AWARENESS LEVELS AND STRATEGIES OF E-WASTE MANAGEMENT IN DANDORA NAIROBI CITY COUNTY, KENYA

BY

ANN KINYA MBUTURA

REG. NO: N50/CTY/PT/26801/2013

A Research Thesis Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Environmental Studies and Community Development in the School of Agriculture and Environmental Sciences of Kenyatta University

MAY 2025

DECLARATION

Declaration by Candidate

This Research Thesis is my original work and has not been presented for award of a degree in any other University.

Name: Ann Kinya Mbutura

Reg. No: N50/CTY/PT/26801/2013

Signed……. Date…….

Declaration by Supervisors

This Research Thesis has been submitted for examination with my approval as the University supervisor

1. **Dr. Joseph K Muriithi:**

Signed……. Date…….

Department of Environmental Studies and Community Development

2. **Dr. Samuel Ochola:**

Signature …… Date: ……

Department of Environmental Studies and Community Development

DEDICATION

This project is dedicated to my parents, who, despite the difficult economic times throughout my primary, secondary, and university education, worked tirelessly to ensure that all eight of their children received a meaningful education. Their unwavering commitment enabled me to complete all four stages of my academic journey without interruption.

I also extend heartfelt gratitude to my husband for his constant support, encouragement, and understanding throughout the many years of my Master's studies.

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to my academic supervisors, Dr. Joseph Muriithi and Dr. Samuel Ochola, for their invaluable guidance and support throughout this study. Despite their demanding responsibilities as university lecturers, they generously dedicated their time to provide insightful advice, constructive feedback, and continuous encouragement especially as I upgraded the scope of my study at various stages. This research would not have been possible without their mentorship and commitment.

My appreciation also goes to the county officers from Dandora Sub-County for their warm hospitality and vital support during the fieldwork. I am equally grateful to the research assistants and respondents who, despite their busy schedules, took time to engage with the questionnaires and contribute meaningfully to the study.

To all others who, in one way or another, supported the successful completion of this research please accept my heartfelt thanks and deep appreciation.

ABSTRACT

Globally, the rapidly increasing use of Information and Communications Technologies (ICTs) has also increased the demand for electronic equipment such as computers and mobile phones. This increase in consumption has resulted in huge amounts of e-waste being generated from scrapped electronics. E-waste contains chemical substances that have adverse effects on human health and the environment. Consequently, handling of e-waste needs to be organized in ways that minimize these adverse effects. The study was carried out in Nairobi specifically Dandora dumpsite which has the biggest population with majority using electronics for their domestic purposes. The study identified the sources, types and effects of e-waste, assessed awareness levels and strategies of e-waste management, examined the impacts of awareness campaigns to residents on disposal of e-waste, evaluated the effectiveness of rethink, refuse, reduce, reuse, repair, regift, recycle (7R strategy) in disposal of e-waste and also investigated the use of Polluter Pay Principle on e-waste management actions in Dandora area Nairobi County. A descriptive research design was used to explain relationships between dependent and independent variables. The target population was 350,000 living in formal settlements. Simple random sampling was used to obtain 328 respondents from the study area, Clusters were made to capture households with the highest variation in socio-economic status while key informants were purposely chosen for the study. Quantitative and qualitative data was involved in establishing the current management strategies of e-waste. Quantitative methods used questionnaires to obtain numerical data while qualitative methods involved the use of key informants and observation to understand key issues, explore possibilities and understand processes in e-waste management. Quantitative data was analyzed using data analysis methods. Descriptive statistical techniques like mean, mode and median were used to summarize the data while inferential statistical. Qualitative data was coded then arranged in themes, which were presented across datasets to determine their similarity. Results on sources of E-waste indicated ICT and telecommunications equipment emerged as the leading source of e-waste in the study area closely followed by toys, leisure/sports items, and large household appliances. Results on the level of awareness indicated that majority 85% had knowledge of electronic waste, while 15% indicated that they had no idea of electronic waste while majority 85.8% understood that some of the electronic waste has hazardous chemical substances in them while 14.3% said they were not aware. Results on electronic separation show that 63% (N= 172) of the respondents indicated they were aware of separation of electronic waste, while 37% (N=102) said they were not aware while 56 % said they were aware of safe methods of handling electronic waste. There was a strong consensus of the respondents on 7Rs effectiveness with 83. 6% agreeing that the application of recycling can offer a quick and reliable approach to e-waste management. Majority 72.3 % of respondents indicated they were aware of the polluter pay principle. This can be interpreted to mean that the respondents were aware that absolute liability for harm to the environment does not only apply to them but extends to other polluters and not only to compensate the victims of pollution but also the cost of restoring the environmental degradation. The study recommends that the Nairobi County government should install dust bins near residential areas and step-up e-waste awareness campaigns and provide training to the communities regarding human health and the environmental impacts of solid waste this will encourage the effective use of the 7Rs strategy in e-waste management concept. The strategy will focus on minimizing environmental pollution and sustainability work and help the county and the country to shift towards circular economy of zero waste and convert some of the waste into energy production.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

3Rs: Recycle Reuse & Recover

7Rs: Recycle, Reuse, Recover, Repair, Refuse, Regift & Rethink

DVD: Digital Versatile Disc

EPA: Environment Protection Agency

E-WASTE: Electrical and Electronic waste

HSBC: Hong Kong and Shanghai Banking Corporation, Ltd

IISD: International Center for Sustainable Development

NEMA: National Environment Management authority

PPP: Polluter Pays Principle

SPSS: Statistical package for social sciences

UNEP: United Nations Environmental Programme

WEEE: Waste Electrical and Electronic Equipment Centre

CBDR: Principle of common but differentiated responsibilities

DEFINITION OF TERMS

Electrical equipment: these are machines which are run by use of electric power. They consist of enclosure, which is a kind of e-component, and also power switch. For instance, micro-controller, major appliance, small appliances and power tool. It can also be said to be the only one to the part of components for distribution system of electrical distribution like distribution boards, electric switchboards, disconnects, circuit breakers, electricity meter as well as transformers (Criscos Provider, 2020).

Electronic Equipment: involves tools that are meant for controlling transmission of any electrons such as audio, amplifier, and also sound system as well as CD players, cassette player, mixer, detector, modem, equalizer, Cathode Ray Oscilloscope, telephone among others (Criscos Provider, 2020).

E-waste: This refers to term encompassing various forms of electrical and electronic equipment that are old, end-of-life electronic appliances that have ceased to be of any value to their owners (IGAD, 2023).

Recycling: Is the processing of utilized materials (waste) into new items to avoid misuse of conceivably helpful materials, lessen the utilization of new crude materials, decrease vitality use, and diminish air contamination and water contamination by lessening the requirement for "traditional" waste transfer or creating another item from a recyclable material (IGAD, 2023).

Awareness: Means knowledge or perception of a situation in dumpsite in regards to electronic waste (EMPA, 2019)

Strategies: Means a plan of action or policy designed to control the increase of electronic waste in dump sites (IGAD, 2023).

.

CHAPTER ONE: INTRODUCTION

1.1: Background information

The international blast impact in mechanical improvement has driven the overall devices industry to twist up the greatest collecting industry on the planet. E-waste may be delineated as waste electrical and electronic apparatus, in whole or to some degree from their gathering and repair process, which are proposed for disposal (Alves, 2023). According to Button (2016), an e-waste is defined as any electronic throw away that is no longer of any use or is now obsolete and whether it works or not. They include televisions, Digital Versatile Disc, (DVD) players, old copier machines, mobile phones, old VCR's, tablet, stereos, fax machines, computers among others It is also referred to as Waste Electrical and Electronic Equipment (WEEE), electronic waste or e-scrap in different regions and found under different circumstances in the world (Vikblad & Lekare, 2019).

E-waste production is doubling faster, the workable expectation of life of electronics continues contracting from their gathering and repair process, which are proposed for disposal (Alves, 2023). It is evaluation of that electronic squander that is growing three to five percent annually for cutting edge nations. Around 40 million tons of e-waste is made every year from their gathering and repair process, which are proposed for disposal (Alves, 2023) According to (IGAD, 2023), the heap of utilized electrical and electronic gadgets, discarded electronic devices, such as phones, computers, and TVs to develop from 48.9 million metric tons worldwide in 2012 to 65.4 million metric tons in 2017; what might as well be called 200 Empire State Buildings or 11 Great Pyramids of Giza.

Discarded electronic devices, such as phones, computers, and TVs represent 8% of civil strong waste around the world Kenya Institute for Public Policy Research and Analysis (Kippra, 2023) from the study, it is explained that in 2015, a portion of the 41.8 million metric tonnes of electronic waste were being produced and released globally. From the study by (International labor Organization (ILO), 2024)they argue the current global electronic production stands at of 50 million tonnes and this could double in 30 years to come. According to IGAD, (2023) this is awesome news for the district, yet includes some major disadvantages. Electronic-squander electronic waste (or e-waste) describes discarded electrical or electronic devices. It is also commonly known as waste

electrical and electronic equipment (WEEE) or end-of-life (EOL) electronics. in region of Africa is rising twenty percent annually because of growing offers of e-merchandise, legitimate as well as unlawful importation of especially second-hand and also excess gear (Kippra, 2023) for instance in 2017 Africa was reported to be 2.2 million tonnes (Baldé *et al.,* 2017). The issue of exporting e-wastes by the industrialized regions to African countries like Kenya, presents the main culprit of all. According to the need for communication and research in developing nations, devices as well as electronics have become more and more common among students and within offices. Electronic waste is currently Kenya's quickest developing waste part. From the study by Kenya News Agency, (2023) it is explained that Kenya generates more than 44,000 tonnes of electronic waste every year. The most recent update is that Kenya's annual electronic waste generation grew from 3,000 metric tonnes in 2012 to 51,000 metric tonnes in 2021 (Kenya News Agency, 2023). Managing waste has been a huge challenge in Kenya. Most of the e-waste ends up in landfills while others are recycled and properly disposed of by individuals or companies.

The National E-Waste Conference and Exhibition held in Nairobi in 2014 heard that the discoveries of an UNEP investigation of 300 school youngsters close to Dandora, found that around half had respiratory issues, and 30% had blood irregularities flagging overwhelming metal harming among other problems associated with contamination from any dumpsite. This water is made use by many people nearing dumpsite and it may lead to mortality due to health problems such as cancer, stomach problems among others (Laniyan & Adewumi, 2019). Dandora, where the investigation of the 300 school youngsters occurred, is home to an unhindered dumping ground 30 sections of land only 8 kilometers from the city of Nairobi. It is the goal for about 2000 tons of recently arrived squander every day, which incorporates overwhelming metals, for example, lead and mercury regularly found in electronic waste that advances into the dirt and pollutes the air (Ankit, 2021).The good thing acknowledged is that the e-waste not just contains the dangerous materials like Mercury, Cadmium, Chromium and others, however it likewise contains some significant substances like Gold, Silver, Palladium and Platinum that might be considered as a financial advantage for the developing countries.

Despite international legislation aimed at controlling the transit of e-waste from one country to another, transboundary movement to LMICs persists, often illegally. E-

waste is classified as hazardous trash because it includes dangerous elements and can produce poisonous compounds if not properly recycled. Many of these hazardous elements are known or suspected to be harmful to human health, and several, such as dioxins, lead, and mercury, are among the top ten chemicals of public concern. Poor e-waste recycling jeopardizes public health and safety (World health Organization (WHO), 2024).

Kenya collects approximately 51,300 metric tons of e-waste each year, with just 5% recycled properly and the remainder disposed of unsafely, harming the environment and human lives. There is an urgent need to educate the public on effective e-waste management in order to reduce the environmental and health risks associated with incorrect disposal. Hazardous chemicals discovered in these wastes have also been related to serious neurodevelopmental and behavioral consequences, particularly in children e-waste contains lead and mercury metals, which build in the soil and harm the natural minerals there.

When garbage is burned, it produces toxic smoke that is harmful to humans when inhaled. The runoff water drains into water sources, harming aquatic life. "E-waste, when correctly managed, can be a resource. The gold medals for the 2020 Tokyo Olympics, for example, were created of recovered technological garbage." To raise awareness about effective e-waste management, the WEEE Centre created a programme aimed at youth who are then involved in sensitizing the community on correct trash disposal. "The kids gather e-waste, such as unused phones, computers, laptops, and electronics, and deliver it to our recycling center. This allows them to earn money because they are compensated based on the amount of e-waste collected (Kenya News Agency, 2025).

1.2: Statement of problem

The issue of e-waste generation compared to the effort to manage it is of greatest concern to many parts of the world. However, due to the increased need to advance information technology, e-waste generation has to go on, for example Kenya is considered to be an IT revolution and so continued e waste production. Kenya collects approximately 51,300 metric tons of e-waste each year, with just 5% recycled properly and the remainder disposed of unsafely, harming the environment and human lives. According to the Waste Electrical and Electronic Equipment (WEEE) Centre, a large

amount of e-waste is in the hands of those who do not know how to dispose of it properly. According to Masori (2025), many individuals and organizations are unaware of the possible environmental and health risks associated with incorrect disposal of electronic devices'-waste contains harmful compounds such as lead, mercury, and cadmium, which cause chronic brain and respiratory system damage as well as severe and irreversible consequences on human health. Hazardous chemicals discovered in these wastes have also been related to substantial neurodevelopmental and behavioral impacts. "E-waste contains Lead and Mercury metals that accumulate into the soil, endangering the natural minerals in it. When the waste is burnt, it emits toxic smoke, which is hazardous to human beings when inhaled. The runoff water Drains into water sources, threatening aquatic life," he explained. Masori observed that rapid technological innovation, driven by the high consumption rates of electric and electronic equipment and their short life cycle, has resulted in a considerable volume of e-waste. She went on to say that most of the waste ends up at dump sites, where it is burned, creating carbon emissions that are hazardous to the environment and health.

At present, waste electrical and electronic equipment (WEEE) or electronic waste (e-waste) age, trans-limit development and transfer are getting to be issues of worry to the strong waste administration experts, ecological specialists, international agencies and governments around the world. However, the problem arises when there is low awareness level and its management strategies thus posing more threat especially to human health (Sultana *et al.,* 2021). The situation in Kenya is declining due to trans-limit development of e-waste from created nations and quickly rising offers of electronic merchandise have prompted cosmic increment of risky electronic squanders in Kenya. There has been increased dumping of such e-waste in one of the biggest dumpsites in Kenya and this dumpsite is located near informal settlement of Dandora areas (Kwame, 2023). These residents interact directly with the e-waste without being aware of the health effects. E-waste releases a deadly cocktail of poisonous waste products including lead, cadmium and mercury which can lead to serious illness and death Intergovernmental Authority on Development (IGAD, 2023). Considering this hardware have a short life expectancy, basically because of out-of-date quality and maturing, their transfer and consequences for well-being and nature are an expanding concern.

Moreover, due to poor implementation of waste management in the county and lack of sufficient approaches to create awareness and proper strategies, the management of E-waste has been a problem. Though not exhaustive, the study dealt with the level of awareness and e-waste management strategies. A study done by Abdul-Aziz, (2022), found out that increasing awareness level on E-waste, can greatly improve and help in coming up with more feasible strategies towards e-waste management. Therefore, this research seeks to determine the level of awareness impacts and strategies of the e-waste management in Dandora Nairobi County, Kenya.

1.3: Research Questions

1. What are the sources, types and effects of e-waste received in Dandora dump site
2. How will the impact of awareness campaigns on disposal of e-waste affect residents of Dandora?
3. In what way will the 7Rs strategy use affect disposal of e-waste among residents?
4. How does the use of Polluter Pays Principle affect e-waste management actions in Dandora?

1.4: Research Objectives

The main objective of this study was to assess awareness levels and strategies of e-waste management in Dandora, Nairobi County. More specifically the study sought to:

1. To find the sources, types and effects of e-waste received in Dandora dump site
2. To examine the impacts of awareness campaigns to residents on disposal of e-waste
3. To evaluate the effectiveness of rethink, refuse, reduce, reuse, repair, regift, recycle (7R strategy) use in disposal of electronic waste
4. To investigate the use of polluter pays principle (PPP) on e-waste management actions

1.5: Justification of study

The purpose of the study was to create awareness of electronic-waste issues in the country, Kenya. This is because e-wastes are new, and their quantities are greatly rising with the rise of people turning digital. Use of 7R strategy: rethink, refuse, reduce, reuse, repair, Regift, recycle of electrical and electronic waste will reduce pollution of water

ways and air which results to a cleaner environment while significantly decreasing the demand for mining heavy metals which reduce greenhouse gas emissions from manufacturing virgin materials. The study will make a start for the process of making decisions in coming up with various strategies that will be meant for improvement of managing e-waste. Information on various methods of handling e-waste in the informal settlements will assist in design and formulation of strategies for disaster risk-reduction and enhance urban planning tools in order to cater for the emerging hazardous wastes from electrical and electronic wastes. In addition, the findings will provide the background information to be used as basis for further research in the study area.

1.6: Significance of the study

Electronic garbage contains toxic compounds, which, if not properly managed at the Dandora dump site, can endanger human health and ecosystems. Companies can reduce, reuse, and recycle electronic equipment and components to mitigate the negative effects of e-waste. Sustainable e-waste management is critical for reducing negative impacts on the environment and human health. It decreases the environmental impact of incorrect disposal while also encouraging responsible management and recycling of electronic devices and components. It is crucial for reducing emissions and building a brand reputation through corporate social responsibility (CSR), and one of the most effective ways to combat e-waste is to reduce its generation. Encourage people to adopt a "buy less, use longer" approach and promote durable and repairable electronic devices.

Reusing garbage allows us to extend the life of electronic gadgets, which is a sustainable strategy. Companies can set up initiatives to refurbish and repurpose gadgets, making them available to individuals and organizations in need. Donating or selling used devices, while guaranteeing adequate operation and data erasure, helps to reduce waste and increases access to technology for marginalized groups. Furthermore, recycling is an important part of sustainable e-waste management. Establishing effective recycling systems aids in the recovery of valuable materials from abandoned devices while reducing the environmental impact of raw material extraction. Partnering with licensed e-waste recyclers guarantees that devices are processed safely and responsibly, while adhering to strict environmental and data security guidelines.

1.7: Theoretical Framework

The Theory of Waste Management represents a more in-depth account of the domain and contains conceptual analyses of waste, the activity upon waste, and a holistic view of the goals of waste management. Waste Management Theory is founded on the expectation that waste management is to prevent waste causing harm to human health and the environment. The proper definition of waste is crucial to constructing a sustainable agenda of waste management. It is largely the case that current legislation attends to existing waste. Definitions emerging from this condition may, however, conflict with the goals of waste prevention, because something that already exists cannot be prevented from arising. When Material is assigned the label of 'waste', it will be treated as such; consequently, despite its explicit wish of waste prevention, implicitly, legislation essentially amasses waste. The inherent philosophical implication of such definitions is that they are not able to facilitate a sustainable waste management system. Therefore, new, dynamic definitions for waste and waste management must be sought, which can explain why waste is created and can offer an intrinsic solution for the problem. A radically new approach, based on an object-oriented modelling language, is presented to define the key concepts of waste management. The primary justification of regulating waste disposal was to regulate waste

Disposal. However, the key to sustainable waste management is waste minimization, in particular the reduction of waste at source. The Sixth Environment Action Programme defines waste minimization as the priority objective of Community waste policy. This dual objective of resources conservation and disposal policy results in the lack of clear definitions of key terms. Opinions diverge sharply on the proper definition of waste

The study was premised by Theory of Planned Behavior (TPB) as a framework in understanding, explaining and predicting behavior. TPB postulates three conceptually independent determinants of intention (Wang *et al.,* 2016). The first is the attitude toward the behavior, the second is subjective norm, and third perceived behavioral control (Wang *et al.,* 2016). TPB also claims that human behavior is best examined when activities participated in are voluntary and under the individual's control. According to a study by Wang *et al* (2016) on 'determinants of residents' e-waste recycling behavior intentions: evidence from China' which considered TPB, it was found that environmental awareness, attitude towards recycling, perceptions of

informal recycling, income, and costs of recycling passed the test hypothesis and they significantly affected e-waste recycling behavior intentions. This theory is therefore useful in this study as it can help predict the specific behavior in relation to user awareness in sound disposal and recycling of electronic waste and help in coming up with solutions that may enhance awareness and help the enforcers ensure sound management of e-waste. According to a study by Nguyen *et al.,* (2018) on "determinants of residents' e-waste recycling behavioral intention: A case study from Vietnam. The findings agree with TPB which revealed that environmental awareness and attitude toward recycling are the primary influencing factors in activating residents' e-waste recycling intention toward formal collections. That shows the fact that those who are participating in e-waste recycling do so mainly because they understand that such behavior contributes to saving natural resources and eliminates the environmental problem (Nguyen *et al.,* 2018).

