DISPOSAL ALTERNATIVES FOR ELECTRONIC WASTE IN KOROGOCHO AND DANDORA INFORMAL SETTLEMENTS: IMPLICATIONS ON WASTE MANAGEMENT IN URBAN CENTRES IN KENYA

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C153/CTY/PT/24472/2010

A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF HUMANITIES AND SOCIAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF PUBLIC POLICY AND ADMINISTRATION OF KENYATTA UNIVERSITY

MAY, 2013

DECLARATION

This research project is my original work and has not been presented for a degree in any other university or for any other award

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This research project is dedicated to my late father Rakem Oluchiri whose inspiration laid down the foundation and aspirations for my advanced learning.

ACKNOWLEDGEMENT

This research project would not have been possible without the patience and support of my lecturers and colleagues of Kenyatta University. The dedicated professional and technical guidance of my supervisor, Dr. Felix Kiruthu was outstanding. Prof. David Minja's advice and technical support are highly acknowledged. I would also like to express my appreciation to my classmates – the first ever Master of Public Policy and Administration class in Kenya.

The support and environment provided by my family enabled me to pursue and complete this work. Special compliments go to my wife Judith, children Faith, John, Olivia and Arthur. My mother Linet and late father Rakem kept encouraging me. I sincerely thank them. My brothers, sisters and relatives kept the fire burning and I greatly appreciate their contribution

I would not forget the support from Mr. D. Morungi, Ms. M. Onyiego, Mr. A. Munanga and Ms. T. Njoki for support during data collection and processing. Finally I acknowledge work of my colleagues and members of staff at MMUST Nairobi centre for their moral support.

I feel my acknowledgement would be incomplete if I did not appreciate that contribution and the goodwill of all the friends and relatives who assisted me both materially and morally during my research work. It is not possible to mention all the people who assisted me in one way or the other during this project. Please accept this collective acknowledgement.

ABSTRACT

Although digital technology improves job prospects and lifts people out of poverty, new technologies and increased turnover of electronic products has led to a rise in e-waste. The situation in Kenya is aggravated by weak enforcement of policies and legislation. This study investigated the main sources of e-waste in Korogocho and Dandora informal settlements. It also established ways in which the e-waste is used. It investigated the impacts of the waste on the livelihoods of the community members. The study also determined ways in which administrative officers responded to the e-waste menace. The study applied descriptive survey research design. It used purposive and simple random sampling strategies and targeted two informal settlements; Dandora and Korogocho. Interview schedules were used to collect data. This was then presented in tables and charts. The study found that shops and other commercial agencies are the main sources of e-waste found within households in Korogocho and Dandora informal settlements. Most of these are shops that located within the city council waste collection routes. Private sources (individual and groups) are also significant sources of e-waste. A significant proportion of the community store and involve themselves in re-sale of e-waste. Some use the e-waste for re-fabrication of secondary and subsequent re-use. The level of awareness among households and community members about the impacts of e-waste on their health is low. The members are not aware of the e-waste potential for toxicity and disease. A correlation statistic established that the respondents discard their e-waste irrespective of knowledge of government laws and policies and therefore points to lack of enforcement of the regulations. Fencing of dumping places and, arresting and prosecution of law-breakers are popular options for enforcement of e-waste regulations, policies and laws. It is recommended that shops and other commercial enterprises should put in place measures for effective collection and management of e-waste. Proper separation mechanisms should be implemented to prevent such waste from reaching households. Private individuals and groups that generate e-waste should similarly use effective management strategies. Public awareness and education about hazards involved in storage and sale of e-waste should be enhanced. The same should target households and other main stakeholders who use e-waste for refabrication and, subsequent re-use and sale. The level of awareness among households and community members about the impacts of e-waste on their health should be also enhanced. This should particularly cover the potential for disease spread and toxicity. Public administration officers in informal settlement areas should embrace all the available procedures to enforce environmental management regulations, policies and laws relating to e-waste management. These should include use of sensitization sessions with the communities.

ABBREVIATIONS AND ACRONYMS

CCK	Communication Commission of Kenya
E- Appliances	Electronic Appliances
EU	European Union
E – Waste	Electronic Waste
ICT	Information and Communication Technology
IT	Information Technology
IWM	Integrated Waste Management
LPUR	Law for the Promotion of Effective Utilization of Resources
LRHA	Law for the Recycling of Specified Kinds of Home Appliances
NEMA	National Environment Management Authority
UNCHS	United Nations Centre for Human Settlement
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

DEFINITION OF OPERATIONAL TERMS

E-waste: Discarded electrical or electronic devices.

Informal Settlements: unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing).

Waste regulations: These are regulations enforced by an environment agency in a country like Kenya.

Waste Policies: Government guidelines comprising statements that provide for ways handling and managing of waste

Disposal: Final placement or riddance of wastes

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CHAPTER ONE

INTRODUCTION

1.1. Background to the Study

Electronic waste (e-waste) is the most rapidly growing segment of the municipal waste stream. E-waste is a general category of electronic products including broken or obsolete televisions, computer monitors, central processing units (CPU), cordless and cell phones, cash registers, videocassette recorders, cell phones, copiers and printers, stereos and speakers, microwaves, x-ray machines, and some scientific equipment (Kurian, 2007). These products may contain toxic materials such as lead, barium, mercury, and cadmium that require proper management as well as valuable resources that should be recovered. It is also notable that materials from e-waste release a deadly cocktail of poisonous waste products including lead, cadmium and mercury which can lead to serious illness and death (Omuterema, 2004). Handling of such material should therefore be done with caution and within a specific policy framework.

Rapid economic growth and the increasing transboundary movement of secondary resources will increasingly require both 3R endeavours (reduce, reuse, recycle) in each country and appropriate control of international material cycles. To meet these needs, the prevention of environmental pollution and efficient utilization of resources will both be important (Terazono *et al.*, 2006).

One of the areas of focus of Basel Convention on Transboundary Movement of Hazardous Substances emphasizes collaboration among existing institutions and programmes to promote better use of cleaner technology and its transfer, methodology, economic instruments or policy to facilitate or support capacity-building for the environmentally sound management of hazardous and other wastes. India and other countries have ratified the convention and find it useful in some of her management measures for e-waste (Ramachandra & Saira, 2004). Further, the Government of India published draft rules on e-waste handling and management in 2010. The rules comprehensively spell the responsibilities of: the waste producers, collection centres, consumers, dismantlers and recyclers among others (Government of India, 2011). Several states in Brazil, a country considered to have the fifth biggest electronic market after China, USA, Japan and Russia, have initiated e-waste initiatives by making e-waste relevant regulations or establishing separate collection of particular e-waste fractions (Streicher-Porte, 2009). However, only about 10% of cities in the country have a proper strategy to deal with recyclable waste (Casaes, 2009). There has been strong industry opposition in the country against application of the concept of Extended Producer Responsibility (EPR) for electrical and electronic products (Streicher-Porte, 2009). The problem of national policy on e-waste persists in this country.

UNEP executive director, Mr Achim Steiner warned that dumping of e-wastes in Africa would increase unless existing international regulations on toxic materials, including those under the international convention for the prevention of pollution from ships, are properly enforced in the country (Otieno, 2006). An e-waste baseline study conducted by the Kenya ICT Action Network (KICTANet) in 2008 noted that e-waste recycling, conducted as one of the management methods is done informally with no regulation in place to safeguard the health of those who dismantle the electronic equipment, nor the environment (KICTANeT, 2008). The absence of a policy and legislative framework, and a practical management system, means that much e-waste remains largely in storage. It also means e-waste is often recycled or disposed of in an unsafe and unsustainable manner. Agencies that handle, transport, recycle, or dispose of e-waste need specific guidance to assure that the growing waste flow of end-of-life electronic products is managed in a way that protects public health and the environment and conserves resources (Ramachandra & Saira, 2004; California Integrated Waste Management Board, 2004).

Local government in Kenya has a primary role in the diversion of electronic wastes from landfills. This rapidly growing segment of waste is one of substantial concern because of its hazardous and toxic materials content. Rapid technological advances and lower product prices for more powerful machines are contributing to shorter product life spans and frequent replacement. Electronic equipment quickly loose

resale value yet consumers are likely to store their old electronics, believing that it still has value.

A 2009 United Nations Environment Programme (UNEP) report, Recycling – From E-waste to Resources, notes that Kenya faces serious environmental and health problems due to increasing hazardous waste from electronic devices (UNEP, 2009). The report lists old mobile phones, photographic and music devices, desktop and laptop computers, printers, pagers, refrigerators, toys and televisions as the main sources of e-waste. There is a need to dispose of large quantities of computers and mobile phones and to arrange for their safe disposal, which includes the right to health and safety measures for workers and the public in general. Schluep (2010) in studies on e-waste management also notes that developing and emerging countries are seriously affected by the waste since they produce a growing amount of e-waste by themselves; some of them receive e-waste from industrialized countries; they face a lack in suitable laws and their enforcement on e-waste management.

Hitherto, Kenya does not have legislation to deal directly with e-waste (Shivoga, 2010; Daily Nation, 2006b and GoK, 2010). At the national level, there is a mix of laws and regulations addressing waste, and some recent references to e-waste, but there is no coordinating framework. The Environmental Management Co-ordination Act (EMCA, 1999) defines hazardous waste, pollutants and pollution, but it does not

address specific aspects of waste such as e-waste. The National Environmental Management Authority (NEMA), responsible for implementation of all policies and regulations relating to the environment, also has no specific regulations focusing on e-waste. At the local level, the 1962 Public Health Act places responsibility for waste management at the local authority level (GoK, 1962). These, however have no e-waste programmes.

Kenya ICT policy (2006) emphasizes minimal environmental impact during the use of ICT devices by various users. The policy also states that the government will ensure that telecommunications operators minimize the effect of their infrastructure developments on the environment and reduce the inconvenience and intrusion caused by such infrastructure (GoK, 2006). The policy contains sections that remotely relate to e-waste. They make appropriate recycling and installation of disposal facilities for e-waste as part of the requirements for renewal of communications licenses (GoK, 2006). This is not given emphasis by consumers. The Communications Commission of Kenya (CCK) (CCK, 2010) has incorporated the foregoing requirement into current legislation. The Kenya Bureau of Standards runs the pre-export verification of conformity programme that aims to minimize the national risk of unsafe and substandard goods entering into the country. The bureau is expected to conduct inspections of second-hand computers entering the country to ensure that they are utilizable.

