A FRAMEWORK FOR SUSTAINABLE E-WASTE MANAGEMENT IN MANUFACTURING AND PROCESSING INDUSTRIES, INDUSTRIAL AREA NAIROBI COUNTY, KENYA

DUNCAN ALIERO MUHANI

Reg: N50/CTY/PT/22911/2012

DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT

Research Project Report Submitted in Partial Fulfillment for the Degree of Master of Environmental Planning and Management in the School of Environmental Planning and Management of Kenyatta University

Supervisors

Dr. Christine Majale

Signature……Date……

Department of Environmental planning and management

Kenyatta University

Ms Carolyn Getao

Signature……Date……

Department of Environmental planning and management

Kenyatta University

DECLARATION

‘‘This research project is my original work and has not been presented for a Degree in any other University’’

Signature……Date……

Name: Duncan Aliero Muhani-N50/CTY/PT/22911/2012

DEDICATION

I dedicate this research project to my late mum; Nancy Agnetta Muhani, who was devoted in ensuring I achieved academic excellence in life

ACKNOWLEDGEMENT

I wish to acknowledge the support and inputs of all the people who contributed to the success of my research project.

First, my greatest appreciation goes to my research project supervisors; Dr. Majale and Ms. Getao for their relentless effort of ensuring that my research work was a success. They took time out of their busy schedule to go through my project report every other time and offer necessary guidance and corrections.

I also want to acknowledge my family members; my dad Silvanus Aliero Muhani and my brothers and sisters for the understanding they gave me during the harsh economic times during course of my study.

My appreciations are also extended to all people who took their time to respond to my interviews and fill the questionnaires.

Lastly, I want to thank my friend Ms. Ruth Njoki Macharia for the encouragement and moral support she gave me during the period of my study.

List of Abbreviations

AC	Alternating current
BAN	Basal Action Network
CGN	County Government of Nairobi
COP8	Code of Practice 8
DNA	Deoxyribonucleic Acid
DTIE	Division of Technology, Industry and Economics
EAK	Engineers Association of Kenya
EC	European Commission
EIA	Environmental Impact and Audit
ELCINA	Electronics Industry Association of India
EMA	Environmental Management Act
EMCA	Environmental Management Coordination Act
EPA	Environmental Protection Agency
EWSR	European Waste Shipment Regulation
GOK	Government of Kenya
IETC	International Environment Technology Centre
ISO	International standards on environmental management such as
ISWM	Integrated Sustainable Waste Management
KAM	Kenya Association of Manufacturers
KEIN	Kenya Environmental Information Network
KEPSA	Kenya Private Sector Alliance,
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNCC&I	Kenya National Chambers of Commerce & Industry
LDC	Less Developed Countries
MEA	Multilateral Environmental Agreement
MENR	Ministry of Environment and Natural Resources
MoI	Ministry of Industrialization
MOU	Memorandum of Understanding
NIMES	National Integrated Monitoring and Evaluation System),
NEMA	National Environmental Management Authority

NEC	National Environmental Council
n.d	Not Dated
NEAP	National Environment Action Plan Committee
NET	National Environmental Tribunal
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
PCB	Polychlorinated Biphenyl
PCC	Public Complaints Committee
PPM	Phenom Pehn Municipality
PVC	Polyvinylchloride
RoHS	Restriction of Hazardous Substances
SPSS	Statistical Package for Social Science
TV	Television
UNEP	United Nations Environmental Program
US	United States
USA	United States of America
USEPA	United States Environmental Protection Agency
WEEE	Waste electrical and electronic equipment

Definition of terms

Passive components: refer to electronic components that can't introduce net energy into a circuit. They also don’t rely on a source of power, except for what is available from the AC circuit they are connected to. Therefore they can't increase the power of a signal, although they may increase a voltage or current (such as is done by a transformer or resonant circuit). Passive components include two-terminal components such as resistors, capacitors, inductors, and transformers.

E-waste: According to WEEE, e-waste refers to discarded electrical or electronic devices, machines or equipment’s.

Institutional framework: Generally understood to mean the systems of formal laws, regulations, and procedures, and informal conventions, customs and norms that broaden, mold and restrain socio-economic activity and behavior.

Legal framework: Refers to a framework that provides guidance on the background statutes, regulations and policies that support systems and process.

ABSTRACT

Kenya's manufacturing and processing sector is among the key productive sectors identified for economic growth and development because of its immense potential for wealth, employment creation and poverty alleviation. Currently Kenya's industrial sector is one of the largest in sub Saharan Africa, the sector is highly fragmented with more than 2,000 manufacturing enterprises. The presence of these industries has led to rise in e-waste due to changes in technology, wear and tear, and high rates of obsolescence of the electrical equipments. The country is also likely to experience an increase in e-waste there will be an upsurge of similar industries due to the formation county government as envisaged by the constitution of Kenya 2010, as the counties are all out to embrace industrial growth. The project explored how an integrated approach to e-waste management can be applied in industrial area, Nairobi County in order to address the problem of e-waste brought about by the presence of high number industries. The study included an analysis of the legal, policy and institutional framework governing e-waste management and general waste management. The study also sought to assess how e-waste is handled in manufacturing and processing industries in industrial area Nairobi as well as examining critical challenges constraining e-waste management in Industrial area, Nairobi County**.** One of the findings of the study was that there exist some legislative gaps to address and regulate e-waste in the country. It was established that the legal and institutional framework governing e-waste do not efficiently address the problem. The national policies do not directly address the problem of e-waste but solid waste in general, enforcement of the regulations on general waste management has proved to be a problem by NEMA as there is no substantive control in the sector. The ministry of environment and natural resources and e-waste handlers-WEEE also believe that the policies and regulations in the country do not sufficiently address the problem of e-waste in specific and that such policies should be reviewed. They observed that those relevant institutions that have the responsibility to manage wastes in the country lack adequate capacity to carry out there mandate; such bodies are not allocated enough funds from the central government. They also have limited personnel to carry out enforcement of the regulations. On environmental reporting which is a prerequisite for sustainable development, many of the respondents at the industry level admitted that there companies do not practice routine environmental reporting where both internal and external auditing on the state of the environment should be done. Routine environmental reporting is very important in realizing sustainability on matters of environmental management; it ensures disclosure of the state of the environment at given periods, which ensures industries comply with laws and regulation governing the sector. Some of the manufacturing and processing industries do not have health and safety measure in place in their organization. Most of the industries do not have procedures of e-waste handling in their organizations, these two issues are very critical when it comes to handling e-waste, there absence in industries means high vulnerability during the handling process. EMCA, 1999 provides for the integration of environmental concerns in national policies, plans, programmes and projects. In this regard, it provides for the formulation of National, Provincial and District Environment Action Plans every five years, there is therefore need to restructure the former provisional administration to fit in the new county government structure for this purpose. The study calls for urgent and comprehensive integrated framework, which will ensure functional systems and structures, are put in place for proper e-waste management hence reducing significantly the human and environmental impacts of poor e-waste handling by taking action to address gaps in policy and institutional framework governing the sector both at the national and county government. It also calls for manufacturing industries to put in place measures towards environmental compliance.

Table of Contents

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF TABLES

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the problem

The world is currently undergoing first rate of industrialization with manufacturing and processing industries on rise, technological change with desire to improve efficiency in industries is also on rise. In the last two decades, the global growth in electrical and electronic equipment production and consumption has been exponential. Today, e-waste is the fastest growing waste stream, about 4 per cent growth a year. The global generations of e-waste is estimated to be about 40 million tonnes per year (Schluep et al., 2009) and this is attributed to increase in market penetration of products in developing countries, development of a replacement market in developed countries and a generally high product obsolescence rate (UNEP, 2004).

Generally, e-waste flows to disadvantaged and historically marginalized areas that are characterized by poor economies. The complexities of decision making such as whether to treat e-waste domestically or through export, or to dispose of or recycle it, raises legal, environmental, political, economic and ethical issues. The trade in e-waste has grown not only between the developed and developing countries but also among the developing countries themselves, reflecting a continuous growth and tolerance for cross-border movement (Ray, 2008). In Asian, illegal exporters of e-waste to China evade detection by routing container ships through Hong Kong, Taipei or the Philippines, and then trans-shipping them to smaller ports in mainland China, where customs officials are corrupts and willing to share the profits. Dubai and Singapore often serve as transit points for e-waste from developed countries (Kalra, 2004). According to Green Peace International, hazardous wastes are also being shipped to China illegally from developed countries like USA, Japan and Canada, despite the fact that Basal Convention prohibits trans-boundary movement of hazardous waste. The escalation of this problem in China is not due to the lack of laws and regulations, but rather due to ineffective enforcement (Ni & Zeng, 2009). China is also among the countries with the highest number of manufacturing and processing industries in the world, in 2011 it was the world's second largest producer of electronic waste producing 2.3 million tonnes, which therefore means that e-waste from used electrical and electronics components is high. Although China enforces many laws and even

signed the Basel Convention, being one of the first global proponents of a total ban on the hazardous waste trade between developed and developing countries, the number of illegal shipments of e-waste to China continues to rise significantly. Despite laws and polices enacted by the Chinese Government on illegal importation and handling of e-waste in China, this problem still escalates has been is thought to escalates due to rather ineffective enforcement (Ni & Zeng, 2009).

In India, a study released by the ELCINA at the electronics industry expo – "Componex Nepcon 2009" had estimated the total e-waste generation in India at a whopping 4,340,000 tonnes by end 2009, e-waste from developed countries finds an easy way into developing countries in the name of free trade (Toxics Link, 2004). This further complicates the problems associated with waste management. But despite a wide range of environmental legislation in India, there are no specific laws or guidelines for electronic waste (Devi et al., 2004). Even though per capita waste production in India is still relatively low, the total absolute volume of wastes generated is high and still growing at a faster rate. Considerable quantities of e-waste are reported to be imported to India (Agarwal, 1998; Toxics Link, 2004). However, no confirmed figures available on how substantial are these trans-boundary e-waste streams, as most of such trade in e-waste is camouflaged and conducted under the pretext of obtaining 'reusable' equipment or 'donations' from developed nations. The government trade data does not distinguish between imports of new and old computers and peripheral parts, so it is difficult to track what share of imports are used electronic goods.

Americans currently own nearly 3 billion electronic products and as new products are purchased, obsolete products are stored or discarded at alarming rates. According to Consumer Electronics Association estimates, about two-thirds of the electronic devices removed from service were still in working order. However, only about 15% of this material was recycled while the vast majority was disposed in landfills (United States Environmental Protection Agency Office of Solid Waste and Emergency Response, 2008). Inconsistencies in worker safety and environmental protection mean potential liability concerns for those sending electronics to recycling facilities especially if these facilities are located in developing countries. However, electronic wastes also contain precious metals such as gold, silver, which offer opportunities for economic extraction. Many

states such as California, Maine, Washington, Minnesota, and Illinois have or are considering legislation that will require manufacturers to pay for the cost of the 'end of life' treatment of electronic products (Electronics Take Back Coalition, 2008). Concerns regarding the potential impact of exporting e-waste for processing in developing countries have led to increased scrutiny from members of the public and environmental organizations, as well as some Members of Congress. On May 21, 2009, Representative Gene Green introduced H.R. 2595, a bill that would amend the Solid Waste Disposal Act (42 U.S.C. 6921) to establish certain e-waste export restrictions. There have also been several congressional hearings on issues associated with e-waste management, one of which specifically addressed issues associated with e-waste exports. While the developed countries such as the U.S. have enacted federal laws regulating hazardous waste generally, individual states, such as California have enacted laws specifically regulating e-waste. International laws are much more stringent than the U.S. concerning e-waste, and states such as California have looked overseas for model laws. U.S. domestic law, even though it does not perfectly address the issue of e-waste, certainly raises the cost of recycling, so that without a robust international legal regime, e-waste will continue to be pushed overseas, where the environmental and human rights consequences are even worse. The U.S. has enacted legislation that aim to regulate hazardous waste, but the country still lacks a comprehensive, effective law that parallels international law.

Analyzing e-waste situation in Africa, the review of existing literature shows that Tanzania has no specific policy or regulation related to e-waste management. However, there are a number of policies and regulations, which aim at protecting the environment and human settlements. The review of these different policies reveals that there is a need for e-waste specific policies to address the different challenges and issues of e-waste management. In addition, a number of regulations and laws provide an institutional framework for a sustainable management of the environment in general, among others, the EMA No. 20 of 2004. Tanzania lacks e-waste management specific legislation. Nonetheless, e-waste management is carried out through the solid waste and hazardous management acts under the environmental management act e-waste, and specifically electronic waste, is addressed in section 4 of the environmental management act. The government through the Prime Minister's Office, environment division, has developed a strategy and an action plan. This strategy, among other things, addresses the issue of e-waste

management. The plan aims at minimizing of environmental and health risks resulting from improper handling of e-waste through stakeholders' participation. The specific objectives of the strategy and action plan are; to review different policies and regulations related to e-waste management, awareness creation on e-waste management, and promotion of recycling and material recovery. However, the strategy is yet to be implemented. The institutional framework for e-waste management in Tanzania is not well developed. However, the existing framework is as a result of a number of different policies and regulations, which have resulted in the establishment of various bodies dealing with waste management but not directly related to e-waste. Because of these policies and regulations, the Tanzania government has established a number of institutions to deal with waste management. The key institution involved in waste management is the Vice President's office. In the Vice President's office, there is a minister responsible for environment issues and the division for environment and the local government authorities are also responsible for environmental management. These regulations and different bodies responsible for their implementations posses challenges in the management of e-waste due to conflict of interest. Regulation and the institutional framework are inadequate. The policies and regulations are insufficient in addressing e-waste management issues and problems, these deficiencies in policies, regulation and institutional framework calls for the need of more effective and efficient framework that will adequately deal with e-waste management issues and problems.

E-waste poses one of the greatest environmental challenges to Kenya. This is linked to the country's need for industrial growth brought about by provisions in the vision 2030 and the Constitution that embraces county governments, and that the counties are all out to bring growth and development by embracing industrial growth. Kenya's manufacturing and processing sector is among the key productive sectors identified for economic growth and development because of its immense potential for wealth, employment creation and poverty alleviation. Currently Kenya's industrial sector is one of the largest in sub Saharan Africa, the sector is highly fragmented with more than 2,000 manufacturing enterprises (GoK, 2004). This trend of development is expected to initiate industrial enterprises, which would in turn result in increased quantities and complexity of pollutants from e-waste.

1.2 Statement of the Problem

The industrial area of Nairobi County has the highest number of industries in one locality in the country and in East Africa at large, most of which are manufacturing and processing. Currently the sector is one of the largest in sub Saharan Africa. Industrialization is also expected to grow to higher levels, and provisions in the vision 2030 and the Constitution of Kenya 2010 that embraces county governments and economic growth in general have necessitated this. Given that, counties are all out to bring economic growth and development by embracing industrial growth. The presence of these will lead to a rise in e-waste from passive elements due increased changes in technology, wear and tear, and high rates of obsolescence of the electrical and electronics equipment's and modules in the industries.

E wastes from passive elements contain toxic substances such as lead, cadmium, mercury, American and lithium (Cui & Jirang, 2008). These toxic materials can be released upon poor disposal and crude recycling process hence posing a threat to the environment. In addition to its damaging effect on the environment, researchers have linked e-waste to adverse effects on human health, such as cardiovascular disease, DNA damage and possibly cancer (UNEP, 2009).

Even though we have several legislative and regulatory frameworks governing general waste management in the country, there are no laws specifically on e-waste. The regulatory structure as it is, is not efficient in handling the situation on the ground hence such waste are not properly managed. This is likely to affect the environment in the near future due to poor handling of the e-waste.

1.3 Research Questions

In response to the research problem, the following research questions were formulated:

1. Do the existing policies provide a framework for safe, efficient and environmentally sound e-waste management?
2. How is e-waste handled in manufacturing and processing industries especially from passive elements?
3. What are the critical challenges and problems of e-waste management from passive elements in industrial area Nairobi County?

4. What are the opportunities, potentials and capacities of matters concerning e-waste management from passive elements in manufacturing?

1.4 Research Objectives

1. To review existing policies and regulatory framework that governs e-waste management in Kenya.
2. To examine out how e-waste from passive elements are being handled in manufacturing and processing industries.
3. To examine critical challenges constraining e-waste management in industrial area Nairobi County.
4. To come up with an integrated plan on e-waste management in industrial area Nairobi County.

1.5 Research Premises

1. Industrial sector in Kenya lacks a clear policy and regulatory framework to control and govern the industry on matters regarding to e-waste management.
2. There are no defined roles and responsibilities of various stakeholders on matters regarding e waste.
3. E-waste guide lines regarding e waste identification has a lot of gaps omitting many other types of e-waste.
4. There is no integrated plan on e waste management in the country and in particular industrial area.

1.6 Justification of the study

The industrial area of Nairobi County has the highest number of industries in one locality in the country and in East Africa at large, most of which are manufacturing and processing industries. The presence of these industries in a common locality have led to a rise in e-waste from passive elements due increased changes in technology, wear and tear, and high rates of obsolescence of the electrical and electronics equipment's and modules. The global generations of e-waste is estimated to be about 40 million tonnes per year (Schluep et al., 2009) and this is attributed to increase in market penetration of products in developing countries, development of a replacement market in developed countries and a generally high product obsolescence rate (UNEP, DTIE, 2004). E-waste generated from these industries is not properly managed due to

lack of clear policy framework that seeks to guide and streamline the sector through proper policies, laws and clear guidelines that brings in all stakeholders.

Despite the fact that several policies and regulatory frameworks have been enacted in most countries, the implementation has been a failure. The 2008 Durban Declaration on e-waste Management in Africa followed the 2006 Nairobi ministerial declaration on e-waste developed from COP8 of the Basel Convention. It requires countries to follow their own process to define their responses and formulate actions in relation to the e-waste problem (Marriott, 2011). It requires countries to review existing legislation, improve compliance with existing legislation and amend existing waste management legislation to allow for regulation of e-waste management (Durban Declaration, 2008), which has not be the realized. Therefore, there is a need to enforce appropriate legislation that specifically targets e-waste.

Findings from this study will therefore come up with a framework that will seek to govern e-waste management in manufacturing and processing sector in Nairobi's industrial area region. Moreover, this will ensure functional systems and structures are put in place to ensure proper e waste management hence reducing significantly the human and environmental effects. Beyond policy formulation, this study will contribute towards resolving the problem of industrial e waste management. To researchers and students, this study is an important contribution to the body of knowledge in the field of environmental planning.

1.7 Significance of the study

The problem of e-waste management is a global issue and with the dire need for industrial growth in Kenya brought about by the vision 2030 and constitution that embraces county government and industrial growth, the problem of e-waste is likely to grow to unmanageable levels if the problem is not addressed. The study will therefore address the problem of e-waste in manufacturing and processing industries hence ensuring functional systems and structures are put in place to ensure proper e-waste management hence reducing significantly the human and environmental effects that are brought about by the industry mismanagement. The study will also seek to define roles of different stakeholders on matters concerning e-waste management hence closing the gaps that have been left on e waste management cycle; the study will also seek to

review with purpose to strengthen various institutional frameworks concerned with waste management and specially e-waste.

1.8 Scope the of study

The Location of the study is in Kenya, Nairobi County industrial area. Its geographical coordinates are 1° 18' 0" South, 36° 50' 0" East Industrial Area.

The main focus of the study being e-waste from passive electrical and electronics elements and modules that have a wide application in manufacturing and processing industries; which includes capacitors, resistors, transducers, transformers, sensors and inductive devices. With a view of carrying out detailed study to examine the critical challenges with regard to this type of e-waste in the sector and how to address the challenges associated with it. The respondents in the study being, the county government of Nairobi, manufacturing and processing industries, communities living near industrial area, waste handlers and all stakeholders in matters of environment who included NEMA, MENR and the MoI.

1.9 Limitations of the Study

- Inaccessibility: most of the residential areas in industrial area are slums hence making access difficult, some of the industries cannot be accessed by public transport as they are located far from main roads.
- Sensitivity of the topic of study: the topic of study was sensitive to some of the people I interviewed and therefore they could not willingly disclose all the information they have.
- Inadequate technical information: many of the respondents have no technical information on e-waste and therefore I could not obtain quality information as anticipated.
- In other areas I was denied entry into their premises, making it difficult for me to conduct interviews in those companies.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter presents a highlight of relevant literature on e-waste and general waste management. The study reviewed various literatures on both local and international policies and institutional framework regarding e-waste management and waste management in general. Literature on critical challenges the world is facing on matters regarding e-waste management was also reviewed. International policies such as the Basel conventions and Bamako conventions were reviewed and various gaps identified. The constitution of Kenya 2010 was also reviewed to determine its strength and weaknesses in relation to e-waste management vis-à-vis sustainability. A key legal framework document such as EMCA 1999 was also reviewed. Important institutional framework concerned with matters of environmental management such as the NEMA, NEC and MENR were reviewed considering their key mandate and service delivery capabilities. Key strength, weaknesses and opportunities were identified concerning the project objectives

2.2 Policies and regulatory framework that govern e-waste management

E-waste constitutes a significant global environmental and health emergency, with implications far broader than occupational exposure and involves vulnerable group and generations to come (Frazzoli et al., 2010); thus several policies and regulatory framework governing e-waste management have been put in place to try to mitigate the problem.

The Basel Convention on control of trans-boundary movement of hazardous wastes is the most significant MEA in relation to tackling the issues surrounding e-waste and its management. As of September 2010, the Convention had 178 signatories (Basel Convention, n.d); it was implemented in order to impose a stronger message about trade in hazardous waste and management within Africa (Tutu, n.d.). Article 4 of the Basel Convention calls for an overall reduction of waste generation, by encouraging countries to keep wastes within their boundaries and as close as possible to its source of generation, the internal pressures should provide incentives for waste reduction and pollution prevention. Parties are generally prohibited from

exporting covered wastes to, or import covered waste from, non-parties to the convention. The Convention states that illegal hazardous waste traffic is criminal but contains no enforcement provisions. According to article 12, Parties are directed to adopt a protocol that establishes liability rules and procedures that are appropriate for damage that comes from the movement of hazardous waste across borders. Most countries in Europe have also adopted several policies to help in control and management of e-wastes.

Policy Restricting the Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive (2002/95/EC) has been in force since 2003. Its purpose is to restrict the use of hazardous substances in electronic equipment (European Commission, n.d.). The RoHS has some exemptions that include; Copper alloy containing up to 4% lead by weight and Lead in high melting temperature type solders is allowed. The servers, switches, routers, cell site and other telecommunication equipment that constitute the global Internet and phone systems are exempt from lead content restrictions, Limited amounts of mercury in fluorescent and other light bulbs. The acceptance of exemptions on RoHS directive posses as a challenge in environmental conservation as certain percentage of hazardous chemicals is still being allowed.

The Bamako convention on the ban on the import into Africa and the control of trans-boundary movement and management of hazardous wastes within Africa is a treaty of African nations prohibiting the import of any hazardous waste. The convention was negotiated by twelve nations of the organization of African unity at Bamako, Mali in January 1991, and came into force in 1998. Impetus for the Bamako convention arose from the failure of the Basel convention to prohibit trade of hazardous waste to LDCs, and from the realization that many developed nations were exporting toxic wastes to Africa. This impression was strengthened by several prominent cases. The Bamako convention uses a format and language similar to that of the Basel convention, but is much stronger in prohibiting all imports of hazardous waste. Additionally, it does not make exceptions on certain hazardous wastes like those for radioactive materials made by the Basel convention. The same convention permits the trans-boundary movement of hazardous wastes generated within Africa subject to very stringent regulatory control. This is a major setback towards sustainability as more develop countries within Africa can willingly transport e-waste to less developed countries within Africa.