The second theory relevant to this study is Pollution Haven Theory (PHT) which posits that, when huge, industrialized countries try to set up manufacturing plants, they search for the least expensive choice as far as assets and work offers the land and material access they require (Alabansa *et al.,* 2021). This means pollution intensive economic activities will relocate to jurisdictions with the most relaxed environmental regulation (Davis *et al.,* 2019). In the case of electronic waste, the pollution haven are the developing countries where incentives thrive to avoid taxes and regulation and permit the disposal of electronic waste. The developing countries have become the pollution haven for the advanced countries. Once the electronic products are manufactured, the companies do not care what happens to them later once they break down. They don't also educate their users on the correct e-waste disposal and the hazardous chemicals found in these substances, people haphazardly throw their old electronics away, causing significant environmental damage (Gibbons, 2021).

1.8: Conceptual Framework

The framework illustrates the interrelationship between dependent and independent variables and is shown in figure 1.1 below**. Objective 1** focuses on identifying the *sources, types, and effects of e-waste in Dandora.* This provides essential background by revealing the scale, origin, and impacts of e-waste, which in turn informs awareness strategies and disposal interventions. These contextual factors indirectly influence the dependent variable proper e-waste disposal.

Objective 2 examines the *impacts of awareness campaigns on e-waste disposal*. The dependent variable is disposal behavior, influenced by independent variables such as awareness initiatives, media, and training. Awareness enhances public understanding of safe disposal practices.

In Objective 3, the study evaluates the *effectiveness of the 7R strategy—rethink, refuse, reduce, reuse, repair, regift, and recycle—in the disposal of electronic waste*. In this case, the independent variable is the application of the 7R strategy, which influences the dependent variable of e-waste disposal outcomes by promoting sustainable behavioral change.

In Objective 4, the study investigates the *use of the Polluter Pays Principle (PPP) in e-waste management actions*. E-waste management actions represent the dependent variable, influenced by the independent variable of the polluter's responsibility. This principle ensures accountability by requiring those responsible for generating e-waste to bear the costs of its proper management, thus addressing negative externalities and protecting global commons.

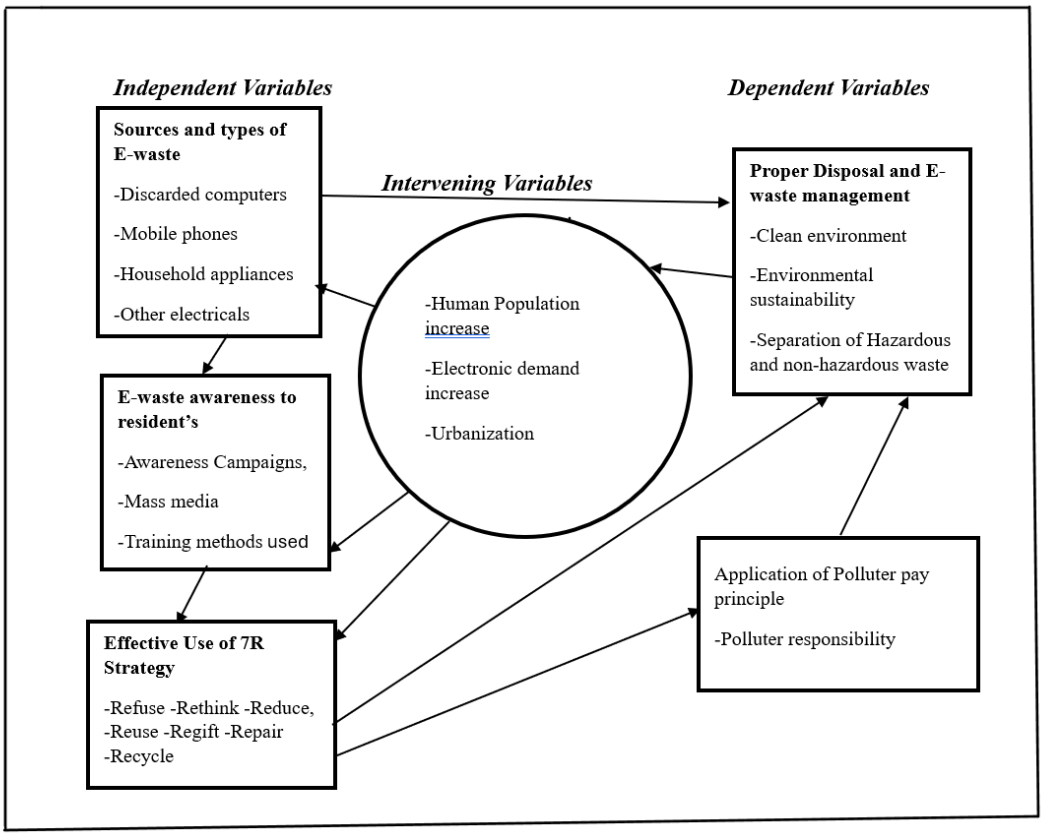

Figure 1.1: Conceptual Framework. Source: (Field work, 2024)

CHAPTER TWO: LITERATURE REVIEW

2.1: Background information

The concept of e-waste became visible back in the 1980s after degradation of environment that came about because of perilous waste imported to creating nations (IGAD, 2023). Discarded electronics, such as cell phones, computers, and televisions keep on prospering because of fast appropriation and utilization of Information and Communication Technologies which have increased discarded electronics, such as cell phones, computers, and televisions. According to Sustainability (2021), electronic waste is the quickest developing waste type that is streaming and is developing with about three to five percentage annually that is., around 3 times quicker compared to normal civil strong waste (Alabansa *et al.*, 2021). Globally, E -waste are production hits at 50 million tonnes every year and form the study. This is projected to increase by 50 percent in next 30 years (Vikblad & Lekare, 2019) this inclusive of Africa continent, for instance 2017 it was reported to produce about two million tonnes (Kenya News Agency, 2023) with Kenya generating more than 44,000 tonnes of e- waste annually.

2.2: Sources, types and effects of e-waste received at Dandora dump site

These discarded devices are considered e-waste and can become a threat to health and the environment if they are not disposed of and recycled appropriately. Common items in e-waste streams include computers, mobile phones, large household appliances, and medical equipment. Every year millions of electrical and electronic devices are discarded as products break or become obsolete and are thrown away.

Millions of tonnes of e-waste are recycled using unsound activities, as well as being stored in homes and warehouses, dumped, and illegally exported. When e-waste is recycled using unsound activities, it can release up to 1000 different chemical substances into the environment, including known neurotoxic ants such as lead (3). Pregnant women and children are particularly vulnerable due to their pathways of exposure and developmental status. The International Labour Organization (ILO) estimates that 16.5 million children were working in the industrial sector in 2020, of which waste processing is a subsector (World Health Organization (WHO), 2024)

The incredible growth and advancement of high technology in the commercial, automotive, military, scientific, general household, and consumer goods sectors has led to the development of high-performance electrical equipment. Consequently, a vast

array of electrical devices has made their way into the market. On the other side, especially in developing nations, this electrical and electronic equipment adds to the growing global waste stream. Along with a host of other elements that are believed to be either directly or indirectly harmful to people and the environment, plastics and polymer components found in these gadgets also add to electronic trash. A mixture of unwanted or used electronics that have outlived their useful life is known as electronic garbage. It accounts for over 5% of total city solid garbage annually and is one of the waste types that develop the fastest in developing nations. (Ajekwene *et al.*,2022).

The largest portion of e-waste worldwide comes from the Information and Communication Technology (ICT) sector, a notable source of e-waste whose hardware incorporates a variety of electrical components. This is due to the ICT division's growth, which has increased the use of electronic equipment tremendously and led to regular upgrades of these devices, which has caused a faster rate of out-of-date, high-quality ICT hardware. Users and consumers are being forced to discard their outdated devices due to these upgrades, which adds massive amounts of electronic garbage to the already heavy waste stream.

Due to their hazardous nature, this growth in e-waste poses health risks to our region and the biological environment. Additionally, it pollutes our landfills by releasing toxins that contaminate submerged materials. In this study, we examine the system for the lawful collection of e-waste, safe material recycling and reuse techniques, and suitable e-waste transfer ways. (Ajekwene *et al.*,2022).

2.2.1: E-waste and Environment

E-waste is poisonous and non-biodegradable, and it accumulates in the environment, including soil, air, water, and living things. For example, open-air burning and acid baths are used to recover valuable materials from electronic components, releasing harmful compounds into the environment. These practices can also expose workers to high levels of contaminants such as lead, mercury, beryllium, thallium, cadmium, and arsenic, as well as brominated flame retardants (BFRs) and polychlorinated biphenyls, which can have long-term health consequences such as cancer, miscarriage, neurological damage, and lower IQs.

It's also worth contemplating how electronic items affect climate change. Every technology ever developed has a carbon footprint and contributes to human-caused

global warming. Produce one tonne of laptops, and potentially ten tons of CO2 are emitted. When carbon dioxide emissions during a device's lifetime are evaluated, they occur primarily during production, before users purchase a product. Lower carbon methods and inputs at the production stage (such as using recycled raw materials) and product lifetime become significant factors of overall environmental effect. (Geneva Environmental Network, 2022).

2.3: Impacts of awareness campaigns to residents on E-waste disposal

Lack of awareness among various stakeholders about the evil impacts of the finish-of-life items (e-waste) is a noteworthy worry in our nation. According to GoK (2019), lack of awareness on e-waste may be contributed by other issues such as poor political will, lacking proper statistics regarding e-waste, general awareness, inadequate expertise as far as the management of e-waste is concerned in the country among others. Earlier studies done in Kenya by WEEE 2023 on e- waste generates an average of 3,000 tons of e-waste each year from printers, computers, monitors, mobile phones, batteries, fridges and other devices. A lack of e-waste awareness, along with poor separation and disposal systems, has led to e-waste being mixed with ordinary waste in dumps (WEEE, 2023). The obligation of mindfulness rests with everybody with learning on e-waste and its effect on the human condition and so the Government anyway should take the bigger rate with regards to educating general society about e-waste and its belongings (Abdulaziz, 2022). However, there are complains that Kenya has become a dumping ground for second hand electronic appliances which have a short lifespan (Kippra, 2023) and the Kenya bureau of standards to set the limit of the years the electronic appliances should be imported into the country to limit the quantity ending up into the dumpsites. According to a report published by KIPPRA (2023) ICT industry in Kenya has witnessed a rapid growth rate with the removal of tax levies on imported computers; mainstreaming of ICT into government operations and the promotion of e-learning in institutions of higher learning. This has created a huge demand for computers and related accessories. As a result, many companies started importing both new and used ICT products into the country. Kenya imports most of its ICT products from the USA, Britain, Malaysia and China. Even though the importation of old products is being discouraged, there is still a considerable chunk of old or refurbished products that are being imported. Some of the old products come as donations to some government institutions and from NGOs to schools. Used ICT products being imported into the

country include refurbished desktops, refurbished laptops, and refurbished mobile phones which are nearing the end of their useful (Kippra, 2023).

According to the National Environment Management Authority (NEMA) (2019) it ought to discover approaches to instruct people in general on the risks of e-squander accordingly. For instance, in any case, NEMA recognized that they have an obligation to make mindfulness like taking an activity of sharpening kids in schools before sharpening every other person (NEMA, 2019) since sharpening of the general population can take numerous structures. This can be done successfully with mass media (University of Minnesota, 2016). The thought of uniqueness is lost in the word 'mass' and different types of media, for example, radio, TV and daily paper report occasions planned for such a huge number of audience members, watchers, and pursuers (nanath, 2021). The advances in telecom systems have reformed the capacity of broad communications to serve more extensive inclusion at a quicker pace around the world (Nanath, 2021). Moreover, this has given an empowering situation to media in the new time to accomplish its definitive point of coming to an extensive group of onlookers. Additionally, ecological training additionally gives individuals a more profound comprehension of nature, moving them to assume individual liability for its preservation and reclamation. So, the broad communications can assume a productive job furnishing individuals with ecological instruction. Study done by conserve energy future (2023) found out that a person does not need to be a regular user of electronic products to understand that electronics will not last for life. This begs the question of what happens to electronics after they break down. Sometimes, they are reused recovered or left to waste without re-use. On other occasions, the wastes are recycled, and that’s where e-waste recycling comes in. (Conserve energy for future, 2023).

2.3.1: Impact awareness campaigns

When properly executed, awareness campaigns can have a major impact on waste management by raising public awareness of appropriate waste disposal procedures, encouraging recycling and waste reduction, and ultimately reducing overall waste generation and improving environmental sustainability. Among the main effects of awareness-raising initiatives on trash management are awareness campaigns that can encourage people to alter their waste management practices, which will boost recycling rates and decrease waste output. This is accomplished by teaching people about the

negative environmental effects of inappropriate garbage disposal and the advantages of recycling.

Effectively planned campaigns can promote community involvement in waste management programs, creating a sense of shared accountability and encouraging teamwork in tackling waste-related problems. By providing accurate information about various waste types, proper sorting techniques, and the significance of reducing waste at the source, knowledge building is another successful campaign strategy used to raise awareness that can dispel common misconceptions about waste management and result in higher recycling rates and lower waste generation.

In a similar vein, policy support is especially useful when the public is aware of the difficulties facing waste management and can push for improved laws and facilities to encourage environmentally friendly disposal methods. Additionally, promoting appropriate recycling and garbage disposal practices can have a positive environmental impact. Awareness campaigns can help create a cleaner environment by lowering pollution, conserving natural resources, and minimizing landfill waste.

However, targeted messaging which involves adjusting campaigns to demographics and taking into account local cultural contexts can optimize their impact, and communication channels which involve using a variety of communication channels, including social media, radio, television, community events, and educational materials can reach a larger audience. These factors all affect how effective awareness campaigns are. While sustainability makes sure that awareness campaigns are not one-time events but rather are a part of a long-term strategy for promoting sustainable waste management practices, community involvement by involving local organizations and community leaders in campaign design and implementation can increase reach and credibility (To to Ton, 2025).

2.4: Effectiveness of 7R strategy on e-waste management

Who states that if the entry points were regulated, then substandard electronics in the name of donations will not be allowed in? E-waste's heterogeneous composition and growing rate impose a need for special waste management that involves adequate treatment to control pollution and valuable recovery of resources. Therefore, the circular economy (CE) approach can be taken as an alternative approach in this regard to achieve sustainability (Ottoni *et al.*, 2022). Embracing a circular economy is

envisaged as a fundamental shift in the way products and materials are produced, consumed, and disposed (Muriithi & Ngare, 2023). The reuse and recirculation of various materials and products are the basis of the circular economy concept (Ghulam & Abushammala, 2023).

Circular economy can be accomplished by measures such as durability, enhancing construction, servicing, repair, reuse, re-manufacturing, refurbishment, and recycling (Muriithi & Ngare, 2023). To support circular actions, governments should enact measures for the 7R (rethink, refuse, reduce, reuse, repair, regift and recycle) strategy. The Zero Waste (7R) presents hierarchy, as a concept, to promote waste avoidance ahead of recycling and disposal (Singh & Hussain, 2021).

Rethink is to adopt a Zero Waste Lifestyle! Rethinking the way, you live and interact with people, things, and the Earth. Refuse means if you don't buy or use Electronic or Electrical Equipment (EEE) in the first place, then you don't have to deal with it as waste. Reduce is using less materials from the start which leads to less waste and less energy use. Reduce your waste in the first place! (University of Colorado, 2021). Re-use of e-waste involves re-utilizing products without changing the components and retaining the product in its original form to extend the products useful life. Can You avoid buying a new product? Re-use is a preferable option to recycling because re-use allows more material and energy savings (Mahkali, 2023).

Repair emphasizes fixing or upgrading your existing objects before you throw them in the landfill. Get creative with repairs for a new life! Regift means it is okay to pass along a gift that doesn't serve you. It doesn't have to be a holiday to Re-Gift. Recycling is the last option if all else fails. Recycling creates new products, and it has been lauded as reducing the magnitude of e-waste and potentially conserving energy and keeping the environment free of toxic material that would otherwise have been released into the environment (UNEP, 2019). From an economic perspective, e-waste recycling is regarded as a gold mine because it can generate several precious materials such as gold, silver, platinum, palladium, iron, and copper. Most of these materials in e-waste are technically retrievable and recyclable (Ghulam & Abushammala, 2023). In recycling there are some methods that require pretreatment, high energy use and most are expensive, and countries may lack adequate funds to do proper recycle in a manner that

is safe for humans and the environment (Ghulam & Abushammala, 2023). Consumers are urged therefore to buy recycled content products to close the loop!

2.5: Effects of polluter pay principle on e-waste management

The polluter pay principle is an internationally recognized principle, which can fill in as a method for preventing pollution, or as a method for building up obligation once pollution has occurred. The polluter pays principle can most straightforward be depicted as a method for crediting obligation regarding the contamination upon the polluter Organization for economic cooperation and development (OECD, 2022). According to Laniyan & Adewumi (2019), the outcome is a market where the genuine ecological expenses of the monetary action occurring are not reflected in the cost of the products.

Making the polluter pay for his polluting activities, the expense for pollution must be taken into consideration when setting the cost of the products being referred to, prompting a market where the right ecological expenses are reflected in the cost of the created merchandise (Organization for economic cooperation and development (OECD, 2022) OECD, 2022). The polluter pay principle is less successful than an arrangement of obligation which is based upon possession (Coase, 2015). In addition, to ensure monetary effectiveness is achieved, the expenses of exchange should likewise stay at a level where they are immaterial.

According to Mberu *et al.* (2020), Dandora dumpsite decommissioning plan has not been able to be worked on, because many communities around who chiefly rely on scavenging the garbage have engaged in a total disagreement with the planners regarding the issue. Thousands of residents (children, women and youths) from these settlements rely on the dumpsite for their income and food (Babs-Shomoye & Kabir, 2016). Therefore, since decommissioning Dandora dumpsite will not solve the problem of e-waste disposal once and for all, the researcher recommends the separation of waste at household level for easier resource utilization and prevention of pollution after disposal, during collection and recycling. It also suggests regular waste collection to avoid creation of mini dumps in residential areas; and adequate support for research and popularization of adoption of appropriate and low-cost Solid Waste Management technologies locally available (Kenya institute of public policy and authority Kippra, 2023).

2.6: Research Gap

Most research has focused on e-waste as an issue in industrialized regions. Nonetheless, in the present worldwide markets, the same kind of electrical items infiltrate markets around the world, in developed and developing nations alike have displayed historic examination provides details regarding the issues creating nations look because of e-squander, so far, few investigations have been done in Kenya on awareness and strategies for e-waste management in Dandora, Nairobi County. Managing waste has been a big challenge in Kenya and most of the e-waste ends up in landfills while others are recycled and properly disposed. The existing management practices related to E-waste in Kenya are poor and have the potential to risk both human health and the environment

A lack of e-waste awareness, along with poor separation and disposal systems, has led to e-waste being mixed with ordinary waste in dumps. It is clear that the public does not identify with what e-waste is and the consequences of its poor management. From the study by Oluoko & Mutisya (2019), private garbage dealers operate on an open competition, hence there is less cooperation with Municipal Authority, and this needs to be looked at by the overall waste management. In addition, there is need to involve public support so that they are able to be separating, recycling, reusing and minimizing waste and this can be done through enhancing awareness levels in people and also reinforcing the available law (Sirage, 2022). However, there are complains that Kenya has become a dumping ground for second hand electronic appliances which have a short lifespan Kenya institute of public policy and authority (Kippra, 2023) and the Kenya bureau of standards to set the limit of the years the electronic appliances should be imported into the country to limit the quantity ending up into the dumpsites.