The level of awareness on e-waste management issues is poor among members of the public both in the formal and informal settlements as various e-waste components are found mixed in municipal waste fractions as established by various studies cited in the literature below.

1.2. Problem Statement

Although digital technology improves job prospects and lifts people out of poverty, new technologies and increased turnover of electronic products has led to a rise in e-waste. A study conducted between December 2007 and April 2008 by the Kenya ICT Action Network in Nairobi in July 2008 found that the total e-waste generated from computers, monitors and printers in the city is 3,000 tonnes per year. This is likely to increase dramatically as the importation and use of computers increases; a 200% rise was recorded in 2007 (Waema & Mureithi, 2008). There is lack of policies and legislation on the methods of disposal of this and other types of waste (Mutuku, 2011). Areas within and bordering the dumping sites such as Korogocho and Dandora dumping site in Nairobi have been cited to be choking with e-waste from discarded refrigerators, television sets, computers and mobile phones. The situation is replicated in many other dumping sites across the country.

E-waste releases a deadly cocktail of poisonous waste products including lead, cadmium and mercury which can lead to serious illness and death (Omuterema, 2004). The engagement of the informal settlement populace in business of informal

collection, dismantling and recycling of domestic e-waste exposes them to serious health risks.

This study therefore investigated the main sources of e-waste in Korogocho and Dandora informal settlements, examined how the waste is utilized, its impact on the livelihoods of community members and how public administration officers respond to the e-waste disposal menace. Mention something on policy implication

1.3. Research Questions

The study was guided by the questions:

a) What are the sources of e-waste in Korogocho and Dandora informal settlements?

b) How is the e-waste utilized in the informal settlements?

c) How does the e-waste impact on the livelihoods of the people in the informal settlements under study?

d) How do the public administration officers respond to the e-waste menace?

1.4. Study objectives

a) To identify the main sources of e-waste in Korogocho and Dandora informal settlements in Nairobi.

b) To examine the ways in which e-waste is utilized in the informal settlements

c) To analyze the impact of e-waste on the livelihoods of the people in Korogocho and Dandora informal settlements

d) To examine the response of the public administration officers in Korogocho and Dandora to the e-waste menace

1.5. Research premises

The study was guided by the following research premises:

a) Industries in Nairobi are the main sources of e-waste in Korogocho and Dandora informal settlements

b) E-waste in Korogocho and Dandora informal settlements is utilized within the locality.

c) E-waste found within Korogocho and Dandora informal settlements has no significant adverse impact on the livelihoods of the people.

d) There is inadequate response by the public administration officers in the management of e-waste in Korogocho and Dandora informal settlements

1.6. Significance of the Study

It is notable that the term e-waste does not appear in both Kenya's legal documents relating to solid waste; Environmental Management and Coordination Act (1999) and Waste Management Regulations of 2006. A recent study suggests that the total e-waste generated from only computers, monitors and printers each year is about 3,000 tons. Most of the waste results from poor methods of disposal of used electronic appliances. This amount of e-waste is likely to increase in future (GoK, 2010). Considering that this research was carried out in a relatively poor segment of the electronic consumer society where product re-use is likely to be

high, the information obtained after completion of the research will serve to inform the Manufacturing Industry, Central Government, local government staff, and the general public on how to properly manage e-waste.

High density unplanned settlements within and bordering the dumping and high generation sites, such as Korogocho and Dandora are likely to suffer most from the effects of e-waste, some of which are health-related. Results of the study will inform policy on the required care during handling and management of used electronic appliances at household and institutional levels.

Data on various methods of handling e-waste in the informal settlements will assist in design and formulation of strategies for disaster risk-reduction for the hazardous substances in such places. The data will also enhance urban planning tools in order to cater for the emerging hazardous wastes from electrical and electronic wastes.

1.7. Scope and Limitations of the Study

The study was conducted over a limited period - four (4) months, between January 2013 and April 2013. This period may not be adequate to administer the research tools exhaustively in the study area since some of the residents may be absent when they are required for interview administration. To overcome this challenge, arrangements were made to seek appointment with respondents to provide the most convenient but acceptable time for administering the research tools.

A lot of waste, composed of various types is generated within the area of study. However the focus is only on e-waste. A study of all the categories of waste can take a lot of time which may extend the period of the study. Furthermore, disposal of e-waste is widespread in Nairobi. Both informal and formal settlements suffer from effects of improper disposal practices. However due to constraints the study only examined Korogocho and Dandora informal settlements. Due to financial and time constraints the study limited itself to community members who have owned at least two of the electronic appliances – Mobile phone, Television, Radio and Computer. Other members who may have owned only one of the appliances were excluded even though they would have had a significant input in the research. To cover for this shortcoming, key informant interviews were extended to respondents with likelihood of unique knowledge, skills and information other than those sampled. The study was conducted in Korogocho and Dandora informal settlement areas in Nairobi, Kenya. These are settlements within the Nairobi County, Kenya in Eastern Africa.

CHAPTER TWO

LITERATURE REVIEW

2.1. World Electronic Products and E-Waste Scenario

The electronic industry is the world's largest and fastest growing manufacturing industry (Radha, 2002; DIT, India, 2003). During the last decade, it has assumed the role of providing a forceful leverage to the socio-economic and technological growth of a developing society. The consequence of its consumer oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge - the growing menace of "Electronics Waste" or "e waste" that consists of obsolete electronic devices. It is an emerging problem as well as a business opportunity of increasing significance, given the volumes of e-waste being generated and the content of both toxic and valuable materials in them (Kurian, 2007). The fraction including iron, copper, aluminium, gold and other metals in e-waste is over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70% (Widmer et al., 2005).

A UNEP report titled "Recycling-From E-waste Resources" published in July 2009 (UNEP, 2009) notes that Kenya is facing serious environmental and health problems due to increasing hazardous waste from electronic devices. The report listed old desktops and laptops computers, printers, mobile phones, pagers, digital photos and

music devices, refrigerators, toys, and television as main sources of wastes. The report warned that if immediate action is not taken to ensure safe and proper collection and disposal of materials, many developing countries will have to deal with large amounts of hazardous e-waste and may suffer dire consequences on the environment and public health fronts.

With sharp rise in sales of electronic devices notably mobile phones, the problem will worsen in the coming years. As noted by UNEP executive director Achim Steiner, developing countries will be reeling under untold burden if e-waste recycling is left to the vagaries of the informal sector, unless action is taken to collect and recycle material (UNEP, 2009).

Establishment of a recycling process requires an efficient collection management. According to de Oliveira et al (de Oliveira, Bernardes & Gerbase, 2012), the main difficulty associated with the implementation of e-waste recycling processes in Brazil as in many other countries is the collection system, as its efficiency depends not only on the education and cooperation of the people but also on cooperation among industrial waste generators, distributors and the government. Over half a million waste pickers have been reported in Brazil and they are responsible for the success of metal scrap collection in the country. The country also has close to 2400 companies and cooperatives involved in recycling and scrap trading. On the other hand, the

collection and recycling of e-waste is still incipient because e-wastes are not seen as valuable in the informal sector. This study posits that the Brazilian challenge is to organize a system of e-waste management including the informal sector which plays a vital role so as to integrate environmentally sound management practices.

2.2. Electronic materials in Kenya

A study conducted between December 2007 and April 2008 by the Kenya ICT Action Network in Nairobi in July 2008 found that the total e-waste generated from computers, monitors and printers in the city is 3,000 tonnes per year. This is likely to increase dramatically as the importation and use of computers increases; a 200% rise was recorded in 2007 (Waema & Mureithi, 2008). The absence of a policy and legislative framework, and a practical management system, means that much e-waste remains in storage. It also means e-waste is often recycled or disposed of in an unsafe and unsustainable manner. This puts both the recycler and local population at risk; residents near dump sites report waste fumes, chemical inhalation, and air and water pollution. However, with the right infrastructure, which is one of the ultimate aims of this study, these volumes are manageable.

According to the Government of Kenya (GoK) (2010), e-waste has become the fastest growing segments of the Kenya's total refuse. The country is exposed to this pollution because of failure to manage her waste, and upsurge in dumping of electronics products due to growing demand for affordable gadgets. The country's

less formal dumping sites are home to electronic gadgets with lethal toxins. In Nairobi, Recycling for Charities websites say the impact of this care-free disposal of e-waste is being felt in Nairobi's Dandora Estate. Dandora is Kenya's largest dumpsite, receiving over around 4,000 tonnes of garbage daily (GoK, 2010). It is further noted by NEMA, Kenya (GoK, 2010) that with unregulated means of disposal, Kenyans have resorted to burning trash as their best and only means of disposing e-waste, not knowing that by incinerating these gadgets, they release toxic chemicals and metals into the air and ground. Globally, reports and campaigning by environmental groups have spurred a flurry of international agreements to regulate the global trade in hazardous waste (Waema & Mureithi, 2008). More than 150 countries, Kenya included have signed up to the UN Basel Convention, an international treaty which came into effect in 1992 and aims to minimize the generation and movement of electronic waste across borders (UNEP & UNU, 2009). These initiatives require support through national and other local mechanisms.

In his book, Morgan (Morgan, 1967) describes the city of Nairobi as a large and flourishing place by 1900 with the settlement consisting mainly of the railway buildings and separate residential quarters for Europeans and Indians. The latter were mainly the labourers employed on the construction of the railway. There was practically no African Settlement. In the first two decades of the last century, almost all the natives in Nairobi lived in informal settlements (Ngau, 1995). The earliest

settlements included Mji wa Mombasa, Maskini, Kaburini, Kileleshwa, and Pangani. Most of these, however, were subsequently demolished, and the indigenous landlords and tenants compelled to live in demarcated ''native locations'.

K'Kakumu & Olima (2006) noted that most of the informal settlements that exist in Nairobi today were established after independence. From 1963 until the late 1970s the policy was to eradicate informal settlements. This hostile attitude was, however, superseded by a conciliatory and accommodating position. There was tacit acceptance of informal settlements, with the authorities adopting a laissez faire approach whereby they generally did not demolish any settlements, but also made no effort to institute improvement programmes. Informal settlements consequently expanded and proliferated unchecked. One of the most striking features of the city is its dynamics that involves transformation into different socio-spatial manifestations. For instance in the 2005 - 2006 period, an estimated 55% of the total population of Nairobi lived in the spatially segregated informal settlements that occupied only 5% of Nairobi's residential area (K'Kakumu & Olima, 2006). The incessant demand for affordable electronic gadgets in many informal settlements is a major contributor to e-waste. It is important to equip the city of Nairobi with effective hazard mitigation strategies especially those related to e-waste as we progress towards the realization of vision 2030.

