternative hypothesis was accepted and the study's null hypothesis was rejected. This leads to the conclusion that solid waste treatment affects efforts aimed at sustaining livelihoods. The findings of the study show that solid waste treatment (R^2=0.383) explains 38.3% of the variations on sustainability of livelihood projects in Nairobi County."

On the last variable, a key informant had the following opinion; *Most residents are aware of solid waste treatment mechanisms as well as facilities. They are just a bit ignorant of the process. We have, of course, collaboration and a lot of support from the county government. We also advocate for modern technologies in handling of solid waste. I think we need proper sensitization of the whole process and to ensure all processes are followed by residents and policy makers.*

4.9 Summary of Results of the Test of Hypotheses

Summary of the results from hypotheses of the study are presented on the Table 4.24.

Table 4. 24: Results from the hypotheses of the study

Objective	**Hypothesis**	**Regression Model**	**Results**	**Decision as a result of empirical evidence**
1. To ascertain the degree toward which source reduction influences the viability of income - generating activities in Nairobi County's peri-urban areas.	1. H_0: Source reduction has no appreciable impact on the viability of livelihood initiatives in Nairobi County's peri-urban areas.	$y= \alpha+\beta_1X_1+e$	{R=0.215, R^2=0.46, β=0.215, t=0.753, F $(_{1,284})$ = 33.95, p<0.05}	Reject H_0 **Accept H_1**
2. To examine how recycling organic waste influence	2. H_0: Recycling organic waste has no appreciable impact	$y= \alpha+\beta_2X_2+e$	{R=0.130, R^2=0.170, β=0.130,	Reject H_0 **Accept H_1**

sustainability of livelihood projects in peri-urban settlements in Nairobi County	on the viability of livelihood initiatives in Nairobi County's peri-urban settlement areas in Nairobi County.		t=17.336, F ($_{1,284}$) = 8.530, p<0.05}	
3. To determine how volume of waste affects the viability of livelihood programs in peri-urban areas of Nairobi County.	3. H_0: Volume of waste has no appreciable impact on the viability of livelihood initiatives in Nairobi County's peri-urban areas.	$y= \alpha+\beta_3X_3+e$	{R=0.491, R^2=0.241, β=0.491, t=1.149, F ($_{1,284}$) = 13.800, p<0.05}	Reject H_0 **Accept H_1**
4. To determine how solid waste treatment influence sustainability of livelihood projects in peri-urban settlements in Nairobi County	4. H_0: Solid waste treatment has no appreciable impact on the viability of livelihood initiatives in Nairobi County's peri-urban areas.	$y= \alpha+\beta_4X_4+e$	{R=0.619, R^2=0.383, β=0.619, t=0.112, F ($_{1,284}$) = 10.230, p<0.05}	Reject H_0 **Accept H_1**

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides an overview of the study's results, conclusions, recommendations, and suggests avenues for future research.

5.2 Summary of the Findings

The summary focused on the primary conclusions derived from the determinants and provided a detailed breakdown of these conclusions in alignment with the determinants discussed in Chapter Four.

5.2.1 Source Reduction and Sustainability of Livelihood projects

The research primary goal was to ascertain how source reduction affects the viability of livelihood programs in Nairobi County's peri-urban areas. The variable's average and standard deviation were 1.04 and 0.475, respectively. The study's null hypothesis, according to the research, was that source reduction had no appreciable impact on the viability of livelihood programs. R=0.215, R2=0.46, =0.215, t=0.753, F (1,284) = 33.95, $p<0.05$ were the results of the study. According to the results, 46% of the variances in the sustainability of livelihood programs in Nairobi County may be attributed to source reduction. The null hypothesis was thus disproved, and it was determined that source reduction significantly affects the endurance of livelihood projects.