CHAPTER THREE: METHODOLOGY

3.1: Study Area

3.1.1: Location

The study was conducted in Nairobi which is the capital and largest city of Kenya. It is located on coordinates: 1° 18' 13.96" Sand 36° 48' 46.79" E as indicated on Figure 3.1. The city has the highest population in East Africa, with an estimated urban dweller of about 5 million inhabitants who lived within 684 km^2 (Nairobi City County, 2022). It is also the central hub for commercial activities and transit goods. Nairobi is also the heaviest consumer of Information and Communications Technology (LCT) products. This is because of the many commercial activities and institutions that are in Nairobi and use many ICT accessories. The study was specifically conducted in Dandora, Nairobi County, which is Nairobi's principal dumping site, Dandora which lies in Embakasi constituency in the Eastern Extension zone of the City of Nairobi bordering Kariobangi south and Korogocho regions. The site is about 10Km from the city center and covers about 700 acres of land. The map is shown in Figure 3.1

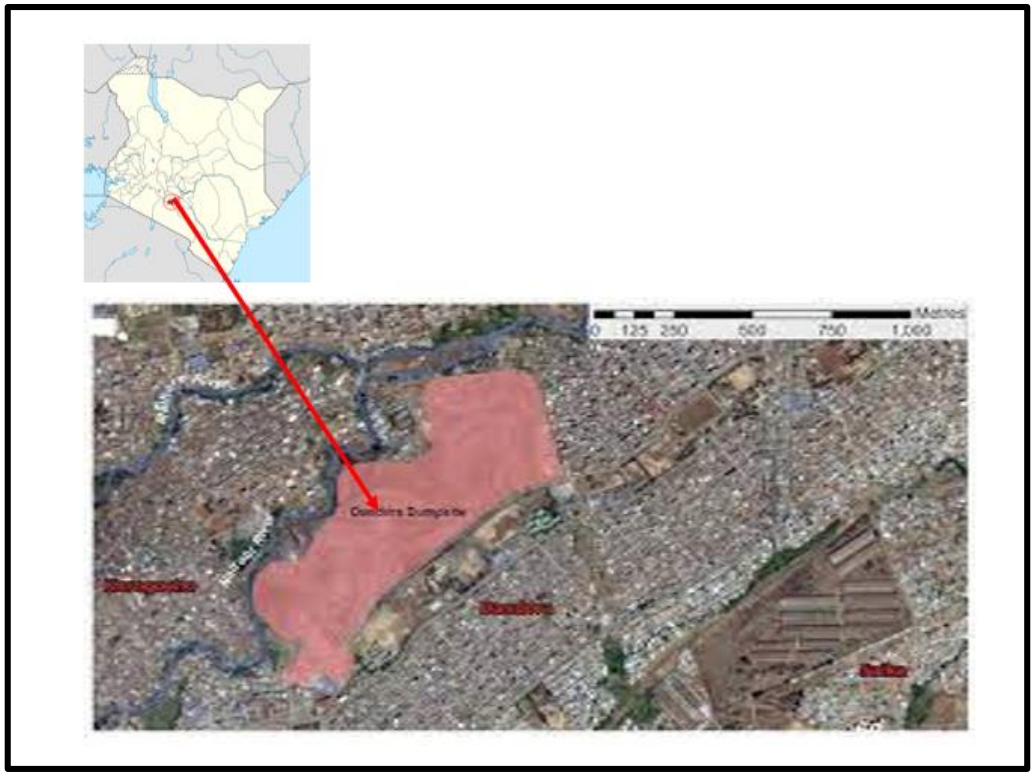

Figure 3.1: Map showing location Dandora dump site. Source: (Geo-Information Science and Earth Observation Kenyatta University, 2025).

Figure 3.2: Lorry dumping waste at Dandora Dumpsite. Source: (Field data, 2023**)**

Figure 3.3: A Photo of A hip of unseparated waste at Dandora Dumpsite. Source: (field data,2023)

3.1.2: Climate

Nairobi has a precipitation amounting to 745 millimeters (29.3 inches) per year: The winters are brief, cool, dry, and partially cloudy, whereas the dry seasons are brief, warm, and gloomy. Rarely is the temperature lower than 50°F or higher than 84°F; it usually ranges between 54°F and 81°F. (The County Government of Nairobi, 2022).

3.1.3: Soils

The soils of the county range from Alluvium and clay filled in river valleys and other depressions that had developed during the periods of intermittent inactivity. (The County Government of Nairobi, 2022)

3.1.4: Economic Activity

The major economic activity is in the community, social and personal services and professional business services sector, accounting for 52.1% of all the income generated in the city. This is followed by the agriculture and forestry sector, the wholesale and retail trade, the manufacturing sector and tourism.

3.1.5: Selection of the dumpsite

Dandora dumpsite, which covers more than 30 acres just outside of Nairobi, is East Africa's largest landfill and one of the largest in the world. Every day, 2,000 tonnes of unsorted and unregulated waste from the city's people and companies are deposited here. Dandora dumpsite in Nairobi, Kenya's Embakasi sub-county. Kariobangi, Baba Dogo, Gitare Marigo, and Korogocho are among the surrounding estates, and the waste is handled by a dumpsite that covers 30 acres. It was founded in 1977 with partly support from the World Bank to provide a higher standard of housing.

It is Nairobi's primary dumping site, and the Oxygenation Ponds, which can be seen on satellite images, are the city's primary sewage treatment facilities. Processed water is discharged into the Nairobi River. Dandora is separated into five phases. The dumpsite is a major contributor to the region's high crime rate. The dumpsite poses an environmental risk. The burning of rubbish at night might cause serious health concerns. Houses near the site are filled with smoke, making it difficult to breathe (United Nations Environmental Programme (UNEP), 2018).

3.2: Study design

This research employed a survey research design- to provide further insight into the research problem by describing the variables of interest. Survey research design was preferred since this method was used for gathering data -to understand a group of people's thoughts, behaviors, or experiences. The design allows the researcher to collect data from large and diverse populations at a relatively low cost, gathering both quantitative and qualitative data, providing anonymity which can encourage honest

responses, ease of data analysis, and the flexibility to ask a wide range of questions about a topic, making it a valuable tool for understanding trends, opinions, and behaviors within a population. The design was described in data collection using survey questionnaires as well as structured interviews involving responses from human beings as the basic analysis. The design was useful in determining the frequency between which the variable relationships occurred. Therefore, the design was mainly to give provisions of various solutions to e-waste management in Nairobi, Kenya. Approaches such as descriptive approach which involved photos and observation, within the set study area of Dandora were used.

3.3: Population

There were many other dumping sites in almost all the estates in Nairobi County however Dandora dumpsite was chosen because it was the largest dumping site in Nairobi County. The population living in the area of Dandora settlements was estimated as 350,000 (KNBS, 2019) and this is what was targeted for the study. The study targeted sampled households in the study area, e-waste 240 waste dealers and 20 recyclers operating in the Dandora; 4 manufacturers all randomly sampled and one county official who was in charge of waste disposal in Dandora, Nairobi County. The study target was the household heads as the baseline unit for the administration of the questionnaires.

3.4: Sampling Procedure

The study employed Simple random sampling to get at a sample size from the Dandora resident's households depending who had owned a mobile phone and radio for at least three (3) years and disposed at least one of the electronic appliances; Mobile phone, Radio, Television and Computer qualified to participate in the study. Only one member of the household, preferably the head, was requested to provide information. Simple random sampling was then used to handpick the people who carried out the informal practices of recovering e-appliances from solid waste dumping sites. Dandora dumpsite is divided into 5 phases including: Kariobangi North, Dandora Area I, Dandora Area II, Dandora Area III, and Dandora Area IV. The sample size of 328 household was divided equally in each of the five phases having 66 respondents who were served with the questionnaires to fill. Convenience or purposive sampling was employed to select respondents who were deemed to give the required information.

3.5: Sample Size

The sample size was determined using Fisher (2003) formula.

$$n = Z^2 pq/d^2$$

Where,

n = the desired sample size (if the target population is > 10,000).

Z = is the standard normal deviate at the required confidence level.

p = is the proportion in the target population estimated to have characteristics being studied

q = 1-0.31 = 0.69.

d = the level of statistical significance set = 0.05

Z = Assuming 95% confidence interval Z = 1.96

$n = 1.96^2 (0.31) (0.69)/0.05^2 = 328$ households

3.6: Instruments

Questionnaires consisting of open-ended and closed items was administered to the household heads. A questionnaire was chosen primarily because of the research design chosen (exploratory survey design) and the information and the expected data sought by the study. The questionnaire contained items obtained from independent and dependent variables which largely influenced decisions about awareness of e-waste disposal and proper management compared to age, gender, education level and other socio-economic components of the households. Five phases were used to deploy the household questionnaires (appendix 1), where participants were chosen using a simple random sampling. A digital camera was used to picture images of sites visited.

3.7: Data collection Procedure

Questionnaires were used to collect quantitative data that was administered to the selected respondents who filled them in. They were established to solve all individual objectives and questions. Structured also known as closed-ended, and unstructured also known as open-ended items were both included in the questionnaire. Unstructured questions gave the respondent entire flexibility to answer the question in their own words, whereas structured questions contained a list over all potential answers from which the respondents choose the one that better defined their position. The test for validity was done by giving data collection instruments to experts (university

supervisors) to go through them and who then later discussed the questions therein ensured reliability.

The study used 2 focus groups consisting of ten people in each of the 5 locations identified. Each of the focus group consisted of male, female and the youth above 18 years mostly waste handlers. Meeting venues and time were set and then a moderator of the sessions was identified to control the plenary sessions. The topics of discussion and questions were formulated and served early enough to avoid wasting time. The purpose of this group discussion was to obtain qualitative and quantitative data on solid waste management, effectiveness and challenges. Focused group discussions allowed the participants a chance to ask more challenging questions in relation to the research topic and others provide possible solutions to the questions asked. It gave more insightful opinion/ views, bridged the research gap and practices on the topic and was used to explore the survey results, which could not be captured statistically like local knowledge on solid waste collection methods and current being used by the people. It was also used to collect data on a wide variety of knowledge and terminologies used in a topic of interest and enabled the process to be managed more smoothly (Nyumba, 2018).

3.8: Data analysis

Analysis of data was done for both research types of quantitative and qualitative data. Quantitative data was analyzed using SPSS version 20, developed particularly to handle data and produce statistics. This showed cause and effect, i.e., the relationship between dependent and independent variables. Descriptive statistical techniques like mean, mode and median summarized the data while inferential statistical this value (α=0.05) was chosen because of the sample size which was adopted from the figures calculated on the basis of 0.95 level of confidence.

Qualitative data took into consideration the attitudes and feelings of correspondences which were made on each issue that was being investigated. It described happenings thus classified and sought how each concept was interconnected to each other. Data under each theme was analyzed separately. Qualitative data was analyzed by organizing data in a way that one was able to identify themes (common, conflicting, minority). Qualitative data was then discussed and presented in form of narrative. The impacts were measured by gathering and analyzing quantitative and qualitative data about the

changes or effects caused by solid waste collection or initiatives often using metrics that reflect the degree of influence or difference made on a particular system or population, depending on the context and goals measured the effects of resident awareness campaigns on e-waste disposal. This may involve gathering data on outputs, outcomes, and occasionally even long-term societal effects.

A chi-square test to examine the statistically significant relationship between two or more categorical variables, essentially checking if the observed distribution of data across categories aligns with what would be expected if there was no relationship between them; this test was particularly used when analyzing data presented in contingency tables.

Pearson correlation was used to measure the strength and direction of a linear relationship between two continuous variables, represented by a coefficient ranging from -1 (perfect negative correlation) to +1 (perfect positive correlation), with a value near zero indicating no correlation; it is commonly used to assess how two variables change together, assuming a linear pattern in the data

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1: **Respondents**

The study covered the targeted Dandora dumping site and the adjacent estate. Respondents were randomly selected from the households and the dumpsite. The head of the households and dumpsite workers were interviewed using structured questionnaire as shown in Appendix 1.The questionnaire consisted of sections on social demographics, sources and types of E-waste received, the impacts of awareness campaigns to residents on disposal of E-waste, effectiveness of rethink, refuse, reduce, reuse, repair, Regift, recycle (7R strategy) use in disposal of e-waste, the effects of Polluter Pay's Principle (PPP) on e-waste management actions, in what way will the 7R strategy use affect disposal of e-waste and how the PPP affect e-waste management actions in Dandora. Data collected was coded and entered in an excel spreadsheet before being exported to SPSS for analysis. In SPSS, data was then determined and classified as ordinal, nominal or scaled. Graph, pie charts were drawn using excel and descriptive statistical analysis.

4.2: Response Rate

Out of 328-targeted sample respondents (328 household questionnaires for the study, 274 answered the questionnaires. Over 90.07 % of questions representing 83.5.7% response rate against the target of 100% rate as indicated Table 4.1. According to Chung (2020). (Chung, 2020) a good survey response rate is affected by how engaged the respondents are with the study, and whether the survey is delivering in a way that's easy for the respondent. Nevertheless, a good survey response rate range between 5% and 30%. While an excellent response rate is 50% or higher. According to Mugenda, (1999) (Mugenda O. M., 1999), a response rate of 70% and over is appropriate for statistical analysis.

However, more generally and irrespective of the type of survey, a typical survey response rates lie anywhere in the region between the 5% to 30% range. By contrast, a survey response rate of 50% or higher is usually considered to be excellent for most cases. on the higher end of the scale which is likely driven by high levels of motivation to complete the survey, this could be because of a strong personal relationship between the customer and business (Cleave, 2022).

Table 4.1: Response Rate

Responses	**Questionnaires**		**Total**	
	n	%	n	%
Received Responses	274	83.5	328	100
Not Received	54	16.4	54	16.4
N	**328**	**100**	**328**	**100**

Source: (Field data, 2023)

4.3: Descriptive Statistics

This section presents the demographic characteristics of the respondents Dandora. The main demographic characteristics of the respondents includes age, gender education, marital status.

4.3.1: Age of the Respondent

A total of 274 household heads were visited during the research and 10 interviews, though the sample size was 328 household heads, 274 were reached by the study. The questionnaires were filled by the household head or any other person within the household identified by the household head. Among the respondents (n=274), 149 were male (45.4 %), while 124 were women representing (37.8%). Majority respondents were between 25-40 years. This could be attributed to the fact that this age group consists of the youth who are active sections of society and might have easily been reached by the study. Further, the area consists of households which are very expensive and which the youth can afford. The mean age for the males was 31.67 while for the females was 30.55 years the oldest was 61 years, while the youngest was 18years. The range was 43 years, while the mean age for both genders was 31.11 years (stdev ± 6.704) (see Table 4.2)

Table 4.2: Age distribution of respondent farmers

	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness	Std. Error
Age	43	18	61	31.11	6.704	.195	.145
Gender							
Male	149						
Female	124						
N	**274**						

Source: (Field data, 2023)

4.3.2: Age and Gender Distribution

Age distribution was further grouped in 10 years to assist in determination of respondent age by gender as presented in Figure 4.1

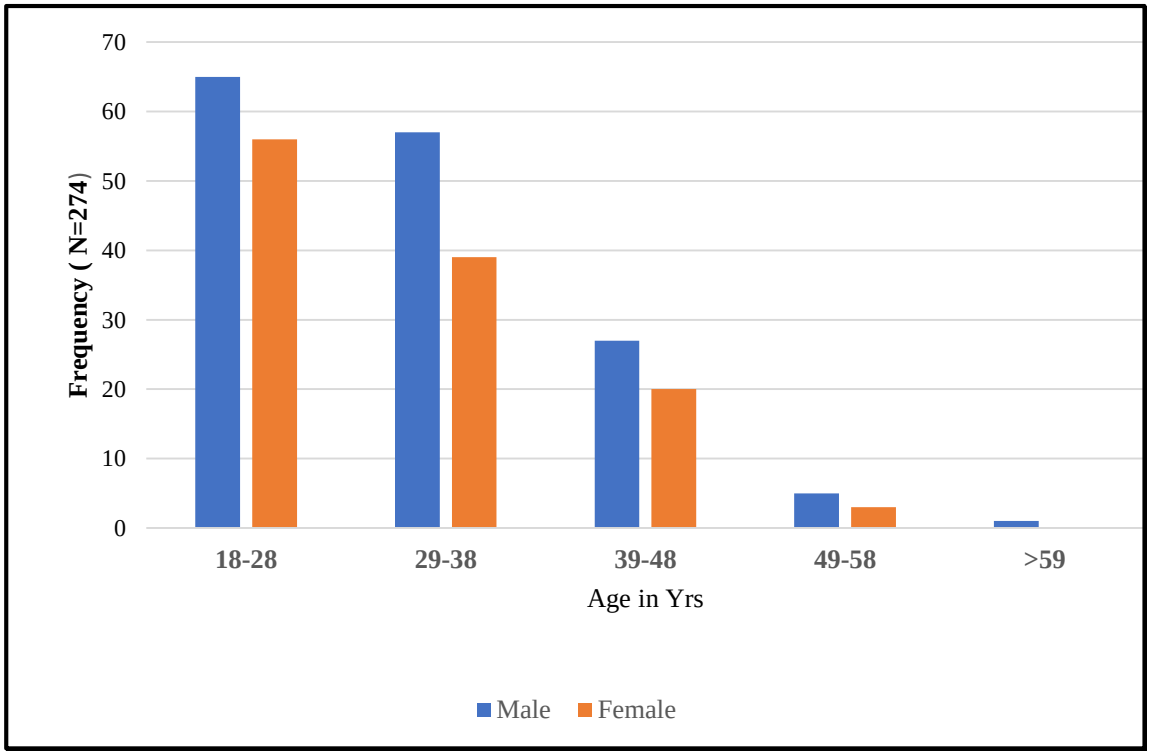

Figure 4.1: Gender-Age distribution of respondents. Source: (Field data, 2023)

The mean age for the female respondents (n=124) was 30.67 years (stdev ± 10.33) while that of male (n= 140) was 31.67years (stdev ±8.77). Although the difference in age was

not statistically significant, (F-Test, df2, F=0.844, P=0.41), men appeared slightly older than women in the sampled population. When grouped in 10 years categories, men were more in all the age groups. This can be attributed to the fact that they were easily reached by the study due to their mobility while vending for their families. The results agree with Omoah *et al.,* (2023) study findings which show that women solid waste workers were denied access to training programs on the use of tricycles (one of the methods of collecting and transporting solid wastes) on the basis that it requires physical strength. In traditional African societies there is division of labour based on gender. This seems to have affected the presence of more female labour in solid waste management also this gender difference was not only limited to the domestic space but also the public spaces (Omoah, 2023).