The 2008 Durban Declaration on e-waste management requires countries to follow their own process to define their responses and formulate actions in relation to the e-waste problem. It requires countries to review existing legislation, improve compliance with existing legislation and amend existing waste management legislation to allow for regulation of e-waste management. This has not been realized in Kenya as no legislation has been reviewed to allow for regulation of e-waste.

More recently, Kenya has been praised as a model for environmental progress in the region following enactment of the constitution that was promulgated on 27, August 2010, and became the supreme legislation of Kenya, which contains specific measures for environmental management. The constitution of Kenya that is supreme law of the land contains specific provisions regarding the environment. The provisions are included in Chapter Four, under 'Rights and Fundamental Freedoms', Chapter Five, under 'Environment and Natural Resources', and Chapter Ten, under 'Judicial Authority and Legal System'. The Fourth Schedule also includes environmental provisions under 'Distribution of functions between National and County Governments' and the Fifth Schedule titled 'Legislation to be enacted by Parliament'. Under article 42, the Environmental rights and freedoms are presented in the new constitution, which states: *Every person has the right to a clean and healthy environment, which includes the right –*
(a) To have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and
*(b) To have obligations relating to the environment fulfilled under Article 70.*11. (Republic of Kenya, 2010)

In chapter, five of the constitution, environment and natural resources have been detailed and consists of four Articles detailing obligations, enforcement, agreements and legislation relating to the environment. The provision on obligations and respect for the environment are found in Article 69, and it consists of two parts, which provides guidance to the State on its role in sustainable management of the environment in Kenya. Article 69 (a) of the new constitution, states '*The State shall ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits*', (Republic of Kenya, 2010). The constitution of Kenya plays a crucial role in

environmental management by acknowledges the importance of environmental sustainability, which will go a great mile in ensuring conservation of the environment.

Kenya's commitment to public participation, as well its reiteration on the responsibility to ensure that public participation serves the purposes for which it is intended, is clearly highlighted in Article 69 (d) of the new constitution, which states that *'[T]he State shall encourage public participation in the management, protection and conservation of the environment*', (Republic of Kenya, 2010). Public involvement is critical to for environmental conservation; all parties involved in environmental matters are brought together hence ensuring success in matters of environmental conservation.

Article 70 of the constitution of Kenya deals with the enforcement of environmental rights and it consists of three parts. The first part states: *If a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress in addition to any other legal remedies that are available in respect to the same matter*. The second part of Article 70 states: *On application under clause (1), the court may make any order, or give any directions, it considers appropriate –*

(a) To prevent, stop or discontinue any act or omission that is harmful to the environment;

(b) To compel any public officer to take measures to prevent or discontinue any act or omission that is harmful to the environment; or

(c) To provide compensation for any victim of a violation of the right to a clean and healthy environment. The third part of Article 70 states: *'For the purposes of this Article, an applicant does not have to demonstrate that any person has incurred loss or suffered injury'*. The commitment by the government to ensure all Kenya's including the vulnerable citizens can apply to a court for redress on environmental issues, whether affected directly or indirectly, has been acknowledged as one of the great innovations of EMCA (Kamau, 2005) and (Republic of Kenya, 2010).

On agreements relating to international laws, Article 2 (6) of the Kenyan constitution states that '*[A]ny treaty or convention ratified by Kenya shall form part of the law of Kenya under this*

Constitution' (Republic of Kenya, 2010). Kenya is party to 16 international environmental treaties, which are designed to protect various aspects of the environment, including biological diversity, natural resources, marine and coastal environment, the ozone layer, wetlands, culture and natural heritage, pollution, international trade in wild flora and fauna, and combating desertification, among others. By stating that any treaty ratified by Kenya shall form part of the Kenyan law, this signifies that the constitution of Kenya embraces both local and international approach to the environmental conservation.

In the fourth schedule contains the distribution of functions between the national government and the county governments. The National Government is responsible for *Protection of the environment and natural resources with a view to establishing a durable and sustainable system of development*. This indicates a macro-level of influence by the national government on environmental conservation and management. The County Governments are responsible for *Implementation of specific national government policies on natural resources and environmental conservation* appropriate within their jurisdiction (Republic of Kenya, 2010).

EMCA 1999 is an Act of Parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment. It was enacted to ensure appropriate legal and institutional framework is in a place for proper management of the environmental and any other matters relating to environment. It seeks to coordinate the activities of the various institutions tasked to regulate the various sectors. These institutions are referred to as Lead Agencies in EMCA. Lead Agencies are defined to include government ministry, department, parastatal, and state corporation or local authority in which any law vests functions of control or management of any element of the environment or natural resource. The enactment of EMCA served as the first and main framework towards environment sustainability. The right to a clean and healthy environment had been acknowledged in the EMCA 1999 (Kenya Gazette, 2000). The provision for legal and institutional framework is one of the basic conceptual tools for environmental management (NEMA waste management regulations, 2006).

The Kenya Vision 2030 is the country's development blueprint covering the period 2008-2030. It aims to transform Kenya into a newly industrialized middle-income country providing a high

quality life to all its citizens by the year 2030. The Vision is based on three key pillars of economic, social and political as well enablers and foundations of micro vision. For each of the pillars and foundations, priority sectors have been identified to drive the aspirations of the vision. It is envisaged that the county government will identify vision 2030 flagship projects and programmes that will be implemented at the county level to include environmental management and work with the national government to ensure there are realized

2.3 Handling of e-waste from passive elements in manufacturing and processing industries

E-waste constitutes a significant global environmental and health emergency concern; this is attributed to the toxic substances it contains. E-waste handling therefore is a very critical and delicate process. Cheap, safe and simple processing methods appropriate for introduction into the informal sector are lacking (Sepúlveda et al., 2010). The processes of handling e-waste is of concern, dismantling and disposing of electronic waste in the third world countries has led to a number of environmental impacts, toxic substances can be found within effluents from cyanide leaching and other leaching activities (Sepúlveda et al., 2010). Such substances may pose significant human and environmental health risks. The following provides an overview of post consumer electronics in terms of product types and component and reported concerns about toxic or hazardous substances, with some of them include, Lead, Mercury, Cadmium, Hexavelent compounds, Berylium and PVC.

Lead is used widely in solders, as an alloying element for machining metals, printed circuit boards, components, incandescent light bulbs, and weighting. Lead oxides occur in leaded glass in cathode ray tubes, light bulbs and photocopier plates, and in batteries. Lead-based solder (typically a 60:40 ratio of tin to lead), which is used to attach electrical components, represents the major solder type used in most EEE applications and typical motherboards have been reported to contain approximately 50g/m2 lead (Five Winds International, 2001).

The global manufactured release of mercury to the atmosphere is approximately 2000-3000 tonnes per year. It is estimated that of the yearly world consumption of mercury 22% is used in EEE (AEA, 2004). Mercury is basically used in thermostats, sensors, relays and switches (on

printed circuit boards and in measuring equipment and discharge lamps). Furthermore, it is used in medical equipment, data transmission, telecommunications, and mobile phones. In the EU, 300 tonnes of mercury is used in position sensors alone.

It is known that in Printed Circuit Boards cadmium occurs in certain components, such as chip resistors, infrared detectors and semiconductors (European Commission, 2000). Older types of CRTs contain cadmium. Furthermore, cadmium has been used as a stabiliser in PVC. Cadmium metal or powder is still used as part of the negative electrode material in nickel-cadmium (NiCad) batteries, as an electrodeposited, vacuum deposited or mechanically deposited coating oniron, steel, aluminium-base materials, titanium-base alloys or other non-ferrous alloys, and as an alloying element in low-melting brazing, soldering and other specialty alloys (AEA, 2004). Cadmium oxide forms part of the negative cadmium electrode in nickel-cadmium batteries, and cadmium sulphide is found widely in CRT and electronic devices.

Hexavalent chromium is used in the plastics, cabling and packaging. Chromium VI is typically used as a hardener or stabilizer for plastic housings and as a colorant in pigments. References to quantities of chromium VI in these components are poor (Five Winds International, 2001). The use that is occurring seems to be in trace amounts, between 0.2 and 0.3 grams per component. As a colour pigment, the European Union is moving to restrict the use of chromium VI. Hexavalent chromium may also be present on the surface of metal parts that have been protected from corrosion with chromate conversion coatings.

Beryllium metal offers a unique and incomparable combination of properties. It is one of the lightest structural materials available but is several times stronger than steel. It has excellent thermal conductivity, high electrical conductivity, and good corrosion resistance, good fatigue resistance, high strength and good formability. Traditionally, copper-beryllium alloys were used in motherboards on personal computers. Beryllium is rarely used in this form anymore, but its use in combination with copper as an alloy is increasing (Five Winds International, 2001). Beryllium improves the properties of copper contact springs because of its high strength, high conductivity and high elastic quality. Between 2 – 4% of these copper alloys is beryllium metal. Beryllium metal is sometimes overlooked as one of the components of concern in end-of-life

electronic equipment. It is used amongst other things, in electrical insulators and resistors, microwave tubes, photographic equipment, rotating mirrors in laser printers, and both beryllium and beryllium oxide are used in heat sinks. Brominated flame retardants including PBDEs Brominated flame retardants (BFRs) are today regularly designed into electronic products as a means for ensuring flammability protection, which constitutes the main use of these substances. The three main groups of PBDEs, which are currently commercially available, are penta-, octa- and deca bromo diphenythether. BFRs are used in a wide range of products including plastics, white goods, car interiors, carpets and carpet underlay, polyurethane foams in furniture and bedding. They occur in EEE in mainly four applications; PCBs, components such as connectors, plastic covers, and cables, and their use has increased markedly over the past two decades, with worldwide production over 200,000 tonnes per year. According to a Danish estimation, WEEE represents about 78% of the total content of brominated flame retardants in waste (European Commission, 2000). Tetrabromobisphenol-A (TBBPA) is the largest volume brominated flame retardant in production today. It is used as a reactive (primary use) or additive flame retardant in polymers, such as epoxy and polycarbonate resins, high impact polystyrene, phenolic resins, adhesives, and others. Its main use in EEE is as a reactive flame retardant in printed circuit boards.

Many different types of plastics are used in the manufacture of electronic equipment. PVC is ubiquitous in electronics, forming the structure of computer housings, keyboards and cables. Estimated quantities of PVC in different products range from 37.1 grams in a keyboard to a total of 314 grams in all of the cables connecting different component pieces together (for example, the cables connecting the monitor, mouse and keyboard to the CPU) (Five Winds International, 2001). The predominant use of PVC plastic in electronics is as a structural feature in plastic computer housings, keyboards and cables. PVC has good chemical resistance that original electronic equipment manufactures look for when designing durable products.

Given that more than 90% of WEEE is land filled, incinerated or shredded without any pre-treatment. This leads to a considerable emission of the targeted substances into the environment hence leading to environmental pollution

The City Council of Nairobi is charged with the primary duty of regulating and managing the solid waste that is generated within its jurisdiction. In exercise of the powers conferred on the Local Governments by section 201 of the Local Government Act (Cap 265) of the laws of Kenya, the City Council of Nairobi in 2007 came up with a structure of solid waste by-laws to aid the regulation and management of all the solid waste that is generated in its area of jurisdiction. Section 4(7) of the by-laws states that the occupier or owner of any residential dwelling or trade remises within area of jurisdiction of the City Council shall deal with the waste arising from the premises in accordance with the directions issued by the Council either specifically or under the scheme of arrangement established by the Council under these by-laws for the management of domestic and trade waste arising in the area where the particular occupier or owner resides or carries on business or other activities. This provision therefore provides a platform for the management of solid waste within the city as it can be relied on by the council to introduce into the city's solid waste management system those directives that aim at reducing the amounts of solid waste generated whether at production or consumption levels

The constitution affirms that the right to a clean and healthy environment is a fundamental right and that any e-waste handling activity should pay attention to this close. Informal recycling enables usually hazardous employment for thousands of people therefore the vital step should be to attempt to address occupational risks in the sector. Workers need to be informed of the effects of e-waste processing on environmental and human health (Wang et al., 2011). As a consequence, regulation has to be combined with incentives for informal recyclers not to engage in destructive processes, such as a financial incentive to deliver parts to central collection sites rather than processing them themselves (Williams et al., 2008). According to Environmental Management and Coordination, no person shall dispose of any waste to public places and that any person whose activity generate waste shall collect, segregate and dispose of by relevant provision in local government act under waste treatment, so that the waste does not present any meaningful harm to the public. The regulation also calls for registration of private waste disposal and handling site.

2.4 Critical challenges constraining e-waste management in industries

While there is a need to enforce appropriate legislation which specifically targets e-waste, enforcement is a challenge in areas of the world with limited resources for governance (Hicks, Dietmar & Eugsterb, 2005), most countries lack capacity to implement the policies and regulatory framework. As of September 2010, the Basal Convention on trans-boundary movement of hazardous wastes had 178 signatories, but countries like USA had not ratified the convention (Basel Convention, n.d.). India on the other hand has ratified the Basel Convention but not the BAN Amendment, and officially opposes its enforcement (BAN, 2011). The non compliance to international e-waste management policies by some countries has posed as a challenge in the control of movement of hazardous waste to developing countries.

While the Bamako convention totally bans the import of hazardous wastes into Africa, it permits the trans-boundary movement of hazardous wastes generated within Africa subject to very stringent regulatory control, and this is a major setback towards sustainability as more develop countries within Africa can willingly transport e-waste to less developed countries within Africa.

Producers of electrical and electronics equipment's are not taking responsibility of the products they produce, this has contributed to the escalation of the problem. Producers should also take responsibility by reducing and eliminating hazardous substances in their products, producing long-lasting products which are simple to recycle and putting in place effective take-back programmes (Joseph, 2007).

The EMCA of 1999 created the NEC as a way to streamline environmental responsibilities and regulations. All of the agencies involved in environmental regulation are represented on the NEC, but it has been ineffective in policing the overlap of responsibilities between agencies. It has not been able to overcome the inter ministry rivalries that are supported by the fee structure currently in place (Bird and Kirira, 10, 2009). Moreover, many of the permanent secretaries of ministries represented on the NEC never attend its meetings, and can therefore not implement any of the suggestions of the NEC. The apex of environmental management structure in Kenya led by the NEC, NEC is dominated by Government officials including the Minister, Permanent Secretaries and the Director-General of NEMA. The other members are mainly appointees of the

Minister and no criteria are defined for such appointment. Given the mandate of the NEC in formulation of policies and directions and setting-up goals and objectives in environmental management, the body is not satisfactorily representative of the public in Kenya.

The Public Complaints Committee is established under Section 31 of EMCA. The PCC is concerned with the investigation of complaints relating to environmental damage and degradation generally. The PCC has powers to investigate complaints against any person or even against NEMA or on its own motion investigate any suspected case of environmental degradation. The PCC is required by law to submit reports of its findings and recommendations to NEC. The law however is weak in that it does not provide PCC with the mandate to see its recommendations carried through. Further, NEC is not specifically required to do anything with regard to the reports submitted by the PCC and will often note and adopt the same without any further follow up action. So far the PCC has experienced challenges such as failure to honor summons, hostility between parties, hostility directed at PCC investigators, lack of understanding of EMCA and abdication of duty by Lead Agencies.

E-waste imposes many challenges on the recycling industry (Smith et al., 2006) as it contains many different materials that are mixed, bolted, screwed, snapped, glued or soldered together. Toxic materials are attached to non-toxic materials, which makes separation of materials for reclamation difficult. Hence, responsible recycling requires intensive labour and/or sophisticated and costly technologies that safely separate materials (BAN, 2011).

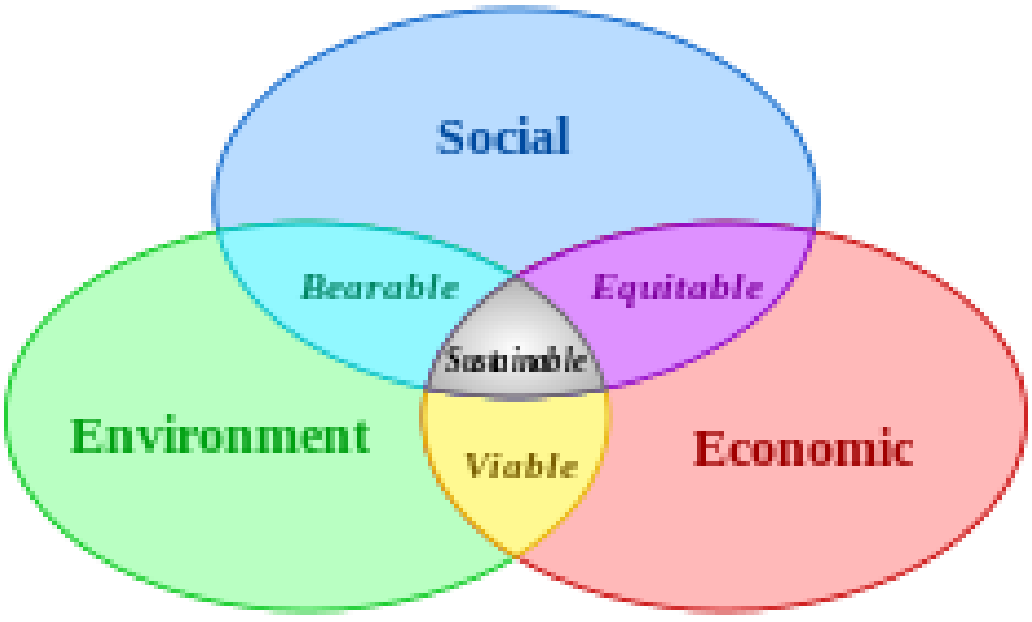
2.5 Theoretical framework towards a sustainable e-waste management

The objective of this project is to provide insights and tools for better management of e-waste from passive elements in Industrial area of Nairobi County. It is a search for creativity, innovation activities and actors for better integrated approach to e-waste management which is now an environmental challenge in Kenya. There is therefore a need to conceptualize management of e-waste in Manufacturing and Processing industries in a more holistic and integrative manner.

2.5.1 Sustainability Theory

It attempt to conceptualize management of e-waste in manufacturing and processing industries in Nairobi industrial area in a more holistic and integrative manner, the sustainability theory was adopted. It attempts to integrate social, environmental, and Economic responses in order to achieve sustainable relation. At the 2005 World Summit on Social Development it was noted that sustainability requires the reconciliation of the three pillars; environmental, social equity and economic demands. To achieve a balance between the economy, ecology and society, it is necessary to have strategic and sensitive sustainable designs (McLennan, 2005). This view has been expressed as an illustration using three overlapping ellipses.

Figure 2.1: Venn diagram of sustainable



Source: (Hart, 2000)

2.5.1.1 Economic model

An economic model in sustainability theory seeks to sustain natural and financial capital. Natural and financial capital is a fundamental system in e-waste management. Sustainability interfaces with economics through the social and ecological consequences of economic activity. Sustainable economics represents a broad interpretation of ecological economics where environmental and ecological variables and issues are basic but part of a multidimensional perspective. Social, cultural, health-related and financial aspects have to be integrated into the analysis. With regard to this project, economic model is important as it's a key support for technological innovations with regard to manufacture of industrial electrical and electronics equipment ensuring that manufactured equipment have minimal pollutants. Financial capital is also important in order to support proper activities of e-waste handling which have toxic substances, and are normally released upon poor disposal leading to environmental degradations. Implementations of key environmental policies that are aimed at protecting the environment also require a lot of financial support. Bodies such as NEMA that are involved in control of the sector through enforcement of the regulations also require a lot of financial support, to ensure they implement the enforcement with much ease. Holistic combination of these economic actors will ensure sustainable e-waste management in manufacturing and processing industries in industrial area of Nairobi County.

2.5.1.2 Social Model

Social model in sustainable development occurs when the formal and informal processes; systems, structures, and relationships actively support the capacity of current and future generations to create healthy and livable communities. Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life. The model looks at human life, laws governing human and environmental relations, the relationship between human rights and human development, corporate power and environmental justice. In order to achieve sustainability in e-waste management, all aspect in the social model must be observed and protected.

2.5.1.3 Environmental model

Environmental model looks at the physical and biological factors along with their chemical interactions that affect an organism. It may also looks at built environment, natural environment encompassing all living and non-living things and the social environment that include the culture that an individual lives in, and the people and institutions with which they interact. For the environment to support human and other bio life, it should be protected from degradation by putting measures that include policies and laws, as poor e-waste disposal could lead to environmental degradation given that e-waste contains toxic and in turn affect the social aspect of sustainability.

In principle, sustainability theory has been able to explain an integrated approach to e-waste management, how system actors that include social, economic and environmental models enable sustainability. In this respect, sustainability theory is relevant and useful in providing explanations to developments in classical e-waste management systems. However, there are some shortcomings. To begin with, the theory fails to provide actor-actor interactions within the heterogeneous parts which is fundamental in exchange of information and learning for better system performance. Second, and in reference to the intention of this study, Sustainability theory fails to provide a framework for the analysis of paradigmatic change of systems.

2.6 Conceptual Framework

E-waste management in manufacturing and processing industries is a complex process requiring comprehensive assessment of its various facets; economic, technological, political and institutional. The envisaged conceptual framework for carrying out a sustainable e-waste management revolves around an integrated approach where aspect in all three levels; social, economic and environmental within sustainability theory are identified and conceptualized. Social model aspect that include, better living condition, good health are realized through proper e-waste disposal which will ensure minimal pollution of the environment. The social welfare of the residence of industrial was investigated by evaluating the distance between there area of residence and disposal sites. Cases of poor e-waste disposal in their neighborhood and e-waste handling criteria of people working in industries were also investigated in the interview. The age,

sex, family size of the residence staying in industrial area was also determined to find out the likely age, sex and people who can be affected by poor e-waste handling.

Economic model aspects of sustainability were investigated through interview with all the relevant stakeholders. Interviews were conducted to determine if manufacturing and processing industries allocate enough resources to matters of environment management, issue of training of personnel to equip them with more knowledge on matters environmental management was also investigated, key government bodies such NEMA were also interviewed to determine if they allocate enough resources on matters of e-waste management. Sustainable e-waste management can be achieved through financial support from relevant stakeholders purposes aiding the activities associated with environmental conservation. Proper e-waste management can be costly in terms of time and resources and so it is important to understand what options exist for managing waste in an effective, safe and sustainable manner (El-Haggar, 2007).

Environmental model aspect for sustainability was determined by detail analysis of policies and regulatory framework governing e-waste management and related waste in manufacturing and processing industries to find out their effectiveness in addressing the issue of e-waste management. Gaps in the policies and regulatory framework both local and international were identified and recommendation made to fill the gap with an intention of ensuring that environment is protected from any forms of pollution though poor e-waste handling which will go a great mile in protection of life support system and improvement of quality of environmental.

2.7 Gap identification

Previous studies on e-waste management have either focused on the general solid waste management socio-technical system or e-waste from computers, fridges, mobile phones and television sets, but no study has been undertaken with focus on e-waste in manufacturing and processing industries despite rapid rise in industries which has resulted to increase in such type of waste in the sector.

On international policies, the Bamako convention totally bans the import of hazardous wastes into Africa, although it permits the trans-boundary movement of hazardous wastes generated within Africa subject to very stringent regulatory control, and this is a major gap and therefore setback towards sustainability as more develop countries within Africa can willingly transport e-waste to less developed countries within Africa.

In the structure of environmental management Kenya, National Environment Council takes the lead role. Government officials including the Minister, Permanent Secretaries and the Director-General of NEMA, dominate national Environmental Council. The other members are mainly appointees of the Minister and there is no criteria defined on how such appointments will be done. Given the mandate of the NEC in formulation of policies and directions and setting-up goals and objectives in environmental management, the body is not satisfactorily representative of the public in Kenya.