5.2.2 Recycling Organic Waste and Sustainability of Livelihood Projects

The study's second goal was to determine how reusing organic waste affects the viability of livelihood initiatives in peri-urban areas of Nairobi County. The variable's mean and standard deviation were, respectively, 1.04 and 0.447. The study investigated the null hypothesis that recycling organic waste had no appreciable impact on the viability of income - generating activities in Nairobi County's peri-urban areas. The research uncovered the following: R=0.130, R^2=0.170, β=0.130, t=17.336, F ($_{1,284}$) = 8.530, $p<0.05$. This established that recycling organic waste explained 17% of the variation of sustainability of livelihood projects in Nairobi County. These results led to the rejection of the null hypothesis and the conclusion that recycling of organic waste

significantly affects the sustainability of livelihood programs in peri-urban settlements in Nairobi County.

5.2.3 Volume of Waste and Sustainability of Livelihood Projects

The third aim of this research was to determine the extent to which waste volume affects the sustainability of income-generating activities in peri-urban areas of Nairobi County. The variable had a mean of 1.01 and a standard deviation of 0.150. The research aimed to test the null hypothesis, which posited that waste volume had no significant effect on the sustainability of income-generating activities in peri-urban settlements of Nairobi County. The research uncovered the following.: $R=0.491$, $R^2=0.241$, $\beta=0.491$, $t=1.149$, $F_{(1,284)} = 13.800$, $p<0.05$. It was established that the volume of waste explained 24.1% of the variation of sustainability of livelihood projects in Nairobi County. Based on these results, the null hypothesis was rejected, and it was concluded that the volume of waste significantly affects the sustainability of livelihood projects in peri-urban settlements within Nairobi County.

5.2.4 Solid Waste Treatment and Sustainability of Livelihood Projects

The study's final goal is to determine how much solid waste treatment affects the viability of livelihood in peri-urban areas of Nairobi County. The variable had a mean of 1.01 and a standard deviation of 0.203. The research aimed to test the null hypothesis, which posited that solid waste treatment had no discernible impact on the viability of income-generating projects in peri-urban settlements in Nairobi County. The study revealed the following: $R=0.619$, $R^2=0.383$, $\beta=0.619$, $t=0.112$, $F_{(1,284)} = 10.230$, $p<0.05$. The study revealed that solid waste treatment accounted for 38.3% of the variability in the sustainability of livelihood projects in Nairobi County. In light of these findings, the null hypothesis was rejected, indicating that solid waste treatment significantly and statistically influences the sustainability of livelihood projects in peri-urban settlements within Nairobi County.

5.3 Conclusions of the Study

This study had a specific focus on investigating the influence of solid waste management practices on the sustainability of livelihood projects in peri-urban areas within Nairobi County.

The primary objective was to assess the degree to which source reduction affects the viability of income-generating activities in these peri-urban communities. According to the research findings, a moderate correlation was identified between source reduction practices and the sustainability of livelihood projects in peri-urban settlements within Nairobi County. Factors such as adopting reusable waste methods, providing waste management training, adhering to environmental policies, and minimizing waste generation were found to contribute significantly to the sustainability of livelihood projects in these areas.

The secondary goal sought to examine whether recycling of organic waste influenced sustainability of livelihood projects in peri-urban settlements in Nairobi County. The study findings showed a weak positive correlation between recycling of organic waste and sustainability of livelihood projects in peri-urban settlements in Nairobi County. Presence of plans and procedures of recycling waste, quantification of organic waste, awareness of organic waste to be recycled and availability of equipment to recycle waste by local government contributed to the sustainability of livelihood projects in peri-urban settlements.

The third objective aimed to evaluate the influence of waste volume on the sustainability of livelihood projects in peri-urban areas within Nairobi County. The study's results revealed the existence of a mild positive correlation between waste volume and the sustainability of livelihood projects in these peri-urban settlements in Nairobi County. Adoption of safe energy practices, awareness of greenhouse gases produced by solid waste, use of smart technologies in relation to waste and understanding the significance amount of energy produced by solid waste contributed sustainability of livelihood projects in peri-urban settlements.