4.3.3: Education and gender cross tabulation

Education forms an integral part of the society where we belong whether formal or non-formal. Education helps to eradicate poverty hunger and gives people a chance to live better lives. It was necessary to examine this variable in relation to gender to find out their relationships and relate to other variables under investigation in the study. Education was classified in five levels (1-5) from none, Primary, secondary, college and university. The results of distribution of gender and education is presented in Table 4.3

Table 4.3: Education and gender

Education		**None**	**Primary**	**Secondary**	**Tertiary**	**University**	**Total**
Gender	Males	51	76	7	15	2	151
	Females	36	63	10	11	3	123
Total		**87**	**139**	**17**	**26**	**5**	**274**

Source: (Field data, 2023)

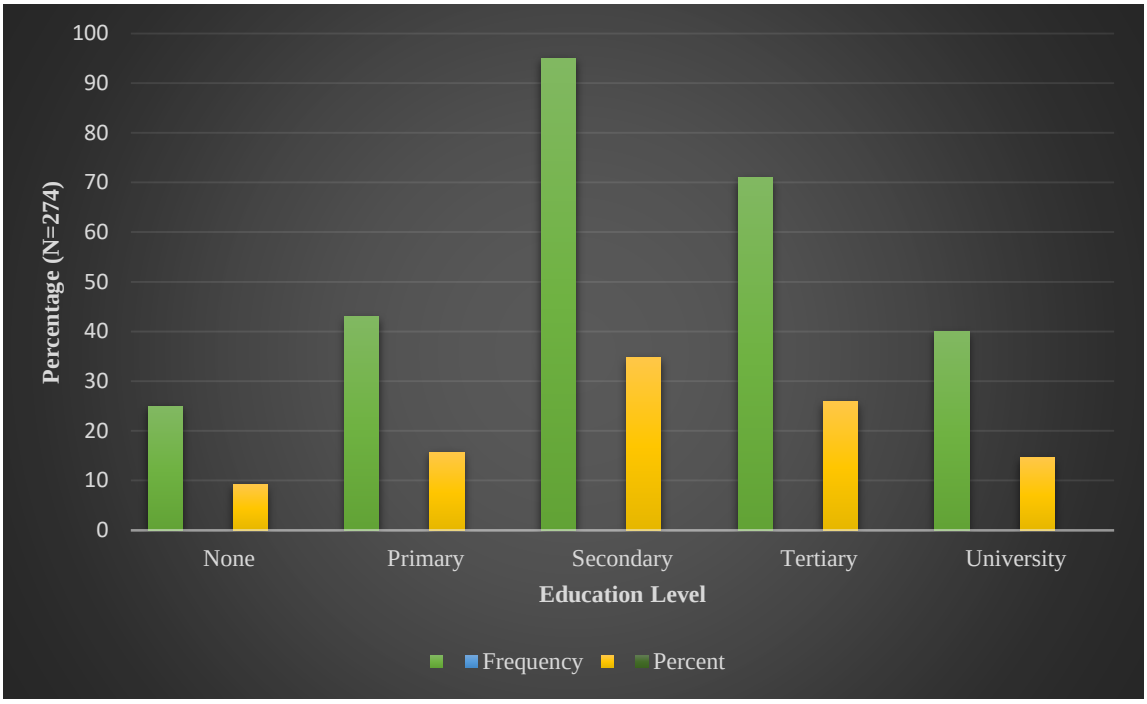

Figure 4.2: Education and gender. Source: (Field data, 2023)

From Figure 4.2 it is noted that both male and female had obtained primary and secondary education. Only 87 respondents 51 males and 36 females did not have formal education. 31.7% of the study respondents had not received any education from any source on managing e-waste, which may be detrimental to curbing the problem in Dandora dump site and other regions across the county. To further explore the link between gender and level of education, data analysis was done using Spss (Chi-square) ($p \leq 0.05$). Results show no significant differences in education levels between male and female respondents as presented in Table 4.4.

Table 4.4: Chi-Square Tests

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.630[a]	8	.000
Likelihood Ratio	9.693	8	.287
Linear-by-Linear Association	2.654	1	.103
N=	**274**		

Source: (Field data, 2023)

4.3.4: Education and Age

Further the study sought to determine the relationship between Gender and level of education by use of Chi-square. The data obtained was analyzed and results showed there was a highly significant association of (0.000) (p=0.05) and a weak positive relationship between age and education as shown in table 4.4 above. These results are attributed to the youthful population (18-45 years) among the sampled population

4.3.5: Marital status

Marital status is an important variable in the management of families and farmlands. It is considered as a foundation of the society, family responsibility and commitment in any given community.

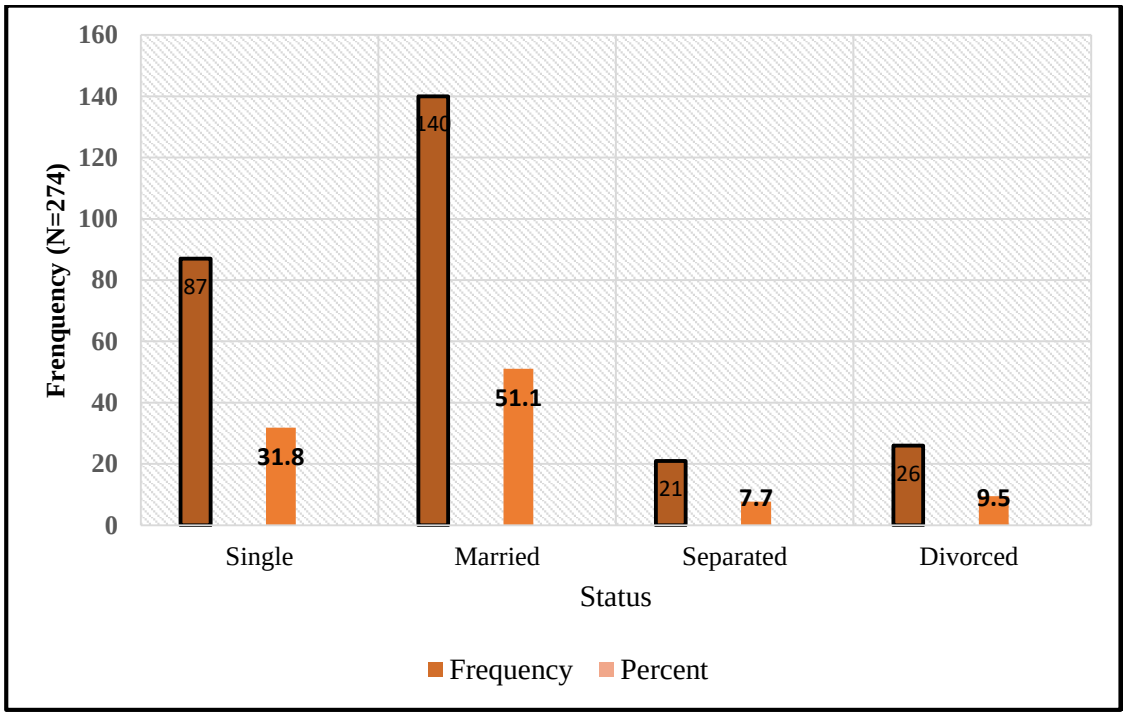

Figure 4.3: Marital status. Source: (Field data, 2023)

Results of the marital status Figure 4.3 above shows that most of the respondents 51.1% were married, followed by those who were single at 31.8%. The reason for studying the marital status was to establish whether there was a link between marital status and E- waste generation and disposal. Results indicated a near perfect positive correction of (0.24), a significant level at the 0.01.

4.3.6: Education level

It is assumed that education is obtained from schooling. Education forms an integral part of society whether formal or non-formal. Education helps to eradicate hunger and poverty and gives people a chance to live better lives. In any society, education forms one of the basic fabrics of that society. Education enlightens people and informs them aware of their rights. In this study, studying education level was important because it informed the research on their awareness level of E- waste and their ability to live and respond to the environmental challenge posed by careless handling of solid waste and a better life. It was necessary to examine this variable in relation to gender to find out their relationships and relate to other variables under investigation in the study. Education was classified in five levels (1-5) from none, Primary, secondary, college and university. In this respect therefore, the study sought to establish the respondent's education level, and the results were presented in Figure 4.4

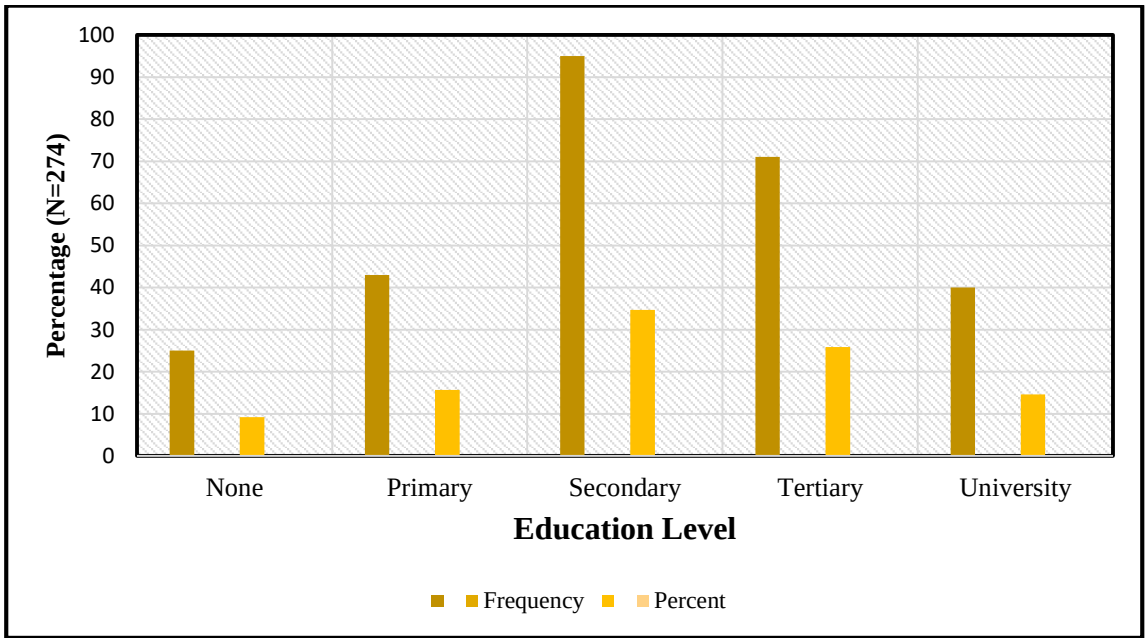

Figure 4.4: Education level. Source: (Field Data, 2023)

Results from figure 4.4 above show that majority 34.7 % (N=71) of the respondents had received secondary education, this was closely followed by those who had tertiary education at 25.9% (N=71). However, those who had attained University education supposed those who had primary education. Results show that 89.6% (N = 206) mean (68.66) had attained secondary level of education and could easily understand the concept of E-waste management. While 25.9 % (N= 68) had primary level of education or below with a mean of 31. The results could be attributed to the fact that the area of

study is an informal settlement characterized by low-income earners and the majority could not afford to take their children to better schools where they can receive better education.

Better schools increase the opportunities of joining higher institutions of learning like universities, which increases their chances of higher paying jobs and a better life. However, the above results cannot be taken authoritatively to mean that the study area is dominated by people who have a secondary level of education. The results are just a representative of the sampled population which sometimes cannot be taken as a true picture of what is on the ground.

4.4: Sources of E-waste

Table 4.5: Sources of E-waste

Sources of Waste	**Responses**			
	Frequency	**Yes**	**Frequency**	**No**
ICT and telecommunications Equipment	202	72%	72	28%
Office electronics	169	62%	104	38%
Large household appliances	180	66%	93	34%
Small household appliances	161	59%	112	41%
Consumer equipment	134	49%	139	51%
Medical equipment	150	55%	49	18%
Toys/leisure/sports equipment	191	70%	82	30%
N	**274**	**100%**	**274**	**100%**

ICT and telecommunications Equipment (N = 202) representing 72% followed by Toys/leisure/sports equipment at (N = 191) representing 70% while large household appliances were at (N = 180) representing 66%. This could be because every year millions of electrical and electronic devices are discarded as products break down or become obsolete and are thrown away. These discarded devices are considered e-waste and can become a threat to health and the environment if they are not disposed of and recycled appropriately.

Electronic waste (e-waste) is one of the fastest growing solid waste streams in the world. Less than a quarter of e-waste produced globally in 2022 was known to be

formally recycled; however, e-waste streams contain valuable and finite resources that can be reused if they are recycled appropriately. E-waste has therefore become an important income stream for individuals and some communities. People living in low- and middle-income (LMICs), particularly children, face the most significant risks from e-waste due to lack of appropriate regulations and enforcement, recycling infrastructure and training. Despite international regulations targeting the control of the transport of e-waste from one country to another, its transboundary movement to LMICs continues, frequently illegally. E-waste is considered hazardous waste as it contains toxic materials and can produce toxic chemicals when recycled inappropriately

The results agree **w**ith study finding by Ajekwene *et al.,(*2022) that the largest portion of e-waste worldwide comes from the Information and Communication Technology (ICT) sector, a notable source of e-waste whose hardware incorporates a variety of electrical components. This is due to the ICT division's growth, which has increased the use of electronic equipment tremendously and led to regular upgrades of these devices, which has caused a faster rate of out-of-date, high-quality ICT hardware. Users and consumers are being forced to discard their outdated devices due to these upgrades, which adds massive amounts of electronic garbage to the already heavy waste stream.

4.5: Level of awareness of the respondents on E-Waste

4.5.1: Knowledge of Electronic Waste

Further, the sought the respondent’s opinion on whether they had knowledge on what E-waste was. This knowledge was important because it formed the basis of the E-waste generation management and better ways of managing it. Data was obtained, analyzed and presented in Figure 4.5

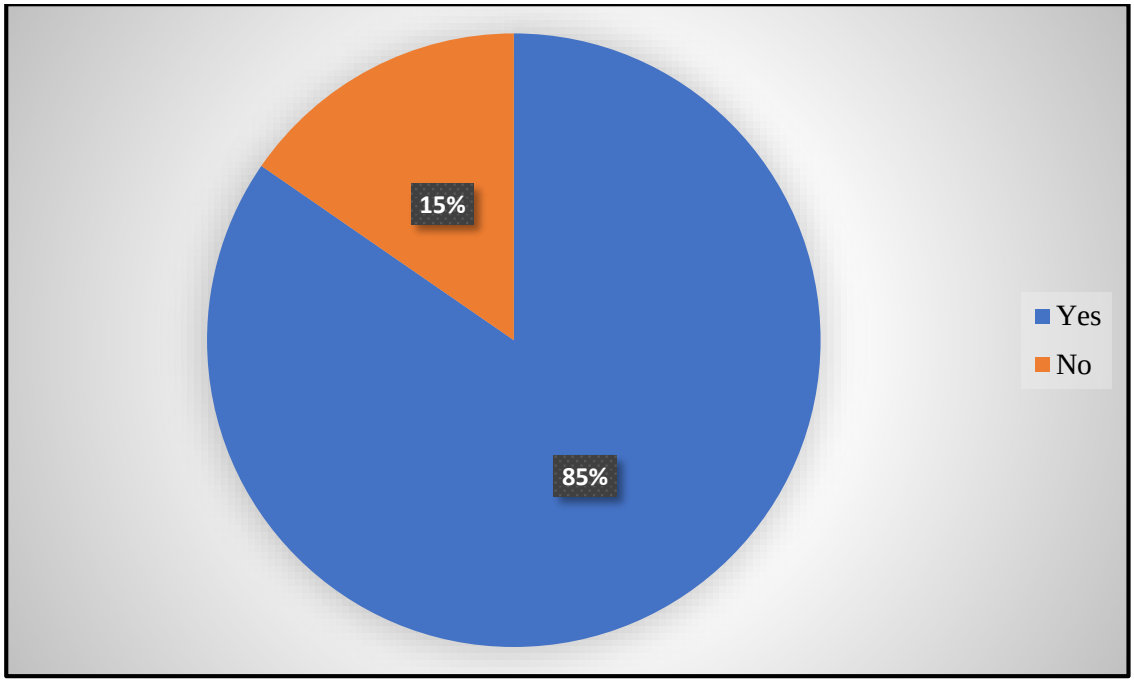

Figure 4.5: Knowledge of Electronic Waste. Source: (Field Data, 2023)

From Figure 4.5 above results show a majority of 85% had a knowledge of electronic waste, while 15% indicated that they had no idea of electronic waste. This result could be because of the education level of the respondents 89.6% (N = 206) shown in (fig 4.4 above). This forms a strong basis for future e-waste management in homes and the area Integrating waste management education into the school curriculum is an excellent strategy to promote attitudes about garbage reuse and recycling, particularly teaching children about the causes and effects of waste disposal and emphasizing the need of waste prevention, reuse, and recycling. Campaigns have engaged local communities through workshops, seminars, and public campaigns to raise awareness of e-waste concerns, promote the circular economy, and underline the significance of safe disposal techniques and recycling.

4.5.2: Hazardous chemical in E-waste

The knowledge of electronic waste should not be limited to knowing them alone but also should include other components in the electronic waste like types and chemical substances that might be in them and their effects on soil, air and water. The study further sought the respondent's perception of whether electronic waste has hazardous substances. Responses were obtained analyzed and results presented in Table 4.6

Table 4.6 Hazardous chemicals in E- waste

	Frequency	Percent
Yes	235	85.8
No	39	14.3
Total	**274**	**100.0**

Source: Field Data, 2023

Results from the above table show that majority of the respondents 85.8% understood that some of the electronic waste have hazardous chemical substances in them while 14.3% said they were not aware. These substances they said could be poisonous when they come into contact with their bodies or we breathe polluted air, animals when they drink water contaminated with these chemicals eaten or soils when it rains. The results are in line with similar results by a study De Rosa *et al.*, (2023) (De Rosa, 2023). According to the American Environmental protection agency (EPA). 1976, the United States Congress defined the term 'hazardous waste' in the Resource Conservation and Recovery Act (RCRA), an amendment to the Solid Waste Disposal Act of 1965, as A combination of or solid waste is which because of its concentration, quantity or chemical, physical, or infectious characteristics may; (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

4.5.3: Awareness of E-waste separation in the area

Further on awareness it was important for this study to find out besides awareness of electronic waste and the chemical composition found in the waste whether the respondents went a step further.

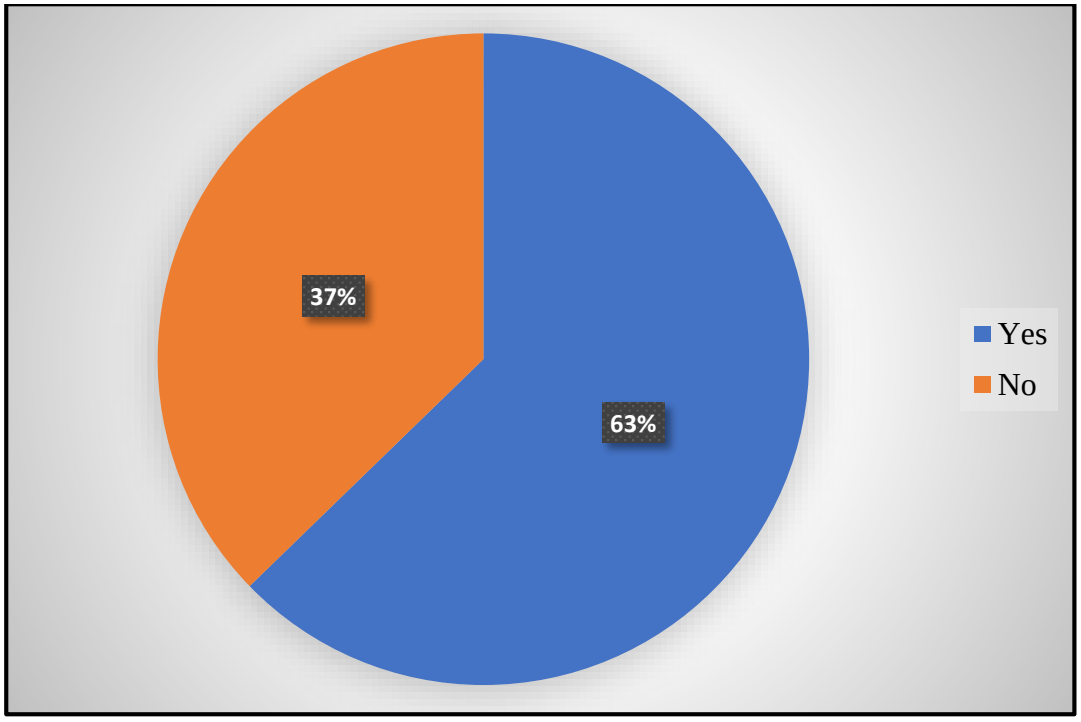

Figure 4.6: Awareness of E-waste separation in the area. Source: (Field Data, 2023)

Results on (Figure 4.6) electronic separation shows that 63% (N= 172) of the respondents indicated they were aware of the separation of electronic waste, while 37% (N=102) said they were not aware. This percentage of those who are not aware of waste separation who include people in the study area who live in places where waste separation is not common, people from rural areas where information is scarce, older generations who might not have been exposed to the idea at a young age, people with low literacy levels, or people who are not actively involved in environmental issues in other words, anyone who is unaware of the advantages and procedures of separating waste into various categories for recycling or appropriate disposal is big and more education should be rolled out to the residents to make them aware. Most of the garbage generated in the houses of collected and put into garbage dumpsite. In this respect the community should be educated on the idea of separating waste at the household level to ensure the management of solid waste in the dumpsite and the country. Separation of garbage in the household helps in putting the biodegradable and degradable waste aside. It can also help houses, especially in rural areas, to use the degradable waste in composite to form organic manure which can later be used in their farms. The household can have the opportunity to select from the non-biodegradable those which can be recycled, reused or repaired.