There are challenges in handling, storage and disposal of domestic waste in Nairobi (Afullo & Odhiambo, 2009; Olima, 1998). Some of these arise from lack of space and appropriate skills. Regulatory issues are also to blame. Omuterema, Waswa and Masibo (2008) note that disposal of solid waste should incorporate integrated waste management alternatives that include reuse, source reduction, recycling, composting and incineration. In her report, Munyua (2010) notes that there are economic opportunities in e-waste management in the form of creating employment via informal recycling businesses. Refurbishment of old ICT equipment has also become an area of business for civil society organizations like Computer for Schools, Kenya (CFSK), who refurbish computers for schools around the country. Small and medium entrepreneurs could be encouraged and supported to tap into e-waste recycling utilizing sustainable business models.

While the technology is fairly simple, landfills involve complex organic processes. To ensure their efficient operation and to limit disturbances and environmental pollution, UNDP, UNCHS ,World Bank & SDC (1996) further note that landfills need to be carefully sited, correctly designed and well operated.

2.3. Sources and effects of e-waste

Other studies done worldwide to establish pollution levels generated from e-waste activities revealed higher concentrations of contaminants in several environmental media adjacent to e-waste dump sites. For instance at Guiyu, Guangdong Province in

China, total polycyclic aromatic hydrocarbons (PAHs) in soil obtained from a printer roller dump site was 593 μg/kg dry weight (Wei Cai & Hung Wong, 2006) . Also high levels of Cu (712, 528 and 496 mg/kg), exceeding the Dutch list action value, were obtained for soil near the printer roller dumping area, sediment from Lianjiang River, and soil from a plastic burn site, respectively. Still in China, Dechlorane plus (DP) from a waste recycling activities, a flame retardant with adverse health effects, was identified and measured in house dust from e-waste recycling and from urban and rural areas of South China, with geometric mean concentrations of 604, 14.5, and 2.89 ng/g, respectively.

From some of these examples, a significant number of contaminants are transferred via house dust which serves as a repository and concentrates many environmental contaminants that accumulate from various pathways, including volatilization and deterioration from household products and deposition of particulates transferred from the outdoors (Lioy, Freeman & Millette, 2002; Hwang, Park, Young & Hammoc, 2008).

Thus, proximity to dumpsite may not be the only areas of high risk but house dust also plays an important role in human exposure to contaminants in the indoor environment. According to Browne and Grizzard (1979), urban storm water causes dispersion of solid wastes, including e-wastes. The wastes are diverse and pollution levels of the affected land in the urban centres depend on the specific land uses. E-

waste has become a significant component of waste from institutional sources such as government and private offices, educational establishments, sports facilities and clubs. It has also become significant in industrial (manufacturing) establishments in urban centres in East Africa. Its significance is emerging in domestic (household) waste just like in healthcare (hospitals, clinics, drugs shops) (Okot-Okumu, 2012).

2.4. Waste collection and transportation

Three main methods of wastes collection can be identified as the informal primary or pre-collection phase mainly from households to community collection points (e.g. skips, bunkers or open roadside) mostly by households, hired labour. The secondary phase collection is from community transfer points to final disposal sites or landfills and is mostly by formal institutions like urban councils and private operators. Private operators mostly collect wastes directly from generating sources (door to door). Private operators collect waste at negotiated fees with the individual clients. Industries and shopping malls in most cases contract private waste collectors to pick wastes from their premises, while community markets and hospitals still rely mainly on urban council collection. Other collection modes take the form of a "summon to bring" system, where a truck is parked at a location and a horn (hooting) summons people to deliver wastes to the truck.

The frequencies of household waste collection vary between low-income and high income groups. The high-income groups dispose waste often 3 times a week that is

determined by the frequency of collection by most contractors of 2-3 times a week similar (Kaseva & Mbuligwe, 2005; Okot-Okumu & Nyenje, 2011).

Much time is spent on collection as most waste is manually loaded onto trucks by urban council workers. Percent of waste collected vary between 35 and 68, which is comparable to other urban councils in developing countries (Vidanaarachchi et al., 2006; Palcznki, 2002; Supriyadi et al., 2000; Scheinberg, 2011). The introduction of private operators has increased solid waste collection levels compared when it was dependent entirely on the urban councils (Kaseva & Mbuligwe 2005; Oberlin 2011; Okot-Okumu & Nyanje 2011). However most of these reported collection efforts only apply to wastes that have reached community collection points (transfer points).

So a higher percentage of urban solid waste does not reach the legal disposal points but end up in the environment. Open dumping is the most common waste disposal methods in urban areas (Oberlin 2011; Okot-Okumu & Nyenje 2011). Where skips and waste bunkers are too far the communities dump wastes indiscriminately and some disposal points are often overflowing with uncollected wastes. This frequently leads to scavenging of categories of wastes such as e-wastes

2.5. E-waste policies and regulations

In countries with advanced regulatory mechanisms on e-waste, policy is geared to address all issues ranging from production and trade to final disposal, including

technology transfers for the recycling of electronic waste (DIT, India, 2003; Ramachandra & Saira, 2004). Clear regulatory instruments, adequate to control both legal and illegal exports and imports of e-wastes and ensuring their environmentally sound management should be in place. The regulations should prohibit the disposal of e-wastes in municipal landfills and encourage owners and generators of e-wastes to properly recycle the wastes. Manufacturers of products must be made financially, physically and legally responsible for their products (Kurian, 2007).

In describing how Japan deals with e-waste, Chung (Chung & Rie, 2008) admits the increasing scarcity of waste disposal sites and increased costs of waste disposal. In recognition of this Japan deals with e-waste in two ways. One is the Law for the Promotion of Effective Utilization of Resources (LPUR), which focuses on enhancing measures for recycling goods and reducing waste generation. The other is the Law for the Recycling of Specified Kinds of Home Appliances (LRHA), which imposes certain responsibilities related to the recycling of used home appliances on manufacturers and consumers. LPUR covers personal computers and small-sized secondary batteries designated as recyclable products while LRHHA deals with four classes of items: television sets, refrigerators, washing machines and air conditioners.

In India, policies and regulations that cover Design for Environment (DfE) and better management of restricted substances may be implemented through measures such as (Kurian, 2007): specific product take-back obligations for industry, financial responsibility for actions and schemes, greater attention to the role of new product design, material and/or substance bans including stringent restrictions on certain substances, greater scrutiny of cross-border, movements of Electrical and Electronic Products and e-waste and, increasing public awareness by labelling products as environmental hazard.

According to Kurian (2007), the effectiveness of legislation would include: coverage on the definition of the term electronic waste; identification of the person/institution that pays for disposal; clarification on whether waste disposal is the responsibility of the producer; the likely benefits of voluntary commitments and, ways in which sufficient recovery of material can be achieved to guarantee recycling firms a reliable and adequate flow of secondary material. Several reports (Royal Media Services, 2012) cite gaps in preparedness in dealing with electronic waste when fake phones are switched off after the lapse of the amnesty period in Kenya. Similar concerns arise for migration from analogue to digital Television in the country.

The two main legislations related to e-waste management in Europe are Waste Electrical and Electronic Equipment (WEEE) (Directive 2002/96/EC) along with the

complementary Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) which seeks to reduce the environmental impacts of WEEE throughout all stages of the equipment's lifecycle, particularly at the end-of life stage, by encouraging the end-of-life management of the product, eco-design, life cycle thinking and extended producer responsibility (Sawhney, Henzler & Melnitzky, 2008).

In his view Savage (Savage, 2006) alludes that the key aims of the WEEE directive was to reduce WEEE disposal to landfill and provide for a free producer take-back scheme for consumers of end-of-life equipment starting 13th of August 2005. It also aimed at improving product design with a view to both preventing WEEE and to increasing its recoverability, reusability and/or recyclability. The other aim was to achieve targets for recovery, reuse and recycling of different classes of WEEE in addition to providing for the establishment of collection facilities and separate collection systems of WEEE from private households. Still, this was supposed to provide for the establishment and financing of systems for the recovery and treatment of WEEE, by producers including provisions for placing financial guarantees on new products placed on the market. The foregoing is accompanied by a timetable and implementing resources from the respective governments. Current practices in the developed and a few developing countries (Arora & GTZ-ASEM, 2008) are; collection, dismantling and, re-use and recovery

2.6. Role of State Administrators

Government administrators are empowered by clauses of the some environmental laws to ensure effective enforcement. The Government of India's regulations on hazardous waste provide for the role of administrators in enforcement (Government of India, 2011). In a study that aimed at recommending the most appropriate method for solid waste management problem in Nairobi, Kasozi and Blottnitz (2010) suggest the application of firm command and control by the department in charge of environment at the City Council of Nairobi. Adequate resources should be provided for this to take root. They also recommend levying of fees that is in tandem with the dumping and waste collection practices of waste-sector organizations. Guidelines relating to the administrators' role directly on e-waste are not provided.

From the above literature, it is apparent that there is scant information on the sources of e-waste, its use, the impact of the waste on livelihoods and the role of the administrators on the e-waste disposal methods. Further, not much has been done on requirements for effective implementation of e-waste disposal regulations and policies in Kenya. According to KICTANet (2008), a policy and regulatory framework to address e-waste management is required to regulate the collection, disposal and handling process, as well as to license key actors. This implies that there are gaps in knowledge about e-waste handling and role of administration that require to be addressed. These were addressed in part by this study.

2.7. Conceptual Framework

Various theories and frameworks that guided related studies in the past are explored for possible adaptation in this study. A study by Mureithi et al (2008) on assessment of e-waste in Kenya largely applied exploratory research framework. It was, by design meant to cover Nairobi and specific IT products: PCs, laptops, Cathode Ray Tubes (CRT) monitors, printers, flat panels screens and other computer accessories. The current study covers radios and telephones in addition to the foregoing products. The focus is also different; informal settlements in Nairobi.