The Environmental Management Coordination Act 1999, created a unique institutional framework for environmental management and coordination that has the public play an important role which include the provincial and district environmental committees. The act should be reviewed to be in tandem with the new constitution which has brought about the county government structure. Policy Restricting the Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive (2002/95/EC) has been in force since 2003. Its purpose is to restrict the use of hazardous substances in electronic equipment (European Commission, n.d.).

The RoHS has some exemptions that include; Copper alloy containing up to 4% lead by weight and Lead in high melting temperature type solders is allowed. The servers, switches, routers, cell site and other telecommunication equipment that constitute the global Internet and phone systems are exempt from lead content restrictions, Limited amounts of mercury in fluorescent and other light bulbs. The acceptance of exemptions on RoHS directive posses as a Gap in environmental conservation as certain percentage of hazardous chemicals is still being allowed.

CHAPTER THREE

3.0 AREA OF STUDY

3.1 Introduction

This chapter presents a highlight of the area of study. The chapter provides the linkages between general physical setup and the social economic set up of the area of study and how poor e-waste management in area is likely to affects both the environment and the residents in the study area.

3.2 Physical Setup

This section will cover the location and extent of the area of study, the topography and drainage of the area, Geology and soils and the climate of Industrial area of Nairobi County.

3.2.1 Location and extent

The area of the study is Industrial area which is situated in Nairobi County, Kenya which is an administrative region and the capital City of the county; its geographical coordinates are 1° 18' 0" South, 36° 50' 0" East, Figure 1 showing the map of industrial area.

Figure 3.1 Map of Industrial Area, Nairobi County

Source: Google map 2013

3.2.2 Topography and drainage

Nairobi's main drainage follows the regional slope of the volcanic rocks towards the east Groundwater level varies considerably with surface topography and season and lies between 0.5 m to 18 m below the ground surface. Groundwater is found to recharge from the nearby rivers. Most of the rivers flowing there join River Athi that discharges water to the Indian Ocean.

3.2.3 Geology and soil

The underlying rock is a greyish brown Rocky Magadi with boulders measuring up to 0.4m thickness. It is 2.4m below the ground level. The whole area is covered with black cotton soils, which are 2m deep below the ground level.

The soils have poor infiltration capacity. This makes the neighborhood prone to water logging owing to the poor capacity to receive and transmit water. The black cotton soil is 2m below the ground level and when constructing the soil has to be excavated till the hard rock for laying the foundation is reached. The soils have a low resource value because black cotton soils cannot be used as building material or road infill due to its characteristics of expanding when wet and contracting when dry. This leads to cracks in foundations and potholes on the roads.

3.2.4 Climate

Nairobi has a temperate tropical climate with two rainy seasons, highest rain fall is received between March and April and the short rainy season is between November and December. The mean annual rain fall ranges between 850-1050mm (Lakin undated). The mean daily temperature ranges between 12 and 26°C. It is usually dry and cold between July and August, but hot and dry in January and February (CBS, 2003). The mean monthly relative humidity varies between 36 and 55 per cent the mean daily sunshine hours varies between 34 and 95 hours (CBS, 2003).

3.2.1 Vegetation

The main types of vegetation present on our site include trees, and grass. They are grown along the road and on open spaces in the front yards. The available vegetation improves the visual quality of the neighborhood in terms of its beauty. It forms an integral element of the natural and cultural landscape.

3.3 Social Economic setup

Industrial area of Nairobi is an important economic setup of the county with many industries located in the area and good road net to facilitate movement of goods and people in the area. It is surrounded by several well of residential areas to include Imara daima, middle class residential area such as pipeline, Mbotela, Kaloleni, Mbotela and low class residential such as Sinai slum, Mukuru Kwa Njega slum and Rasta slum.

3.3.1 Transportation and Communication

The mode of transport in industrial area is road transport. The existing road system is sufficient with well-planned vehicular circulation. Jogoo road to the south, Lusaka road to the East, Enterprise road to the south and outer ring road to the west, the inner area has many other feeder roads which include Lungalunga road and Likoni road All roads within the neighborhood are two-lane, two way single carriageways. The road width ranges from 60m to 18m with adequate road reserves which can accommodate the future expansion of the roads in the area. The pedestrian footpaths are present on the primary distributor but missing in all roads. As a result movement is not segregated from vehicular movement. There are also many footpaths, which cross through the open spaces in the estate and these have led to a high level of insecurity in the estate. Most dwellers of the neighborhood rely on public transport, which is attributed to the busy transportation edge along Jogoo road that enables the residents to commute to their places of work or town and train transport. There is also railway network that traverses industrial area.

3.3.2 Trade Commerce and industry

The area is an important hub for trade and industry as most industries are located in the area, the area also houses many wholesalers. The area has a good road network to facilitate access to the area for trade purposes.

CHAPTER FOUR

4.0 RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter analyzes the best approach research design which is a plan to be followed that will specify the methods and procedures for collecting and analyzing the required information in order to realize the research objectives. The scope of the study is traced to include the area and population with an intention of determining why the location was chosen for study purposes and the exact location of the study area. Secondly, the research methodology is described. Since the study intends to gain insights on the extent of e-waste mismanagement, the overall nature of the study was mainly a qualitative, exploratory case study. Thirdly, the rationale of this case study is outlined, and methods of sampling and data collection described, also highlighting the limitations encountered during data collection and how they were dealt with. Finally, methods of data analysis are presented.

4.2 Research design

This section provides an introductory discussion on the research methodology and design strategy that was used in the study and will focus on the research design and methodology with main focus being, research method, research format, research technique, the population, sampling procedure, sampling type, sampling technique and data analysis which was applicable to my study, Including ethical considerations. It describes the methods and procedures that were employed in the course of the study and their relevance towards attaining the research objectives and goals. Case study design, was adopted in my study, with an in depth study on e-waste in manufacturing and processing industries.

4.3 Study Area

The study area of the project is industrial area of Nairobi County. The industrial area of Nairobi County has the highest number of industries in one locality in the country and East Africa at large, most of which are manufacturing and processing industries. The presence of these industries in a common locality have led to a rise in e-waste from passive elements due increased changes in technology, wear and tear, and high rates of obsolescence of the electrical and

electronics equipment's and modules. There is therefore need to determine the critical challenges with regard to this type of waste in the sector and how to address all the challenges and problems associated with e waste.

4.4 Target population

The population of study was manufacturing and processing industries that are located in industrial area of Nairobi County with a population of about 2000 industries and the household from the neighboring residential areas which include the Viwandani Ward with a population of 44,881, Kwa Njenga ward with a population of 32,600, Kwa Reuben ward with a 32,600 and Kware ward with a population of 32,601, which are likely to be affected by poor e-waste handling. Other included relevant stakeholders that such as the Ministry of Environment and Natural Resources, National Environmental Management Authority, Ministry of Industrialization and the county government of Nairobi and e-waste handlers

4.5 Sampling Technique

Owing to the constraints of time, finances and human resources, the sample size for the population under study was selected by clustering the area under study where, individual industries within these clusters were further selected by simple random sampling, a technique ensuring that each industry has an equal chance of being selected. This was facilitated by the fact that industrial area is planned on the neighborhood unit concept. A number of other sampling techniques were employed during the data gathering process. These are as follows, Purposive sampling was used to select key stakeholders in the matter of environment that include the Ministry of Environment and Natural Resources, National Environmental Management Authority, Ministry of Industrialization and the county government of Nairobi and e-waste handlers. Simple random sampling was used in neighborhood and residential area to collect information from the residence living in and surrounding industrial area, given that the separate slums are located in clusters in different regions under different names, residences were further selected by simple random sampling, where every member is given equal opportunity of being selected

4.6 Sample Size

The sample size of industries and residences who reside in industrial area was determined using. The formula,

$s = X\,2NP\,(1-P) \div d\,2\,(N-1) + X\,2P\,(1-P)$.

s = required sample size.

$X2$ = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (0.01)

Source of formula; (NEA, 1960)

Given the total population of industries is 2000, confidence level is 95% and confidence interval is 10. The sample size of industries obtained was 92. Given the population of the residence in industrial area is 150,000, confidence level is 95% and confidence interval is 10. The sample size of the people is 96.

4.7 Research Instruments

The project was realized through explorative research that looks to establish the state of e-waste from passive elements in manufacturing and processing industries in industrial area Nairobi County. A research methodology framework was developed which guided the development of the research tools.

Both qualitative research method that included group discussions, observation and reflection field notes, pictures, and quantitative research method where numerical data were adopted for data collection and enquiry into the area of interest to determine the flow of e-waste and subsequent disposal. The research questions and theories, composed of variables were measured in a systematic way and data analysed using statistical procedures. The study assumed a descriptive design which employed the following approaches: secondary research, research tools design, field research, analysis of research findings and report writing, since the study was

seeking for more detailed and accurate information on e-wastes management practices to uncover the challenges and come up with sound and workable solutions to the challenges. The aims of this study are: To establish if organizations have e-waste management plan disposal policy in place and whether asset disposal policy include electronic products, to understand how do organizations store or treat end of use electronic products, to understand whether waste management practitioners are trained on e-waste management practices and understand methods used by waste management companies or organizations to destroy e- wastes in damp sites.

4.7.1 Secondary Research

This provided background information and important insights and guidelines for the design of the research tools and the subsequent field research. It involved review of relevant literature, policy documents, industry reports, media publications, company reports where applicable as well as internet sources among other secondary sources of information. All these sources and materials used in the research will be acknowledged and included in the list of references.

4.7.2 Field Research

Field research was conducted using a combination of the following methods; Interviews, Observations, focused group discussions and photography which provided the key primary data.

4.7.2.1 Residents and other stakeholder interviews

Household from the neighboring residential areas in industrial area Nairobi County who are likely to be affected by poor e waste handling in the industries were interviewed and included the Viwandani Ward, Kwa Njenga ward, Kwa Reuben ward and Kware Ward. A stakeholder mapping was carried out to determine every player in the e-waste management sector. Key considerations was those with control or interests in the following ways; Policy formulations and regulatory mandates, human rights issues, and key government ministries that are directly involved to matters environment and included the MENR, MoI and NEMA.

4.8 Nature and sources of data

Data to be collected was aimed at addressing the study objectives. With regard to the first objective on evaluation of existing policies and regulatory framework governing e-waste

management, primary data and secondary data were collected with the aim of determining gaps in existing legal, policy and regulatory frameworks in waste management, Institutional mandates and framework for sustainable development, The level of involvement all stakeholder in e-waste management.

In relation to objective two on examining how e-waste is handled in manufacturing and processing industries, primary and secondary data was collected to determine levels of stakeholder responsibilities on matters of e-waste management, evaluate effect of poor e-waste handling to the environment, how e-waste is disposed and determines how e-waste is handled in manufacturing and processing industries.

In relation to the third objective of examining critical challenges constraining e-waste management in manufacturing and processing industries, primary data was collected to evaluate level of compliance on environmental legislation by industries, effectiveness of monitoring and policy implementation the relevant key stakeholder, safety concerns during e-waste handling in manufacturing industries.

4.9 Methods of data collection

In line with that semi-structured interviews along with the questionnaires were used as data collection tools. Two sets of questionnaires were distributed; the first set targeted manufacturing companies, the second set of questionnaire targeted processing companies which are major consumer of electrical and electronic products. Questionnaires were hand delivered to respondents and followed up later for collection. Structured interviews were conducted to either sections leaders or managers of key stakeholders to environment issues and included the Ministry of Environment and Natural Resources, National Environmental Management Authority, Ministry of Industrialization and the county government of Nairobi and e-waste handlers to gather their views on e-waste management practices. In addition, four dumping sites and one recycling industries were visited to observe e-waste management practices on site.

4.10 Data analysis and Presentation

Data collected was sorted, organized, conceptualized, refined, and interpreted using methods drawn from the constant comparative analysis techniques, Quantitative and qualitative methods was used to analyse data. Data on questions that are quantitative in nature such as e-waste types, quantities of waste handled was analysed using Microsoft word where charts and tables were generated. Qualitative data, mainly obtained from interviews and document analysis, was categorized to allow for meaningful analysis. Quotes, individual remarks and case illustrations built from interviews were used to further lend valuable support to data. Public policy data and information were subjected to content analysis.

Table 4.1: Representation of variables, sources of data and data analysis

N	OBJECTIVES	VARIABLES	Sources of Data	Data analysis
1	Review of policies and regulatory framework that govern e-waste management in Kenya	Existing legal and policy framework in e-waste management Institutional mandates for enforcement of e-waste management Effectiveness of various policies in addressing e-waste	NEMA, Ministry of Environment, Industries, county government, Constitution of Kenya, EMCA, Factories act, Companies corporate policies	Qualitative analysis
2	How e-waste from passive elements are being handled in manufacturing and processing industries	Methods of e-waste disposal Classification of e-waste E-waste collections and transportations Roles of various stakeholders in waste handling Determine impact of poor e-waste disposal	E-waste transporters, E waste recyclers, Industries, county government	Photography, pie charts, bar graphs
3	Critical challenges constraining e-waste management in industrial area Nairobi	Identify institutional constrains regarding e-waste management Identify roles of various stakeholders in e waste management	Industries, NEMA, County government, Ministry of environment, ministry of industrialization, other stakeholders	Photography, pie charts, bar graphs

CHAPTER FIVE:

5.0 DATA PRESENTATION, ANALYSIS AND DISCUSSIONS

5.1 Introduction

This chapter presents a highlight of key data collected and a detailed analysis and discussion of the research findings in the relation to the objectives. On objective on policies, legal and institutional framework that govern e-waste management in Kenya, key policies such as the constitution of Kenya, EMCA 1999, Factories Act, NEAP document, county council act. Roles of key institutions such as the NEMA, PCC, and NEC were reviewed with relation on data collected. On objective two about how e-waste from passive elements is being handled in manufacturing and processing industries, data on e-waste handling, disposal, and measure put in place in industries was analyzed and inferences discussed. On objective three on challenges industries are facing on matters to do with e-waste management, data on critical challenges industries and key stakeholders face was collected, analyzed and inferences discussed.

5.2 Policy, legal and institutional framework that govern e-waste management in Kenya

In Kenya, environmental laws, policies and legislation governing the environmental sector are scattered in sector specific laws and policy papers. Institutions and departments dealing with issues relating to the environment are equally numerous. Sector specific laws are deficient in that they are characterized by uncoordinated legal regime that are developed to facilitate resource allocation and to deal with environmentally adverse effects of resource exploitation.

5.2.1 The Constitution of Kenya

The constitution of Kenya contains specific provisions intended to protect the environment and the people. The constitution acknowledges fundamental rights and freedoms where every person has the right to a clean and healthy environment. According to our finding, many people still live in areas experiencing poor e-waste disposal. From those who were interviewed at the household level, 28% admitted that they experienced cases of e-waste disposal in their neighborhood. This indicates the irresponsibility of the concerned in handling e-waste in the desired manner. Disposal of e-waste in residential areas is dangerous and poses danger to those who reside there

which is total disregard of the spirit of the constitution. The State has a responsibility in ensuring sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensures the equitable sharing of the accruing benefits. Therefore this provision acknowledges the role of the state in ensuring sustainable development as well as the importance of equitably sharing benefits derived from the environment.

According to the constitution of Kenya, any treaty or convention shall form part of the law of Kenya; the country has thus ratified several international treaties on environmental management among others. Some of treaties include, the Basel Convention and Bamako Convention. Despite the fact that Kenya has subscribed to international standards on environmental conservation, the government is doing little to ensure enforcement of the conventions. There is also little effort from the industries in subscribing to international standards on environmental conservation. From the interview schedule at the industry level, 96% of the responded admitted that there companies have not subscribed to international standards regarding to environmental management such as ISO 14001, while a mere 4% admitted that there organization had subscribed to the standards. International standards on environmental management are important as it ensures continuous improvement hence sustainability of the environment. The non-conformance by industries to international legislation regarding environmental management is a clear indication of critical challenge regarding e-waste management as most industries do no observe the laid down procedure regarding e-waste handling.

Information collected from the households, industry level and relevant stakeholders such as NEMA and the ministry of environment and natural resources, major causes of fast growth of e-waste in manufacturing and processing industries include change in technology, industrialization, wear and tear, absoluteness and the presence of counterfeit products in the market. This has resulted in first growth of e-waste at industry level. From the interviews, it is claimed that e-waste at the industry level is poorly managed, as there are no structures in place to address the menace. There are no e-waste specific policies and the enforcement of general waste regulations is poorly done as the bodies with responsibilities to enforce the same such as NEMA and the county government lack capacity in terms of personnel and finances. Industries also lack social

responsibilities of embracing environment conservation by adopting laid down rules and regulations on e-waste.

5.2.2 The Environmental Management and Coordination Act of 1999 (EMCA)

The Environmental Management and Coordination Act of 1999 (EMCA) was enacted to ensure appropriate legal and institutional framework are in a place for proper management of the environmental and any other matters relating to environment. EMCA is expected to address all aspects and procedures in relation to environment, including law enforcement and monitoring of compliance. However, strategies to achieve this have not been fully implemented due to the following reasons; In adequate institutional capacity and resources to mobilize and link activities effectively within and between sectors, Specific environmental sectoral laws that do not adequately articulate the links between development, population and environmental concerns and Limited budgetary provisions to finance the effective implementation of environmental programs set out in national development plans. EMCA 1999 established the following institutional framework to govern the environment in Kenya

5.2.2.1 National Environment Action Plan Committee

The NEAP was established under Section 37 of EMCA. This cross-sectoral committee is responsible inter alia, for the development of a five-year national environment action plan. The national environment action plan shall contain among other aspects analysis of the natural resources of Kenya and their distribution, quantity and various uses. It shall also recommend legal and fiscal incentives for business that incorporate environmental requirements into their planning and operational processes as well set out guidelines for the planning and management of the environment and natural resources. The national environment action plan shall be binding upon adoption by Parliament. Provincial and district environmental committees are also required to develop their own five year environmental action plans which are incorporated in the national environment action plan.

The first NEAP was prepared in 1994 and several recommendations were made for implementation. Since then the following are some major milestones achieved to date: Enactment of EMCA in 1999; Establishment of NEMA and other EMCA, 1999 institutions namely. National Environment Council, National Environment Tribunal, Public Complains

Committee, National Environment Trust fund; Gazettement of District and Provincial Environment Committees whose responsibility is to oversee environmental management activities in their areas of jurisdiction; Development and implementation of various environmental management regulations such as. Environmental Impact Assessment and Audit Regulations, Waste Management and Water Quality Regulations, Biodiversity Regulations, Ozone Depleting Substances Regulations whereas regulations on Hazardous Chemicals, Air Quality and Noise are being developed in consultation with lead agencies and stakeholders. Other achievements include development of Biodiversity Strategy and Action Plan 1999 and the Establishment of KEIN.

5.2.2.2 The National Environmental Council

The NEC is established under Section 4 of EMCA and is the highest policy making body under EMCA. Minister chairs it in charge of the environment. It is responsible for policy formulation and directions for purposes of EMCA by setting national goals and objectives, promotes cooperation among both public and private organizations, and is engaged in environmental protection programmes. The EMCA of 1999 created the National Environmental Council (NEC) as a way to streamline environmental responsibilities and regulations. All of the agencies involved in environmental regulation are represented on the NEC, but the NEC has been ineffective in policing the overlap of responsibilities between agencies. Many of the permanent secretaries of ministries represented on the NEC never attend its meetings, and can therefore not implement any of the suggestions of the NEC (Bird and Kirira, 10, 2009). However, Government officials including the Minister, Permanent Secretaries and the Director-General of NEMA, dominate the apex of environmental management structure in Kenya led by the National Environment Council. The other members are mainly appointees of the Minister and no criteria are defined for such appointment. Given the mandate of the NEC in formulation of policies and directions and setting-up goals and objectives in environmental management, the body is not satisfactorily representative of the public in Kenya. The composition of NEC should be reconstituted to bring on board professionals and their roles should be redefined to enable them raise pertinent environmental issues affecting people on the ground such as poor e-waste disposal

5.2.2.3 National Environmental Management Authority

NEMA was established under the EMCA No. 8 of 1999, as a principal instrument of Kenyan government with the overall mandate supervision, co-ordination and of all policies relating to environment. It was enacted in 1999 against a backdrop of 78 sectoral laws dealing with various components of the environment, with the supreme objective being; to bring harmony in the management of the country's environment Section 9(i) of EMCA. It mandates the Authority to exercise general supervision and coordination over all matters relating to the environment and to be the principal instrument of the Government of Kenya in the implementation of all policies relating to the environment. NEMA is also tasked with preparing manuals, codes and guidelines relating to environmental management and prevention or abatement of environmental degradation for public consumption. In addition, it is to prepare an annual report on the state of the environment. Environmental information may be disseminated to the public through these potential avenues. However, there is no requirement for publication or dissemination of the annual environmental report. The only condition is on the Minister of Environment to place the report before the National Assembly of Kenya as soon as possible upon its publication.

The failure to provide for mandatory publication in the local dailies limits accessibility of the annual report to the public. Access to Environmental Information the Act mainly secures the passive component of the right to access environmental information. Section 123 of EMCA provides that any person may have access to any record transmitted to National Environment Management Authority. However, such access is at discretion of the Authority and only available upon application. The Authority may also impose a fee for grant of any such access. The records available and kept are such as gazetted by the Director-General. The Authority is within its right to insist on maintaining the confidentiality and, therefore, restricting access to any document.

5.2.2.4 The Public Complaints Committee

The Public Complaints Committee is established under Section 31 of EMCA. The PCC is concerned with the investigation of complaints relating to environmental damage and degradation generally. The PCC has powers to investigate complaints against any person or even against NEMA or on its own motion investigate any suspected case of environmental degradation. The PCC is required by law to submit reports of its findings and recommendations

to NEC. The law however is weak in that it does not provide PCC with the mandate to see its recommendations carried through. Further, NEC is not specifically required to do anything with regard to the reports submitted by the PCC and will often note and adopt the same without any further follow up action. So far, the PCC has experienced challenges such as failure to honor summons, hostility between parties, hostility directed at PCC investigators, lack of understanding of EMCA and abdication of duty by Lead Agencies.

5.2.2.5 The National Environment Tribunal

The NET is established under Section 125 of EMCA for the purpose of hearing appeals from administrative decisions by organs responsible for enforcement of environmental standards. An appeal may be lodged by a project proponent upon denial of an EIA license or by a local community upon the grant of an EIA license to a project proponent. NEMA may also refer any matter that involves a point of law or is of unusual importance or complexity to NET for direction. The proceedings of NET are not as stringent as those in a court of law and NET shall not be bound by the rules of evidence as set out in the Evidence Act. Upon the making of an award, NET's mandate ends there as it does not have the power to enforce its awards. EMCA provides that any person aggrieved by a decision or award of NET may within 30 days appeal to the High Court. The National Environment Tribunal is empowered to inquire into the matters arising from refusal to grant or transfer a license, imposition of any condition, limitation or restriction on a license, the amount of money required to be paid as a fee and the imposition of an environmental improvement order by the Authority. The Tribunal is made of a Chairperson appointed by the Judicial Service Commission, an advocate, a lawyer with professional qualifications in environmental law and to other persons of exemplary academic competence in environmental matters. The tribunal apparently does not deal with matters relating to the access to and use of environmental resources. Its mandate is limited to the matters provided for in the Act. It is not suitable for settling environmental conflicts at community level.

The Tribunal also does not envisage the participation of all interested parties, such as developers, government, the community, nongovernmental organizations, and environmental groups in a joint effort aimed at restoring the environment, and agreeing on the sustainable use of the same.