4.5.4: Sources of Information about E-waste

Information to any society is important because it helps society in making informed decisions in relation to their lives. Sources of information are classified as secondary sources or primary sources. In this study sources of information sought by the study are listed in Figure 4.7

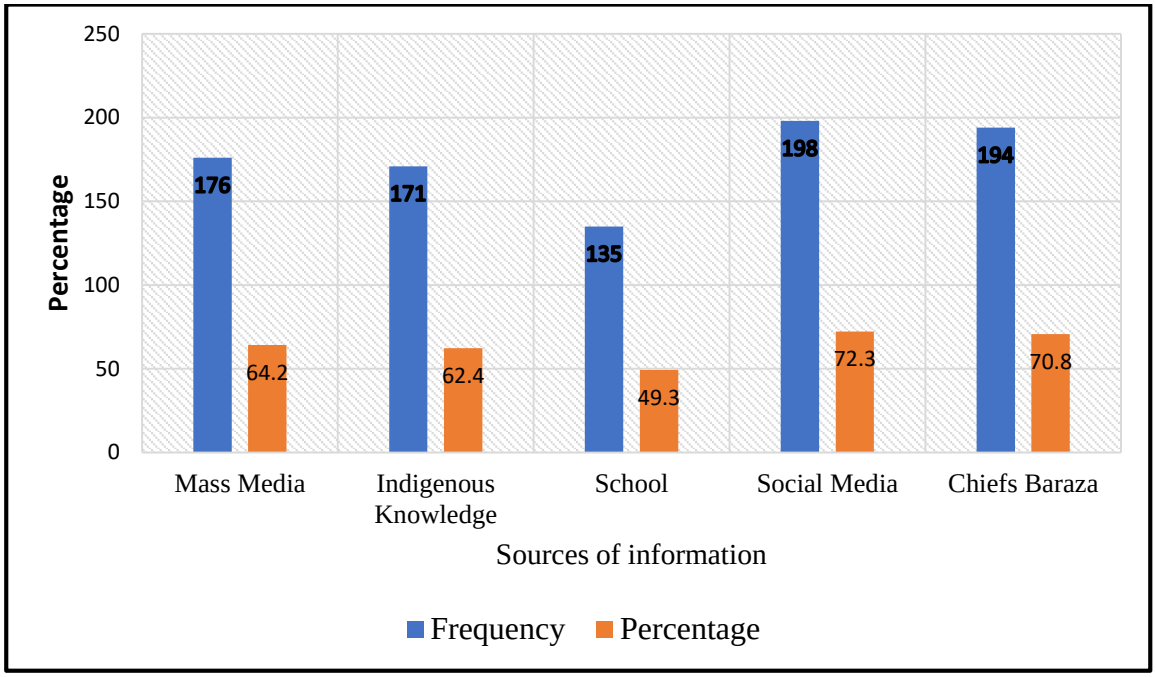

Figure 4.7: Sources of information. Source: (Field Data, 2023)

Results indicated that 72.3 % said that they learned about electronic waste through social media showing that it was the most popular means of informing the public followed by mass media at 64.2%. This result can be associated with the fact that most of the people in the area and the country have mobile phones where they can engage in apps like TikTok, Facebook, WhatsApp, Instagram and twitter. As of January 2023, the number of people using the social media in Kenya stood at 10.5 million, marking the third highest volume in the study period. In contrast to 2014, the country had roughly three times more social media users in 2023 (Statista, 2023). Mass media instruments include Radio, Television, Computers and through YouTube. However, the chief's baraza as a source of information recorded the highest number of those who said they were not aware of it with 70.8% this is significant that the chief's Barazas as one of the important sources of information. Indigenous knowledge (which was practices, and beliefs developed by residents through interaction and experience with the

environment) as usual is supposed to have played a significant source of information. But unlike in the olden days when information was handed over to the young through their parents, results shows that 62.4 % while schools came in last with 49.3% (all the variables' percentages worked out of 100%)**.**

4.5.5: Generation of E-waste in Houses

The study sought to find out whether the respondents generated electronic waste in their houses. To find out whether houses generated electronic waste, responses were obtained analyzed and results presented in Table 4.7

Table 4.7: Generation of E-waste

	Frequency	**Percent**
Yes	227	82.9
No	47	17.2
Total	**274**	**100.0**

Sources: (Field data, 2023)

From Table 4.2 above, 82.9% of the respondents agreed that they generated electronic waste in their houses and added to the list the sources of e-waste. This is because of the influx and uptake of cheap and user-friendly electrical appliances for domestic uses in the country and the area of study especially from China and India. Also, the importation of used (second hand) electrical appliances, mostly from Europe and America which are short lived has compounded the problem in the country. Every year millions of electrical and electronic devices are discarded as products break or become obsolete and are thrown away. These discarded devices are considered e-waste and can become a threat to health and the environment if they are not disposed of and recycled appropriately.

4.5.6: Sources of E- Waste

Further, besides generation of electronic waste from households in the study area, the study explored other sources of E-waste. Data was obtained, analyzed and results presented as shown in Figure 4.8

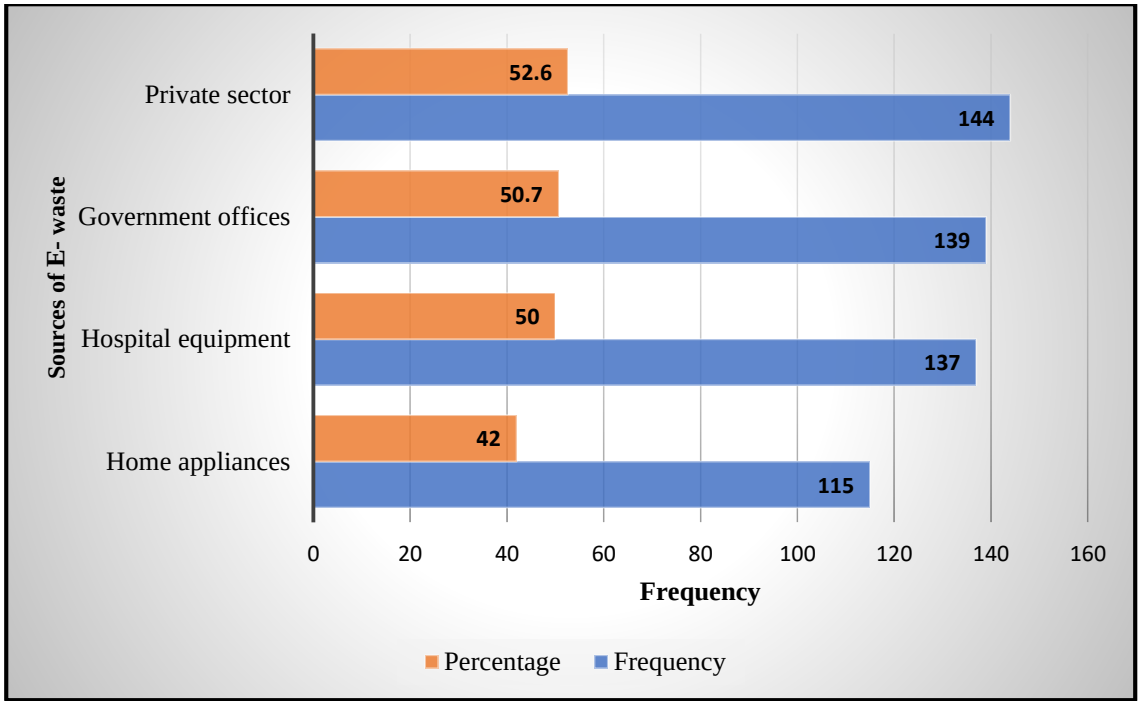

Figure 4.8: Sources of E- waste. Source: (Field Data, 2023)

Results indicate that the majority of 52.6% of the electronic waste is from the private sector. Government offices 50.7% where the rest of the sources were distributed in other variables (all percentages worked out of 100% in all variables). This is because most of the electronic appliances are found it private sectors and in government offices who doubles as the biggest importers of the same. The results are contrary to the expectation that home appliances could have produced the highest percentage because of the spread. The study was limited to a specified area and if it could have been in wider coverage including the rural areas, probably the results could have been different. The above results agree with similar study done by Ankit et al., (2021) showed that the highest composition of e-waste consists of washing machines, dryers, vacuum cleaners, air conditioners, coffee machines, irons, etc., is about 30%, computers, printers, telephones, CD, DVD, hi-fi sets fax and refrigerators 20% (Ankit, 2021).

Figure 4.9 A photo of electronic E-waste dumped at the Dandora dump site
Source: (Field data, 2023)

Figure 4.10 A photo of solid waste handlers at the Dandora dump site. Source: (Field data, 2023)

Figure 4.11: A photo of researcher with research assistants during data collection at the Dandora dump site. Source: (Field data, 2023)

4.5.7: Implementation of waste Management policies

The management of E-waste requires a holistic approach from all sectors of society, from international, government, private to personal effort. In this respect the data was obtained, analyzed and results presented in table 4.8

Table 4.8: Implementation of waste Management policies

	Frequency	Percent
Yes	108	39.3
No	166	60.7
Total	**274**	**100.0**

Results show that 60.7% of the respondents agreed that government policy in connection with electronic waste and which is in existence was not implemented in the area. This is because the sectors concerned lacks enough labour force and finances to enforce the policies. Again, the country has not sensitized the public enough on electronic separation, management and disposal. This makes it difficult to sort the garbage when it arrives at the dumpsite. Coupled with this, some of the dumpsites in Kenya are controlled by cartels who are not well educated to manage the dumpsites making it difficult for organizations wishing to better manage the sites. In an effort to address poor solid waste management, NEMA developed some minimum requirements as a baseline for implementation by the Counties. This included designation, securing and manning of the disposal sites, promotion of efficient collection and transportation of waste (National Environment Management Authority, Kenya (NEMA), 2014).

4.6: Impacts of awareness campaigns to the residents on E-waste Disposal

4.6.1: Awareness of methods of handling E-waste

Awareness of methods of tackling a problem is important in making an informed choice on the best solutions. The study collected data on the respondent's awareness specifically on methods of handling E- waste. This is especially when a gadget cannot be reused recycled or recovered. The data obtained was analyzed and presented as in Figure 4.12

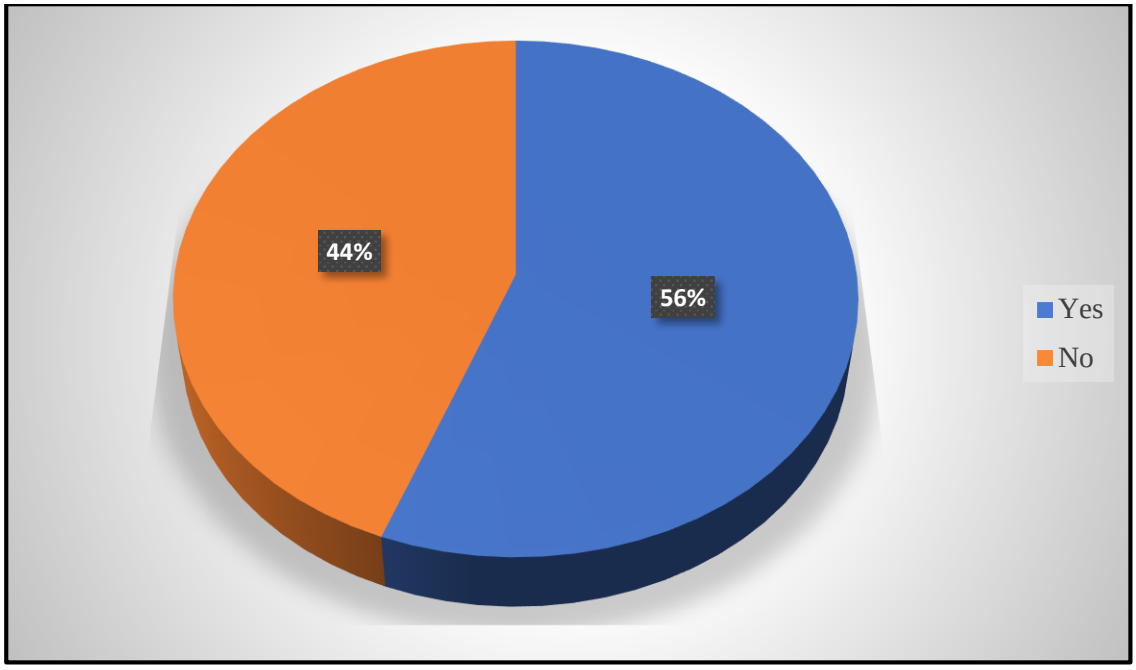

Figure 4.12: Awareness of methods of handling E-waste. Source: (Field Data, 2023)

Figure 4.10 above gives results on the awareness of methods of handling electronic waste. 56 %. The results are supported by education levels in the area. Again, the study area being a dumpsite area, most of the youth find their livelihood from the dumpsite and gain knowledge as a result of their daily involvement in the dumpsite therefore they seamlessly become aware of methods of handling e-waste. Studies done by Adeel *et al.,* (2023) agree with the above findings and the necessity of creation of more awareness and highlighted the lack of a comprehensive studies on consumer' awareness of e-waste and its disposal practices in most developing nations, mainly in Africa and south Asia. This poses a great need for more research to explore and enhance awareness on e-waste and its disposal practices to get the specific information to the handlers, while the in-depth results, would be beneficial in forming the policies needed. Hence, the present study explores the respondent's awareness of e-waste and the factors hindering e-waste disposal (Adeel, 2023). Raising public awareness of e-waste is crucial for driving behavioral changes and encouraging responsible disposal. Educating young people is especially important since they may be influential in encouraging sustainable behaviors and shaping their communities. Engaging youth in e-waste management initiatives promotes environmental stewardship, green job creation, and a sustainable circular economy that includes resource efficiency, refurbishment, repair,

recycling, reverse engineering, and component recovery. This information is being disseminated to households. Increased levels of awareness and knowledge among consumers will play a significant role in reducing e-waste, help manage e-waste dumping, and improve recycling strategies (Almulhim, 2022)

4.6.2: Methods of disposing E- waste

Electronic waste or e-wastes are materials produced from irreparable electronic gadgets such as a computer, laptops, mobile phones etc. These items are sometimes disposed off by burying in landfills or through incineration. Data was obtained analysed and presented in Table 4.10

Table 4.10: Methods of disposing E- waste

Ways of disposing of E- Waste	Frequency	Percentage
Landfill	132	48.2
Dispose with General Waste	161	58.8
Storage	162	59.1
Repair	182	66.4
Donation	205	74.8
Incineration	145	52.9
N= 274	**Each out of 274**	**100**

4.6.3: Environmental effects of E-waste disposal

The study further sought to explore the effects of careless e-waste disposal to the environment especially when e-waste material is exposed to excess heat, toxic chemicals are released into the air damaging the atmosphere. Respondent's responses were obtained and analyzed and results recorded as shown in Table 4.11

Table 4.11: Environmental effects of E-waste disposal

Effects of E-waste on the Environment	Frequency	Percentage
Accumulates in the environment	218	79.6
Poisons soils	204	74.5
Pollutes the air	181	66.1
Poisons Water	181	66.1
Harmful to living things	201	73.4
N= 274	**Each out of 274**	**Each out of 100**

Majority of the respondents, 79.4% agreed that e-waste accumulated in the atmosphere and harms the environment. The results seem to be almost in unison that E-waste is dangerous, and solutions needs to be found to avert the eminent danger of waste disposal.

Similarly, a study done by Geneva environmental networks found out that E-waste can be toxic, not biodegradable and accumulates in the soil, environment, air, water and in the bodies of living things. For example, acid baths and open-air burning are used to recover valuable materials from electronic components that usually release toxic materials leaching into the environment. Also throwing away an old cell phone might not seem very impactful to the environment at the time, but most e-waste will end up directly into a landfill. Once in a landfill, this waste can lead to lead, mercury, lithium, cadmium, and other toxins in the air, soil, and water (UNDP, 2023).

4.6.4: Solutions of Reducing E-Waste Generation in Kenya.

Globally the rapid advances in technology and the shifting tastes of consumers on electronic gadgets have brought about new challenges in the manner in which the disposal of these gadgets is being managed. The number of people using electrical appliances Kenya have also drastically increased. This has pushed many researchers to find solutions to the ever-increasing generation of e-waste. The study sought data from the respondents and presented it in Table 4.12

Table 4.12: Solutions of Reducing E-Waste Generation in Kenya.

Ways of reducing E- Waste generation	Frequency	Percentage
Donate or Sell Working Electronics.	167	60.9
Consume Less.	134	48.9
Use Your Old Mobile Phone for Music or GPS.	216	78.8
Recycle via a Retailer.	182	66.4
Check E-Cycling Centers in Your State.	154	56.2
Organize Your Electronics.	223	81.4
Know Your State's Laws About Battery Disposal	202	73.7
N= 274	**Each out of 274**	**Each out of 100**

Results shows that 81.4% didn’t want to organize their electronics which is done to describe the manner in which electronic transformation of organizations is done in line with today's Internet era, while 78.8% of the respondents did not believe using an old mobile phone for playing music of GPS was a good idea. This is because of the rapid advancement in technology where the new mobile phone comes with modern application technology abreast with customer needs. Again, mobile phones released years ago have run outdated versions of iOS or Android which means they often don't have critical security updates that can keep you and your data safe from prying eyes. a study done by Geneva Environmental Network. (2022). found out that most people wish to have control over activities in their mobile phones and feel threatened by new technology which they don’t understand. Additionally, many elderly people feel overwhelmed by the new technology and regard the things in their homes as extensions of their tools, identity and symbols and prefer maintaining them instead of disposing them. Their style and taste probably molded when they were middle age. The older generation are not in the vanguard in respect to taste, consumption and trends on the contrary Geneva Environmental Network. (2022).