The framework that guided the study on levels of heavy metal pollutants in Municipal Solid Waste in Nairobi City (Omuterema, 2004) focused on levels of heavy metal hazards in Municipal Solid Waste. It applied direct cause-effect relationship framework where different environments would result in varying levels of heavy metals. These wastes are not as widespread in households as electronic appliance waste materials. The latter encompass other hazardous substances such as organic materials in addition to heavy metals. Wider, more focused management and related policy enforcement strategies need to be explored.

There are multiple waste disposal hierarchies that are applicable in the current study. The theory and framework of the hierarchy of the European Union Waste Strategy, established in 1989, and revised in 1996 and illustrated in Figure 2.1 is considered most suitable for this study. The first priority in waste management is waste

minimization, followed by recovery and finally proper disposal (White, Rodney & Jones, 1996).

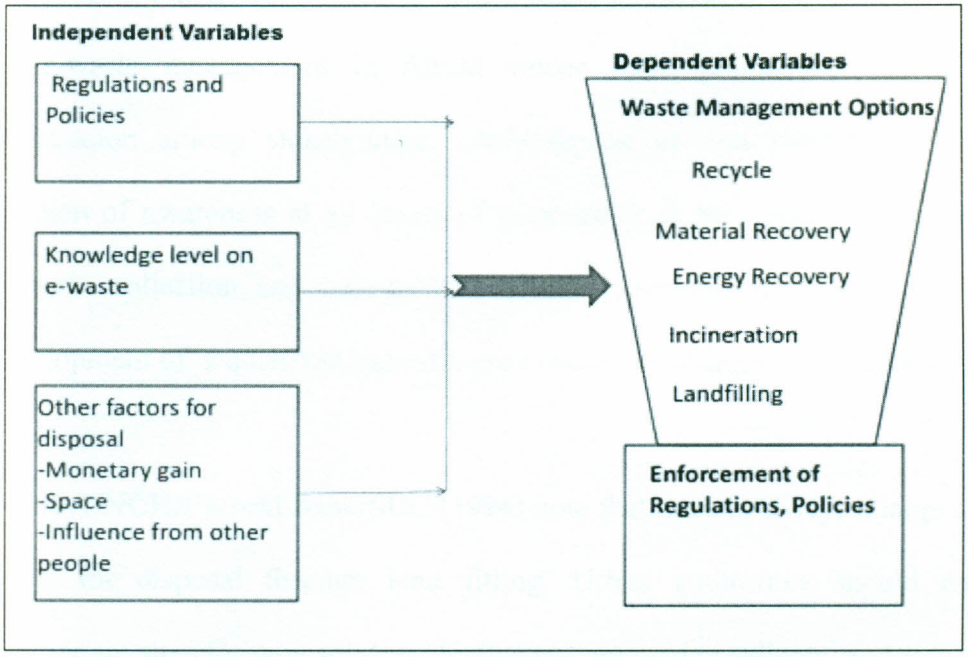

Figure 2.2: Conceptual Framework: Waste Management Hierarchy

Source: Modified from White *et al.* (1996)

This hierarchy gives guidelines on the levels of preference for different solid waste management options. It is often feared that the Hierarchy will be accepted as dogma and not take into account specific local and regional environmental and economic constraints. Additionally, the lack of scientific basis for the hierarchy as well as its limited applicability when a variety of different options are being used plus the absence of cost considerations within the hierarchy all add to the criticism (White et.

al., 1996). The hierarchy is however in tandem with the principles of Integrated Waste Management (IWM). It is also in harmony with the proposals of one of the most recent initiatives in dealing with e-waste in Africa – The Durban Declaration on e-waste management in Africa whose main points are: improvement of cooperation among stakeholders, establishment of an institutional framework, creation of awareness at all levels of governance & the general public, support of markets, collection and management of data development of a legal framework, development of a qualified and efficient e-waste recycling sector (Schluep, 2010).

UNDP/UNCHS/World Bank/SDC (1996) note that there is always a large quantity of waste for disposal through land filling. Urban authorities should ensure that appropriate sites for new solid waste disposal are made available, and that these sites will become accessible for the timely execution of Municipal Solid Waste Management improvements.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Research Design

It refers to the strategy to integrate the different components of the research project in a cohesive and coherent way. Rather than a "cookbook" from which you choose the best recipe, it is a means to structure a research project in order to address a defined set of questions (Kombo & Tromp, 2006; Trochim and Land, 1982).

This study employed a descriptive research design and at a later stage, correlational design. Descriptive research design is designed to provide further insight into the research problem by describing the variables of interest. A descriptive study is concerned with determining the frequency with which something occurs or the relationship between variables.

In this case, the researcher sought to find out methods used in disposal of the used electronics and further investigate the reasons behind this. The design was aimed at providing solutions to problems mostly when one believes that a particular event influences the dependent variable. It involves observing and measuring things as they are.

Further, the research correlated the level of knowledge of respondents on e-waste management, the government regulations and policies to methods adopted for disposal.

3.2 Variables/Categories of Analysis

The type and number of waste appliances in the category of e-waste were determined for household e-appliances; Mobile phones, Radio, Television (TV) and Computer (the most preferred being first and least preferred last in the list). The electronic item found to have been disposed by a household or individual person were examined as per the objectives.

The sources of e-waste were determined from;

(a) industries;

(b) shops and other commercial institutions

(c) waste dealers/resellers

(d) other homesteads

Ways in which the e-waste is utilized was chosen from several options, among them:

(a) re-fabrication and sale

(b) re-fabrication and subsequent re-use for a different function

(c) storage and sale

(d) re-use for the function of the original unit

(e) other(s) (specify)

The impacts of the e-waste on the livelihoods of the people were chosen from:

(a) Health – disease spread

(b) Health - Toxicity impacts

(c) None

(d) Other (specify)

The response of the public administration officers to e-waste disposal within the area

(a) Prevent disposal through ensuring fencing of dumping places

(b) Conduct sensitization sessions with the community in various ways

(c) Arrest and prosecution of law-breakers

(d) Other (specify)

3.2. Research Area

This study was conducted in Korogocho and Dandora informal settlements within Nairobi city. This is the Kenyan capital city located in Nairobi Region. The Region borders Eastern Region to the East, Rift Valley Regions to the South and West, and Central Region to the North. The Region has a population of 3,138,295 which forms 7.7% of the total population (2009 Kenya census) (GoK, 2011). It covers an area of 696 km square kilometres (269 square miles). The city lies on the Nairobi River in the south of the nation and has an elevation of 1795m above the sea level. The location of Nairobi city is at latitude 1 degree, 17'S and Longitude 36 degrees 49'E. The city is located 500km (300mi) west of the Indian Ocean in

Kenya's Central Highlands (GoK, 2011).

The county has eight divisions namely: Central, Dagoretti, Embakasi, Kasarani, Kibera, Makadara, Pumwani and Westlands. Nairobi Central Business District is located in Pumwani Division.

3.3. Target Population

The study was carried out in Korogocho and Dandora informal settlements within Nairobi with a population of over 780,000 (census of 2009) (GoK, 2011). The study focussed on public administration officers with jurisdiction over Korogocho and Dandora. Targeted also were sampled households in the study area, e-waste dealers and recyclers operating in the two informal settlements; manufacturers and government waste policy institutions.

3.4 Sampling Techniques and Sample Size

This study employed systematic random sampling to arrive at a sample size from the Korogocho and Dandora residents. In a random sample, every person in a target population theoretically has an equal chance of being selected to take a survey. A transect was made across each of the two settlement areas so as to capture households with the highest variation in socio-economic status. Households that have owned at least a mobile phone and radio for at least three (3) years and disposed at least one of the electronic appliances; Mobile phone, Radio, Television and Computer qualified to participate in the study. Only one member of

the household, preferably the head was requested to provide information.

Purposive sampling and snow ball technique was applied to select the persons who carry out the informal practices of recovering e-appliances from solid waste dumping sites. Purposive sampling was also used to select government officers to participate in the study.

3.5 Sample Size

The target population was over 20,000 households distributed over the two informal settlements, Korogocho and Dandora (GoK, 2011). The sample size is calculated taking into account the Confidence Interval to be used and precision level. Assuming that the findings reflect the true picture of the represented population 95% of the time, the Cochrane formula was applied as described by Bartlett, Kotrlik and Higgins (2001), Raosoft Inc. (2004) and by Enanoria (2007). This is stated as:

$$n=Z^2 \times p\,(1-p)/ę^2$$

Whereby,

n is the calculated sample size

Z is the confidence level (95%)

ę is the level of precision (5%)

p is the proportion of the population with required characteristics (taken to be 30%).

Hence the sample size was $\frac{1.96^2 \times 0.3\ (1 - 0.3)}{0.052} = 323$

So the sample comprised 323 households. The above sample size determination ensured fairness in sampling (Mugenda (2008). The household population density in the area is high (over 6 persons). According to Kothari (2003), the number of households as indicated above is representative for a study covering a population of over 10,000 persons. There are about five hundred (500) boys and girls who scavenge at the major waste disposal sites in the three areas. Fifty (50) of them or 10% were sampled through a random process and snow balling.

3.6 FGD and Key Informant Samples

Sample size for focus group discussion (FGDs) participants was determined based on the prevalence of e-waste storage/holding and recycling places. Ten (10) FGDs were held. This adequately covers the targeted geographical area.

Key persons such as Government officers in the Ministry of Communication and National Environment Management Authority were interviewed. The ministries in charge of environment, health and communication interact with e-waste issues, so interviews were sought from two (2) relevant persons from each ministry. The person

in charge of waste disposal activities at the city council of Nairobi also participated. Members of the public and other persons with extensive information in the study area were interviewed and any resources offered were used. Boys and girls found at the waste dumping sites were also interviewed. Public administration officers including the Chiefs, County government Assistants and County representatives were part of the key informants.

3.7 Research Instruments and Methods of Data collection

The study employed interview guides to collect both qualitative and quantitative data.

3.7.1 Interview guides

The study used interview guides to collect data from the respondents. An interview guide is a carefully designed instrument consisting of a set of items to which the respondents are expected to react, usually in writing. The guides were used because the study is concerned mainly with the views, perceptions and feelings of the respondents and such variables cannot be directly observed. The study used self-constructed semi-structured guides, with a mixture of focused and free-response items in a single instrument. This enabled the study to collect quantitative data from the closed-ended sections, and qualitative data from the open-ended sections.