5.2.3 Factories Act

The Factories Act is one of the existing laws that deal with those sectors that generate solid waste. Section 13 of this Act makes it mandatory for every factory owner to ensure that the factory environment is kept in a clean state and from effluvia arising from any drain, sanitary convenience or nuisance and without prejudice to the quality of the foregoing provision. The foregoing provisions include accumulations of dirt and refuse which shall be removed daily by a suitable method from the floors and benches of the workrooms, and from the staircases and passages. The floor of every workroom is to be cleaned at least once a week by washing or, if it is effective and suitable, by sweeping or by any other method. Even though the Act provides for a section to ensure that the factory environment is kept clean, it does not clarify or provide a section on reduction of the waste generated by such factories or the segregation of the waste cleaned from the stated parts of the factory rooms. It also does not provide for enforcement procedures.

5.2.4 County Council of Nairobi

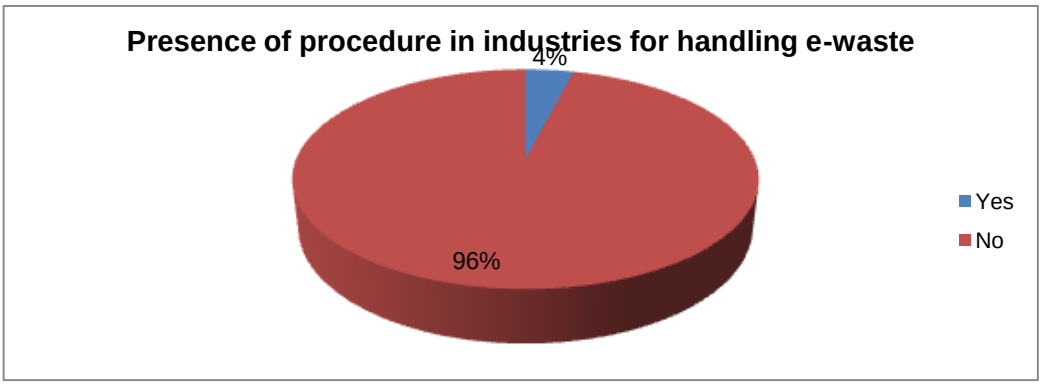
At the National level, Monitoring and Evaluation is conducted through the NIMES, whose main aim is to improve the effectiveness and quality of tracking of implementation of various development policies, strategies and programmes. The county and lower level monitoring and evaluation of projects and programmes are part of this system. Currently the county of Nairobi does not have a county monitoring and evaluation system in place. It is expected that counties will put in place, while complimenting the National Monitoring and Evaluation system. The system will take cognizance of the projects and programee included in the County integrated development plans as well as indicators facilitating the medium term expenditure framework process and development aspects of the respective county.

The city council of Nairobi came up with by laws on solid waste management in Nairobi in 2007 under the power confirmed upon it by the Local Government Act (Cap 265) in order to regulate and manage solid waste that is generated within its jurisdiction. Under Section 4(7) of the By-laws, the occupier or owner of any residential dwelling or trade premises within area of jurisdiction of the City Council shall deal with the waste arising from the premises in accordance with the directions issued by the Council, either specifically or under the scheme of arrangement established by the Council under these By-laws. This provision therefore provides a platform for

the management of solid waste within the city as the council, the By-law refers to solid waste in general and not e-waste in particular and this brings about the challenge of during handling of e-waste and other solid waste. The county government should amend the By-law in order to include e-waste in particular. According to section 8(4), it shall be the duty of every occupier and every owner of premises wherein any hazardous waste or clinical waste is generated to make suitable arrangements, including the separation of such waste from other non-hazardous waste or non-clinical waste, to the satisfaction of the council. The enforcement by the county government is not efficient due to minimal labour force and knowledge of e-waste hence posing as a challenge in the e-waste management.

5.3 How e-waste from passive elements is handled in manufacturing and processing industries

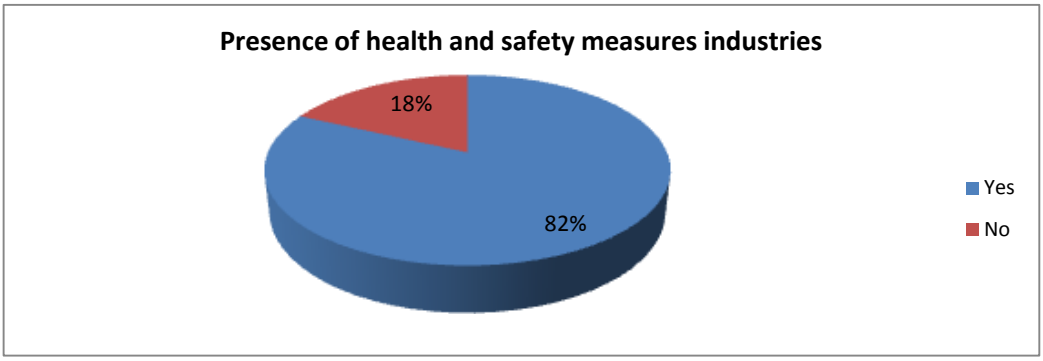
Figure 5.1: Presence of procedure on e-waste handling in industries



Source: Field data, 2014

From Figure 5.1, 96% of those who were interviewed admitted that there organization did not have procedures of handling e-waste, while 4% had procedure on e-waste handling. The high percentage of non conformance with regards to e-waste handling clearly indicates that most manufacturing and processing industries handle e-waste in disregard of the internationally accepted standards. E-wastes from passive elements contain toxic substances such as lead, cadmium, mercury, American and lithium (Cui & Jirang, 2008). Poor handling of e-waste endangers the life of those handling and also leads to environmental pollution. Enforcement of such standards should be done to ensure conformance with laid down procedures.

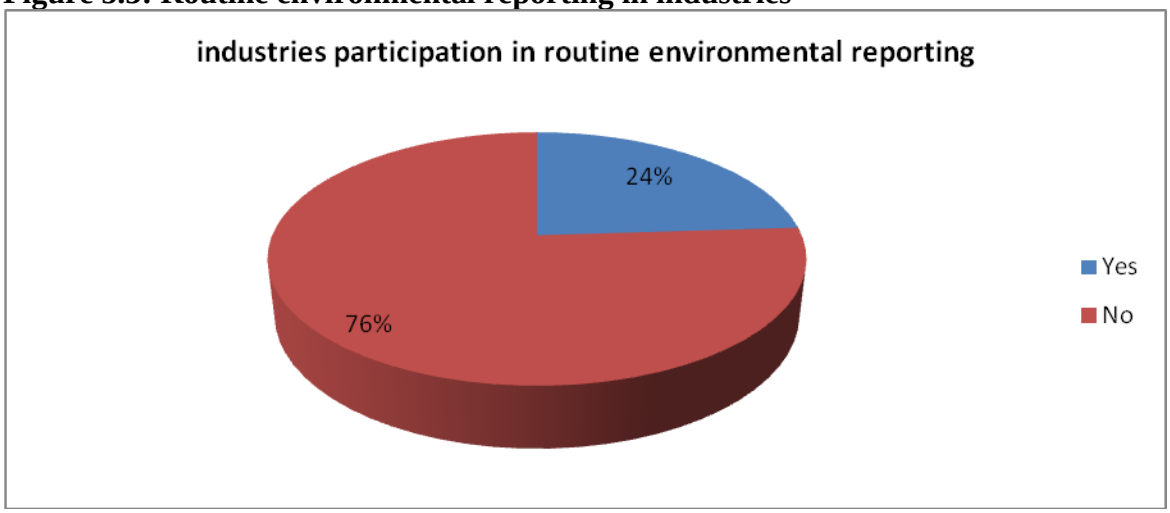
Figure 5.2: Presence of health and safety measures in industries



Source: Field data, 2014

From Figure 5.2, 82% of the respondents in manufacturing and processing industries admitted that there organization had health and safety measures in place, while 18 % did not have health and safety measure in their industries. Such measure included safety policies, working procedures and adequate first aid facilities. The high percentage of organization with health and safety measure is particularly encouraging because, the measure will be of importance when it comes to e-waste handling. The non-conformance to health and safety measure is attributed to poor enforcement from the side of the government and ignorance by the respective industries concerning the same. This therefore means that some industries do not observe health and safety measure when handling e-waste and other related wastes, which means that many people are at risk during the handling process and the environment is also at risk to pollution. Enforcement from respective bodies such as NEMA and the County Government of Nairobi should be done to ensure compliance.

Figure 5.3: Routine environmental reporting in industries



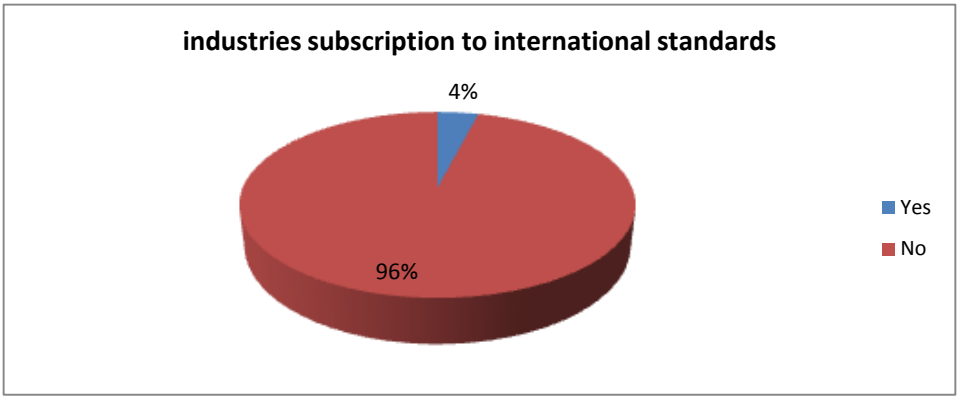
Source: Field data, 2014

From figure 5.3, above, 76% of the respondents admitted that there companies do not practice routine environmental reporting, where as 24% admitted that there organization practiced routine environmental reporting. The process includes self auditing and external auditing to ensure conformance with laid down standards. Routine environmental reporting is very important in realizing sustainability on matters of environmental management; it ensures disclosure of the state of the environment at given periods, which ensures industries comply with laws and regulation governing the sector, and it's a prerequisite by EMCA. The high percentage of none

compliance to routine environmental reporting in industries is attributed to poor enforcement by the relevant bodies and ignorance by the industries.

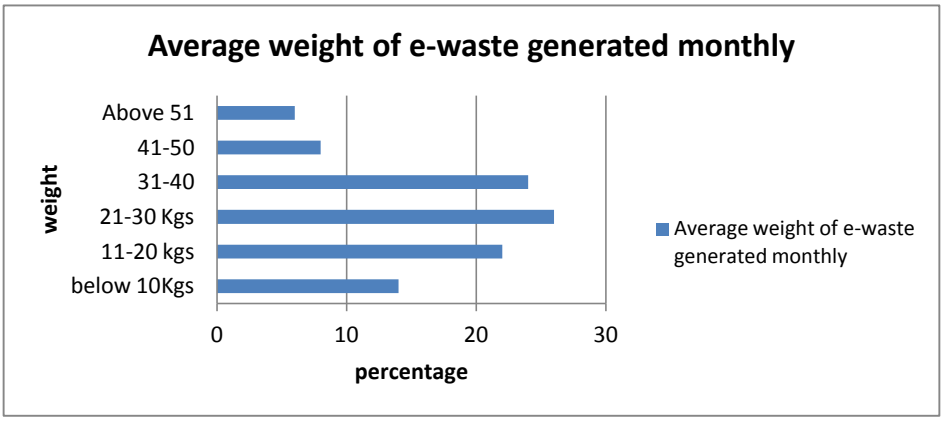
From Figure 5.4, below 96% of the responded admitted that there companies have not subscribed to international standards regarding to environmental management, while 4% admitted that there organization had subscribed to the standards. International standards on environmental management such as ISO 14001, is important as it ensures continuous improvement hence sustainability of the environment. Most of the companies that admitted to have subscribed to such standards were international companies. It is of importance that companies subscribe to such standards, which will ensure that regulations and procedure regarding e-waste are observed in industries. Non-compliance to internationally recognized standards is attributed to ignorance by respective companies and lack of enforcement from respective bodies such as NEMA; this in turn leads to poor e-waste management as there are no regulations in place to govern the e-waste handling.

Figure 5.4: Industries subscription to in international standards



Source: Field data, 2014

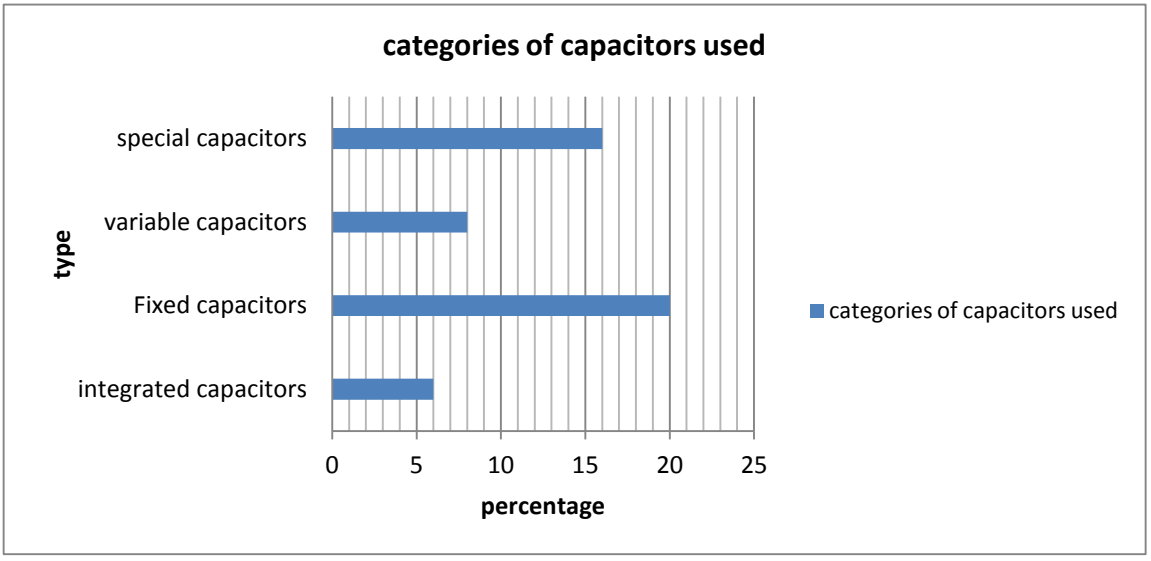
Figure 5.5: Weight of e-waste generated in industries



Source: Field data 2014

From Figure 5.5 above, 26 % of manufacturing and processing industries generated 21-30Kgs of e-waste monthly, 24% generated 31-40kgs per month, and 22% generated 11-20kgs per month, while 7% generate 41-50kgs, 14% of the industries generate below 10kgs while 6% generate 51 kgs and above of the e-waste. This passive e-waste generated from industries include, capacitors, resistors, magnetic and inductive devices and transducers/sensors/detector as shown in Figure 5.6, 5.7 ,5.8 and 5.9

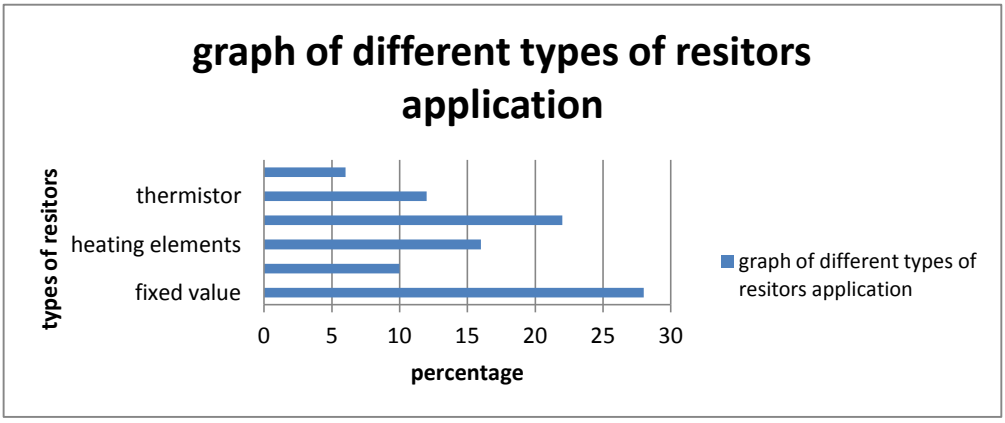
Figure 5.6: Types of capacitors used in manufacturing and processing industries



Source: Field data 2014

This Figure 5.6 shows the varieties of capacitors used in manufacturing and processing industries. Fixed value capacitors 20%, special capacitors 16%, variable capacitors 8%, and integrated capacitors 6%. This therefore confirms that all the different categories of capacitors are used in manufacturing and processing industries in industrial area where they have a wide of application that include power factor corrections by compensating for inductive electrical equipment loads that is generated by motors and other inductive devices, in resonant circuits, as safety capacitors, electrolytic capacitors. The capacitors dielectric is made of aluminium oxide (Al2O3) or tantalum oxide (Ta2O5). They also contain PCB's due to the electrical insulating property, difficult inflammability, chemical and thermal stability of polychlorinated biphenyls (PCB's). This toxic composition of the capacitors could lead to environmental pollution if they are disposed of poorly after their lifespan is over.

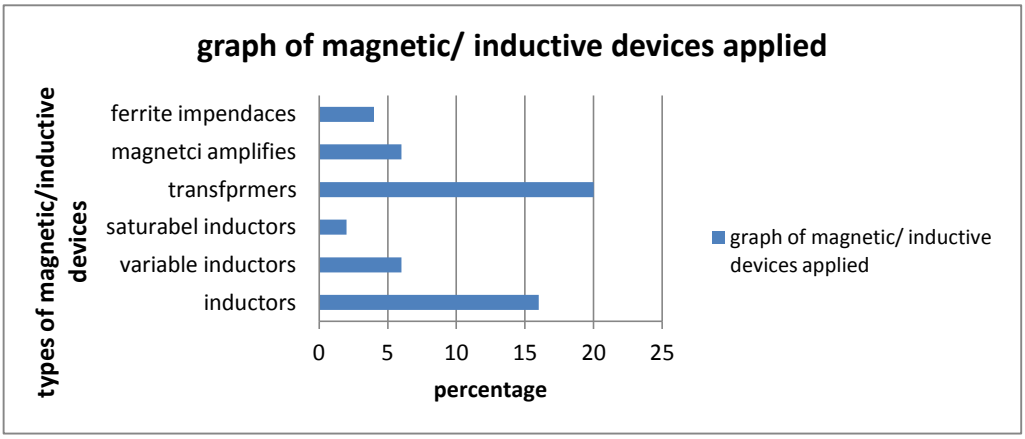
Figure 5.7: Graph of resistors used in manufacturing and processing industries



Source: Field data 2014

From graph 5.7, there are a variety of resistors used in manufacturing and processing industries, fixed value resistors 27%, resistance wires 23%, heating elements 16%, thermistors 13%, and variable resistors 10% and humisors 6%. This therefore confirms that all the different categories of resistors are used in manufacturing and processing industries in industrial area. Due to wear and tear and change in technology, these resistors may be discarded as e-waste. The resistors contain nickel, lead, epoxies, silver, and sulfur and once they are disposed off poorly could lead to environmental pollution.

Figure 5.8: Graph of magnetic and inductive devices used in industries



Source: field data 2014

Magnetic and inductive devices have a wide application in industries, From Figure 5.8, Transformers 20%, and Inductors 17%,

Photo image 5.0: E-waste from AC Induction motors (photo series by Duncan Aliero Muhani)

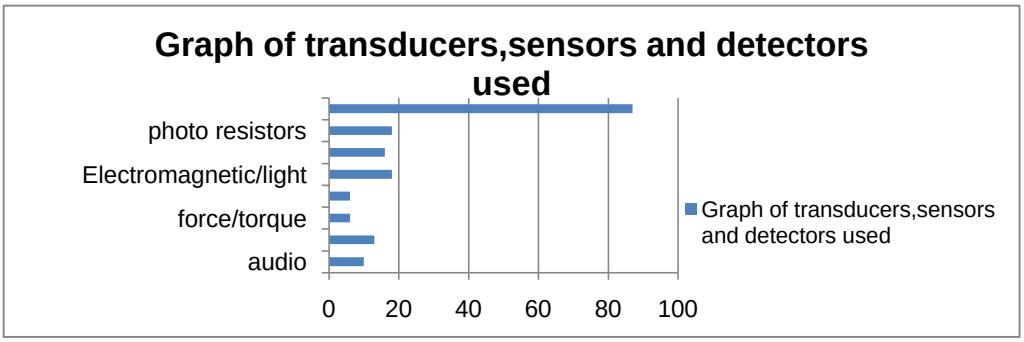
Picture showing e-waste from inductive devices (Motors).

Magnetic amplifies 6%, variable inductors 6%, ferrite impedances 4%, and saturable inductors 2%. From Figure 5.8, this confirms the presence of magnetic and inductive devices in manufacturing and processing industries where they have a wide of applications. These

components contain cadmium, lead, brominated dioxins, copper, nickel, antimony, chromium and beryllium. The toxins could lead to environmental pollution if they are disposed of poorly after they wear out.

Transducers, sensors and detectors have a wide application in manufacturing and processing industries. From Figure 5.9 below, transducers, sensors and detectors used in manufacturing and processing industries include, Photo resistors have an application of 18%, electromagnetic/light 18%, humidity 16%, position/motion 14%, audio 10%, thermal 10% and force/torque 10%. This therefore confirms the presence of magnetic and inductive devices in manufacturing and processing industries where they have a wide of applications.

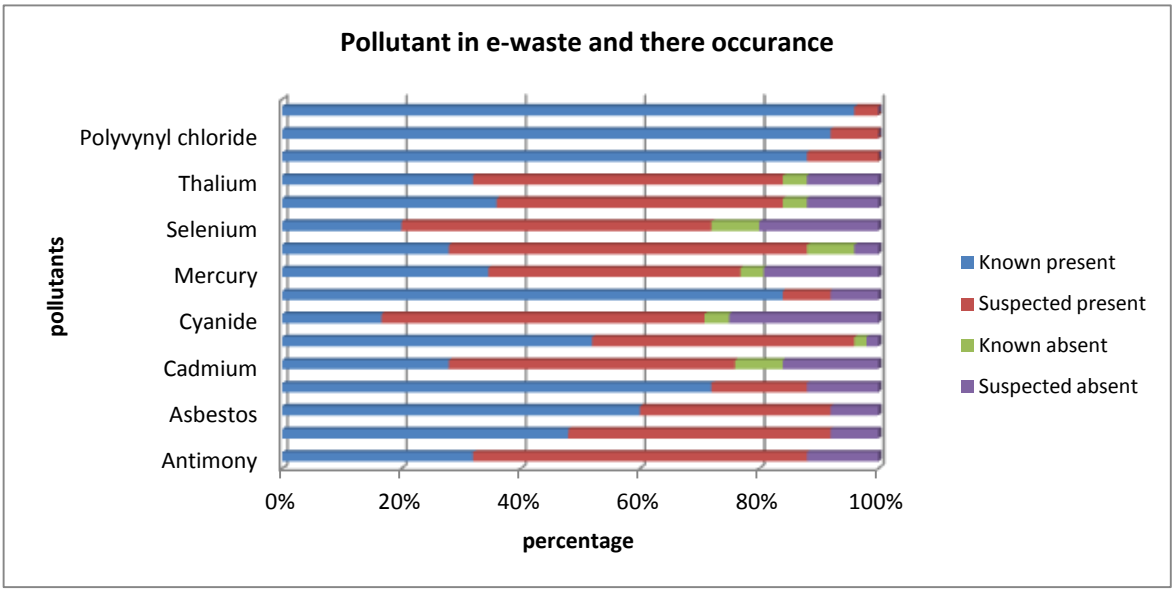
Figure 5.9 transducers, sensors and detectors used in industries



Source: Field data 2014

Due to wear and tear, change in technology and obsoleteness, the above electrical and electronics equipment could end up being discarded as e-waste and given that they contain the following compounds cadmium, lead, nickel, copper, nickel, antimony, Chromium and beryllium. The toxins could lead to environmental pollution if they are disposed of poorly.