4.7: Effectiveness of 7R strategy on e-waste management actions (Ranking)

Further, the study explored the effectiveness of the 7Rs as one of the methods used in in E- waste management through a ranking scale where the respondents were expected to rank the multiple choices provided in the questionnaires. Data was obtained from their responses and presented as shown Figure 4.13

4.7.1: Awareness of 7Rs among the respondents

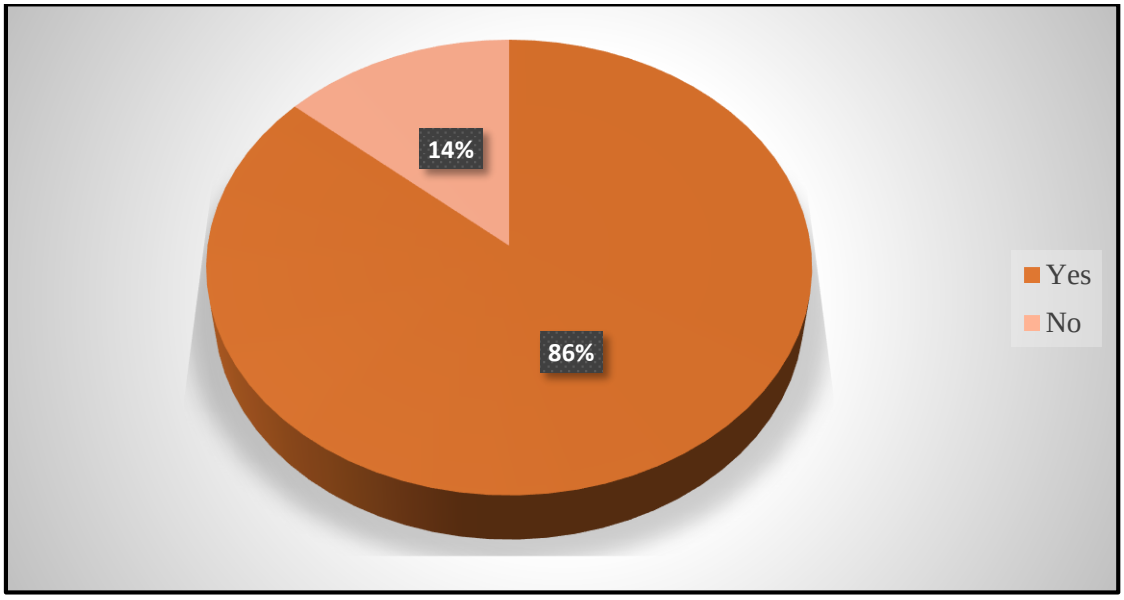

Figure 4.13: Awareness of 7Rs among the respondents. Source: (Field Data, 2023)

There was a strong consensus of the respondents reached by the study on whether they were aware of 7Rs strategy as an effective way of managing E waste in the area. 86% agreed that the application of reuse, recover, repair, recycle, regift, and rethink and refuse can offer a quick and reliable approach to waste management. This level of awareness can form a strong base for the implementation of the government policies on E-waste management in most county government dumpsites, particularly Dandora dumpsite the Biggest in the country. A study done by the electronic file organization found out that public awareness of the appropriate solid waste management practices that is the was the starting point for and fundamental ingredient of a sound resource-efficient and material-cycle society. It forms the basis of public capacity, which empowers the public to undertake actual actions of each element of the 7Rs. Such actions consequently become the inputs for the advancement or "performance" of 7Rs for a sound material-cycle society. Local and Central governments, entrepreneurs, environmental NGOs, mass-media, and others should all be involved in creating awareness because they influence public awareness through their practices, policies, and operations, which as a whole lead to "capacity development" (Abdulaziz,2022). This is portrayed in Figure 4.13. on how public awareness and the related actions can be increased forms the focus of this factsheet

4.7.2: Effectiveness of 7R strategy on e-waste management actions (Ranking)

Table 4.13: Effectiveness of 7R strategy on e-waste management actions

7 Rs	Frequency	Percentage
Recycling	229	83.6
Reuse	200	73.0
Reduce	163	59.5
Repair	196	71.5
Re-gift	94	34.3
Refuse	75	27.4
Recover	87	31.8
N= 274	**Each out of 274**	**Each out of 100**

There was a strong consensus of the respondents reached by the study on whether the 7Rs were an effective way of managing e-waste in the area. 83. 6% agreed that the application of recycling can offer a quick and reliable approach to waste management. The result could be because of the slow uptake of the e-waste by most companies dealing with e-waste materials from those wishing to dispose them, separation, repair and reintroduction of the same to the market in what is now gaining speed the circular economy. Similarly, the collection of solid waste in the country is done in an up-hazard manner by either street boys or chain of organized cartels. Electronic waste (e-waste) is one of the world's most rapidly rising solid waste streams (1). Less than a quarter of the e-waste produced globally in 2022 was known to be formally recycled; yet, e-waste streams include valuable and finite materials that can be repurposed if properly recycled. As a result, e-waste has become a significant source of cash for both individuals and communities. People in low- and middle-income countries (LMICs), particularly children, face the greatest risks from e-waste due to a lack of suitable rules, enforcement, recycling infrastructure, and training. Despite international legislation aimed at controlling the transit of e-waste from one country to another, transboundary movement to LMICs persists, often illegally. E-waste is considered hazardous waste because it includes poisonous elements.

E-waste is considered hazardous waste as it contains toxic materials and can produce toxic chemicals when recycled inappropriately. Many of these toxic materials are known or suspected to cause harm to human health, and several are included in the 10 chemicals of public health concern, including dioxins, lead and mercury. Inferior recycling of e-waste is a threat to public health and safety. Most of the e-waste handlers

do so without proper personal protective equipment they use bare hands (World health organization (WHO) 2024).

Most of the useful e-waste ends up being heaped up somewhere in the hope of selling it in future increasing the chances of more emissions into the atmosphere, air, soil or even in water as the sun strikes them. Similar studies done by NEMA in its vision 2030 plan strived to develop a strategy which will assist institutions, and the public involved in a 7R oriented society, by Reducing; Recycling; Rethinking, Re-using; Repairing, Refusing, and Refilling their waste. The main guiding principle on the National Waste Management Strategy is ZERO WASTE PRINCIPLE which treats waste as a resource that can be harnessed to create employment, wealth and reduce pollution of the environment (NEMA, Vision 2030).

4.7.3: Benefits of using 7Rs in E-Waste Management

Besides effective management of the 7Rs in e-waste management, it can also help in reducing the number of materials people buy and use, recycle product and reusing items and packaging, all these actions are significant in reducing our environmental impacts and help us achieve a "circular economy". The study therefore sought to find out the benefits of using the 7Rs as a strategy of managing the environment. Data was analyzed and results presented as in Table 4.14

Table 4.14: Benefits of using 7Rs strategy

	Frequency	Percentage
Green House Gas (GHG) reduction through energy efficiency and resource efficiency and can reduce the Carbon Dioxide (CO2) emission.	227	82.8
Techniques adaptation, employment and job creation.	217	79.2
Production of organic gas from bio-degradable wastes	215	78.5
Attracting foreign direct investment through emission reduction credits and pollution reduction and other environmental benefits	217	79.2
Prevent pollution and enriches soil condition and can provide a healthy environment to the people of the cities	230	83.9
Would be economically profitable as it will generate reusable power and energy	223	81.4
	Each out of 274	**Each out of 100**

Results shows a general consensus on all the variables examined the benefits of 7Rs to the environment in the area of study with majority of the respondents 83.9% agreeing that the strategy enriches soil condition and prevents pollution. This in turn creates a health and cleaner cities for the inhabitants. This was closely followed by 82.8% of those who said that the strategy reduces the production of Green House Gas (GHG) through adoption of energy efficiency and resource efficiency domestic appliances which reduce the Carbon Dioxide (CO2) emission. The above results are in line with HSBC report which urges all environment and government stakeholders to make sure they are promoting recycling across all sectors. Business can increase their monetary returns if their waste or trash is treated rightly. This can be done by collaborating with waste management agencies, one can recycle and reuse waste instead of buying new products. Most governments are giving state tax credits and incentives that are available for businesses who' are willing to adopt clean energy solutions like the use of solar, wind or geothermal energy that is going green. In reality making electronic waste (or e-waste) disposal clean and sustainable across the country helps to prevent e-waste contributing to environmental degradation by collecting waste and spreading awareness on more sustainable methods to dispose e-waste (HSBC, 2023).

4.8: Effects of Polluter Pays Principle (PPP) on waste management

4.8.1: Knowledge of polluter pays principle

The knowledge of the 'polluter pays' principle helps people to know their rights like those who pollute the environment should bear the cost and responsibility managing it to lessen the damage brought about by pollution to the environment and human health. Figure 4.14 the respondent's opinion in connection to their awareness

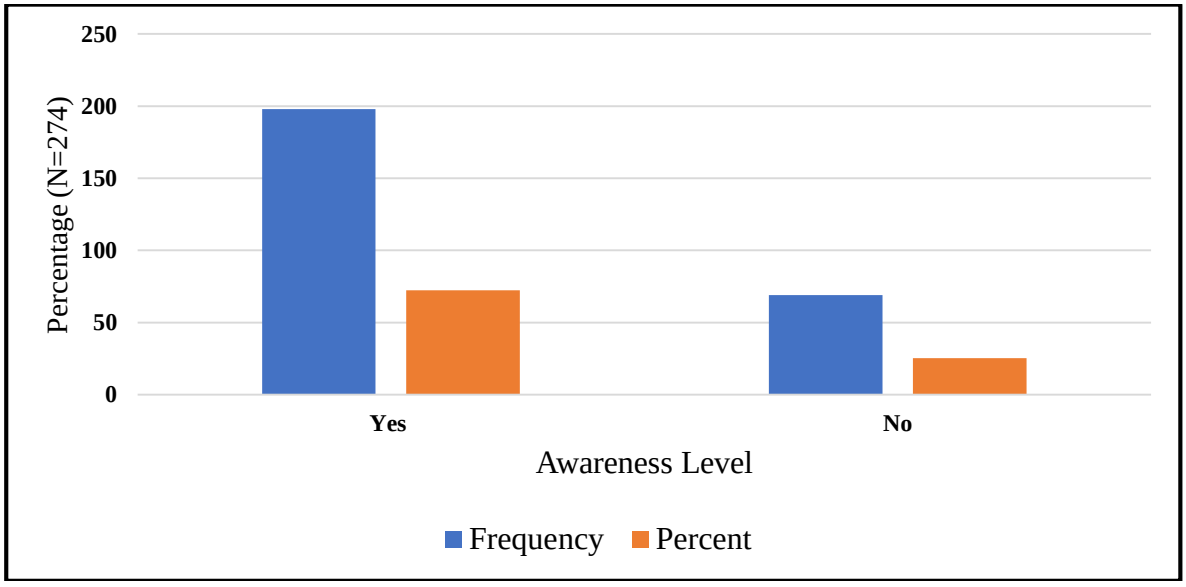

Figure 4.14: Knowledge of polluter pays principal. Source: (Field Data, 2023)

Majority 72.3 % of respondents indicated they were aware of the PPP principle This can be interpreted to mean that the respondents are aware that absolute liability for harm to the environment does not only apply to them but extends to other polluters and not only to compensates the victims of pollution but also the cost of restoring the environmental degradation. The principle can be used in allocation of costs of pollution and the control measures to encourage the rational use of scarce environmental resources. It also helps in avoiding the distortions in investments and international trade.

The above results agree with a report by the International Center for Sustainable Development IISD (2022) that the cost measures should be reflected in the cost of services and goods that causes consumption and production of goods. however, despite

these seemingly straightforward applications of the PPP and positive advances made in this principle, the polluters should be made to pay for the environmental harm they cause by taking on the costs of preventing pollution and the control measures nonetheless its uses in contemporary international environmental law shows there still exists considerable ambiguities and uncertainties. Unlike the principle of common but differentiated responsibilities (CBDR), the Polluter pays Principle refers to economic reparations from those responsible for environmental harm which is an issue of individual responsibility rather than state responsibility.

Therefore, the PPP helps to establish a mechanism to reduce environmental degradation but does not help in determining who the polluter is. Unsurprisingly, few organizations or people dare to step forward to claim the title of "the polluter." This lack of clarity on who makes up the connections of the chain of polluters is the reason why the PPP has found its way into regulations of some countries, particularly those in the European Union. These countries have not uniformly been incorporated into the universal international agreements, which would require all countries enforce its rules (ICSD, 2022)

4.8.2: Application of polluter Pays Principle in the area

The polluter pays principle is a relatively new concept to most African countries. In Kenya, the concept is currently gaining popularity with the effects of climate change being felt far and wide across the country. The sought respondents' opinions on whether they were aware of polluter pay principle. Data obtained was analyzed and presented as shown

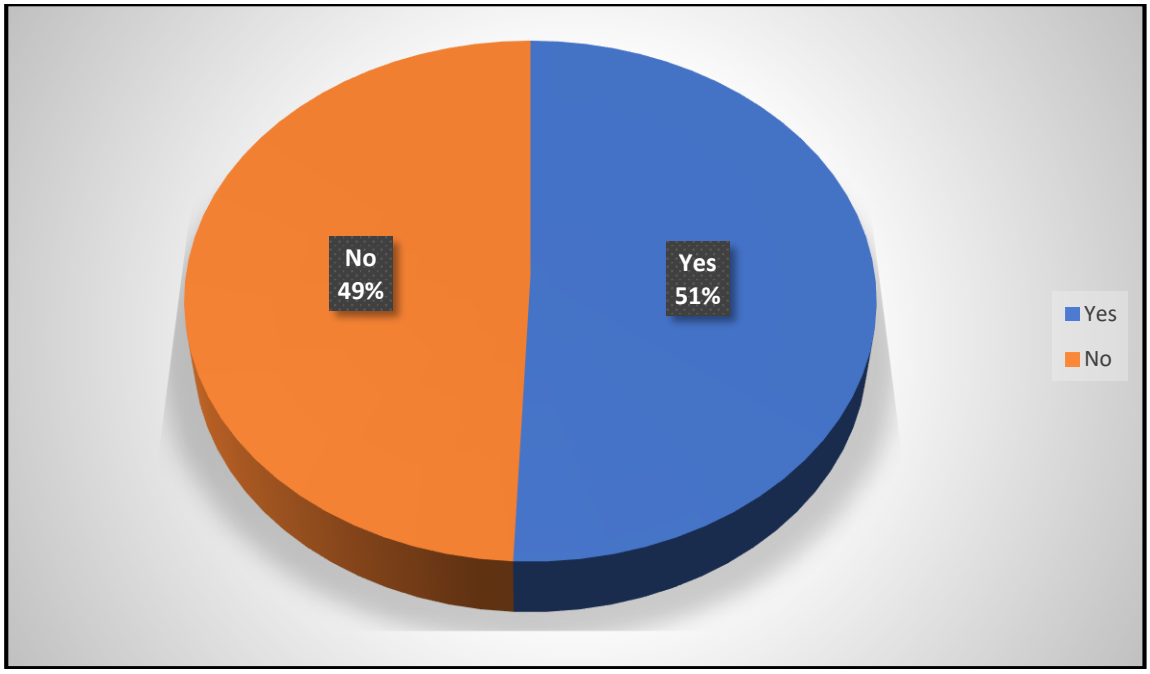

Figure 4.15: Application of polluter Pays Principle in the area. Source: (Field Data, 2023)

From the above Figure 4.15, results show 51 % of respondents believe that the application of the polluter pays principle can work in the country and the area of study if the law enforcement agencies act swiftly on polluters of the environment. However, 49 % were of the contrary opinion that the principle is simply on paper and cannot work in the country because of the systemic corruption in almost all sectors. Since One specific application of the PPP consists in adjusting these taxes or fees which are in conformity with domestic law, to cover more entirely the cost of certain exceptional measures to control and prevent accidental pollution in specific hazardous installations which are occupied by public authorities, the principle can be applied to specifically target greenhouse gas emitters through a so-called 'carbon price'. This sets a charge on the emission of greenhouse gases that are equivalent to the corresponding potential cost caused through future climate change, forcing emitters to internalize or take on, the cost of pollution

The findings concur with the results of study done by London School of Economics (2022) which found that the ‘polluter pays’ principle is the commonly accepted practice that sates that those who pollute should bear the costs of managing the pollution they cause and should prevent damage to the environment and human health. For instance, a factory that produces a potentially poisonous substance as a by-product of its activities

should be held responsible for its safe disposal. The PPP is part of a set of broader principles to guide sustainable development globally (formally known as the 1992 Rio Declaration). The principle underpins most of the regulation of pollution affecting water, land and air. Pollution is defined in United Kingdom law as contamination of water, land and air by potentially harmful or harmful substances. - (London School of Economics, 2022).

4.8.3: Benefits of application of Polluter Pays Principle

It has been argued that the application of PPP economically promotes efficiency; promotes harmonization of international environmental policies and legally, it promotes justice and defines the method of to how to allocate costs within a state.

Table 4.15: Benefits of application of Polluter Pays Principle

Benefits	**Frequency**	**Percentage**
Economically, it promotes efficiency	220	80.3
Legally, it promotes justice	200	73.0
It promotes harmonization of international environmental policies	176	64.2
It defines how to allocate costs within a state	143	52.2
Focuses attention on the implications of waste generation	169	61.7
Provides a direct economic incentive for waste prevention Recover	171	62.4
Ensures that the waste management costs arising during the life of a product are included in the price charged to consumers	202	73.7

Results from Table 4.15 shows that majority 80.3% (N= 220) of the respondents believed that the application of the PPP has an economic benefit of promoting efficiency in the production sector followed by 73.0% (N=202) saying that the principle has a legal benefit of promoting environmental justice and international justice by forcing the international community to honor the multilateral environmental agreements which aims at making the environment a heaven for the future generation by controlling Greenhouse gas emission to acceptable 1.5. Also, Effective waste management can help reduce costs through methods like source reduction, optimizing recycling processes, and composting organic waste. Implementing these strategies leads to substantial financial and environmental benefits. Degrees Celsius pre-industrial era. However, though there are enormous benefits of application of PPP, the

application is faced with enormous challenges like some industries hide the fact that they are directly responsible for pollution and the administration cost of trying to locate the polluter may be very expensive. Still some types of environmental pollution may sometimes be horrific and long-lasting. Calculation of the cost to pay for the environmental damage may require government agencies or authorities to force them pay the full social cost. (Economic help, 2017).

4.8.4: Disadvantages of polluter pays Principle

Industrial facilities may also try to hide the fact that they are responsible for a pollution event. Administration expenses spent to identify the polluter, and hold them to account, may also be considerable. Some types of environmental pollution are long-lasting and horrific. Drinking water and sewage treatment services are subsidized and there are limited mechanisms in place to fully assess polluters for treatment costs. The ppp can be effective in eliminating the continued degradation of the environment. The principle places a fee on emission of greenhouse gases that equals the cost incurred by the environment. Thus making polluters bear the cost that was otherwise borne by others. This principle aims to ensure that polluters bear the costs of their actions and encourage sustainable development practices globally (Earth and Planetary Sciences, 2025).

4.8.5: Success of E-waste management Campaigns

E-waste campaigns through the media and other forums have helped to minimize greenhouse gas emissions: Recycling electronic waste lowers greenhouse gas emissions from raw material extraction and production. Resource Recovery: Recycling allows valuable metals such as gold, silver, and platinum to be recovered from electronic recyclables. Proper waste management can help to reduce pollution, prevent disease transmission, and conserve natural resources. It can also generate job opportunities and stimulate the local economy. Improper waste management has a serious impact on both the environment and human health. Waste that is not disposed of properly can pollute the air, water, and land, causing significant environmental deterioration. It can also harm animals and marine life, with a cascade impact on the food.

Improper waste management can have a serious impact on human health. Hazardous waste exposure can lead to respiratory problems, skin irritation, and other health issues. Improper disposal of medical waste can spread illnesses, posing a serious threat to

public health. All these negative effects can be reduced by employing good waste management procedures World Health Organization (WHO), (2024)

4.8.6: The Benefits of Effective Waste Management

Effective waste management provides various environmental, health, and economic benefits. Proper waste management can help to reduce pollution, prevent disease transmission, and conserve natural resources. It can also generate job opportunities and stimulate the local economy. Recycling waste can reduce the demand for raw materials, save energy, and lower greenhouse gas emissions. By minimizing waste generation, we can lessen the demand for landfills, which can pose environmental and health risks. Effective waste management can also contribute to environmental sustainability. It can help us transition to a circular economy, in which garbage is viewed as a resource and reused or recycled. By implementing sustainable waste management procedures, we may reduce our environmental impact and contribute to a better, cleaner future (Sk, 2022)

4.8.7: Correlation between Gender, education and generation of E-waste

In this section, the study sought to find out whether there was a relationship between the level of education, gender and the generation of E-waste. The aim of this was to find out whether the level of education attained increased or reduced the amount of E-waste generated by each individual household.

Table 4.16: Correlation between Gender, education and generation of E-waste

		Education	Generation of E-waste	Gender
Education	Pearson Correlation		-.051	.313**
	Sig. (2-tailed)		.398	.000
				-.020
	N	**274**		

**. Correlation is significant at the 0.01 level (2-tailed).

Further statistical analysis gave a moderate negative correlation of (-051) (p=0.01) between education and generation E-waste. This result could be attributed to the lumping up of the waste together with the general waste (no separation) and the fact

that when an electronic appliance fails it has failed and education cannot bring it to a functioning state unless one is trained in related field. On gender and education, results gave weak positive correlation of (.313) (p=0.01) which was statistically significant. Gender and the generation of E-waste gave a weak negative correlation of (-020). This is gender inequality between gender and waste management and the quicker we address this the faster we create a more sustainable waste management sector.