3.7.2 Validity and Reliability

For the validity of the instrument, the researcher conducted a pilot survey. This involved pre-testing the interview guides with selected community members. Kothari

(2003) suggests that a pilot study is conducted to ensure clarity and proper interpretation of the guiding instrument by the expected respondents. Validity is concerned with whether the findings are really about what they appear to be about. To test for validity, the data collection instruments were administered to conveniently selected respondents.

Reliability refers to the consistency of measurement and is frequently assessed using the test– re-test reliability method. Reliability is increased by including many similar items on a measure, by testing a diverse sample of individuals and by using uniform testing procedures. Triangulation increases reliability of any study and with this in mind, questionnaires, interview guides, observation and focus group discussion were used to verify collected data. The use of focus group interviews was a brain storming session that gave the researcher an opportunity to verify issues from participants and open the topic up for further investigation.

3.7.3 Data Collection Procedures

The researcher and research assistants familiarized with the boundaries of the study areas; Korogocho and Dandora divisions. Sending introductory letters and booking appointments with the government administration offices in the area of study were done. The researcher administered the instruments in person and using two research assistants to the household heads, community elders and government departmental heads of the Ministry of Information and Communication, Local Government and

Ministry of Environment and Mineral Resources, Ministry of Health and Sanitation and Ministry of Medical Services at the district level. Prior to issuing the interview guides, appointments were made for time allocation by the respondents. Instructions about the research were read and explained to participants. Ample time of one week was given for filling of the guides which were later on collected by the research assistants. Observation checklists, photographs and secondary sources such as journals and other periodicals were also used to collect data and information.

3.7.4 Data Analysis

The data collected in this study was entered into the Statistical Package for the Social Sciences (SPSS 17) program for statistical analysis and then presented through percentages, means, standard deviations, frequencies and charts. Correlation statistic was done to determine whether there is a relationship between awareness of the health effects of e-waste and nature of disposal practices used.

The data was entered, edited and analyzed by use of descriptive statistics. Frequency and percentages were used in the analysis and tables and figures were generated during the analysis. To facilitate analysis of the data, each variable in the interview guide was assigned a numerical representation and the response from each respondent was coded using a defined coding scheme to easily facilitate data analysis.

Qualitative research utilizing case study method is one tool that this study relied on in data analysis. Case study method emphasizes a limited number of events, studies relationships among them and examines contemporary real life situations. Therefore the case study method is among the most appropriate method to use in researching this topic. The focus on Korogocho and Dandora ensured in-depth study and gave more information on the cases under study. Data analysis ran concurrently with data collection. This gave the researcher an opportunity to accommodate issues that were not anticipated and emerged during the period of study to seek more information or clarification.

3.7.5 Data Management and Ethical Considerations

Considering the fact that the research subjects in qualitative research are human beings, great care must be taken to prevent harm to these people. Some of the major ethical issues to be considered are the issues of informed consent (the researcher having received consent from the subject before data collection commences and after the subject has been adequately informed about the research), the right to privacy (protecting the identity of the participant from the reader) and protection from harm (this entails physical, emotional or any other harm to the subject in the course of the research). The researcher has kept the information given private and confidential and where necessary has used pseudonyms for individuals and places to protect identities of informants.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Introduction

This chapter presents a descriptive analysis of the data gathered in relation disposal alternatives for electronic waste in Korogocho and Dandora informal settlements with its implications on waste management policy in urban centres in Kenya. In this study, a total of 316 respondents were interviewed. The respondents were randomly selected from the five phases of Dandora and Korogocho. The method employed assured an equal chance of representation of all the phases within the division. Three hundred (300) valid responses were recorded. Descriptive techniques were used to organize, summarize and interpret quantitative information. Data was then presented in form of frequency tables and charts where applicable. This presentation is based on the questionnaire that was administered.

4.2. Background characteristics of the respondents

This section presents the characteristics of personal attributes of individual respondents. They include; gender, age, house heads, level of education, time lived in the community, electronic appliances/devices owned by household, e-appliances owned by the household not in-use, and qualifications the respondents had on e-waste management. The rationale behind inclusion of these attributes in the analysis is that they help to shed some light on the knowledge the respondents had on e-waste and its management.

4.3. Gender and age of respondents

The research requested the heads of households to indicate their gender, and age. The results are as shown in Table 4.1

Table 4.1 Distribution of respondents by their gender and age

Gender		Age		Total
		12 - 20 years	Over 20 years	
Male	Count	20	125	145
	%	13.8%	86.2%	100.0%
Female	Count	20	135	155
	%	12.9%	87.1%	100.0%
Total	**Count**	**40**	**260**	**300**
	%	**13.3%**	**86.7%**	**100.0%**

Majority of the respondents 86.7% were over 20 years while 13.3% of them were between 12-20 years. From the same table it is clear there are more female than male respondents. This implies that in some cases there were female heads of household. The researcher then enquired from the respondents to indicate whether they were all heads of the household. The results are as shown in Table 4.2.

Table 4.2: Distribution of respondents by their gender and status as a head of the household

Status as head of the household		Gender		Total
		Male	Female	
Yes	Count	112	88	200
	%	56.0%	44.0%	100.0%
No	Count	33	67	100

	%	33.0%	67.0%	100.0%
Total	**Count**	**145**	**155**	**300**
	%	**48.3%**	**51.7%**	**100.0%**

From Table 4.2, majority of the male respondents (56.0%) indicated they were the head of their households while 44.0% of the female were the heads of their household. The rest of the respondents were heads of their household. This shows that there are as many female households as the male headed household in the area of study. This would assist in getting the information needed in establishing the disposal alternatives for electronic waste.

4.4. Level of education

The researcher asked the head of households to indicate their highest level of education. The results are as shown in Table 4.3.

Table 4.3: Status as a head of household and their highest level of education

		Highest level of education			**Total**
Head of the household		Secondary education	Primary education	Not gone to school	
Yes	Count	40	126	34	200
	%	20.0%	63.0%	17.0%	100.0%
No	Count	30	49	21	100
	%	30.0%	49.0%	21.0%	100.0%
Total	**Count**	**70**	**175**	**55**	**300**
	%	**23.3%**	**58.3%**	**18.3%**	**100.0%**

Majority of the head of household (63.0%) had attained primary level of education, while 20.0% of them had a secondary level of education and 17.0% of them had not gone to

school. This shows that majority of the respondents had some knowledge on how to dispose electronic waste.

4.5. Time in the area

The researcher sought from the household heads the amount of time they had stayed within the community. The results are as shown in Table 4.4.

Table 4.4: Period of stay within the community

Period of residence	Frequency	Percent
Between 0 -6 months	30	10.0
Between 6 months- one year	10	3.3
Between 1 year - three years	50	16.7
Between 3 years - five years	55	18.3
Between 5 years - Seven years	30	10.0
over Seven years	125	41.7
Total	**300**	**100.0**

Most of the household heads (41.7%) indicated that they had stayed within the community for seven years and more while 18.3% of them had less than five years within the community and 10.0% of the respondents said they had stayed in this area for less than six months. These results is an indication that majority of the respondents had come across or had seen the way electronic waste is being disposed by their households or from the neighbouring households.

4.6. Main sources of e-waste in Korogocho and Dandora

With sharp rise in sales of electronic devices notably mobile phones, the problem will worsen in the coming years. As noted by UNEP executive director Achim Steiner, developing countries will be reeling under untold burden if e-waste recycling is left to the

vagaries of the informal sector, unless action is taken to collect and recycle material (UNEP, 2009). Armed with this knowledge the researcher sought to identify the main source of e-waste in Korogocho and Dandora informal settlements in Nairobi. The results are as shown in Table 4.5.

Table 4.5: Electronic appliances / devices your household owned in the last three years

Appliance	Frequency	Percent
Television	120	40.0
Radio	230	76.7
Mobile Phone	195	65.0
Computer/ Laptop	5	1.7
No Response	35	11.7

N= 300

Majority of the respondents (76.7%) owned a radio in the last three years while 65.0% of them owned a mobile phone and 40.0% of them owned a television set. When asked which of the appliances has developed problems during that time 44.7% of them had their radio developing problems, while 35.0% said their mobile phone has had problems, 14.7% of them having their television spoilt and 13.7% of them had none of their items spoiling during that duration. Other appliances such as a DVD as well developed problems during that period.

4.7. Qualifications on e-waste management

According to the Government of Kenya (2010), e-waste has become the fastest growing segments of the Kenya's total refuse. The country is exposed to this pollution because of failure to manage her waste, and upsurge in dumping of electronics products due to growing demand for affordable gadgets. This prompted the question on the qualification in e-waste management. The results are as shown in Table 4.6

Table 4.6: Qualifications on E-waste management

Training	Frequency	Percent
Short training /Seminar (s)	40	13.3
None	260	86.7
Total	**300**	**100.0**

Majority of the respondents (86.7%) had no qualification on management of e-waste while 13.3% had some training through seminars with Nongovernmental organization like JICA, Ministry of Environment and NEMA.

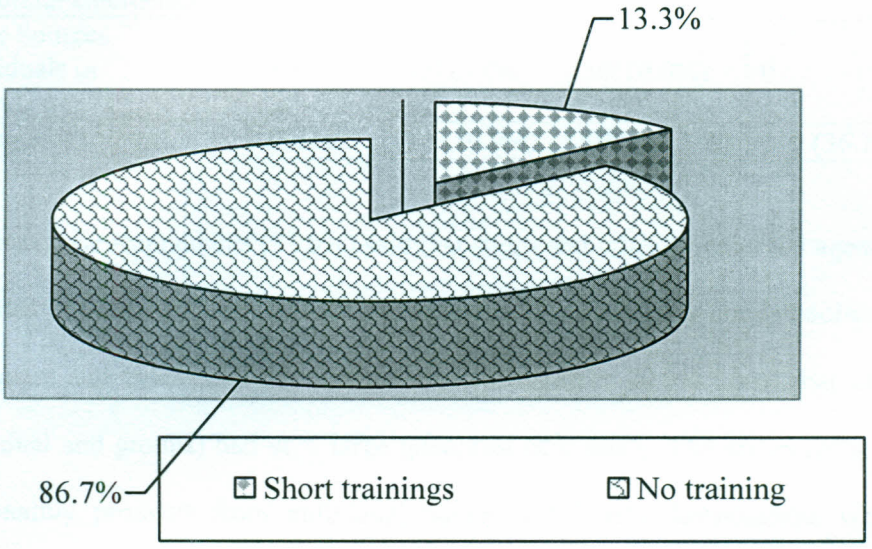

Figure 4.1: Qualifications on e-waste management

These findings show that there is still need for the government and other stakeholders to create more awareness on the same. The researcher observes that this is because even those in the waste management have not been trained.