Figure 5.10: Pollutants and there occurrence in e-waste



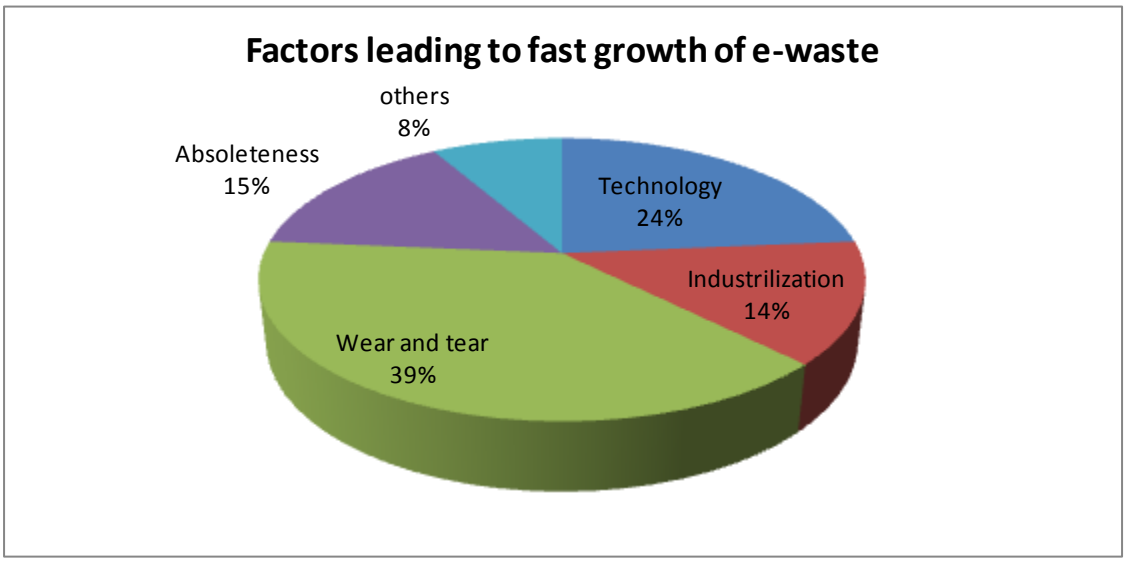
Source: Field data, 2014

From Figure 5.10 copper has the highest pollutant that is known to occur in e-waste at 96%, followed by polyvinyl chloride at 92 %, brominated flame retardants at 88%, beryllium 72%, asbestos at 60%, lead at 84 % and the least known to occur being selenium at 14%, followed by thalium at 32 % and silver at 36%. Toxic substances suspected to be present include nickel at 60%, arsenic at 56 %, and cyanide at 52 %, with copper being the least suspected to be present at 4% followed by polyvinyl chloride at 8 %. Toxic substances known to be absent include at polyvinyl chloride at 0%, copper 0%, brominated retardants 0%, lead 0% followed by cyanide and mercury at 4%. Toxic compounds suspected to be present include polyvinyl chloride at 0%, copper 0%, brominated retardants 0%, with selenium and mercury at 20 %.

From the data in Figure 5.10, compounds that are known to occur in most e-waste generated in manufacturing and processing industries in industrial area include lead, copper, polyvinyl chloride and brominated flame-retardants because none was suspected to be absent or known to be absent. They are known to occur freely in most electrical and electronic equipment, wires, and modules. Lead, PVC and copper are the highest occurring compounds by composition in e-

waste. Other compounds such as mercury, chromium, cadmium, silver, thalium and cyanide are also know to be present

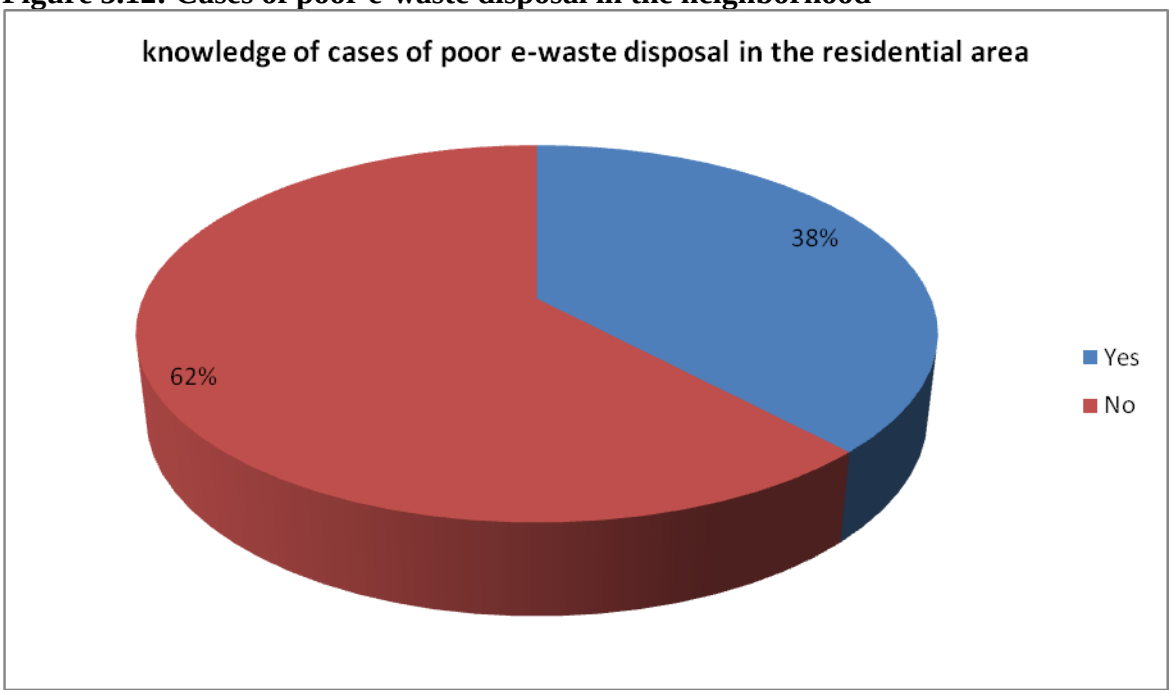
Figure 5.11: Factors leading to fast growth or e-waste in manufacturing and processing industries



Source: Field data, 2014

From Figure 5.11, there are several factors leading to fast growth of e-waste in industries, from data collected at the industry level, wear and tear is the leading cause of e-waste at 39%, technology 24%, obsolete equipments 15 %, industrialization 14%, and others at 8%. Most of the electrical and electronic equipment tend to wear with time and are later disposed off as e-waste; industrialization is also among the leading causes of rise in cases of e-waste. Due to the growth of the industry sector, the consumption of electrical and electronics equipment has risen hence rise in e-waste, obsolete devices is also another major cause of e-waste, new technology emerges which is more efficient rendering other equipment's and machine outdated and thus disposed off as e-waste. Other causes of e-waste growth in industries are the proliferation of counterfeits in the market. Such electrical and electronics equipments have a shorter lifespan hence there rate of wear is faster hence a rise in e-waste.

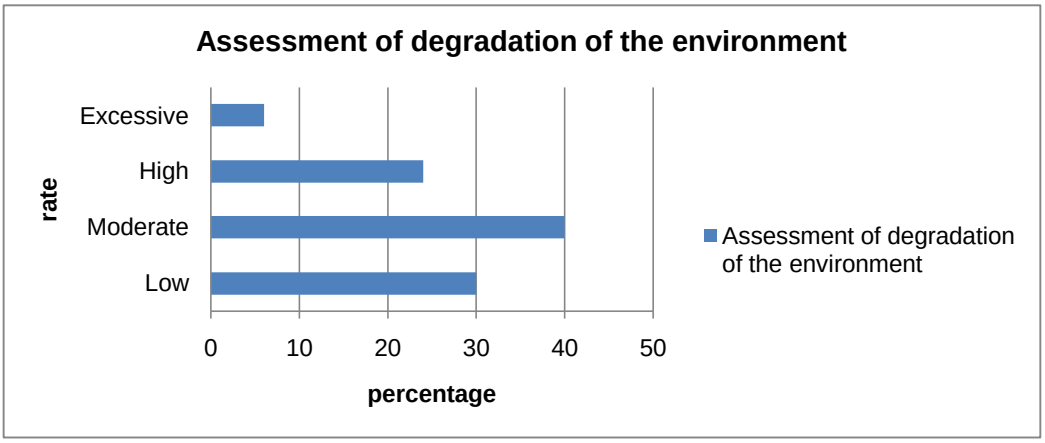
Figure 5.12: Cases of poor e-waste disposal in the neighborhood



Source: Field data, 2014

From Figure 5.12, 62% of those residents interviewed are not aware of any cases of poor e-waste disposal in their neighborhood, while 28% admitted to have cases of e-waste disposal in their neighborhood. This indicates the irresponsibility of the concerned in handling e-waste in the desired manner, of those who admitted to having cases of e-waste disposal in their neighborhood said the disposed e-waste in their neighborhood is normally mixed with other solid wastes where street children sorting thrash pick them e-waste and sell them as scrap metals to metal dealers. Disposal of e-waste in residential areas is dangerous and poses danger to those who reside, as it leads to pollution of the environment especially during the recovery processes where the electronics components are burned to obtain metal parts to sell to scrap dealers.

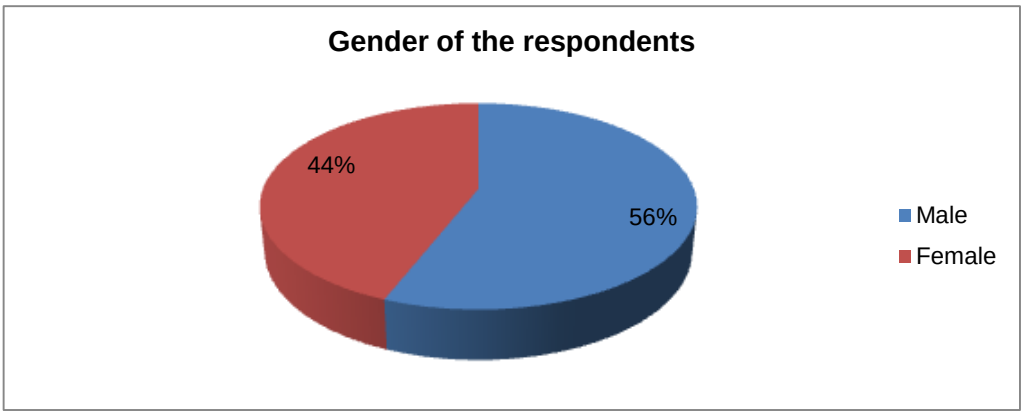
Figure 5.13: Assessment of the environment degradation through e-waste pollution



Source: Field data, 2014

From Figure 5.13, 40% of the respondents claimed that the rate of degradation of the environment due to poor e-waste disposal is moderate, 30% claimed that it is low, 23% claimed it is high while 5% claimed it is excessive. The entire respondent claimed that the major cause of degradation of the environment is during the recovery process where the e-waste is burned in order to recover metal scrap. Dangerous fumes that are emitted during the process such as lead fumes, brominated flame fumes, mercury vapor are normally released to the environment hence causing pollution which endangers lives of the residence which is elaborated in Figure 5.14, 5.15, 5.16, 5.17 and 5.18

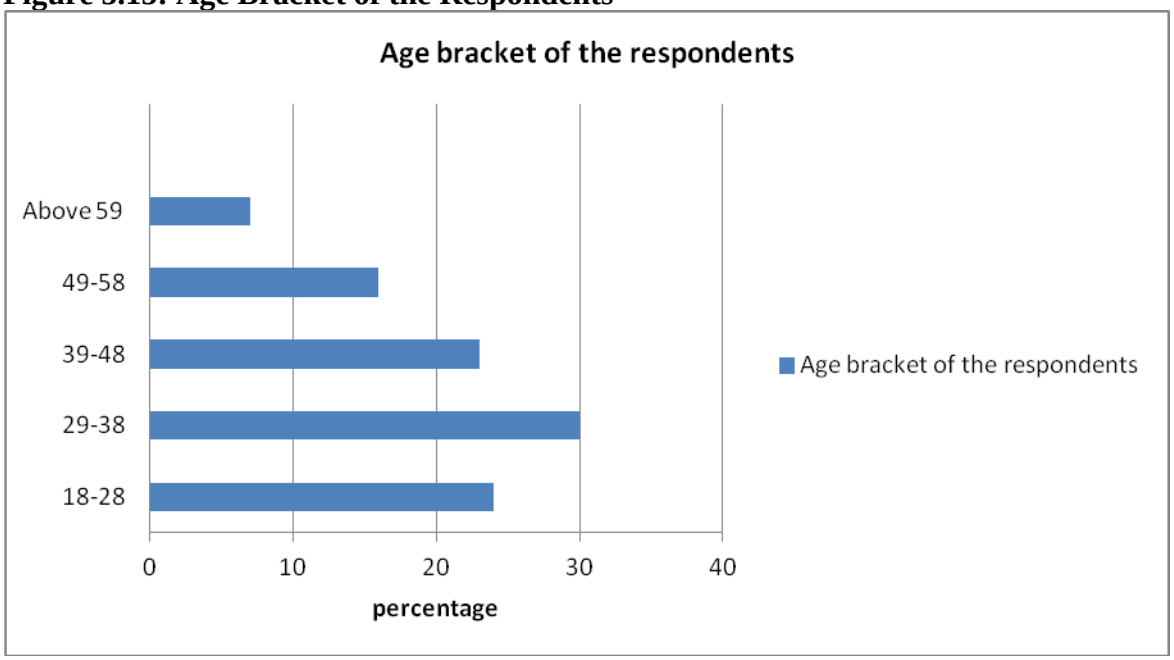
Figure 5.14: Genders of the respondents



Source: Field data, 2014

From figure 5.14, 56% of the respondents who were interviewed at the household level were male, while 44% were female. The high male to female ratio of the respondents is attributed to the working environment which is more technical. This therefore means in cases of poor e-waste handling at the industry level and poor disposal cases, more male people are likely to be affected than female.

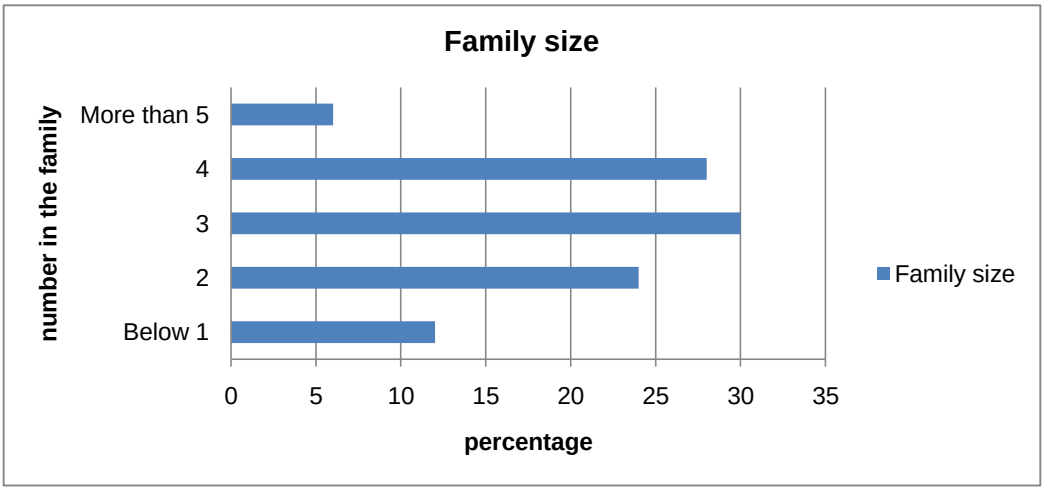
Figure 5.15: Age Bracket of the Respondents



Source: Field data, 2014

From figure 5.15, 30% of the respondents are aged between 29-39 years, 24% 18-28 years, 23% at 39-48 years, 15% at 49-58years and 7% above 59 years. Most of the people who work in industrial are aged before 18-39 years which is a youthful age and is the most productive. While those aged above 59 years are the least at 7%, even though they are more experienced, they are not as productive hence there minimal number. From the above graph, the group that is likely to be affected by cases of poor e-waste handling is those aged between 18-39 years, because are the majority.

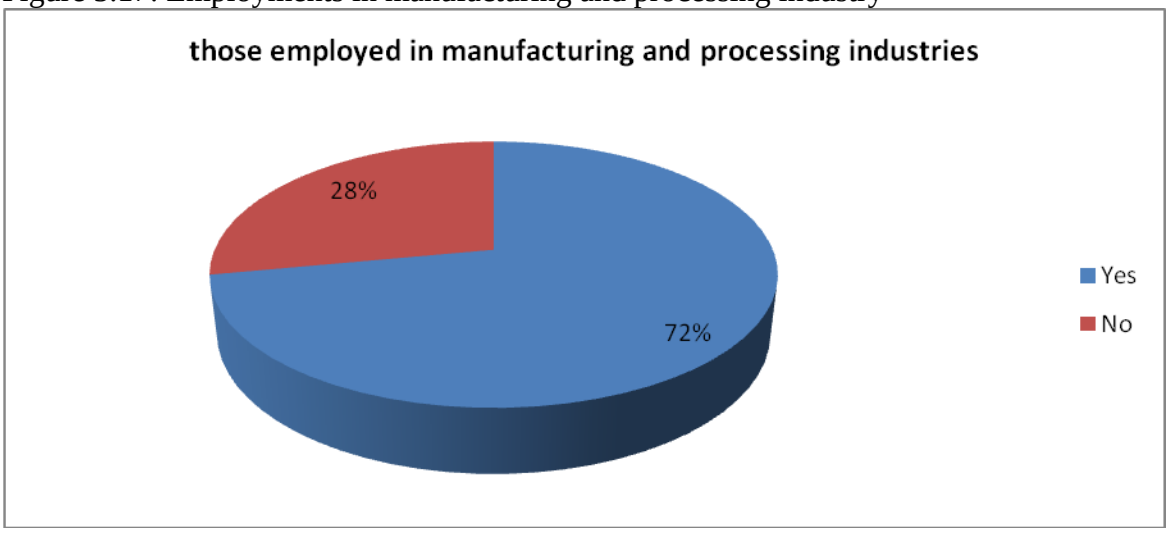
Figure 5.16: Family size



Source: Field data, 2014

From figure 5.16, 30% of the respondents have a family size of 3, while 27% have a family size of 4, 24% have a family size of 2, and 12% have a family size of below 1. This affirms that majority who reside and work in industries in industrial have families. These groups of families are likely to be affected in cases of poor e-waste handling process hence affecting the whole community.

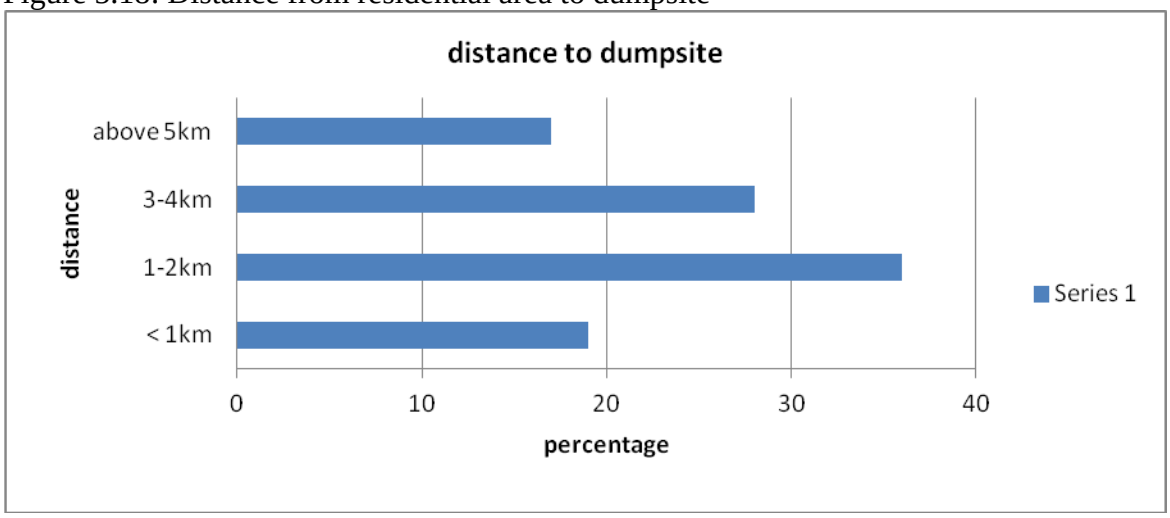
Figure 5.17: Employments in manufacturing and processing industry



Source: Field data, 2014

From Figure 5.17, 72% of those employed are employed in manufacturing and processing industries, while 28% are employed in other sectors, which include the government and NGO's. This therefore means that if industries do not put in place health and safety measure many people who are employed in industries are likely to be affected in cases of poor e-waste handling.