The last objective tried to gauge how much solid waste treatment influences sustainability of livelihood projects in peri-urban settlements Nairobi County. The research findings indicate a moderate positive correlation between solid waste treatment and the sustainability of livelihood projects in peri-urban settlements in Nairobi County. Factors such as awareness of solid waste treatment mechanisms, collaboration and partnership in solid waste treatment and application of modern technologies in handling of solid waste contributed to sustainability of livelihood projects in peri-urban settlements.

5.4 Recommendations of the Study

This study made the following utilizing suggestions;

1. That was done determined that source reduction is a crucial consideration in sustainability of livelihood projects. The study therefore recommends that it is necessary to keep a investigate the cause of the solid waste in the sense that it is reduced as much as possible. That makes sustainability of livelihood projects in peri-urban settlements is manageable.
2. Recycling of organic waste similarly contributed to sustainability of livelihood projects in peri-urban settlements. Proper awareness and education on organic waste and proper organic waste disposal is an essential need to the community.
3. The research established that volume of waste had significant influence on sustainability of livelihood projects in peri-urban settlements. Few residents had the knew the idea of adoption of safe waste practices, use of smart technologies and effects of greenhouse effects to the environment, the government through local authorities should conduct proper sensitization on solid waste best practices and effects to people as well as the environment.
4. The study also established that solid waste treatment mechanisms influence sustainability of livelihood projects. The study recommends proper solid waste treatment mechanisms that applies modern technology as well as the involved parties exercising collaboration and partnerships in all processes involved.

5.5 Suggestions for Further Research

The research recommended studies listed here to be conducted in the future;

- Integration of project management into sustainability of livelihood projects
- Policies affecting sustainability of livelihood projects.

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APPENDICES

Appendix I: Letter of Introduction

Zachariah Obati Munayi,
P.O. Box 30197-00100
Nairobi.
24th May, 2022.

Dear Respondent,

RE: LETTER OF INTRODUCTION FOR COLLECTION OF DATA

I am a student pursuing Master of Arts degree in Project Planning and Management at the University of Nairobi. As part of the requirement for the award of the degree, I am undertaking a research study titled ***'Influence of Solid Waste Management Practices on Sustainability of Livelihood Projects in Peri-Urban Settlements in Nairobi County, Kenya'***. I therefore request your assistance in completing the questionnaires attached.

Kindly answer all the questions truthfully.

The research results will be used for academic purposes only and will be treated with confidentiality. Only a summary of the results will be made public. Your cooperation is highly appreciated.

Yours sincerely,

Zachariah Obati Munayi
L50/29100/2019
Tel: +254 725 981 396
Email: dr.zackobati@gmail.com

Appendix II: NACOSTI Permit

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NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 679180

Date of Issue: 21/February/2023

RESEARCH LICENSE

This is to Certify that Mr.. Zachariah Obati Munayi of University of Nairobi, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: INFLUENCE OF SOLID WASTE MANAGEMENT PRACTICES ON SUSTAINABILITY OF LIVELIHOOD PROJECTS IN PERI-URBAN SETTLEMENTS: A CASE OF EMBAKASI WEST SUB-COUNTY, NAIROBI COUNTY, KENYA for the period ending : 21/February/2024.

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Appendix III: Questionnaires for Residents

The purpose of this questionnaire is to collect data regarding the impact of solid waste management practices on the sustainability of livelihood projects in peri-urban settlements within Embakasi West, Nairobi County. Please note that all gathered data will be used exclusively for academic research. However, we anticipate that the insights gained from this study will play a significant role in enhancing the sustainability of projects dedicated to improving the livelihoods of the local community. The management of the obtained data shall be professional and private. Please complete each section as needed and in the proper manner.

Section A: Demographic Information (Tick appropriately where applicable)

1. Please state your gender

   Male [ ] Female [ ]
2. Please state your age
   i. Below 25 years [ ]
   ii. 25-35 years [ ]
   iii. 36-45 years [ ]
   iv. 46-55 years [ ]
   v. Above 55 years [ ]
3. Please state your highest education level
   i. PhD degree [ ]
   ii. Masters' degree [ ]
   iii. Bachelor's Degree [ ]
   iv. Certificate degree [ ]
   v. Others (please specify)…….
4. Are you a resident of Embakasi West?