4.8. Source of waste management

Waste comes from different areas such as industries, institutions, shops and enterprises, private sources such as individuals or groups, the government and even the airport (Table. 4.7).

Table 4.7 Distribution of sources of E-Waste as established by respondents

Sources	Very large quantities	Large quantities	Moderate	Little	None
Industries	20 (6.7%)	100 (33.3%)	115 (38.3%)	60 (20.02%)	5(1.7%)
Institutions	20 (6.7%)	75 (25.0%)	130 (43.3%)	75 (25.0%)	0
Shops and other commercial enterprises	100 (33.3%)	175(58.3%)	25(8.3%)	0	0
Private Sources (Individuals or Groups)	195(65.0%	75(25.0%)	30(10.0%)	0	0
Government sources	10 (3.3%)	30 (10.0%)	100 (33.3%)	110 (36.7%)	50 (16.7%)

Majority of the respondents (91.6%) said that shops and other commercial agencies had large quantities of e-waste. These include all the shops in Nairobi, city council collection from the city square and cybercafes from all over town. Another 90.0% noted that private sources (individual and groups) had very large quantities of e-waste. The components of this waste were mainly products from individual homes and hotels. Respondents who pointed at industries, institutions, the government sources and the airport as sources of e-waste were fewer. This shows that the main sources of e-waste are shops and private sources.

4.9. Ways of utilizing e-waste

There are positive and negative impacts of e-waste on the livelihoods of the people in Korogocho and Dandora informal settlement. Hence the researcher sought to know from the residents' way in which e-waste was utilized. The results are as shown in Fig 4.2 below.

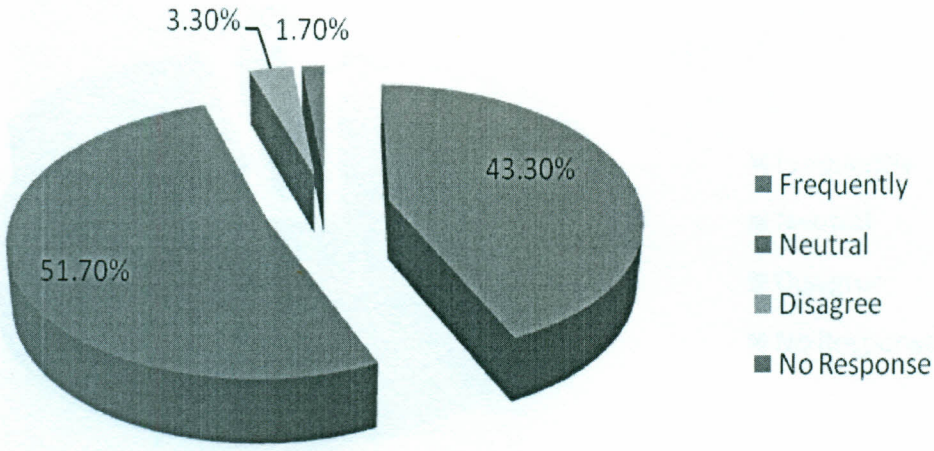

Figure 4.2: Wastage re-fabrication and sale

From the analysis it is evident that only 43.3% of the household heads prefer re-fabricating and selling the e-waste whereas only 3.3% disagreed with this option. More than one half (51.7%) remained neutral.

Re-fabrication and subsequent reuse in another option that the study sought to examine its use and the figure 4.3 below shows various responses.

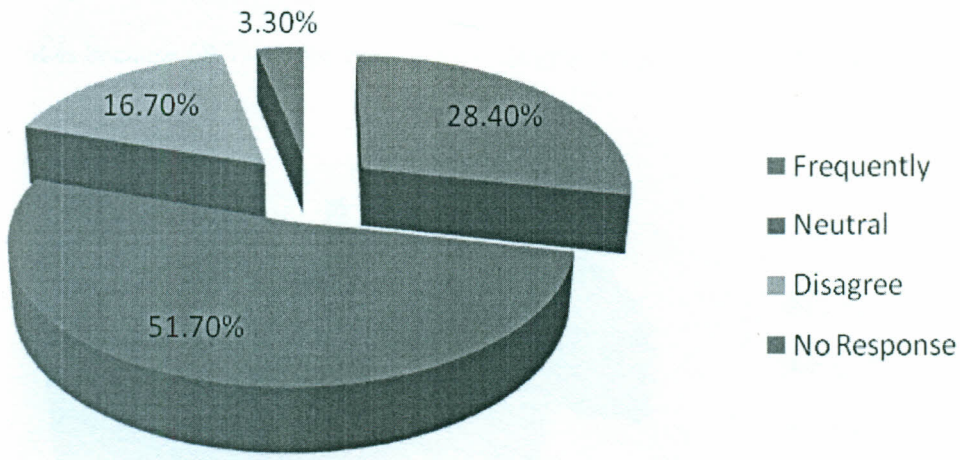

Figure 4.3: Respondents preferring re-fabrication and subsequent re-use

Only 28.4% used this option whereas 16.7% disagreed preferring this option. Many household heads (75%) frequently store their e-waste and sell whenever an opportunity arises and only 1.7% disagreed with this option (Fig. 4.4).

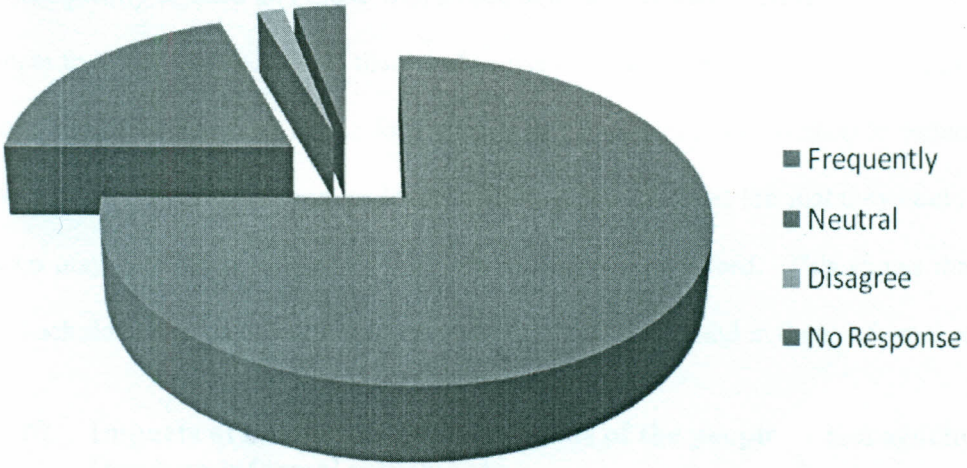

Figure 4.4: Respondents preferring storage and sale

The least frequent use was donating electronics to friends or/and relatives free of charge. This is because 68.3% of the respondents disagreed with this choice (Fig. 4.5).

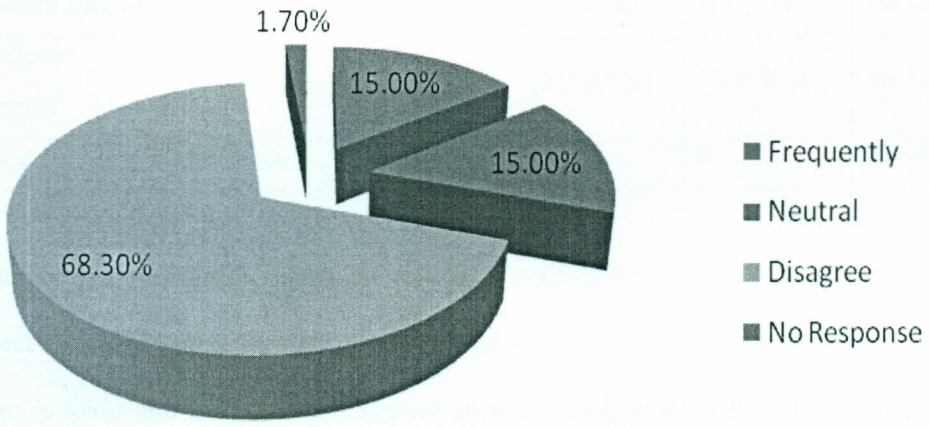

Figure 4.5: Respondents preferring donating used electronics

To support their views majority of them indicated that the e-waste was re-fabricated and sold to create jobs, generate income and to protect the environment. Others who re-fabricated and subsequently re-used and those who stored and sold wished to clean the environment, reuse them to avoid losses, recycle them and re-use them to reduce diseases and injuries. Those who indicated that they re-use for function of the original unit, wished to reduce pollution, secure their children and reduce losses and those who donated felt that they could help others who may have been in need of the same and could not afford. This shows that the entire household heads a reason for the use of e-waste that was found in their informal settlements.

4.10. Impacts of e-waste on the livelihoods of the people in Korogocho and Dandora informal settlements

The researcher enquired to know from the household heads the negative impact that e-waste has on the livelihood of the people. The results are as shown in Table 4.8.

Table 4.8: The impacts of the e-waste on the livelihoods of the people

Impact	Strongly agree	Agree	Neutral	Disagree	No Response
Disease spread	110(36.7%)	140(46.7%)	15(5.0%)	5(1.7%)	30(10.0%)
Toxicity impacts	50(16.7%)	120(40.0%)	85(28.3%)	15(5.0%)	30(10.0%)
None	10(3.3%)	5(1.7%)	0	0	285(95.0%)

It can be deduced from this table that household heads were aware that e-waste had an impact on their health through spread of diseases. Also they understand that this kind of waste is toxic and therefore can impact on their livelihoods if they come in contact. The researcher observes that the main dump site for Nairobi and its residents was Dandora dump site.