Figure 5.18: Distance from residential area to dumpsite



Source: Field data, 2014

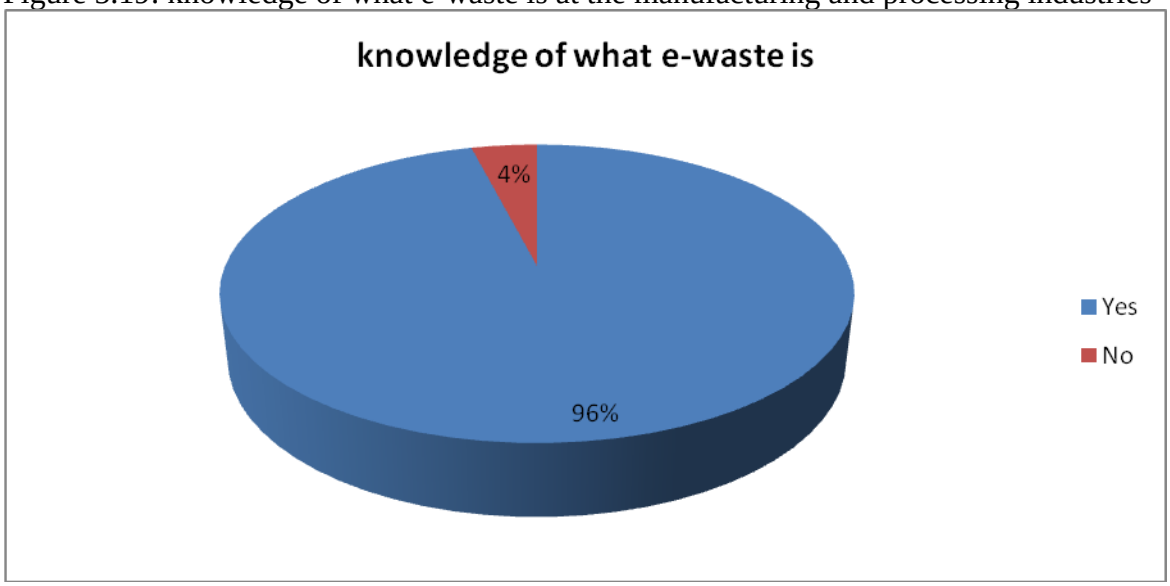
From figure 5.18, 36% of the responded are located within 1-2km to a dumpsite, 27% are located 3-4km to a dumpsite, while 18% are located below 1km to a dumpsite and 12% are located 5km and more from known dumpsites. From the data shown, most of the residences are at a risk of suffering from consequences of poor environmental management due to poor e-waste disposal. This is because of their location near dumpsites

Photo image 2: E-waste from AC Electrolytic capacitors (photo series by Duncan Aliero Muhani)

Picture 2 showing e-waste from electrolytic capacitors, which are later, disposed off near residential area, and given that most of the residential areas in industrial area are slums, this makes the case even more worrying. Cases of e-waste disposal in residential neighborhood is as a result of poor e-waste handling from the concerned that include, industries, waste collectors and recyclers

5.4 Critical challenges constraining e-waste management in industrial area Nairobi County

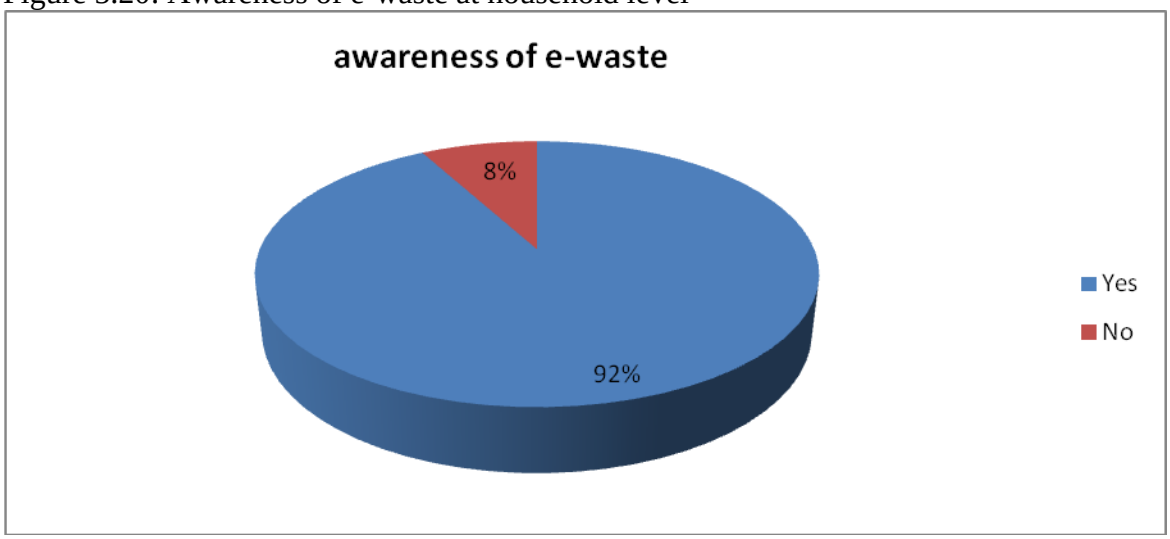
Figure 5.19: knowledge of what e-waste is at the manufacturing and processing industries



Source: Field data 2014

From Figure 5.19, 96% of the respondents in manufacturing and processing industries know what e-waste means, while 4% had no clue about e-waste. While at the household level, as shown in Figure 5.20, 92% know what e-waste is and 8% of those interviewed had no information about e-waste.

Figure 5.20: Awareness of e-waste at household level

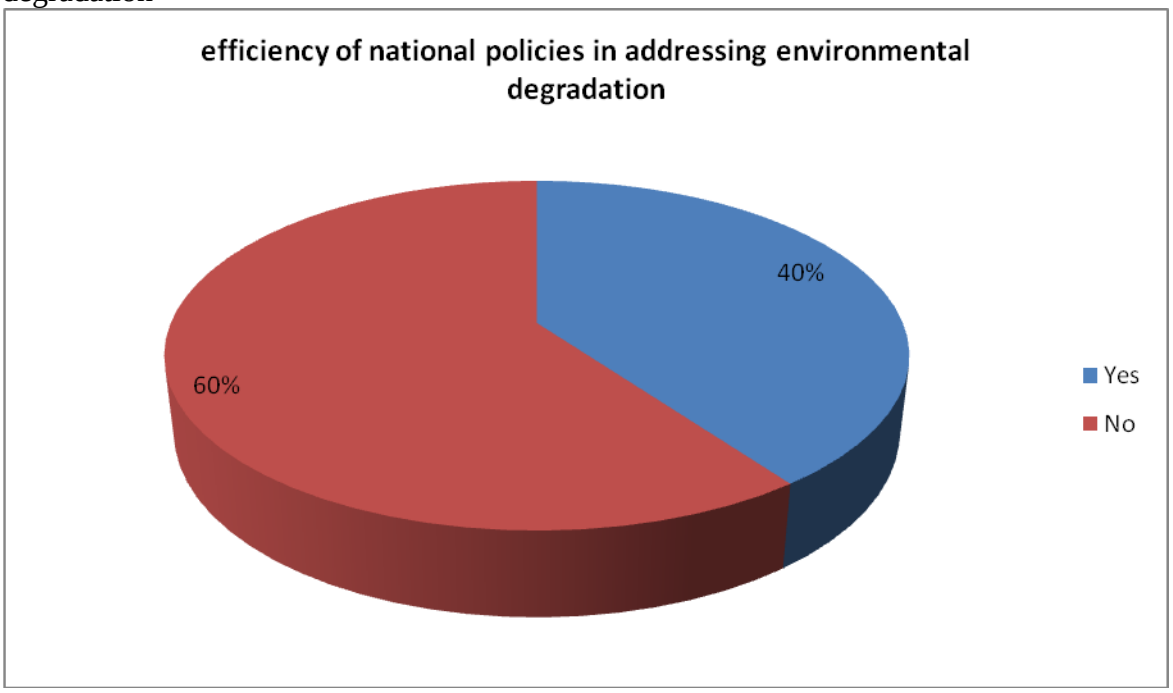


Source: Field data 2014

The higher percentage of people who know what e-waste means is industries is attributed to the technical knowledge they have and the education levels, because most of them are technicians and engineers who work in industries. The 4% of those people don't have information about industrial e-waste associated it to old computers and other household items that include fridges and TVs. The high numbers of those who dint know what e-waste is at the household level can be attributed to low levels of especially tertiary education among the residence. Most of those who were interviewed admitted to have heard about e-waste through media and newspaper.

The general knowledge on e-waste is very important as it is the very first critical stage in fighting e-waste at any level therefore training and capacity building should be undertaken in industries and general public to enlighten people on the matter

Figure 5.21: Household take on the efficiency of national policies in addressing environmental degradation

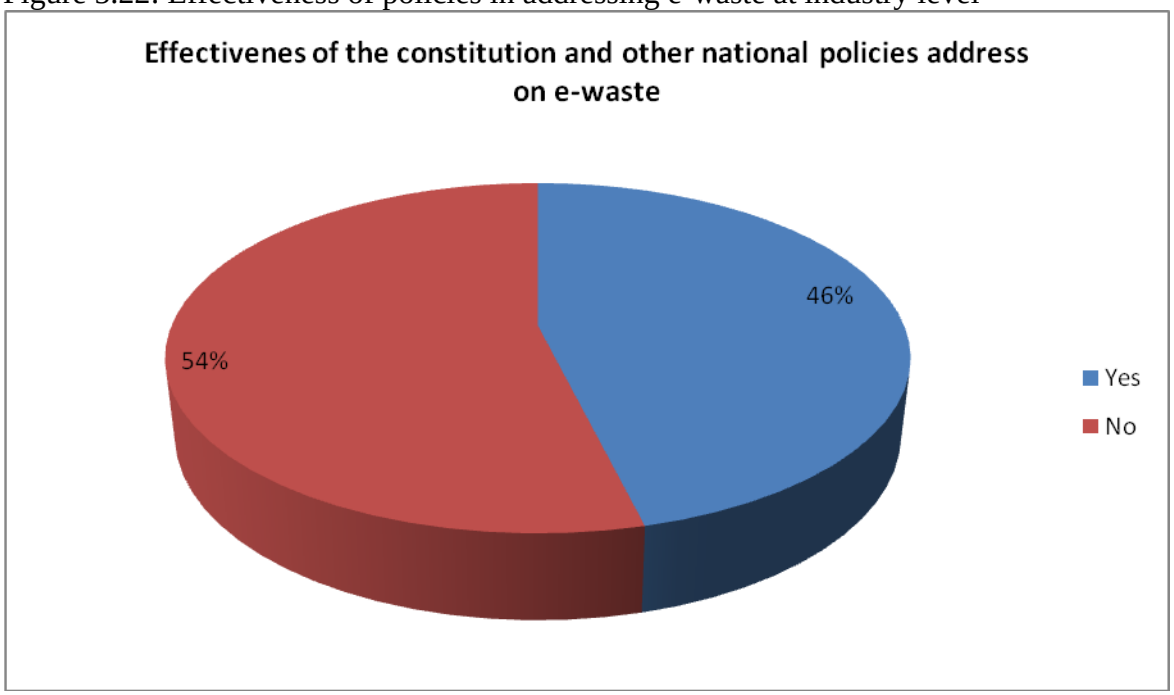


Source: Field data, 2014

From Figure 5.21 above, 60% of the respondent at the household level thought that the national policies do not efficiently address the problem of e-waste, while 40% thought the policies fully address the problem of e-waste. While at industry level as shown in Figure 5.22, 54% of the respondents believe the constitution effectively address the problem of e-waste while 46 % believe the constituion does not effectivly address the issue. Many of the 60% at the household

level claimed that the national policies do not directly address the problem of e-waste but address solid waste a whole, they also claimed that enforcement of the regulation has proved to be a problem by NEMA and there is no control in the sector. They also thought that the national government does not provide enough financial support to bodies that are involved in environmental management such as NEMA and the Ministry of Environment and Natural Resources hence such bodies cannot efficiently carry out their mandate.

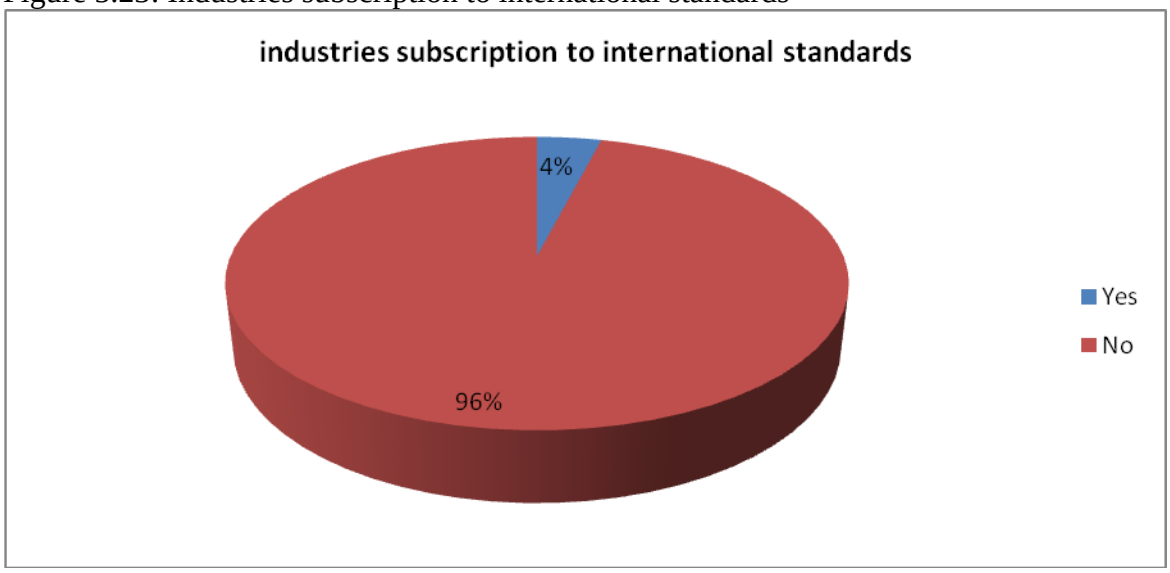
Figure 5.22: Effectiveness of policies in addressing e-waste at industry level



Source: Field data 2014

At the industry level 46% of the respondents accredited especially the constitution of kenya on its key address on right to clean and healthy environment, 54% of the respondents thought the constitution and other key legislations in kenya don't fully address the issue of e-waste, specifically it was stated that there are no legislation specifically governing e-waste, they also attributed in effectivenes of the policies due to the poor enforcement of the same. The in effectiveness of the constitution and other national policies to address key issues regarding to e-waste is critical and its has raised many challenges regarding e-waste handling which has escalated the problem.

Figure 5.23: Industries subscription to international standards

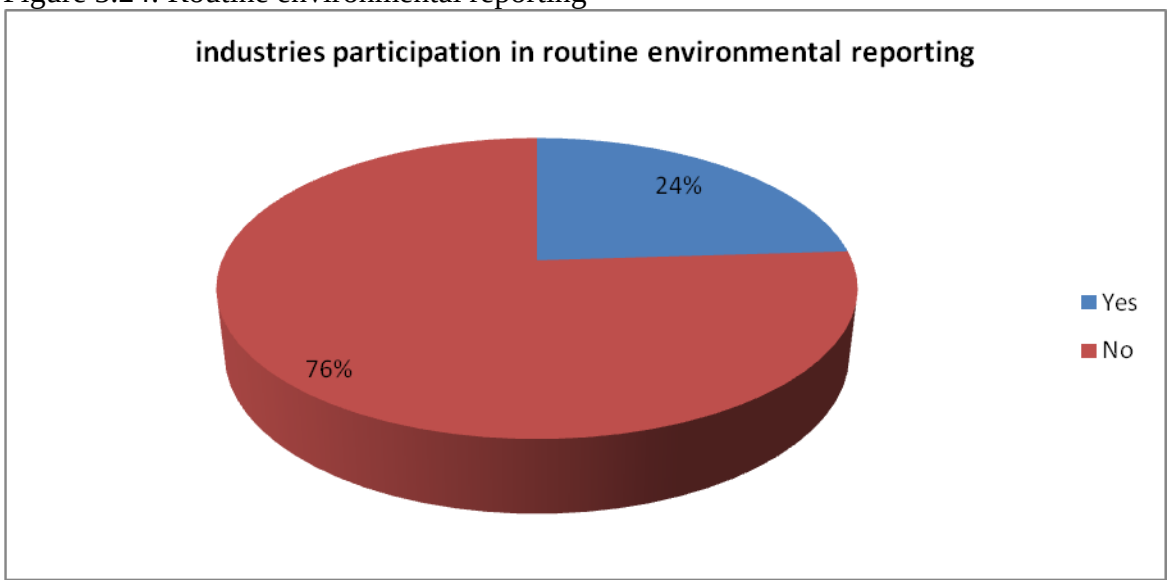


Source: Field data, 2014

From Figure 5.23, 96% of the responded admitted that there companies have not subscribed to international standards regarding environmental management, while 4% admitted that there organization had subscribed to the standards. International standards on environmental management such as ISO 14001, is important as it ensures continuous improvement hence sustainability of the environment. Most of the companies that admitted to have subscribed to such standards were international companies. The non-conformance by industries to international legislation regarding environmental management is a clear indication of critical challenge regarding e-waste management as most industries do no observe the laid down procedure regarding e-waste handling. It is of importance that companies subscribe to such standards.

From figure 5.24, below, 76% of the respondents admitted that there companies do not practice routine environmental reporting, where as 24% admitted that there organization practiced routine environmental reporting. Routine environmental reporting is very important in realizing sustainability on matters of environmental management; it ensures disclosure of the state of the environment at given periods, which ensures industries comply with laws and regulation governing the sector. The activities include internal and external audits of the state of the environment.

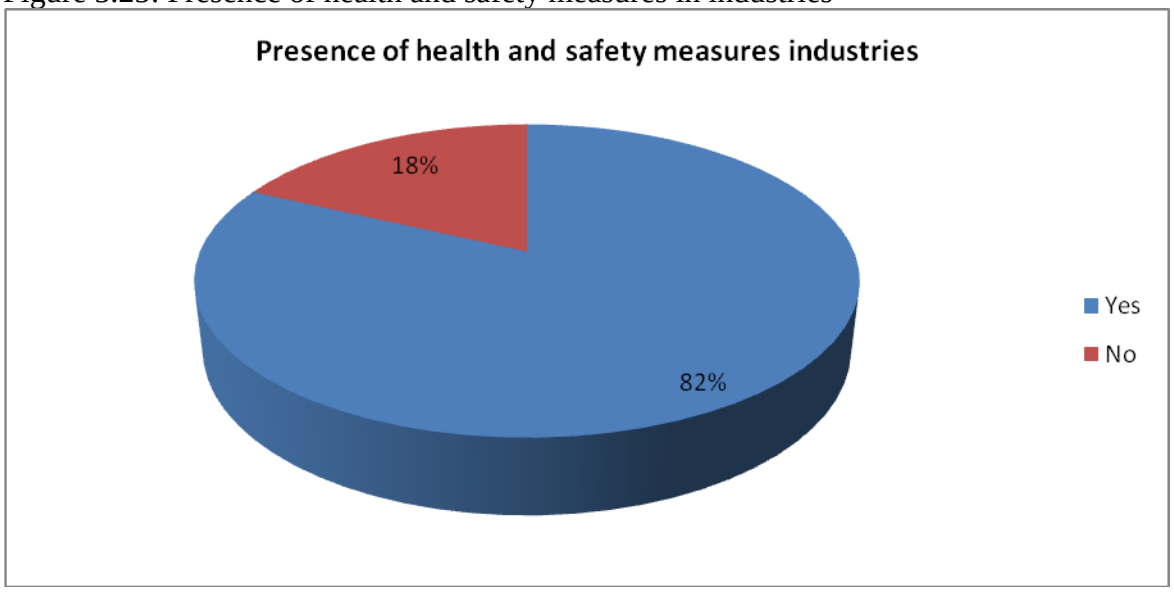
Figure 5.24: Routine environmental reporting



Source: Field data, 2014

The high percentage of none compliance to routine environmental reporting in industries is attributed to poor enforcement by the relevant bodies and ignorance by the industries, this therefore is a critical challenge regarding e-waste management at the industry level as they cannot report on the actual state of the environment in industries.

Figure 5.25: Presence of health and safety measures in industries

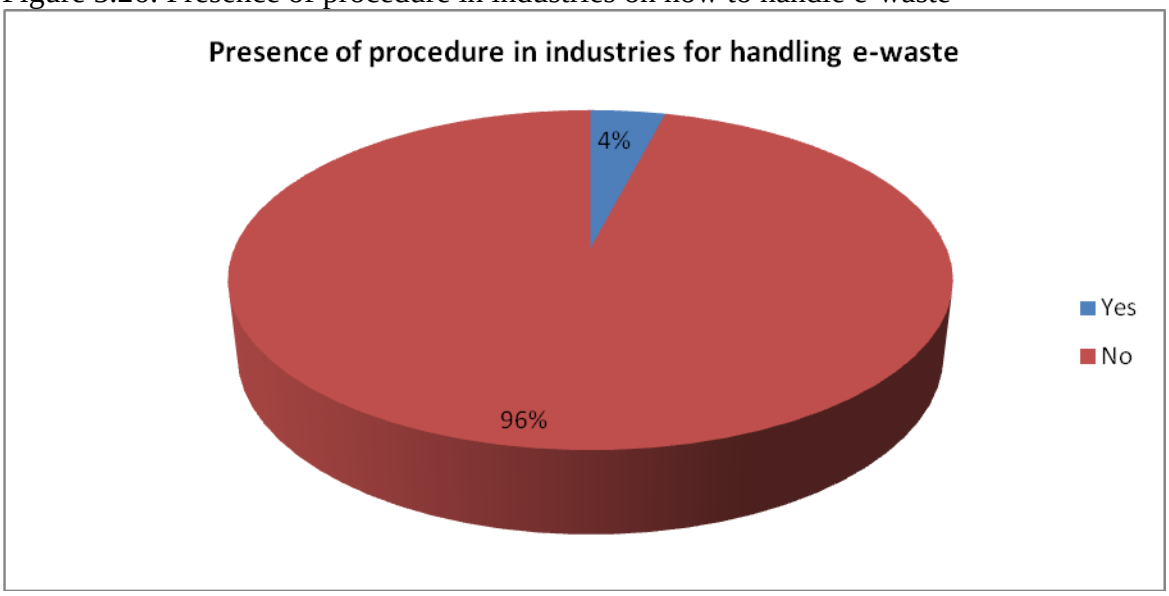


Source: Field data, 2014

From Figure 5.25, 82% of the respondents in manufacturing and processing industries admitted they have health and safety measure in their organization, while 18 % admitted that there was no health and safety measure in their organization. The high percentage of organization with health and safety measure is particularly encouraging because, the measure will be of importance when it comes to e-waste handling. The high percentage of non-conformance to health and safety measure could be attributed to poor enforcement from the side of the government and ignorance by the respective organization regarding the same and therefore posing as a challenge to e-waste management

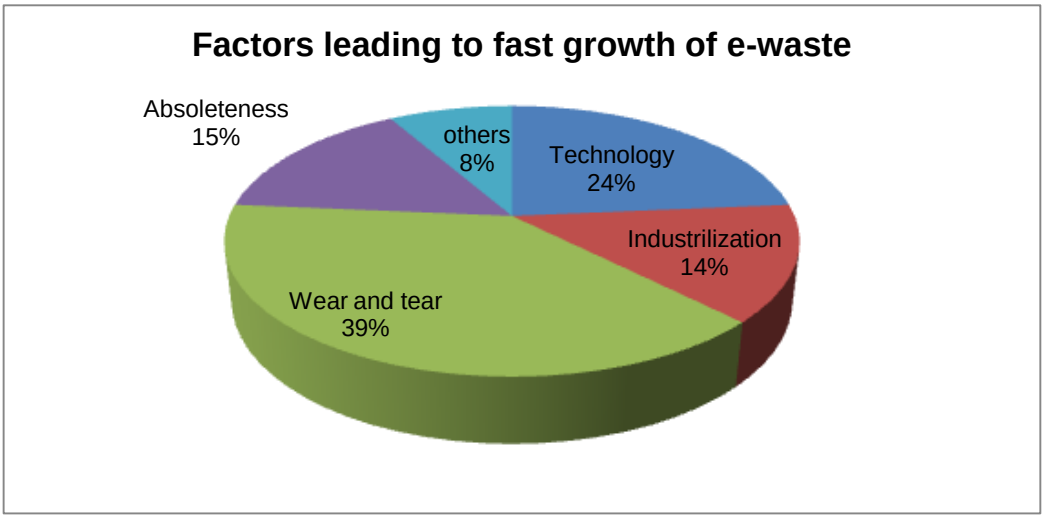
From Figure 5.26 below, 96% admitted to absence of procedure regarding e-waste handling in there organizations, while a mere 4% admitted to have the procedures in place. E-waste handling is adelicate exercise given that e-waste contains various compounds of toxic substances which could cause environmental pollution and harm workers. Every organization should put in place procedures of e-waste handling in order to minimize environmental degradations.

Figure 5.26: Presence of procedure in industries on how to handle e-waste



Source: Field data, 2014

Figure 5.27: factors leading to fast growth of e-waste in manufacturing and processing industries



Source: Field data, 2014

From Figure 5.27, there are several factors leading to fast growth of e-waste in industries, wear and tear is the leading cause of e-waste at 39%, technology 24%, obsolete 15 %, industrialization 14%, and others at 8%.

Photo image 3: E-waste from counterfeits AC oiled field capacitors (photo series by Duncan Aliero Muhani)

Picture 3, showing e-waste from counterfeits oiled field capacitors that have a short life span, which later wear and disposed off as e-waste.