In many countries, women are traditionally responsible for managing household waste as part of their everyday responsibilities, hence they are more involved in domestic waste management and waste management services. Women generally work in the bottom tiers of the informal waste management business, sorting and segregating rubbish at dump sites. At the same time, men dominate higher-income and decision-making positions, such as truck drivers, scrap dealers, repair shop personnel, and those involved in the purchase and reselling of recyclables. This reflects the gendered division of labor in society, but it also implies that when waste management operations are codified, women are frequently excluded from protections and advantages such as social security or higher salaries. As the trash industry modernizes and implements new.

4.8.8: The correlation between Gender, Education and E-waste disposal

Descriptive Statistics

Table 4.17: Correlation between Gender, Education and E-waste disposal

		E-Waste disposal
Education	Pearson Correlation	.012
	Sig. (2-tailed)	.839
Gender	Pearson Correlation	-.079
	N= 274	

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

Result from the above Table 4.17 gives a weak positive (0.12) (p= 0.05) a statistically significant correlation between education and e-waste disposal. This could be because responsible education doesn't require expertise. People can be shown how to sort the e-waste and recycle or repair. Gender and e-waste disposal gave a strong negative relationship of (- 0.79). This is because of gender differences in solid waste management.

Table 4.18: Correlation between waste disposal and education

		Education	Land fill	General waste	Storage	Repair	Donation	Incineration
Education	Pearson Correlation	1	.120*	.162**	-.003	.020	.083	.039
	Sig. (2-tailed)		.048	.007	.958	.740	.171	.522
	Covariance		.073	.155	-.005	.035	.161	.103
Land fill	Pearson Correlation		1	.424**	.277**	-.030	.252**	.391**
	Sig. (2-tailed)			.000	.000	.621	.000	.000
	Covariance			.274	.281	-.036	.329	.701
General waste	Pearson Correlation			1	.221**	.020	.228**	.325**
	Sig. (2-tailed)				.000	.741	.000	.000
	Covariance				.353	.038	.470	.919
Storage	Pearson Correlation				1	.063	.364**	.317**
	Sig. (2-tailed)					.301	.000	.000
	Covariance					.184	1.177	1.406
Repair	Pearson Correlation					1	.190**	.156*
	Sig. (2-tailed)						.002	.010
	Covariance						.718	.805
Donation	Pearson Correlation						1	.521**
	Sig. (2-tailed)							.000

	Covariance	2.975
Incineration	Pearson Correlation	1
	Sig. (2-tailed)	
	Covariance	
	N =274	

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

**. Correlation is significant at the 0.01 level (2-tailed).

When with other variables in e-waste disposal education showed a strong (0.162) positive relationship with landfill when compared with the other variables. This could be because of the fact that educated people are aware of the environmental impacts careless e- waste disposal can cause to air through emission, soil when the poisonous chemicals dissolve or mixes with soil or water when they dissolve in water. In this respect therefore the are careful when disposing them. The study sought to find the relationship between land fill and disposal of e-waste disposal. Results showed weak positive correlation (0.424) this result can be attributed to the fact that landfills act as recipient of solid waste including e-waste.

When e-waste disposal with general waste was correlated with the other the other variables of e-waste disposal methods it showed a weak positive relationship (0.325) with incineration. This is because in some way the e-waste parts which are not useful find their way in the incinerator while others are burned together with the other general waste at the damp site. In most dumpsites in Kenya Dandora included, most of the not useful solid waste are burned that why in most dumpsites, one will notice smoke billowing almost daily as the waste burns this compound the problem of air pollution

Further the study showed a correlation between storage of electrical appliances for prestige or future use and results obtained showed a weak positive (.364) correlation with donation of old, unused or unwanted gadgets to other people who need them. This can be as a result of the fact that some government offices discard old and unused electrical equipment like desktop computers, printers and scanners for other institutions like schools. Non- governmental organizations donate their electronic equipment's to other institutions which need it.

When repair of old gadgets or upgrading of old equipment was correlated with donation of unwanted gadgets results showed a weak positive relationship of (.190). This could be because of financial constraints facing most institutions, they prefer to repair them to save on the cost of buying new or refurbished equipment. They would also prefer to donate the equipment as earlier stated. Donation of old equipment and incineration had a strong positive relationship of (.521). This could be because many organizations might prefer to donate unwanted electrical equipment than watch it burn.

Table 4.19: Correlation between E-waste management and Education and effectiveness of 7Rs

		Awareness	Education	Recycle	Reuse	Reduce	Repair	Regift	Refuse	Recover
Awareness	Pearson Correlation	1	-.051	-.094	-.043	-.068	-.073	-.032	.031	.007
	Sig. (2-tailed)		.398	.121	.479	.263	.230	.603	.607	.912
Education	Pearson Correlation		1	.129*	.003	.207**	.100	.064	-.096	-.112
	Sig. (2-tailed)			.033	.963	.001	.101	.295	.116	.064
Recycle	Pearson Correlation			1	.338**	.664**	.659**	.151*	.120*	.117
	Sig. (2-tailed)				.000	.000	.000	.013	.047	.054
Reuse	Pearson Correlation				1	.405**	.341**	.162**	.280**	.290**
	Sig. (2-tailed)					.000	.000	.007	.000	.000
Reduce	Pearson Correlation					1	.658**	.137*	.044	.113
	Sig. (2-tailed)						.000	.024	.467	.062
Repair	Pearson Correlation							.266**	.131*	.153*
	Sig. (2-tailed)							.000	.030	.011
Regift	Pearson Correlation							1	.563**	.459**
	Sig. (2-tailed)								.000	.000

Refuse	Pearson Correlation	1	.736**
	Sig. (2-tailed)		.000
Recover	Pearson Correlation		1
	Sig. (2-tailed)		

N= 274

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

**. Correlation is significant at the 0.01 level (2-tailed).

Further the study investigated whether there was a correlation between levels of education of the respondents of Dandora Dumpsite, level of awareness of e-waste management and the 7Rs as one of the best methods of solid waste management including e-waste. Statistical analysis was done using SPSS and results showed negative correlation between the level of awareness with all 7Rs variables except with refuse (.031) a weak positive correlation and recovery (.007) also a weak positive correlation. This could be because of the awareness campaigns done in the Dandora dumpsite and the country on proper e-waste management practices to ensure occupational safety among the waste handlers.

When education was correlated with all the 7Rs, results showed a positive relationship with all the 7R variables under observation except in refuse (-.096) and recover (-.112) which both gave a strong negative correlation. Earlier study results showed that most of the respondents age was youthful therefore, most of the e-waste workers in the dumpsite are youthful and not much educated. Coupled with this, they use unsustainable technologies to manage e-waste in the dumpsite like using their bare hands to sort the e-waste from the other solid wastes posing a great danger to their health. Results of correlation with the other variables are shown in table 4.18 above.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1: Summary

A total of 274 household heads were visited during the research and interviews, though the sample size was 328 household heads. Among the respondents (n=328) targeted 274 were reached and out of these, majority 149 were male (45.4 %) participated in the study, while 124 were women representing (37.8%) participated. Majority respondents were between 25-40 years. The mean age for the males was 31.67 while for the females was 30.55 years the oldest was 61 years, while the youngest was 18years. The range was 43 years, while the mean age for both genders was 31.11 years (stdev ± 6.704)

ICT and telecommunications equipment was the greatest source of E- waste in the study area. It was closely followed by Toys/leisure/sports, while large household appliances followed. This could be because every year, millions of electrical and electronic devices are discarded as products break or become obsolete and are thrown away. These discarded devices are considered e-waste and can become a threat to health and the environment if they are not disposed of and recycled appropriately.

The study sought to determine the study respondents' level of awareness and willingness to engage in a study on how to manage e-waste in Dandora dumpsite. The study found out that proper waste disposal using the 3Rs and the 7Rs by extension can be critically important in minimizing the environmental problems being experienced in the area, country and globally.

The study also determined an increased level of awareness among the study participants awareness of methods of handling electronic waste. 56 %. However, 44% of the study participants appeared to lack a detailed understanding and proper education of e-waste management. For example, 31.7% of the study respondents had not received any education from any source on managing e-waste, which may be detrimental to curbing the problem in Dandora dump site and other regions across the county. This is a major weakness affecting the community in the study area and local agencies in their efforts to deal with e-waste. Therefore, to address this issue, it is important to accelerate awareness campaigns to increase the level of awareness among household members on ways of managing e-waste.

The reasons that the respondents provided for disposing of electronic products included theft, upgrades, damage to the products and the availability of current or modern technologies they wanted to get. The need to match with global advance in technology has pushed a lot of people to discard the current electrical equipment and buy new ones, increasing the quantity of E-waste being generated by individual household. However, the disposal of the old equipment presents an environmental challenge to people in Dandora, the county and the country at large, this has been exacerbated by the rapidly increasing population due to rural urban migration. The study found out that poor waste disposal methods has also increased environmental problems with majority 79.4% agreeing that e-waste accumulated in the atmosphere and harms the environment. The results seem to be almost in unison that e-waste is dangerous, and solutions needs to be found to avert the eminent danger of e-waste disposal, because most of the respondents lacked adequate knowledge of how to dispose e-waste effectively.

The study also revealed that most participants were willing to engage in e-waste management with majority 80.3% of the respondents who believed that the application of the PPP has an economic benefit of promoting efficiency in the production sector followed by 73.0% saying that the principle has a legal benefit of promoting environmental justice and international justice by forcing the international community to honor the multilateral environmental agreements which aims at making the environment a heaven for the future generation by controlling greenhouse gas emission to acceptable 1.50C pre- industrial era.

Majority of e-waste handlers in the study area were males. This is in contrary to the expectations of existing literature that more female workers would be involved. The same study also established there was an increased engagement of younger age population in informal e-waste sector. The high involvement of the youth in this sector indicates a higher unemployment rate in the area of study.

Results indicate that 52.6% of the electronic waste is from the private sector. Government offices 50.7% where the rest of the sources were distributed in other variables. This is because most of the electronic appliances are found in private sectors and in government offices who doubles as the biggest importers of the same. Results show that 60.7% of the respondents agreed that government policy in connection with electronic waste and which is in existence was not implemented in the area. Results on the awareness of methods of handling electronic waste. 56 %. Majority of the respondents, 79.4%, agreed that e-waste accumulated in the atmosphere and harms the

environment. The results seem to be almost in Unison that E-waste is dangerous and solutions need to be found to avert the eminent danger of waste disposal.

There was a strong consensus of the respondents reached by the study on whether they were aware of 7Rs strategy as an effective way of managing e-waste in the area. 86% agreed that the application of reuse, recover, repair, recycle, regift, and rethink and refuse can offer a quick and reliable approach to waste management. This level of awareness can form a strong base for the implementation of the government policies on e-waste management in most county government dumpsites, particularly Dandora dumpsite, the biggest in the country.

5.2: Conclusion

Results on electronic separation show that majority of the respondents indicated they were aware of separation of electronic waste, and said they were not aware. This percentage of those who are not aware of waste separation is big and more education should be given to the residents to make them aware. Most of the garbage generated in the houses is collected and put into garbage dumpsite. The study found out separation of garbage in the household helps in putting the e-waste aside and other solid waste aside. The household can have the opportunity to select from the e-waste those which can be reused, recovered, repaired, recycled or regifted.

There was a strong consensus of the respondents reached by the study on whether they were aware of 7Rs strategy as an effective way of managing e-waste in the area. 86% agreed that the application of reuse, recover, repair, recycle, regift, and rethink and refuse can offer a quick and reliable approach to waste management. This level of awareness can form a strong base for the implementation of the government policies on e-waste management in most county government dumpsites, particularly Dandora dumpsite the biggest in the country.

The majority 72.3 % of respondents indicated they were aware of the Polluter Pay Principle (PPP). This can be interpreted to mean that the respondents are aware that absolute liability for harm to the environment does not only apply to them but extends to other polluters and not only to compensate the victims of pollution but also the cost of restoring the environmental degradation. The principle can be used in allocation of costs of pollution and the control measures to encourage the rational use of scarce environmental resources.

5.3: Recommendations

ICT and telecommunications equipment emerged as the leading source of e-waste in the study area closely followed by toys, leisure/sports items, and large household appliances. It is imperative that targeted e-waste management strategies be developed and implemented by authorities and stakeholders specifically for high-volume categories such as ICT equipment.

The study recommends the stepping up of the e-waste public awareness campaigns to educate consumers on the environmental and health risks associated with improper disposal, while promoting repair, reuse, and safe recycling practices. Additionally, policies that encourage extended producer responsibility (EPR) should be enforced to ensure manufacturers take part in the lifecycle management of electronic products.

Thirdly national and county governments can significantly reduce environmental pollution and move toward a zero-waste society by promoting and implementing the 7R strategy in e-waste management. This approach emphasizes waste minimization and supports bold, sustainable practices essential for long-term environmental stewardship.

Finally, national and county authorities should promote the adoption of economic instruments that internalize environmental costs, in line with the Polluter Pays Principle. This approach ensures that those responsible for pollution bear the associated costs, thereby protecting public interest while avoiding distortion of international trade.

5.4: Areas of Further Research

Future studies should focus on quantifying the monetary benefits of effective e-waste management practices, particularly recycling. Such research can help estimate cost savings from reduced landfill use and pollution, as well as gains from energy conservation, natural resource preservation, job creation, and broader economic contributions to communities.

Further research is needed to examine the long-term environmental effects of e-waste, given its toxic composition, non-biodegradability, and tendency to accumulate in air, water, and soil. Understanding its impact on ecosystems and human health will inform safer disposal practices and stronger environmental policies.

REFERENCES

Abdulaziz. (2022). *Household's awareness and participation in sustainable electronic waste management practices in Saudi Arabia.* Retrieved 9 29, 2023, from https://www.sciencedirect.com/science/article/pii/S2090447922000405#:~:text=Increased%20levels%20of%20awareness%20and,separation%20and%20disassembly%20

Adeel. (2023). *University students' awareness of e-waste and its disposal practices in Pakistan: a construction of the conceptual framework.* Journal of Material Cycles and Waste Management. Retrieved 9 25, 2023, from https://link.springer.com/article/10.1007/s10163-023-01707-7

Africanews. (2023, march 7). *Entrepreneurs in Nairobi find a way to tackle electronic waste*. Retrieved from africanews.com: https://www.africanews.com/2023/03/07/entrepreneurs-in-nairobi-find-a-way-to-tackle-electronic-waste//#:~:text=Kenya's%20annual%20electronic%20waste%20generation,of%20by%20individuals%20or%20companies

.Alabansa, S., Mahrad, B., Icely, J., & Newton, A. (2021). Electronic Waste, an Environmental Problem Exported to Developing Countries: The GOOD, the BAD and the UGLY. *Sustainability, 13*(9), 5302. Retrieved 9 29, 2023, from https://www.mdpi.com/2071-1050/13/9/5302

Alves. (2023). *Global E-Waste - Statistics & Facts.* Retrieved 9 29, 2023, from Global E-Waste - Statistics & Facts

Andrews, K. (2014). Economic value of marriage, family and relationship breakdown. Retrieved 5 4, 2023, from https://formerministers.dss.gov.au/15362/economic-value-of-marriage-family-and-relationship-breakdown/

Ankit. (2021). *Electronic waste and their leachates impact on human health and environment: Global ecological threat and management.* doi:https://doi.org/10.1016/j.eti.2021.102049

Babs-Shomoye, F., & Kabir, R. (2016). Health Effects of solid waste disposal at a dumpsite on the surrounding human settlements. *Journal of Public Health in Developing Countries, 2*(3), 268-275.

Balde, C.P., , Forti, V.,, Gray,V., , Kuehr, R., , & Stegmann, P. (2017). *The Global E-Waste Monitor.* Bonn/Geneva/Vienna: UNU, ITU & ISWA.

Button, K. (2016). 20 Staggering E-Waste Facts. *e-waste exposed*. Retrieved November 25, 2022, from https://laptrinhx.com/link/?l=http%3A%2F%2Fwww.earth911.com%3Fp%3D330999%26preview_id%3D330999

Chung. (2020). What Is A Good Survey Response Rate? *Smart Survey*. Retrieved 10 26, 2023, from https://www.smartsurvey.co.uk/blog/what-is-a-good-survey-response-rate

Cleave. (2022). What does an average survey response rate look like? *smart survey*. Retrieved 10 26, 2023, from https://www.smartsurvey.co.uk/blog/what-is-a-good-survey-response-rate

Coase, M. C. (2015). Economic Assessment of Municipal Waste Management Systems-Case Studies Using a Combination of Life Cycle Assessment and Life Cycle Costing. *Journal of Cleaner Production*, 253-263.

Conserve energy for future. (2023). *What is E-waste Recycling and Process of Recycling Electronic Waste.* Retrieved 9 25, 2023, from https://www.conserve-energy-future.com/e-waste-recycling-process.php

Criscos Provider. (2020). *What does electrical equipment mean?* Retrieved from https://staffhelp.secure.griffith.edu.au/app/answers/detail/a_id/4038/~/what-does-electrical-equipment-mean%3F#:~:text=Electrical%20equipment%20means%20any%20apparatus,voltage%20greater%20than%20extra%2Dlow

Davis, J.-M., Akese, G., & Garb, Y. (2019). Beyond the pollution haven hypothesis: Where and why do e-waste hubs emerge and what does this mean for policies and interventions? *Geoforum, 98*, 36-45. Retrieved November 5, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S001671851830280X

De Rosa. (2023). *Hazardous Wastes.* Environmental Soil Chemistry (Second Edition), 2003. Science Direct . Retrieved from https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/hazardous-waste

Earth and Planetary Sciences. (2025). Polluter-Pays Principle. Retrieved 3 4, 2025, from https://www.sciencedirect.com/topics/earth-and-planetary-sciences/polluter-pays-principle#:~:text=This%20principle%20aims%20to%20ensure,encourages%20sustainable%20development%20practices%20globally.

Economic help. (2017). *Polluter pays principle (PPP).* Retrieved 9 25, 2023, from https://www.economicshelp.org/blog/6955/economics/polluter-pays-principle-ppp/#:~:text=The%20polluter%20pays%20principle%20is,is%20a%20tax%20on%20petrol.

Elanpro. (2022). E-WASTE. *Intoroduction to e-waste*.

Electronic File Organization. (2016). *Electronic File Organization Tips.* Retrieved 9 25, 2025, from https://www.nist.gov/system/files/documents/2022/03/30/ElectronicFileOrganizationTips-2016-03.pdf

EMPA. (2019). *What is e-waste?* Retrieved 9 29, 2023, from https://www.step-initiative.org/e-waste-challenge.html

Geneva Environmental Network. (2022). The Growing Environmental Risks of E-Waste. Retrieved 3 4, 2025, from https://www.genevaenvironmentnetwork.org/resources/updates/the-growing-environmental-risks-of-e-waste/

Geo-Information Science and Earth Observation Kenyatta University, 2025).

Ghulam, S. T., & Abushammala, H. (2023). Challenges and Opportunities in the Management of Electronic Waste and Its Impact on Human Health and Environment. *Sustainability, 15*(3), 1837. Retrieved from http://dx.doi.org/10.3390/su15031837

Gibbons, S. (2021, October 21). How Companies Are Addressing The E-Waste Problem. *Forbes*.

Gill, F. L., Viswanathan, K., & Karim, M. Z. (2018). The critical review of the pollution haven hypothesis. *International Journal of Energy Economics and Policy, 8*(1), 167-174. Retrieved 11 7, 23, from https://www.researchgate.net/publication/322919576_The_critical_review_of_the_pollution_haven_hypothesis

GoK. (2019). *Ministry of Environment and Forestry National E-Waste Management Strategy-Revised Draft.* Nairobi.

Great Lakes Electronics Corporation. (2023). *What is E-waste? Definition and Why It's Important.* Retrieved 9 25, 2023, from https://www.ewaste1.com/what-is-e-waste/

Hansen, U. E., Nygaard, I., & Dal Masso, M. (2020). The dark Side of the sun: Colar e-waste and environmental upgrading in the off-grid solar PV value Chain. *Industry and Innovation,*, 1-21.