4.11. The response of the public administration officers in Korogocho and Dandora to the e-waste menace

Government administrators are empowered by clauses in some environmental laws to ensure effective enforcement. The Government of India's regulations on hazardous waste provide for the role of administrators in enforcement (Government of India, 2011). In a study that aimed at recommending the most appropriate method for solid waste management problem in Nairobi, Kasozi and Blottnitz (2010) suggest the application of firm command and control by the department in charge of environment at the City Council of Nairobi. The researcher sought from the household heads the responses of the public administration officers to e-waste disposal. The results are as shown in Table 4.9.

Table 4.9: Response of the public administration officers to e-waste disposal

Item	Agree	Neutral	Disagree	Strongly Disagree
Prevent disposal through ensuring fencing of dumping places	245(81.7%)	45(15.0%)	5(1.7%)	5(1.7%)
Conduct sensitization sessions with the community in various ways	105(35.0%)	65(21.7%)	125(41.7%)	5(1.7%)
Arrest and prosecution of law-breakers	170(56.7%)	65(21.7%)	20(6.7%)	5(1.7%)

Majority of the respondents (81.7%) agreed that the public administration officers prevent disposal of e-waste through ensuring fencing of dumping places and 56.7% of them said that they should arrest and prosecute law-breakers and 35.0% of them agreed that the public administration officers should conduct a sensitization session with the community in various ways.

4.12. Knowledge and skills on e-waste management regulations and policies

The study established that 35% agreed that they were aware of government laws and policies on e-waste. On the contrary 18.3% strongly disagreed having knowledge of this (Ttable 4.10).

Table 4.10: Knowledge and Skills about e-waste management legislation and policies

Project/programme	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	No response
Aware of government laws and policies about handling of e-waste	45(15.0%)	105(35.0%)	50(16.7%)	40(13.3%)	55(18.3%)	5(1.7%)
Local administrators provide guidance/information on how to handle and/or dispose e-waste	45(15.0%)	50(16.7%)	50(16.7%)	30(10.0%)	120(40.0%)	5(1.7%)
Government department(s) provide guidance on how to handle and/or dispose e-waste	0	10(3.3%)	65(21.7%)	65(21.7%)	155(51.7%)	5(1.7%)
Non-government agencies provide information on how to handle and/or dispose e-waste	45(15.0%)	50(16.7%)	50(16.7%)	30(10.0%)	120(40.0%)	5(1.7%)

According to the study, 40% were of the opinion that local administrators in this informal settlements do not provide guidance or information on how to handle and/or dispose e-waste. Similarly, 51.7% are of the opinion that government department(s) in Korogocho and Dandora do not provide guidance on how to handle and/or dispose e-waste. From the table

above, 40% of household strongly disagreed with the statement that Non-government agencies provide information on how to handle and/or dispose e-waste

4.13. Government department charged with enforcement of the policies and laws on waste management

Several government agencies are either directly or indirectly charge with the responsibility of enforcing environmental policies and statutes. According to the responses, 33.3% identified NEMA as sole institution charged with dealing with e-waste. Public Health Department at the City Council of Nairobi and to a small extent the Ministry in charge of Health and Sanitation were observed to be in charge of e-waste issues. Communication Commission of Kenya (CCK) plays a crucial role (Table 4.11).

Table 4.11: Institutions charged with e-waste management

Institution	Frequency	Percent
National Environment Management Authority (NEMA)	100	33.3
Public Health Department	5	1.7
Communication Commission of Kenya	5	1.7
All the above institutions	15	5.0
None of the above	65	21.7
NEMA, Public Health Department	50	16.7
NEMA, Public Health Department, CCK	35	11.7
NEMA, None of the above	5	1.7
No Response	20	6.7
Total	**300**	**100.0**

Considerable percentage (21.7) did not associate any government institution with e-waste management and this is a pointer to lack of visibility for this institution in enforcing e-waste legislations.

4.14. Source of knowledge on handling and/or disposal of e- waste

The respondents were provided with a list of possible sources of information on e-waste. The study found out that 31.7% of respondents obtain their skill and learn about e-waste over the Radio while 20.0% get such knowledge through Television. A combination of print media and Television or print media, radio and others was each category selected by 1.7% (Fig. 4.5).

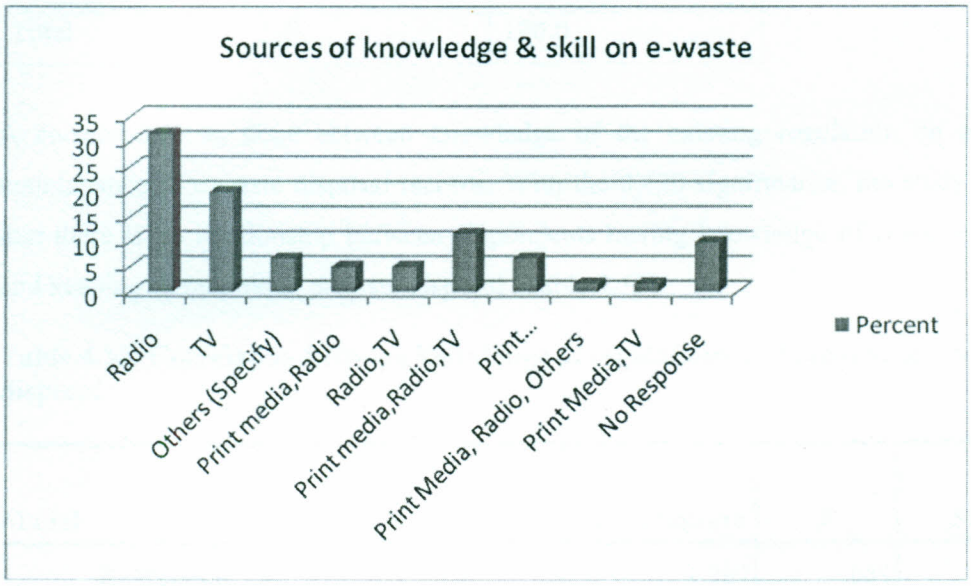

Figure 4.5: Sources of Knowledge and skills on e-waste in Korogocho and Dandora

4.15. Records of e-waste materials disposal

Keeping an inventory of e-waste is essential in understanding proper ways of handling e-waste. It gives an opportunity to understand the nature of waste as well as identify acceptable ways of management. From this study it was established that 73.3% did not keep any records of e-waste they generate and only 13.3% rarely keeps such records (Table 4.12).

Table 4.12: Inventory of e-waste

Options	Frequency	Percent
Sometimes	25	8.3
Rarely	40	13.3
Not at all	220	73.3
No Response	15	5.0
Total	300	100.0

A correlation was done between knowledge of the existing regulation on e-waste and maintenance of e-waste disposal records. With the 0.420 significance, the study established that there is no relationship between respondents having knowledge of e-waste regulations and keeping of records of e-waste disposal (Table 4.13).

Table 4.13: Correlation between knowledge of regulations and records of e-waste disposal

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.261	1	1.261	.651	.420[a]
	Residual	575.294	297	1.937		
	Total	576.555	298			

Even those who have knowledge of e-waste did not bother to keep record of e-waste disposal

A correlation was also done between awareness of government regulations and disposal means. From Table 4.14, it can be deduced that there is no correlation between respondent's awareness of government laws and policies about handling of e-waste and disposal of the same. Further the study sought to find correlation between awareness of government regulations and preferred disposal means. The results are shown in the table below.

Table 4.14: Correlation between awareness of government regulations and disposal means

Correlations								
Control Variables			**Government department charged with enforcement of the policies and laws on waste management**	**Re-fabrication and sale**	**Re - fabrication subsequent re – use**	**Storage and sale**	**Re - use for the function of the original unit**	**Donate used electronics to friends or/and relatives free of charge**
Whether aware of governments laws and policies about handling of e- waste	The govt. department charged with enforcement of the policies and laws on waste management	Correl.	1.000	-.137	-.160	.096	.042	.091
		Signif. (2-tailed)	.	.018	.006	.100	.475	.118
		df	0	296	296	296	296	296
	Re-fabrication and sale	Correl.	-.137	1.000	.678	.034	.256	.267
		Signif. (2-tailed)	.018	.	.000	.556	.000	.000
		df	296	0	296	296	296	296
	Re - fabrication subsequent re - use	Correl.	-.160	.678	1.000	.101	.005	.114
		Signif. (2-tailed)	.006	.000	.	.081	.926	.050
		df	296	296	0	296	296	296

Correlations								
Control Variables			**Government department charged with enforcement of the policies and laws on waste management**	**Re-fabrication and sale**	**Re - fabrication subsequent re – use**	**Storage and sale**	**Re - use for the function of the original unit**	**Donate used electronics to friends or/and relatives free of charge**
	Storage and sale	Correl.	.096	.034	.101	1.000	.372	.226
		Signif. (2-tailed)	.100	.556	.081	.	.000	.000
		df	296	296	296	0	296	296
	Re - use for the function of the original unit	Correl.	.042	.256	.005	.372	1.000	.369
		Signif.(2-tailed)	.475	.000	.926	.000	.	.000
		df	296	296	296	296	0	296
	Donate used electronics to friends or/and relatives free of charge	Correl.	.091	.267	.114	.226	.369	1.000
		Signif. (2-tailed)	.118	.000	.050	.000	.000	.
		df	296	296	296	296	296	0

The respondents discard their e-waste irrespective of knowledge of government laws and policies and therefore points to lack of enforcement of the regulations.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The study makes the following conclusions:

Shops and other commercial agencies are the main sources of e-waste that is found within households in Korogocho and Dandora informal settlements. Most of these are shops that located within the city council municipal waste collection routes. Private sources (individual and groups) are also significant sources of e-waste. These include individual homes and hotels.

A significant proportion of the community in the informal settlements store and involve themselves in re-sale of e-waste. There are dealers who buy e-waste from the community and either re-fabricate secondary products for subsequent re-use or resale to large scale dealers without re-fabrication.

It is evident that there is significant level of awareness among households and community members about the impacts of e-waste on their health. However, the level of awareness is not in tandem with the improper ways in which they dispose their waste.

Fencing of dumping places and, arresting and prosecution of law-breakers are popular options for enforcement of e-waste regulations, policies and laws. Sensitization methods are not popular among the law enforcement officers.