Most of the electrical and electronic equipment tend to wear with time and later disposed off as e-waste; industrialization is also among the leading causes of rise in cases of e-waste. Due to the growth of the industry sector, more industries are developed which means the consumption of electronics equipment's rises and therefore a rise in e-waste, obsolete devices is also another cause of e-waste, emergence of new technology renders other equipment's and machine outdated and thus disposed off as e-waste. Other causes of e-waste growth in industries is the availability of counterfeits and substandard equipment in the market which don't last for long

The Ministry of Environment and Natural resources attributed the following issues to be very serious with regards to e-waste management; Inadequate services coverage where they claimed some industries are not given the required services with regards to e-waste management, lack of enforcement measures and capabilities by respectives bodies such as NEMA and the county government and lack of general control on hazardous waste. They attributed issues such as poor quality services, lack of authority to make financial and adminstrative decisions, lack of financial resources, lack of vehicles for use to transport wastes, lack of legislation, poor response to waste minimization as very serious issues in relation to e-waste management. Issues considered not serious included lack of well trained personnel, poor cooporations by governemtn agencies

CHAPTER SIX

6.0 Summary of the Findings, Conclusion and Recommendations

6.1 Summary of the Findings

Gaps were identified in awareness levels, technology to manage e-waste, financing, collection, disposal of e-waste, e-waste policy and collaboration. The study found that Kenya does not have clearly laid down strategies for managing e-waste. The current legislation in the country does not provide sufficient legal framework to address the menace of e-waste. There exists a gap in local policies as none specifically addresses the problem of e-waste, most policies address issues of waste in general or solid waste in particular. There also exists a gap in enforcement of both the local and international legislation regarding to e-waste and related waste. Equally there is no local clear policy on importation of e-waste in the country even though the country has subscribed to international policies as the Bamako Convention; enforcement of the convention has been left to respective countries to implement. The country has not enacted laws on procedure of implementation and enforcement the same.

In Kenya, environmental laws, policies and legislation governing the environmental sector are scattered in sector specific laws and policy papers. Institutions and departments dealing with issues relating to the environment are equally numerous. Sector specific laws are deficient in that they are characterized by uncoordinated legal regime that are developed to facilitate resource allocation and to deal with environmentally adverse effects of resource exploitation.

The NEC leads the apex of environmental management structure in Kenya; Government officials including the Minister, Permanent Secretaries and the Director-General of NEMA dominate NEC. The other members are mainly appointees of the Minister and no criteria are defined for such appointment. Given the mandate of the NEC in formulation of policies and directions and setting-up goals and objectives in environmental management, the body is not satisfactorily representative of the public in Kenya. There need to be clear laid down structure on appointment of NEC membership to ensure wholesome representation of all stakeholders in matters of environment

Most industries have not put in place measure to address the problem of e-waste and general environmental health and safety guidelines; this include corporate policies on e-waste, e-waste handling procedures and environmental health and safety measures. Therefore, e-waste is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal. E-waste is thus proving to a serious emerging environmental challenge, which requires urgent attention at the industry level.

There is no quantifiable data to determine the exact amount of e-waste being handled in manufacturing and processing industries, in Industrial area of Nairobi County both at the County level and at the national level, therefore estimation of future trends of e-waste in industries is hard.

Key institution such as NEMA, with mandate to ensure sound environmental management have failed to achieve their role as the institution has inadequate personnel to carry out auditing to determine levels of conformance, they also have limited financial support from the government to support their activities hence high in efficiency rate of such institutions. NEMA is also tasked to carry out publication of annual environmental reports; however, there is no requirement for publication or dissemination of the reports. The only condition is on the Minister of Environment to place the report before the National Assembly of Kenya as soon as possible upon its publication. The failure to provide for mandatory publication in the local dailies limits accessibility of the annual report to the public. Access to Environmental Information the Act mainly secures the passive component of the right to access environmental information. Section 123 of EMCA provides that any person may have access to any record transmitted to National Environment Management Authority. However, such access is at discretion of the Authority and only available upon application. The Authority may also impose a fee for grant of any such access. The records available and kept are such as gazetted by the Director-General. The Authority is within its right to insist on maintaining the confidentiality and, therefore, restricting access to any document.

EMCA has created a unique institutional framework for environmental management and coordination that has the public play an important role. On its part, the membership of the

Provincial and District Environmental Committees, which in charge of environmental management at the Province and District levels respective, is satisfactorily representative, Under section 29 (1) of EMCA, the Minister shall by notice in the gazette appoint Provincial and District Environment Committees of NEMA in respect of every province and district respectively. These committees will assist NEMA in effectively carrying out its function of proper management of the environment at this level. The Kenyan Constitution that was promulgated in 2010 had provision of the formation of county government, hence doing away with provincial and district level representation, this section 29 (1) that formed the provincial and district committee should be reviewed to be in tandem with the new constitution.

The Public Complaints Committee is established under Section 31 of EMCA. The PCC is concerned with the investigation of complaints relating to environmental damage and degradation generally. The PCC has powers to investigate complaints against any person or even against NEMA or on its own motion investigate any suspected case of environmental degradation. The PCC is required by law to submit reports of its findings and recommendations to NEC. The law however is weak in that it does not provide PCC with the mandate to see its recommendations carried through. Further, NEC is not specifically required to do anything with regard to the reports submitted by the PCC and will often note and adopt the same without any further follow up action. So far, the PCC has experienced challenges such as failure to honor summons, hostility between parties, hostility directed at PCC investigators, lack of understanding of EMCA and abdication of duty by Lead Agencies. There is therefore need to restructure the PCC by given them more powers to investigate and take some action with regards to complaints against any person or institution.

The NET is established under Section 125 of EMCA for the purpose of hearing appeals from administrative decisions by organs responsible for enforcement of environmental standards. An appeal may be lodged by a project proponent upon denial of an EIA license or by a local community upon the grant of an EIA license to a project proponent. NEMA may also refer any matter that involves a point of law or is of unusual importance or complexity to NET for direction. The proceedings of NET are not as stringent as those in a court of law and NET shall not be bound by the rules of evidence as set out in the Evidence Act. Upon the making of an

award, NET's mandate ends there as it does not have the power to enforce its awards. The National Environment Tribunal is empowered to inquire into the matters arising from refusal to grant or transfer a license, imposition of any condition, limitation or restriction on a license, the amount of money required to be paid as a fee and the imposition of an environmental improvement order by the Authority. The tribunal apparently does not deal with matters relating to the access to and use of environmental resources. Its mandate is limited to the matters provided for in the Act. It is not suitable for settling environmental conflicts at community level. The Tribunal also does not envisage the participation of all interested parties, such as developers, government, the community, non-governmental organizations, and environmental groups in a joint effort aimed at restoring the environment, and agreeing on the sustainable use of the same.

The Factories Act is one of the existing laws that deal with those sectors that generate solid waste. Section 13 of this Act makes it mandatory for every factory owner to ensure that the factory environment is kept in a clean state and from effluvia arising from any drain, sanitary convenience or nuisance and without prejudice to the quality of the foregoing provision. Even though the Act provides for a section to ensure that the factory environment is kept clean, it does not clarify or provide a section on reduction of the waste generated by such factories or the segregation of the waste cleaned from the stated parts of the factory rooms. It also does not provide for enforcement procedures.

Currently the county of Nairobi does not have a county monitoring and evaluation system in place, whose main aim is to improve the effectiveness and quality of tracking of implementation of various development policies, strategies and programmes. So there is no system to take cognizance of the projects and programee included in the County integrated development plans as well as indicators facilitating the medium term expenditure framework process and development aspects of the respective county.

.

6.2 Conclusion

E-waste management, which is already a major concern in Industrial area of Nairobi County, is becoming more complicated by the rise in industrialization in the country. The rapid rise in industries in the region has led to rise in e-waste due to wear and tear, obsoleteness of electrical and electronics equipment's and modules and the presence of counterfeit in the market, given that the there is a gap in the existing policies to fully address the issue, e-waste is growing out of control. Therefore there exists an urgent need for restructuring of the sector; Establishment of policies, establishment of Institutional framework and infrastructures and strengthen the existing ones, improvement of e-waste collection, transportation, treatment, storage, recovery and disposal, need to be established, at national and/or regional levels for the environmentally sound management of e-wastes. Establishment of e-waste collection, exchange and recycling centers should be encouraged in partnership with private entrepreneurs and manufacturers.

It is expected that counties will put in place a county monitoring and evaluation system in, while complimenting the National Monitoring and Evaluation system. The system will take cognizance of the projects and programee included in the County integrated development plans as well as indicators facilitating the medium term expenditure framework process and development aspects of the respective county

When policy on e-waste is being formulated, three well established principles should be drawn upon to guide policy development in the WEEE management in Nairobi County:

- Precautionary principle; where theory or circumstantial evidence suggests damage potential exists, in the absence of fuller evidence, the burden of proof that the activity is not harmful to the environment is left to those suspected to have caused the risk
- Prevention is better than cure; it is cheaper in the end to prevent risks and affects from occurring rather than to concentrate entirely on cleaning up problems, so eco-design mechanisms to minimize WEEE generation is a logical approach;
- Polluter pays principle; those who create the risks should incorporate the costs of dealing with them into their operating costs

6.3 Recommendations

6.3.1 Short Term Recommendations (1-3 years)

- Industries should put in place environmental, health and safety measures; to include corporate policies and regulations.
- Industries should provide training and capacity building to equip their employees with knowledge regarding e-waste.
- Education, training and awareness creation on e-waste menace by the county government and NEMA to manufacturing and processing industries and other stakeholders.
- County government of Nairobi should allocate e-waste collection and disposal sites and centers.
- Enforcement of existing legislation in order to realize environmental sustainability.
- County government of Nairobi should put in place a county monitoring and evaluation structures in order to monitor and evaluate e-waste management projects.

6.3.2 Long Term Recommendations (more than 5 years)

- Parliament should enact new policies and legislation that will govern e-waste management in the county and review existing ones on general waste management to include e-waste.
- The county government and the national government should develop efficient e–waste recycling sector.
- The county government and the national government under Kenya National Bureau of Statistics should collect and manage data to on e-waste at industry level.
- The central government under NEMA should create a awareness at industry level and the general public on e-waste
- The county government should enact bylaws to govern e-waste in the county and review the already existing regulation on general waste management to include e-waste.
- The central government under the ministry of education in conjunction with relevant stakeholders should develop programmes on e-waste management to be undertaken under undergraduate and postgraduate level.

- The central government should explore modern technological advancement in industrial electrical and electronic components and modules that have minimal toxic substances.
- County of Nairobi should put in place a county monitoring and evaluation system.
- The factories act should be reviewed to include advocacy on waste minimizations and provide enforcement procedures.
- The PCC should be restructured and given more powers to investigate and take some action with regards to complaints against any person or institution.
- Restructuring of the NEC to define clearly laid down structure on appointment of NEC membership to ensure wholesome representation of all stakeholders in matters of environment.

6.4 Areas for further studies

- Impact of poor e-waste disposal to the human population and the environment.
- Opportunities and prospects of e-waste recycling activities in the country.
- An analysis of approaches to environmental protection applicable to Nairobi County e-waste management.
- Achieving nexus between the county government and central government management approach to waste.
- Developing inclusivity for e-waste management to include other industries such as the assembly industries and service industries and incorporate them into stakeholders in e-waste management.
- Explore modern technological advancement in industrial electrical and electronic components and modules that have minimal toxic substances.

References

AEA. (2004). WEEE & Hazardous Waste. A report produced for DEFRA, UK Government. AEA Technology Report AEAT/ENV/R/1688.

Agarwal, R. (2004, january). *The World Final Dumpyard*. Retrieved January 8, 2014, from ban: http://www.ban.org

Alastair, I. (2004). Mapping Environmental Justice in Technology Flows: Computer Waste Impacts in Asia Global Environmental Politics 4:4, Massachusetts Institute of Technology

Basel Action Network (BAN). 2011. *Toxic trade news:* "Cochin Port a safe conduit for imported e-waste*";* "Most aspects of e-waste not regulated in U.S., Va.*";* "Research identifies U.S electronic waste as likely source of toxic jewellery imports from China"; "178 countries agree to allow the ban on exports of toxic wastes to developing countries to become law." Retrieved on 1^{5th} January, 2014, from http://www.ban.org

Beukering, P., Sehker, M., Gerlagh, R., & Kumar, V. (1999). Analyzing urban solid waste in developing countries. *a perpective from Bangalore, India* , p. 24.

Bell, S., & McGillivray, D. (2006). *Environmental Law*. Oxford: Oxford University Press.

Boote, D. N., & Beile, P. (2005). Scholars before researchers: On the centrality of the dissertation literature review in research preparation. Educational Researcher 34/6, 3-15.

Constitution of Kenya [Kenya], 27 August 2010, available at: http://www.unhcr.org/refworld/docid/4c8508822.html [accessed 23, March 2014]

Cui, J. & Zhang, L. (2008). Metallurgical recorey of metals from electronic waste. *A review journal of hazadours meterial* , vol. 158, no. 2-3 pp. 228-256.

Devi, B., Shobha, S., & Kamble, R. (2004). E-waste, the hidden harm of Technological Revolution. *Journal IAEM* , Vol. 31, pp. 196-205.

El-Haggar, S. M. (2007).*Sustainable industrial design and waste management: Cradle-to-cradle for sustainable development* (p. 424). Oxford: Elsevier/Academic Press.

European, C. (n.d). *Waste Electrical and Electronic Equipment*. Retrieved January 11, 2014, from http://ec.europa.eu/environment/waste/weee/legis-en.htm

European Commission, (2000). Proposal for a Directive of the European Parliament and of the Council on Waste Electrical and Electronic Equipment. European Commission, Brussels.

European Commission (n.d). *Waste Electrical and Electronic Equipment*. Retrieved on 11th January, 2014, from http://ec.europa.eu/environment/waste/weee/legis_en.htm

Five Winds International. (2001). Toxic and Hazardous Materials in Electronics. An Environmental Scan of Toxic and Hazardous Materials in IT and Telecom Products and Waste. 2001. Prepared for Environment Canada, National Office of Pollution Prevention and Industry Canada.

Frazzoli, C., Orisakwe, O.E., Dragone, R. Mantovani, A. (2010). "Diagnostic health risk assessment of electronic waste on the general population on developing countries' scenarios", in Environmental Impact Assessment Review, Vol. 30, No. 6, pp. 388–399.

GoK, 2010 the Constitution of Kenya, Nairobi: Government Printer

GoK (Government of Kenya) 1999; the Environmental Management and Co‐Ordination Act, 1999, Ministry of Environment and Natural Resources, GoK, Nairobi GoK, 1994 National Environment Action Plan (NEAP) Report 1994

Hicks, C., Dietmar, R., & Eugsterb, M. (2005).The recycling and disposal of electrical and electronic waste in China, Legisltative and market responses.*Environmental Impact Assessment Review* , Vol. 25, pp. 459-471

Jensen, A. and Remmen, A. (eds) (2004): Background Report for a UNEP Guide to Life Cycle Management. UNEP DTIE.

Joseph, K. (2007). *Electronic waste management in India: paper presented at the Eleventh International Waste Management and Land fill Symposium.* . Cagliari, 1-5, October.

Kamau, E.C (2005). Environmental Law and Self-Management by Industries in Kenya: *Journal of environmental Law*, 17, 229-240.

Kalra, V. (2004). E-waste in India: System failure imminent: Take action now! (Delhi, Toxics Link). Retrieved on 4th January, 2014, from http://www.toxicslink.org/pub-view.php?pubnum=40

Kojima, M. (2005).“Chapter 6: Transboundary movements of recyclable resources in Southeast Asia” (Institute of Developing Economies)

McLennan, J. F (2005).“The Philosophy of Sustainable Design.”Bainbridge Island, WA: Ecotone Publishing LLC

Ni, H. G. and Zeng, E. Y. (2009) Law enforcement and global collaboration are the keys to containing e-waste tsunami in China. *Environ. Sci. Technol.* **43**, 3991-3994.

Ray, A. (2008). Waste management in developing Asia: Can trade and cooperation help? : *The Journal of Environment & Development*, Vol. 17, No. 1, pp. 3–25.

Roberto, A. (2004) "The Precautionary Principle: A New Legal Standard for a Technological Age", *Journal of International Biotechnology Law*, 1, p. 11–19 [4]

Stankovic, J. (2011). ‘’E-waste management in Macedonia and Serbia’’ Retrieved on 5th January, 2014, from http://www.bewman.eu/serbia.html

Schluep, M. et al. 2009. *Recycling: From e-waste to resources*, Sustainable Innovation and Technology Transfer Industrial Sector Studies (Nairobi and Bonn, UNEP and STeP). Retrieved on 2nd January, 2014 from http://www.unep.org/PDF/PressReleases/E-Waste_publication_screen_FINALVERSION-sml.pdf

Shinkuma, T.; Minh Huong, N.T. 2009. “The flow of e-waste material in the Asian region and a reconsideration of international trade policies on e-waste”, in *Environmental ImpactAssessment Review*, Vol. 29, No. 1, pp. 25–31.

Shobana Ramesh and Kurian Joseph (2006). Electronic waste generation and management in an Indian city, Journal of Indian Association for Environmental Management, Vol. 33, No.2, pp 100-105

Sepúlveda, A. et al. (2010). “A review of the environmental fate and effects of hazardous substances released from electrical and electronic equipments during recycling: Examples from China and India”, in *Environmental Impact Assessment Review*, Vol. 30, No. 1, pp. 28–41.

Smith, T., Sonnenfeld, D. A. & Naguib Pellow, D. (2006). Challenging the chip: Labor rights and environmental justice in the global electronics industry (Philadelphia, PA, Temple University Press) Basel Convention. n.d.

Toxic Links (2004). E-waste in Chennai Time is running out. Retrieved 1st January, 2014 from www.toxixslink.org

Tutu, K. (n.d). The Bamako Convention and good management of hazardous wastes: a case for sustainable development. Retrieved on 1st January, 2014 from http://www.basel.int/legalmatters/regworkshops/ethiopia/bamako.ppt#280,1

United Nations Environmental Program (UNEP), *Recycling—From E-Waste to Resources* (New York: UNEP, 2004), accessed at www.unep.org, on Jan. 23, 2014.

U.S Environmental Protection Agency. (2010). Reduce, Reuse, Recycle. *Wastes - Resource Conservation*. Retrieved January 5, 2014, from http://www.epa.gov/wastes/conserve/rrr/

Williams E. (2008). "Environmental, social and economic implications of global reuse and recycling of personal computers", in Environmental Science & Technology, Vol. 42, No. 17, pp. 6446–6454

Appendix I: Planning Matrix on Integrated Management on E-Waste In Industrial Area, Nairobi County

OBJECTIVE	ISSUES	STRATEGY	ACTIVITIES	ACTORS (STAKEHOLDERS)
1 Policies and regulatory framework governing e-waste management in Kenya	Lack of clear policy and legal framework on e-waste management	Parliament to enact laws and policy on e-waste management	Introductions of motions and enactment of policies on e-waste management policies	National assembly and County assembly
	In-effective regulatory framework on e-waste management	Parliament to enact policies to strengthen existing institutions and form more institutions	Introductions of motions and enactment of policies on formation of more institution to manage e-waste and strengthening the existing ones	National assembly and County assembly
	Non conformity of policies and regulatory framework governing e-waste	Ensure conformance of policies and regulatory framework at all levels	Enforcement both local and international policies regarding e-waste	NEMA ,county government and industry level
	Lack of adequate monitoring and evaluation exercises	Ensure timely monitoring and evaluation of conformance	Timely monitoring and evaluation of state of e-waste management at all levels	County government, NEMA
	Financial constraints at institutional level	Ensuring adequate budget allocation	Adequate budget allocation to key institution concerned with e-waste management	County government, Private sector, Central government

2. How e-waste from passive elements are being handled in manufacturing and processing industries	Lack of corporate policy on e-waste management	Ensuring industries have measure to regulate the e-waste	Industries to put in place corporate policies on e-waste	Ministry of environment, NEMA, County government
	Lack of Environmental, health and safety measures	Ensuring industries have environmental health and safety measures	Industries to put in place environmental health and safety measures	NEMA, County government
	Lack of e-waste handling guidelines and procedure	Ensuring industries have guides in place on e-waste handling	Subscription on international environmental management such as ISO 140001	Industries, NEMA
	In adequate e-waste disposal and handling facilities	Ensuring availability of adequate e-waste disposal and handling facilities	Allocation of e-waste disposal and handling facilities	County government, central government
	In adequate data and on e-waste	Ensuring availability of data on e-waste in manufacturing and processing industries	Accurate collection and storage of data on e-waste in manufacturing and processing industries	KNBS, County government
	In adequate information on e-waste	Ensuring people at all levels have adequate information on e-waste	Capacity building and on job training	County government, industry level, central government

3. Critical challenges constraining e-waste management in industrial area Nairobi county	Lack of clear Policies and legislation	Ensuring that policies and other regulation are in place and being adhered to	Enactment of policies and regulation	National assembly, County assembly
	Poor enforcement	Ensuring compliance at all levels	Monitoring of procedures at the industry level -Evaluation of companies compliance	NEMA, County government, Industries (Self auditing)
	Non Compliance	Ensuring compliance of laws and regulation at all levels	Carrying out self and external auditing	Industries, NEMA
	In-effective regulatory framework on e-waste management	-Parliament to enact policies to strengthen existing institutions and form more institutions	Introductions of motions on formation of more institution to manage e-waste	National assembly and County assembly
	Non conformity of policies and regulatory framework governing e-waste	Ensure conformance of policies and regulatory framework at all levels	Enforcement of both local and international policies regarding e-waste	NEMA ,county government and industry level
	Financial constraints at institutional level	Ensuring availability of finances	Adequate budget allocation to key institution concerned with e-waste management	Central government, county government and other stakeholders

Appendix Ii: Indicative Monitoring and Evaluation Matrices

OBJECTIVE	Activity	Monitoring Indicator	Means of Verification	Period	Lead Institution
1. Policies and regulatory framework governing e-waste management in Kenya	Introduction of policies in parliament and enactment of policies	.E-waste policy in place E-waste regulatory structures in place	Policy on e-waste	Annual	National assembly and County assembly
	Strengthening existing regulatory framework	Amendments on existing policies	Effectiveness of policies and regulatory framework	Annual	National assembly and County assembly
	Checking conformance to policies	Improved e-waste management	Audit reports	Annual	NEMA ,county government and industry level
	Monitoring and evaluation exercises	Presence of audit reports at both the industry and the regulatory level	Reports Management plans Stakeholders meeting	Bi-annual	County government, NEMA, Industries
	Financial support and budget allocation	Adequate finances	Status reports Inventory Successful operation of e-waste management activities	Annual	County government, Private sector, Central government
2. How e-waste from passive elements are being handled in manufacturing	Putting in place Corporate policies on e-waste management in industries	Corporate policies in place	Status reports Presence of Corporate policies at industry level	Annual	Ministry of environment, NEMA, County government

and processing industries	Putting in place Environmental, health and safety measures at industry level	Environmental health and safety policies in place	Status report Presence of Environmental health and safety measures, Audit reports	Annual	NEMA, County government
	Putting in place handling guidelines on e-waste	E-waste handling guides in place in industries	Reports Subscription to standards such as ISO 140001	Annual	Industries, NEMA
	Allocation of adequate e-waste disposal and handling facilities	Availability of adequate e-waste disposal and handling facilities	Status report	Annual	County government, central government
	Collection of data on e-waste	Availability of data on e-waste in industries	Data, Reports	Quarterly	KNBS, County government
	Capacity building and on job training about e-waste	Informed population	Status reports Site meeting reports	Bi-Annual	County government, industry level, central government
3. Critical challenges and problems constraining e-waste management in industrial area Nairobi county	Introduction of policies in parliament and enactment of policies	E-waste policy in place	E-waste policy	Annual	National assembly, County assembly
	Enforcement of policies	Compliance at all levels	Audit reports	Quarterly	NEMA, County government, Industries (Self auditing)

	Ensuring compliance	Conformance at all levels	Audit reports	Bi annual	Industries, NEMA
	Strengthening regulatory framework on e-waste	Amendments on existing regulatory framework	Effective regulatory framework	Annual	National assembly and County assembly
	Finance and budget allocation	Adequate finances	Status reports Inventory records Successful completions of all activities on e-waste	Annual	Central government, county government and other stakeholders

Appendix III: Questionnaire for the Households

I am a student of Kenyatta University undertaking a master degree course in environmental planning and management and I am carrying out a research on e waste management in manufacturing and processing industries in industrial area of Nairobi County. I am therefore collecting information for this purpose; I am kindly requesting you to answer the following questions as appropriate. **All data collected will be treated with at most confidentiality and used exclusively for the purpose of the study**

Section 1: Household Information and socio-economic factors [Tick where appropriate]

1) Name of area of Residence……
2) Gender of respondent [1] Male [2] Female
3) Age of respondent [1] 18-28 [2] 29-39 [3] 40-50 [4] 51-60 [5][6] 61 and above
4) Marital status **[ ]** Single **[ ]** Married **[ ]** Separated **[ ]** Divorced **[ ]** Widowed
5) Education level [1] No Education [2] Primary education [3] Secondary education
   [4] Tertiary education
6) What is the family size? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] More than 5 [ ]
7) Are you employed?
   [ ] Yes [ ] No
8) If employed, in which sector?
   [1] Government [2] NGO [3] Private sector [4] Self employed
9) If in private sector is it in manufacturing and processing industry [ ] Yes [ ] No
10) For how long have you lived in this area?
    [1] Less than 12 months [2] 1-5 years [3] Over 5 years

General: (Tick where appropriate)

1. a. Do you know what e-waste is? [1] Yes [2] No, if Yes
   b. Are you aware that some hazardous fractions in e-waste from passive elements need a special treatment in order to be safely disposed of?[1] Yes [2] No, if Yes
   c. What are some of the problems associated with poor e-waste handling

   .....