   Yes [ ] No [ ]
5. How long have you been living in Embakasi West?..... years

6. Do you own the house or have you rented?

   Own [ ] Rented [ ]

7. How many are you in the house? …….Adults …….Children

Section B: Sustainability of Livelihood Projects

8. Do you practice waste segregation at home?
   Yes [ ] No [ ]
9. Do you agree that local authority provides appropriate waste disposal methods?
   Yes [ ] No [ ]
10. Kindly rate the below statements /factors on sustainability of livelihood projects
    5= Strongly Agree, 4= Agree, 3= Neutral, 2=Disagree, 1=Strongly Disagree

Statement	5	4	3	2	1
Sustainability of livelihood projects brings about environmental stability					
There is a high level of energy recovered from solid waste in this community					
Most of the residents are aware of livelihood projects in this community					
Improper waste disposal leads to livelihood deterioration					
Local government is active on collection and disposal of solid waste					

11. How many projects related to solid waste management do you know in your community?
    ……..

Section C: Source Reduction

12. Kindly rate the below statements /factors on source reduction
    5= Strongly Agree, 4= Agree, 3= Neutral, 2=Disagree, 1=Strongly Disagree

Statement	5	4	3	2	1
We have reusable methods of solid waste disposal					
We have training on how to dispose waste as well as reusing waste where necessary					
Environmental policies are strictly followed by waste handlers					
Most of the residents practice waste minimization					

Section D: Recycling Organic Waste

13. Kindly rate the below statements /factors on Recycling Organic waste

5= Strongly Agree, 4= Agree, 3= Neutral, 2=Disagree, 1=Strongly Disagree

Statement	5	4	3	2	1
There are plans and procedures on organic waste that I am aware of					
I can confidently quantify the percentage of organic waste disposed					
I am aware of organic waste recycled per day					
I know several equipment used by the local government to recycle waste					

Section E: Volume of Waste

14. Kindly rate the below statements /factors on volume of waste

5= Strongly Agree, 4= Agree, 3= Neutral, 2=Disagree, 1=Strongly Disagree

Statement	5	4	3	2	1

I have adopted a safe energy practice in relation to solid waste					
I am aware of greenhouse gas emission and how to mitigate the effects					
I am aware of climate smart technologies					
I understand there is significant amount of energy produced by solid waste					

Section F: Solid Waste Treatment

15. Kindly rate the below statements /factors on solid waste treatment

    5= Strongly Agree, 4= Agree, 3= Neutral, 2=Disagree, 1=Strongly Disagree

Statement	5	4	3	2	1
I am aware if solid waste treatment mechanisms					
There is collaboration and partnership in solid waste treatment					
There are modern technologies applied in handling of solid waste					

Appendix IV: Interview Guides for Key Informants

The main purpose of this interview is to collect data related to the influence of solid waste management practices on the sustainability of livelihood projects in peri-urban areas within Embakasi West, Nairobi County. The data collected will be used exclusively for academic research, and it is expected that the findings will offer valuable insights for improving the sustainability of projects aimed at enhancing the well-being of the local community. Rest assured, all collected data will be handled professionally and kept confidential

Section A: Specific Information

1. In what division do you work?
2. How long have you been employed in this division? Do you have specific technology you use in waste reduction and do the technologies adhere to environmental policies?
3. Are there any available plans and procedures of organic waste and what would be the estimate of waste recycled per day?
4. Do you save on GHG and what would be the estimate of amount of emission saved?
5. Have the residents adopted climate smart technologies?
6. What is the amount of energy produced from solid waste in the community?
7. Do you have a treatment plant for solid waste and are residents aware of the same?
8. What is the estimate amount of waste treated in a day?
9. What type of technology do you use for treating solid waste?

Report Signed by:
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