HSBC. (2023). *Discover the 3Rs (Reduce, Reuse, and Recycle) of Waste Management.* Retrieved 9 25, 2023, from https://www.businessgo.hsbc.com/en/article/what-is-3rs-reduce-reuse-recycle

International labor Organization (ILO). (2024). The future of work in the electronics industry. *Advancing decent work in more inclusive, sustainable and resilient electronics*. Retrieved 2 26, 2025, from https://www.ilo.org/sites/default/files/2024-11/The%20future%20of%20work%20in%20the%20electronics%20industry_WEB_Rev.pdf

International labor Organization (ILO). (2024). The future of work in the electronics industry. *Advancing decent work in more inclusive, sustainable and resilient electronics*. Retrieved 2 26, 2025, from https://www.ilo.org/sites/default/files/2024-11/The%20future%20of%20work%20in%20the%20electronics%20industry_WEB_Rev.pdf

lmulhim, A. I. (2022). Household's awareness and participation in sustainable electronic waste management practices in Saudi Arabia. *Ain Shams Engineering Journal, Volume 13,*(Issue 4, June 2022, 101729). doi:https://doi.org/10.1016/j.asej.2022.101729

ICSD. (2022). H*ow to Enforce the Polluter-Pays Principle.* Retrieved from How to Enforce the Polluter-Pays Principle

IGAD. (2023). *Electronic Waste (E-waste) Management plan.* IGAD. Retrieved 9 29, 2023, from https://igad.int/wp-content/uploads/2023/05/E-Waste-Management-Plan-for-Intergovernmental-Authority-on-Development-EA-RDIP-P176181-PCDF9PGZW2.pdf

Kenya News Agency. (2025). Experts Warn Kenyans Against Unsafe E-Waste Disposal. Retrieved 3 4, 2025, from https://www.kenyanews.go.ke/experts-warn-kenyans-against-unsafe-e-waste-disposal/#:~:text=Kenya%20collects%20an%20approximate%2051%2C300,the%20environment%20and%20human%20life.

KBNS. (2019). *2019 Kenya Population and Housing Census: Volume I.* Nairobi: the kenya national bureau of statistics. Retrieved from https://housingfinanceafrica.org/app/uploads/VOLUME-I-KPHC-2019.pdf

Kippra. (2023). *Rejuvenating Local Manufacturing in the Context of Secondhand Economy.* Retrieved 9 25, 2023, from https://kippra.or.ke/rejuvenating-local-manufacturing-in-the-context-of-secondhand-economy/

KNBS. (2019). *Kenya Population and Housing Census Volume, I: Population by County and Sub-County* . Nairobi: Government of Kenya.

kwame. (2021). *Examining Enforcement of Environmental Laws at Dandora Dumpsite in Kenya: A Review.*

Kwame. (2023). *Examining Enforcement of Environmental Laws at Dandora Dumpsite in Kenya: A Review.* Research gate. doi:DOI:10.2139/ssrn.3882169

Laniyan, T. A., & Adewumi, A. J. (2019). Health risk assessment of heavy metal pollution in groundwater around and exposed dumpsite in southwestern Nigeria. *Journal of Health and Pollution, 9*(24), 191-210.

London School of Economics. (2022). *What is the polluter pays principle?* Retrieved 9 25, 2023, from https://www.lse.ac.uk/granthaminstitute/explainers/what-is-the-polluter-pays-principle/

Madkhali. (2023). *A Comprehensive Review on E-Waste Management Strategies and Prediction Methods: A Saudi Arabia Perspective.* Retrieved 9 29, 2023, from https://www.mdpi.com/2673-9585/3/2/12

mahkali. (2023). *A Comprehensive Review on E-Waste Management Strategies and Prediction Methods: A Saudi Arabia Perspective.* MDPI. Retrieved 9 29, 2023, from https://www.mdpi.com/2673-9585/3/2/12

Maniul, Sk, M. M., Jinnah, Md A., Rukhsar, A. (2022). IMPACT OF E-WASTE MANAGEMENT ON EVIRONMENTAL DEVELOPMENT: AN OVERVIEW. Retrieved 3 4, 2025, from https://www.researchgate.net/publication/372440672_IMPACT_OF_E-WASTE_MANAGEMENT_ON_EVIRONMENTAL_DEVELOPMENT_AN_OVERVIEW

Mberu, B., Mutua, M., Kabaria, C., Amugsi, D., & Muindi, K. (2020). Levels of Households exposure to soolid waste dumpsites and associated loss to health in urban Kenya and Senegal. *Cities and Health*, 1-12.

Micah. (2020). *Dandora Landfill in Nairobi, Kenya.* Retrieved 9 29, 2023, from https://ejatlas.org/conflict/dandora-landfill-in-nairobi-kenya

Muriithi, J. K., & Ngare, I. O. (2023). Transitioning circular economy from policy to practice in Kenya. *Front. Sustain.* doi:10.3389/frsus.2023.1190470

Mugenda, O., & Mugenda, M. A. (1999). Research Methods. Quantitative and qualitative approaches. 46-48

Nairobi County Government. (2024). About Nairobi City County. Nairobi: Nairobi County Government. Retrieved 9 16, 2024, from https://nairobi.go.ke/about-nairobi/

.Nairobi City County. (2022). *Growing Nairobi population an indicator of more opportunities.* Retrieved 9 29, 2023, from https://twitter.com/047County?ref_src=twsrc%5Etfw%7Ctwcamp%5Eembeddedtimeline%7Ctwterm%5Escreen-name%3A047County%7Ctwcon%5Es1_c1

nanath. (2021). *The role of communication medium in increasing e-waste recycling awareness among higher educational institutions.* Research Gate. doi:DOI:10.1108/IJSHE-10-2020-0399

National Environment Management Authority, Kenya (NEMA). (2014). THE NATIONAL SOLID WASTE MANAGEMENT STRATEGY. Retrieved 3 4, 2025, from chrome-extension://kdpelmjpfafjppnh bloffcjpeomlnpah/https://www.nema.go.ke/images/Docs/Media%20centre/Publication/National%20Solid%20Waste%20Management%20Strategy%20.pdf

NEMA . (2019). *Kenyas state of the environment Report 2019-2021*. nema. Nema. Retrieved 9 2019, 2023, from https://www.nema.go.ke/images/Docs/EIA_1840-1849/Kenya%20State%20of%20Environment%20Report%202019-2021%20final-min.pdf

Nema. (2023). *World Bank-Africa Environmental Health and Pollution Management (AEHPMP).* Retrieved 9 25, 2023, from

https://www.nema.go.ke/index.php?option=com_content&view=article&id=348&Itemid=534

NEMA. (Vision 2030). *The National Solid Waste Management Strategy.* Retrieved 9 25, 2023, from https://www.nema.go.ke/images/Docs/Media%20centre/Publication/National%20Solid%20Waste%20Management%20Strategy%20.pdf

Nguyen, H. T., Hung, R.-J., Lee, C.-H., & Nguyen, T. H. (2018). Determinants of Residents' E-Waste Recycling Behavioral Intention: A Case Study from Vietnam. *Sustainability, 11*(1), 164. Retrieved 11 6, 2023, from https://www.mdpi.com/2071-1050/11/1/164

Nyumba, K. W. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. methods in ecology and evolution. doi: https://doi.org/10.1111/2041-210X.12860

OECD. (2022). *The implementation of the Polluter Pays Principle.* Retrieved 9 29, 2023, from https://www.oecd.org/water/background-note-polluter-pays-principle-29-20-march-2022.pdf

Oluoko, O. A., & Mutisya, E. (2019). The Enterprise of Waste Management among the Urban Youth for Sustainable Development in Kenya. *Journal of Sustainability, Environment and Peace, 1*(2), 45-51.

Omoah. (2023). *Solid waste management and gender dynamics: Evidence from rural Ghana.* doi:https://doi.org/10.1016/j.resglo.2023.100111

Ottoni, M., Xavier, L. H., & Junior, A. (2022). E-Waste Management and Valorization Options Towards Circular Economy in Brazil: Status and Perspectives. In Circular Economy and Waste Valorisation. *Springer*, 219-244.

Puckett, J., & Smith, I. (2002). Exporting harm: Seattle Basel Action Network. *E-Waste Management*. Retrieved Sep 18, 2015, from http://www.unepie.org/scp/waste/ewm/faq.htm

Singh, S., & Hussain, C. M. (2021). Chapter Six - Zero waste hierarchy for sustainable development. (C. M. Hussain, Ed.) *Concepts of Advanced Zero Waste Tools*, 123-142. doi:https://doi.org/10.1016/B978-0-12-822183-9.00006-4

Sirage. (2022). E-waste Awareness and Management Among People Engaged in E-waste Selling, Collecting, Dismantling, Repairing, and Storing Activities in Addis Ababa, Ethiopia. *sage*. doi:https://doi.org/10.1177/11786302221119145

Statista. (2023). *Number of social media users in Kenya from 2014 to 2023.* Retrieved 9 25, 2023, from https://www.statista.com/statistics/1304674/number-of-social-media-users-in-kenya/

Sultana. (2021). *Awareness and Practice on Household Solid Waste Management among the Community People.* Retrieved 9 29, 2023, from

https://www.scirp.org/journal/paperinformation.aspx?paperid=109371#:~:text=Inadequate%20training%20may%20impact%20awareness,to%20manage%20household%20solid%20waste.

To to Ton. (2025). From Awareness to Action: Educating the Public on Waste Management. Retrieved 2 26, 2025, from https://tontoton.com/how-to-raise-waste-management-awareness/#:~:text=Awareness%20campaigns%20play%20a%20vital,eco%2Dfairs%20encourage%20grassroots%20participation.

Taylor. (2020). *Levels of household exposure to solid waste dumpsites and associated loss to health in urban Kenya and Senegal.* Retrieved 9 29, 2023, from https://www.tandfonline.com/doi/abs/10.1080/23748834.2020.1768686

UNDP. (2023). *The Growing Environmental Risks of E-Waste.* Retrieved 9 25, 2023, from https://www.genevaenvironmentnetwork.org/resources/updates/the-growing-environmental-risks-of-e-waste/

UNEP. (2014). National E-waste Conference and Exhibition. *chemicals and Pollution Action.* Nairobi: UNEP.

UNEP. (2019). *UN report: Time to seize opportunity, tackle challenge of e-waste.* Retrieved 9 29, 2023, from https://www.unep.org/news-and-stories/press-release/un-report-time-seize-opportunity-tackle-challenge-e-waste

University of California Museum of Paleontology. (2023). *Burning of fossil fuels.* Retrieved from https://ugc.berkeley.edu/background-content/burning-of-fossil-fuels/

University of Colorado. (2021, November 1). Live Zero Waste. *7 Steps to Live Zero Waste Life*. (D. o. Affairs, Compiler) Colorado, Boulder. Retrieved 11 7, 2023, from https://www.colorado.edu/ecenter/7-steps-live-zero-waste

University of Minnesota. (2016). *Understanding Media and Culture.* Retrieved 9 29, 2023, from University of Minnesota

UNwomen. (2019). The gender gap in agricultural productivity in sub-Saharan Africa: Causes, costs and solutions. Retrieved 5 4, 2023, from https://www.unwomen.org/en/digital-library/publications/2019/04/the-gender-gap-in-agricultural-productivity-in-sub-saharan-africa

Vikblad, C. J., & Lekare, D. (2019). *The livelihoods of municipal solid waste workers – sustainable or a vicious cycle of debt and vulnerability? : A case study in Babati, Tanzania.* Retrieved from Essays.se: https://www.essays.se/essay/411c709477/

Wang, Z., Guo, D., & Wang, X. (2016). Determinants of residents' e-waste recycling behaviour intentions: Evidence from China. *Journal of Cleaner Production,*

137, 850-860. Retrieved 11 6, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0959652616310514

WEEE . (2023). *WEEE Centre, Nairobi Kenya.* Retrieved 9 9, 2023, from www.weeecentre.com/

World health Organization (WHO). (2024). Electronic waste (e-waste). Retrieved 3 3, 2025, from https://www.who.int/news-room/fact-sheets/detail/electronic-waste-(e-waste)#:~:text=Despite%20international%20regulations%20targeting%20the,toxic%20chemicals%20when%20recycled%20inappropriately.

World Health Organization (WHO). (2024). Electronic waste (e-waste). Retrieved from https://www.who.int/news-room/fact-sheets/detail/electronic-waste-(e-waste)#:~:text=These%20discarded%20devices%20are%20considered,household%20appliances%2C%20and%20medical%20equipment.

APPENDIX 1: QUESTIONNAIRE

LETTER OF INTRODUCTION TO THE RESPONDENT

Ann Kinya Mbutura

annmbutura@gmail.com

Dear respondent,

I am a postgraduate student from Kenyatta University, pursuing a Degree in Master of Environmental Studies & Community Development. As a requirement for fulfillment for the award of a degree, I am required to identify a topic in my area, carry out data collection and write a project report on the same. My study focuses on awareness levels and strategies of E-Waste management in Dandora, Nairobi County. I have therefore identified you as one of the respondents for this research. The information you provide to me will be invaluable in assisting with this report and in efforts to improve E-Waste management.

This questionnaire is to collect data for purely academic purposes. All information will be treated with strict confidence. Do not put any name or identification on this questionnaire. *Answer all* ***questions as indicated by either filling in the blank or ticking the option that applies*.**

Questionnaire serial no. ……

<u>Section A: Socio-Demographic factors</u>:

1. What is your Name……
2. Name of the village …….
3. Name of the Ward……
4. Constituency ……
5. Date……
6. GPS Location …….
7. GPS: Longitude ……. Latitude ……
8. Name of the interviewer ……..
9. Age: How old are you? ..... (Years)
10. Gender: Male [ ] Female [ ]

11. State your marital status: Single [ ] Married [ ] Divorced [ ] Separated [ ]

12. What is your highest level of education? (a) None (b) Primary (c)Secondary (d)Tertiary (e)University

SECTION B: Level of awareness of the residents on e-waste.

1. The following question contains a list of sources of E-waste generated in Nairobi County. Use the agreeing scale 1= Yes 2= No to express your opinion on whether you agree with the sources.

Sources and types of E-waste	**Choose by Ticking**	
	Yes	**No**
ICT and telecommunications Equipment		
Office electronics		
Large household appliances		
Small household appliances		
Consumer equipment		
Medical equipment		
Toys/leisure/sports equipment		

2.Do you know something called electronic waste (E-Waste)

Yes [ ] No [ ]

3.Are you aware that some of the e-waste has hazardous chemicals substances harmful to your health?

Yes [ ] No [ ]

4. Have you heard about waste disposal by separation?

Yes [ ] No [ ]

5.The following question contains a list of sources of information concerning electronic waste in Kenya. Kindly choose your source of information by ticking

Sources of Knowledge	Choose by Ticking
Mass Media (print and electronic)	
Indigenous Knowledge	
Schools	
Social media /Interaction	

Chiefs Barazas	

6.Do you generate electrical & electronic (e- waste) in your house?

Yes [ ] No [ ]

Where do you think most E waste come from? Kindly tick against the multiple choices given below

Sources of E- waste	Choose by Ticking
Home appliances	
Hospitals equipment	
Government offices	
Private sectors	

5. Do you know of any electronic waste management policies currently implemented in Kenya?

Yes [ ] No [ ]

SECTION B: Impacts of awareness campaigns to residents on e-waste disposal

1. Are you aware of any Method of handling electronic waste in your area?

Yes [] No []

2. The table below contains methods of disposing electronic waste. Kindly indicate by ticking how you dispose electronic waste from your household.

Ways of disposing E- Waste	Choose by Ticking
Landfill	
Dispose with General Waste	
Storage	
Repair	
Donation	
Incineration	

3. The table below consists of the environmental effects of careless disposal of E-waste. Choose by rating 1, 2, 3, 4 or 5 in order of effect according to your understanding.

Effects of E-waste to the Environment	Choose by Racking				
	1	2	3	4	5
Accumulates in the environment					
Poisons soils					
Pollutes the air					
Poisons Water					
Harmful to living things					

4. The following are some suggested solutions of reducing e-waste generation in Kenya. Kindly express your opinion by ticking against the best ways of reducing E-waste in your area.

Ways of reducing E- Waste generation	Choose by Ticking
Donate or Sell Working Electronics.	
Consume Less.	
Use Your Old Mobile Phone for Music or GPS.	
Recycle via a Retailer.	
Check E-Recycling Centers in Your State.	
Organize Your Electronics.	
Know Your State's Laws About Battery Disposal	

SECTION C: Effectiveness of 7R strategy on e-waste management actions

1.Are you aware of 7Rs that is (Recycle, Refuse, Reduce, Reuse, Repair, Re-gift and Recover).

Yes [ ] No [ ]

2.Use the rating scale 1,2,3,4,5,6 or 7 to express your opinion on which of the method in order is the most effective for managing e-waste

7 Rs	Choose by Ranking						
	1	2	3	4	5	6	7
Recycling							
Reuse							
Reduce							
Repair							
Re-gift							
Refuse							
Recover							

3.Rate the following benefits of using the 3R strategy in e-waste management

Where 1=strongly disagree, 2=disagree, 3= Neutral , 4=agree, 5= strongly disagree

	1	2	3	4	5
Green House Gas (GHG) reduction through energy efficiency and resource efficiency and can reduce the Carbon Dioxide (CO2) emission.					
Techniques adaptation, employment and job creation.					
Production of organic gas from bio-degradable wastes					
Attracting foreign direct investment through emission reduction credits and pollution reduction and other environmental benefits					
Prevent pollution and enriches soil condition and can provide a healthy environment to the people of the cities					
Would be economically profitable as it will generate reusable power and energy					

SECTION D: Effects of PPP use in e-waste management

1. The following is a description of the polluter pays principle. The 'polluter pays' principle is the commonly accepted practice that those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment.

Are you aware of this principle?

Yes ( ) No ( )

2. In your opinion, the polluter pay principle been applied in your area?

Yes ( ) No ( )

3. The table below has a list of some benefits of using the polluter pays principle for waste management. Express you opinion on each of them by ranking 1, 2, 3, 4, 5, 6, 7 and 8 against each of them in order of priority.

Benefits	Choose by Ranking							
	1	2	3	4	5	6	7	8
economically, it promotes efficiency								
legally, it promotes justice								
it promotes harmonization of international environmental policies								
it defines how to allocate costs within a state								
focuses attention on the implications of waste generation								
Provides a direct economic incentive for waste prevention Recover								
Ensures that the waste management costs arising during the life of a product are included in the price charged to consumers								

APPENDIX II NACOSTI PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **520726**

Date of Issue: **22/September/2023**

RESEARCH LICENSE

This is to Certify that Ms.. Ann Kinya Mbutura of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: Awareness Levels and Strategies of E-Waste Management in Dandora Nairobi County, Kenya for the period ending : 22/September/2024.

License No: **NACOSTI/P/23/29647**

520726

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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

See overleaf for conditions

APPENDIX III AUTHORIZATION LETTER

KENYATTA UNIVERSITY
OFFICE OF THE EXECUTIVE DEAN, GRADUATE SCHOOL

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

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Executive Dean, Graduate School

DATE: 3rd August, 2023

TO: Ms. Ann Kinya Mbutura
C/o Department of Environmental
Studies & Community Development

REF: N50/CTY/PT/26801/2013

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting on 12th July, 2023, approved your Research Proposal for the M.Env. Studies Degree entitled, **"Awareness Levels and Strategies of E-Waste Management in Dandora Nairobi County, Kenya."**

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation.

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

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

Thank you.

REUBEN MURIUKI
FOR: EXECUTIVE DEAN, GRADUATE SCHOOL

CC. Chairman, Environmental Studies & Community Development Department

Supervisors:

1. Dr. Joseph K. Muriithi
   C/o Envi. Studies & Community Development Dept.
   Kenyatta University

2. Dr. Samuel Ochola
   C/o Envi. Studies & Community Development Dept.
   Kenyatta University