   .....

d. In your own opinion has contributed to fast growth in e-waste in manufacturing and processing industries?

   .....

   .....

E-waste System and Facilities

(Tick where appropriate)

1. How far is your house from nearest solid waste dumpsite? [1] Less than 1 Km [2] 1≤ but ≤2 km [3] 2≤but ≤3 km [4] 3≤but≤4 km [5] e) 4≤but≤5 km
2. Do you know of any case of poor e-waste disposal in your neighborhood?
   [1] Yes [2] No
3. State any disadvantages of poor e-waste disposal and handling under following categories
   a. environmental

   .....

   .....

   b. social

   .....

   .....
4. How do you assess degradation of the environment due to poor e-waste disposal
   [1] Low [2] Moderate [3] High [4] Excessive
5. Kindly give your overall assessment on e waste management in processing and manufacturing industries

   ……

   ……

Institutional framework and administration

1. a. Does the constitution of Kenya and other national policies such as EMCA sufficiently address the problem of e-waste in manufacturing and processing industries?
   [1]Yes [2] No, If No
   b. what should be done to improve the situation

   ……

   ……
2. Please state any priority areas of improvement regarding to e-waste management from passive elements at the following levels?

(a) Central Government level

……

……

(b) County Government level

……

……

(c) Industry level

……

……

3. What recommendations would you make in order to achieve full support from all the relevant stakeholders on matters regarding e waste management from passive elements?

A. Central Government

……

……

B. County Government Level

……

……

C. Industries

……

……

D. Other stake holders

……

……

Appendix IV: Questionnaire for Manufacturing and Processing Industries

I am a student of Kenyatta University undertaking a master degree course in Environmental Planning and Management. I am carrying out a research on e-waste management in manufacturing and processing industries in industrial area of Nairobi County. I am therefore collecting information for this purpose; I am kindly requesting you to answer the following questions as appropriate. **All data collected will be treated with at most confidentiality and used exclusively for the purpose of the study.**

Please Tick where appropriate

Education and awareness:

2. Do you know what e-waste is?

   [1] Yes [2] No, if Yes

3. What are the different types of passive e-waste generated by your company under following categories?

   a. **Capacitors**

   [1] Integrated capacitors [2] Fixed Capacitors [3] Variable capacitor [4] Special application capacitors

   b. **Resistors**

   [1] Fixed value Resistors [2] Variable Resistors [3] Heating elements [4] Resistance Wire [5] Thermistor [6] Humistor [7] Varistor

   c. **Magnetic (Inductive) devices**

   [1] Inductors [2] Variable inductors [3] Saturable Inductors [4] Transformers [5]Magnetic amplifier (toroid) [6] Ferrite impedances, beads [7] Motor/Generator [8] Solenoid [9]Loudspeaker and microphone

   d. **Transducer, sensors and detectors**

   [1] Audio [2] Position, motion [3] [Force, torque [4] Thermal [5] Magnetic field [6] Humidity [7] Electromagnetic, light

4. What is the attitude of your organization regarding environmental management?

   [1] Very good [2] Good [3] Average [4] Poor [5] Very poor

5. Do you support the principle of waste minimization [1] Yes [2] No

6. As the first stage in the e-waste hierarchy, do you believe that further support and funding should be dedicated to e waste minimization initiatives?

   [1] Yes [2] No

E waste System and Facilities

1. What is the average weight from e waste generated from your industry monthly?

   [1] Below 10kgs [2] 10-20kgs [3] 21-30kgs [4] 30-40kgs [5] 41-50kgs [6] Above 51

2. For the above generated wastes, does your company practice?

   [1] On site storage [2] Offsite storage [3] On site disposal [4] Offsite disposal

   If on site storage

3. a. Do waste collectors come and pick up e-waste in your company? e.g. informal, private or municipal collection?[1] Yes [1] No

   b) If No how do you dispose of your E-waste?

……

……

4. Is the current e-waste collection convenient to you? [1] Yes [2] No

   a. If No what could be done to improve the situation?

   .....

   .....

5. What are the main obstacles for a proper e-waste collection in your organization?

   ……

   ……

Priority Pollutant Information:

1. Please indicate by placing an "X" in the appropriate box by each listed chemical whether it is "Suspected to be Absent," "Known to be Absent," "Suspected to be Present," or "Known to be Present" in e wastes generated from your industry

CHEMICAL PRESENT	KNOWN PRESENT	SUSPECTED PRESENT	KNOWN ABSENT	SUSPECTED ABSENT
Antimony				
Arsenic				
Asbestos				
Beryllium				
Cadmium				
Chromium				
Cyanide				
Lead				
Mercury				
Nickel				
Selenium				
Silver				
Thallium				
Brominated flame retardants				
Polyvinyl chloride				
Copper				

2. What are the problems associated with poor e-waste management in manufacturing and processing industries?

   a. Environmental

   ……

   ……

   ……

   b. Social

   ……

   ……

3. What has contributed to fast growth in e-waste in manufacturing and processing industries? [1] Technology [2] Industrialization [3] Wear and tear [4] Obsoleteness [5] others specify

……

……

4. What are some of the health issues brought about by toxic substances from e-waste?

……

……

Institutional framework and administration

4. a. Is the constitution of Kenya and other national policies such as EMCA sufficiently address the problem of e waste in manufacturing and processing industries

[1] Yes [1] No

b. if No, what the main issue that needs to be addressed by the policies and the laws

……

……

5. Describe the organo-structures in your organization in charge of environmental management?

……

……

5. Are there laid down procedures in your organization regarding e-waste handling?

[1] Yes [2] No

6. Is your company member of any association or body which is in charge of a proper e-waste management (collection & recycling)? [1] Yes [2] No If yes name the body?

……..

7. a. Are there any health and safety measures put in place in your company? [1] Yes [2] No,

if No

b. what do you think should be done to improve the situation

……..

8. a. Does your organization undertake routine environmental reporting? [1] Yes [2] No,

if yes b. What are the benefits of routine environmental reporting?

……

……

9. Has your organization subscribed to international standards regarding environmental health and safety management? (Such as ISO 450001 e.t.c.) [1] Yes [2] No

10. If your answer is yes, name the standard?

……..

11. Kindly give your overall assessment on e-waste management in processing and manufacturing industries

……

……

Strategy Review

1. Please state any priority areas of improvement regarding to e-waste management from passive elements at the following levels?

(d) Central Government level

……

……

(e) County level

……

……

(f) Industry level

……

……

2. What recommendations would you make in order to achieve full support from all the relevant stakeholders on matters regarding e-waste management from passive elements?

E. Central Government

……

……

F. County Government

……

……

G. Industries

……

……

H. Other stake holders such as NGOs and the residents

……

……..

Appendix V: Interview Schedule for the County Government of Nairobi

I am a student of Kenyatta University undertaking a master degree course in environmental planning and management. I am carrying out a research on e-waste management in manufacturing and processing industries in industrial area of Nairobi County. I am therefore collecting information for this purpose; I am kindly requesting you to answer the following questions as appropriate. **All data collected will be treated with at most confidentiality and used exclusively for the purpose of the study**

Details of Respondent(s):

Name of respondent: …….

Position of Respondent:

……

Date: ……

General: (Tick where appropriate)

1. a. Do you know what e-waste is [1] Yes [2] No, if yes

   b. What are the roles and responsibilities of the County Government of Nairobi with regards to e-waste management?

   ……

   ……

2. Describe in your own words the most important problems and needs your City is facing in relation to e-waste management in Nairobi's industrial area

   ……

   ……

3. a. Do you have a department in the county government of Nairobi dedicated to issues of e-waste management? [ ] Yes [ ] No, if No

   b. What are you contemplating doing about mitigating the issue of e-waste management in relation to this?

……

……

E Waste System and Facilities (Tick where appropriate)

1. What is the average weight from e-waste is collected monthly in manufacturing and processing industries in Nairobi County? ..... [KGS]
2. Who is responsible for collection and disposal of e-waste from manufacturing and processing industries in industrial area Nairobi County?

   ……

   ……

3. a. Do you have a designated area for dumping of e-waste?

   [1] Yes [2] No, if No

b. How do you dispose of e-waste?

……

……

4. What are the challenges e-waste handlers are facing (both private and County Government of Nairobi)?

……

……

5. What are the risks associated with poor e-waste disposal and handling?

   a. Environmental

……

……

   b. Social

……

……

6. Describe the method of disposal for the e-wastes collected in manufacturing and processing industries in Nairobi's industrial area?

……

……

   a. Estimate how many disposal sites of e-waste exist in Nairobi?

……

   b. What is the average distance (in kilometers one way) from your industry to a disposal site?

……

   c. How long is the trip (in minutes one-way) from your industrial to a disposal site, at the time of day when the collection service is provided?

…….

7. a. Are there any laid down procedures provided by Nairobi County government for manufacturing and processing industries regarding e-waste handling? [1] Yes [2] No,

   b. What should be done in order to mitigate the problem associated e-waste handling in manufacturing and processing?

……

…….

Financing (Tick where appropriate)

1. What is the amount of the total City recurrent budget for all services on e-waste? (ksh)

……

2. What is the amount of the City's waste management budget that is allocated for e-waste collection, e waste disposal and maintenance of the e waste equipment? (Ksh)

……

3. a. Do you have a City by laws requiring manufacturing and processing to pay an e-waste user charge? [1] Yes [2] No,

   b. if No what is being done to help mitigate the issue of e-waste

   ……

   ……

4. a. Within your City, is there a tariff structure for e waste user fees which are payable by manufacturing and processing industries? [1] Yes [2] No,

   b. if No what is being done to bring the manufacturing and processing industries in issues of e-waste management

Private Provision of Services: (Tick where appropriate)

1. a. Are there licensed private e-waste handlers in Nairobi County? [1] Yes [2] No if Yes

   b. What are the challenges the private sectors is facing during e waste handling and disposal?

   ……

   ……

2. Please indicate which of the following types of private sector provision of service exist in the City. [1] collection of industrial wastes at collection points [2] Collection of industrial wastes from large factories
3. a. Does your City have by laws requiring manufacturing and processing industries to cooperate with any private sector agents appointed by the City to provide e-waste services?

   [ ] Yes [ ] No

   b. if No what is being done to ensure cooperation of manufacturing and processing industries and the private sector

Institutional framework and administration

6. a. Is the constitution of Kenya and other national policies such as EMCA sufficiently address the problem of e-waste in the country? [Yes] [No], if No

   b. What should be done to ensure the problem of e-waste is efficiently addressed

   ……

   ……

7. Are there any county by laws on e-waste management? [1] Yes [2] No. if No

   a. What is the county government of Nairobi contemplating doing in order to fully address the problem of e-waste management

   ……

   ……

   b. Why is it important to have bylaws and laws on e-waste

……

……

8. a. Are there institutional structures for enforcement laws on e-waste?

[1] Yes [2] No, if No

b. How does the county government of Nairobi ensure compliance of laws on e-waste?

……

……

9. What challenges are experienced by the county government of Nairobi during enforcement process?

……

……

10. a. Does your organization conduct an independent audit to determine the levels of compliance in manufacturing and processing industries? [1] Yes [2] No, if No

b. How does the county government of Nairobi determine the levels of compliance in manufacturing and processing industries on issues to do with e-waste management?

……

……

11. a. Does your organization carry out training and sensitization to manufacturing and processing company on matters regarding e-waste? [1] Yes [2] No

b. How does the county government of Nairobi help enlighten manufacturing and processing industries on issues to do with e-waste management?

……

……

12. Kindly give your overall assessment on e-waste management in processing and manufacturing industries

……

……

13. Please state any priority areas of improvement regarding e-waste management from passive elements?

(a) Central Government level

……

……

(b) County Government Level

……

……

(c) Industry level

……

……

(d). other stake holders

……

……

14. In your opinion what has contributed to a fast growth in e-waste in manufacturing and processing industries?

……

……

15. Problems encountered in e waste management service. (**Please tick as appropriate)**

Problem	very serious	serious	not so serious	no problem
Inadequate service coverage (some industries not given service)				
Poor service qualities (not frequent enough.)				
Lack of authority to make financial and administrative decision				
Lack of financial resources				
Lack of trained personnel				
Lack of vehicles				
Lack of equipment				
Old vehicle/equipment frequent breakdown				
Lack of capability to maintain Vehicle and equipment				
No proper institutional set-up for e waste management service				
Lack of legislation				
Lack of enforcement measure and capability				
Lack of planning (short, medium and long term plan)				
Rapid urbanization outstripping service capacity				
Difficult to locate and acquire landfill site				
Poor cooperation by Government agencies				
Poor response to waste minimization (reuse/recycling)				
Lack of control on hazardous waste				

16. What is the expected projected growth in e-waste generation in manufacturing and processing industries in the next 5 years? [1] <2% [2] 2%-4% [3] 5-7% [4] 8-10% [5] above 11%
17. Please state any priority areas of improvement regarding to e-waste management from passive elements at the following levels?

(g) Central Government level

……

……

(h) County Government level

……

……

(i) Industry level

……

……

18. What recommendations would you make in order to achieve full support from all the relevant stakeholders on matters regarding e-waste management from passive elements?

a. Central government

……

……

b. County government

……

……

c. Industries

……

……

d. Other stakeholders

……

……

Appendix VI: Interview Schedule for the Key Stakeholders-NEMA

I am a student of Kenyatta University undertaking a Master degree course in Environmental Planning and Management. I am carrying out a research on e-waste management in Manufacturing and processing industries in industrial area of Nairobi County. I am therefore collecting information for this purpose; I am kindly requesting you to answer the following questions as appropriate. **All data collected will be treated with at most confidentiality and used exclusively for the purpose of the study**

Details of Respondent(s):

Name of respondent: …….

Position of Respondent:

……

Date: ……

General: (Tick where appropriate)

4. a. Do you know what e waste is [1] Yes [2] No, if yes

   b. What are the roles and responsibilities of the NEMA with regards to e-waste management?

   ……

   ……

5. Describe in your own words the most important problems and needs the City is facing in relation to e-waste management in Nairobi's industrial area

   ……

   ……

6. a. Do you have a department in NEMA dedicated to issues of e-waste management?

   [ ] Yes [ ] No, if No

   c. What are you contemplating doing about mitigating the issue of e-waste management in relation to this?

……

……..

E Waste System and Facilities (Tick where appropriate)

8. Who is responsible for collection and disposal of e-waste from manufacturing and processing industries in industrial area Nairobi County?

   ……

   ……

9. a. Are there any designated area for dumping of e-waste?

   [1] Yes [2] No, if No

   b. How is e-waste disposed?

   ……

   ……

10. What are the risks associated with poor e-waste disposal and handling?

    c. Environmental

    ……

    ……

    d. Social

    ……

    ……

11. a. Are there any laid down procedures provided by NEMA to manufacturing and processing industries regarding e-waste handling? [1] Yes [2] No,

    b. What should be done in order to mitigate the problem associated e-waste handling in manufacturing and processing industries?

    ……

    …….

Institutional framework and administration

19. a. Is the constitution of Kenya and other national policies such as EMCA sufficiently address the problem of e waste in the country? [Yes] [No], if No

    b. What should be done to ensure the problem of e-waste is efficiently addressed?

    ……

    ……

20. Are there any laws on e waste management? [1] Yes [2] No. if No

    c. What is the NEMA contemplating doing in order to fully address the problem of e waste management

    ……

    ……

    d. Why is it important to have bylaws and laws on e-waste

    ……

    ……

21. a. Are there institutional structures by NEMA for enforcement laws on e-waste?

    [1] Yes [2] No, if No

    b. How does the NEMA ensure compliance of laws on e-waste?

    ……

    ……

22. What challenges are faced by NEMA when carrying out there mandate on matters of environmental management?

    ……

    ……

23. What challenges are experienced by NEMA during enforcement of laws and regulation on e-waste in manufacturing and processing industries?

……

……

24. a. Does NEMA conduct an independent audit to determine the levels of compliance in manufacturing and processing industries? [1] Yes [2] No, if No

b. How does the NEMA determine the levels of compliance in manufacturing and processing industries on issues to do with e0-waste .management?

……

……

25. a. Does your organization carry out training and sensitization to manufacturing and processing company on matters regarding e-waste? [1] Yes [2] No

b. How does the county government of Nairobi help enlighten manufacturing and processing industries on issues to do with e-waste management?

……

……

26. How does NEMA promote integrations of environmental consideration into development plans, polices, programs and projects as your key mandate

……

……

27. What are the challenges NEMA is facing in carrying out surveys on e-waste in order to assist in proper management and conservation of the environment as your key mandate

……

……

28. Kindly give your overall assessment on e-waste management in processing and manufacturing industries

……

……

29. As your role to advise the Government on legislative and other measures for the management of the environment or the implementation of relevant international conventions, treaties and agreements. What is the advice of NEMA with regard to e waste in manufacturing and processing industries?

……

……

30. In your opinion what has contributed to a fast growth in e-waste in manufacturing and processing industries?

……

……

31. Problems encountered in e-waste management service. Please tick as appropriate

Problem	very serious	serious	not so serious	no problem
Inadequate service coverage (some industries not given service)				
Poor service qualities (not frequent enough.)				
Lack of authority to make financial and administrative decision				
Lack of financial resources				
Lack of trained personnel				
Lack of vehicles				
Lack of equipment				
Old vehicle/equipment frequent breakdown				
Lack of capability to maintain Vehicle and equipment				
No proper institutional set-up for e waste management service				
Lack of legislation				
Lack of enforcement measure and capability				
Lack of planning (short, medium and long term)				
Rapid urbanization outstripping service capacity				
Difficult to locate and acquire landfill site				
Poor cooperation by Government agencies				
Poor response to waste minimization				
Lack of control on hazardous waste				

32. What is the projected growth in e-waste generation in manufacturing and processing industries in the next 5 years? [1] <2% [2] 2%-4% [3] 5-7% [4] 8-10% [5] above 11%

33. Please state any priority areas of improvement regarding to e-waste management from passive elements at the following levels?

(j) Central Government level

……

……

(k) County Government level

……

……

(l) Industry level

……

……

34. What recommendations would you make in order to achieve full support from all the relevant stakeholders on matters regarding e-waste management from passive elements in manufacturing and processing industries in industrial area of Nairobi County?

e. Central government

……

……

f. County Government

……

……

g. Industries

……

……

h. Other stakeholders

……

……

Appendix VII: Questionnaire for e-waste recyclers and handlers

I am a student of Kenyatta University undertaking a master degree course in Environmental Planning and Management. I am carrying out a research on e-waste management in manufacturing and processing industries in industrial area of Nairobi County. I am therefore collecting information for this purpose; I am kindly requesting you to answer the following questions as appropriate. **All data collected will be treated with at most confidentiality and used exclusively for the purpose of the study.**

Please Tick where appropriate

Education and awareness:

General: (Tick where appropriate)

7. What are the roles and responsibilities of your organization with regards to e-waste management?

   ……
   ……
   ……
   ……
   ……

8. What is your organization's capacity and capability in e-waste handling?

   ……
   ……
   ……
   ……
   ……

9. Describe in your own words the most important problems and needs the City is facing in relation to e-waste management in Nairobi's industrial area

   ……
   ……
   ……
   ……
   ……

10. What are the different categories of e-waste handled by your organization?

    ……
    ……
    ……
    ……
    ……

E waste System and Facilities

6. What is the average weight from e-waste do you handle monthly?

   [1] Below 100kgs [2] 100-150kgs [3] 151-200kgs [4] 201-250kgs [5] Above 250Kgs

7. For the above handled e-waste does your organization practice?

   [1] On site storage [2] Offsite storage

   If offsite storage

8. a. Do you collect e-waste from companies and other organizations for handling processes? [1] Yes [1] No

   b) If No, how do you get the e-waste?

   ……

   ……

   ……..

9. a. What are the main processes involved in e-waste handling/recycling?

   ……

   ……

   ……

   ……

   …….

   b. How do you dispose of the unwanted parts of e-waste?

   ……

   ……

   ……

   ……

10. What are the main obstacles constraining proper e-waste collection, handling and recycling processes in the country?

    ……

    ……

    ……

    ……

Priority Pollutant Information:

12. What are the suspected chemicals found in the e-waste that you handle?

    ……

    ……

    ……

    ……

    ……

13. What are the problems associated with poor e-waste management in manufacturing and processing industries?

    c. Environmental

……

……

……

……

d. Social

……

……

……

……

14. What has contributed to fast growth in e-waste in manufacturing and processing industries? [1] Technology [2] Industrialization [3] Wear and tear [4] Absoleteness [5] others specify

……

……

……

15. What are some of the health issues brought about by toxic substances from e -waste?

……

……

……

……

Institutional framework and administration

35. a. Is the constitution of Kenya and other national policies such as EMCA sufficiently address the problem of e waste in manufacturing and processing industries

[1] Yes [1] No

b. if No, what the main issue that needs to be addressed by the policies and the laws

……

……

……

36. a. Are there any health and safety measures put in place in your organization?

[1] Yes [2] No,

If No

b. What are you contemplating doing to improve the situation?

……

37. a. Does your organization undertake routine environmental reporting? [1] Yes [2] No,

If Yes

b. What are the benefits of routine environmental reporting?

……

……

……

38. What role does your organization play to help enlighten manufacturing and processing industries on issues to do with e-waste management and general e-waste awareness?

……

……

……

39. a. Has your organization subscribed to international standards regarding environmental health and safety management? (Such as ISO 450001 e.t.c.) [1] Yes [2] No

b. If Yes, name the standard?

……..

c. Kindly give your overall assessment on e-waste management in processing and manufacturing industries

……

……

……

……

……

Strategy Review

3. State priority areas of improvement regarding e-waste management in manufacturing and processing industries at the following levels?

(m) Central Government level

……

……

……

……

(n) County level

……

……

……

……

(o) Industry level

……

……

……

……