5.2. Recommendations

The study recommends:

i. Shops and other commercial enterprises should put in place measures for effective collection and management of e-waste. Proper separation mechanisms should be implemented to prevent such waste from reaching households. Private individuals and groups that generate e-waste should similarly use effective management strategies.

ii. Public awareness and education about hazards involved in storage and sale of e-waste should be enhanced. The same should target households and other main stakeholders who use e-waste for re-fabrication and, subsequent re-use and sale.

iii. The level of awareness among households and community members about the impacts of e-waste on their health should be enhanced. This should particularly cover the potential for disease spread and toxicity.

iv. Public administration officers in informal settlement areas should be able to embrace all the available procedures to enforce environmental management regulations, policies and laws relating to e-waste. These should include prevention of disposal through ensuring fencing of dumping places, promotion of sensitization sessions with the communities and, arresting and prosecution of law-breakers.

5.3. Suggestions for interventions and further work

The study makes the following suggestions:

i. A sanitary landfill should be established to ensure effective management of all types of waste in the informal settlements

ii. Awareness and training on waste management and recycling should be enhanced

iii. Safe e-waste to be recycling initiatives should be supported and promoted

iv. The local area administration, particularly the City Council should step up management efforts for e-waste by ensure fencing off the dumping site and ensuring cleanliness to avoid scavenging and spread of diseases.

v. Initiatives targeting job-creation in e-waste sector should be explored

vi. Promotion of waste separation at source should be pursued

vii. E - waste issues should be studied at all levels of schooling – primary to tertiary institutions.

viii. Community initiatives, especially those involving youth can offer avenues for interventions on e-waste issues.

BIBLIOGRAPHY

Afullo, Augustine & Odhiambo, Frank (2009). *The Primary Solid Waste Storage Gaps Experienced by Nairobi Households*. Ethiopian Journal of Environmental Studies and Management Vol.2 No.3 2009, Africa Journals Online. www.ajol.info/index.php/ejesm/article/download/.../34626. Accessed on 8.01.2013

Arora, J. and GTZ-ASEM (2008). *E-Waste Management.* Open Guide, UK.

Bartlett, J. E., Kotrlik, J.W and Higgins, C.C. (2001). *Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning, and Performance Journal*, 19(1), pp43-pp50. Retrieved from http://www.osra.org

Browne, F. X., and T. J. Grizzard (1979).*Water Pollution, Non Point Sources* Virginia Polytechnic Institute and State, Vol. 51 No. 6 University Manassas, Virginia. *Journal (Water Pollution Control Federation)* 1979, Water Environment Federation

California Integrated Waste Management Board (2004). *Best Management Practices For Electronic Waste, April 2004*. Produced for Santa Clara County Department of Environmental health San Jose.

Casaes, Diego (2009). *Brazil: Fighting for more recycling with the Electronic Waste Manifesto.* Accessed online on 11.01.2013.

Chung, S. & R. Murakami-Suzuki (2008). *A Comparative Study of E-waste Recycling Systems in Japan, South Korea and Taiwan from the EPR Perspective: Implications for Developing Countries* in: Michikazau Kojima ed., promoting 3Rs in Developing Countries: Lessons from the Japanese Experience, Chiba, IDE JETRO, 2008

Comboni Missionaries (2008). *Presentation of Korogocho slum. Korogocho.org, Comboni Missionaries.* 8 January 2008.

Communication Commission of Kenya (CCK), GoK (2010).ICT Sector Regulations Review. Government Printer, Nairobi

Daily Nation (2006a) Korogocho. BEGA KWA BEGA Development project. Accessed 2009-06-02

Daily Nation (2006b). Grave danger in dump-sites. Editorials Publication Date:11/27/2006

De Oliveira C.R., Bernardes A.M. & Gerbase, A.E. (2012).Collection and recycling of electronic scrap: a worldwide overview and comparison with the Brazilian situation, Journal of Waste Management, Volume 32, Issue 8, August 2012, Pages 1592– 1610

DIT, India (2003). *Environmental management for Information Technology industry in India,* Department of Information Technology (DIT), Government of India, p.122-124.

Enanoria, W. (2007). *Sample Size Estimation.* Retrieved from http://webcast.idready.org, Accessed on 9.01.2013

Environmental Studies, Anna University, Chennai, India. Proceedings Sardinia (2007). *Eleventh International Waste Management and Landfill Symposium*, S. Margherita Di Pula, Cagliari, Italy; 1 - 5 October 2007. By CISA, Environmental Sanitary Engineering Centre, Italy

Fontana, D. & Frey, S. (1994). *The Research Process,* UK
Government of India (2011). *Ministry of Environment and Forests Notification*, 14th May 2011, New Delhi.

GoK (2010). *Management of Electronic Waste*, by Samuel Munene, National Environment Management Authority (NEMA, Kenya). Proceedings of a Seminar on E-waste management in Kenya . Masinde Muliro University of Science & Technology in Kakamega, Kenya, February, 2010.

Government of Kenya (2011). *Kenya, Statistical Survey.* Ministry of Planning. Government Printer, Nairobi, Kenya

GoK (2006). *National Information & Communications Technology (ICT) Policy,* Ministry of Information and Communication. Government Printer, Nairobi.

Government of Kenya (1962) *Public Health Act.* Government Printer, Nairobi, Kenya

Hwang, H.M., E.K., Park, T.M. Young, B.D. Hammock (2008). *Occurrence of endocrine-disrupting chemicals in indoor dust.* Sci Total Environ 404: 26–35.
Jing Wang, Mi Tian, Chen, Zheng, Luo, Tai-Cheng An & Mai (2011). *Dechlorane Plus in house dust from E-waste recycling and urban areas in South China: Sources,*

degradation, and human exposure. Environ. Toxicol. Chem. 2011;30:1965–1972. © 2011 SETAC, Volume 30, Issue 9, pages 1965–1972, September 2011

K'Akumu, O.A. and W.H.A. Olima (2006). *The dynamics and implications of residential segregation in Nairobi*. School of the Built Environment, University of Nairobi, Kenya. Elsevier, Habitat International 31 (2007) 87–99

Kaseva, M.E., & Mbuligwe, S.E. (2005). *Appraisal of solid waste collection following private sector involvement in Dar es Salaam.* Habitat International 29,

Kasozi, A. & H. V. Blottnitz (2010). *Solid Waste Management in Nairobi: A Situation Analysis Technical Document accompanying the Integrated Solid Waste Management Plan*. Prepared for CCN, Supported by UNEP.

Kombo, D. K. & Tromp, D. L .A. (2006). *Proposal and Research project Writing, An Introduction*. Paulines Publications Africa, Nairobi, Kenya.

Kothari (2003). *Research Methodology*. Prentice Hall, India

Kurian, J. (2007). *Electronic Waste Management in India*–Issues and Strategies Centre

Kenya ICT Action Network (KICTANet) (2008). *E-waste Management in Kenya: A baseline study*

Leung, A., Zong Wei Cai, Ming Hung Wong (2006). *Environmental contamination from electronic waste recycling at Guiyu, Southeast China.* Journal of Material Cycles and Waste Management, March 2006, Volume 8, Issue 1, pp 21-33. Retrieved on 21st March 2013 at http://dx.doi.org/10.1007/s10163-006-0002-y.

Lioy, P. J., N. C.G.Freeman, J.R. Millette (2002). Dust: A metric for use in residential and building exposure assessment and source characterization. Environ Health Perspect 110: 969–983.

Morgan, W. T. W. (1967). *Nairobi City and Region*. Nairobi: Oxford University Press.

Mugenda, A. G. (2008). *Social Science Research, Nairobi*. Applied Research and Training Services, 2008.

Munyua, A. W. (2010). *ICTs and Environmental Sustainability.* Published for Kenya ICT Action Network (KICTANet)

Mureithi, M., T. Waema, A. Wanjira, A. Finlay & M. Schluep (2008). *E-Waste in Kenya. Baseline Assessment*. Proceedings of the 19th Waste Management Conference (IWMSA (Wastecon 2008), Durban, S. Africa

Mutuku Mulatya, D. (2011). *Nairobi Household Solid Waste Management Practices: Need for Re-Strategizing.* An MSc Research project, Jomo Kenyatta University of Agriculture and Technology

Ngau, P. M. (1995). *Informal settlements in Nairobi: A baseline survey of slums and informal settlements and inventory of NGOs and CBO activities*. Technical Report No. 2.

Oberlin, A.S. (2011). *The Role of Households in Solid Waste Management in East Africa Capital Cities.* PhD Research project. Environmental Policy Series. Wageningen University. The Netherlands, In: Okot-Okumu, J. (2012). Solid Waste Management in African Cities – East Africa, *Department of Environmental Management; School of Forestry Environmental and Geographical Sciences; College of Agricultural and Environmental Sciences; Makerere University Kampala, Uganda. Accessed from* http://dx.doi.org/10.5772/50241 on 23rd March 2013

Okot-Okumu, J. (2012). Solid Waste Management in African Cities – East Africa, *Department of Environmental Management; School of Forestry Environmental and Geographical Sciences; College of Agricultural and Environmental Sciences; Makerere University Kampala, Uganda. Accessed from http*://dx.doi.org/10.5772/50241 on 23rd March 2013

Okot-Okumu, J., & Nyenje. R.(2011). "Municipal solid waste management under decentralisation in Uganda." Habitat International 35

Olima, W. H. A. (1998). *Informal tenure and environmental services*. A paper presented at 10th ITN Africa conference, KCCT Conference Centre, Mbagathi, 30th November–3rd December.

Omuterema S. (2004). *Levels of Heavy Metals in Municipal Solid Waste in Nairobi City.* National Council of Science & Technology Project Reports.

Omuterema S., G. Waswa and M. Masibo (2008). *Identification of Municipal Disposal Site for Kakamega Municipality. Journal of Science, Technology, Education & Management*, Masinde Muliro University of Science & Technology, Kakamega, Vol.2.No. 2, 56 - 61

Otieno, J. (2006). *UNEP cautions over electronic waste dumping.* Daily Nation. Article by Otieno, Jeff. Nation Publishers 11/27/2006

Palczynski, J. R. (2002). *Study on Solid Waste Management Options for Africa.* African Development Bank.

Radha, G. (2002). *'A Study of the Performance of the Indian IT Sector'* at www.nautilus.org accessed on 21st June 2005.

Ramachandra T.V. and Saira V. K. (2004). *Environmentally Sound Options For E-Wastes Management.* Energy and Wetlands Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore. Envis Journal of Human Settlements, March 2004.

Raosoft Inc. (2004). *Sample Size Calculator.* Retrieved from http://www.raosoft.com
Royal Media Services (2012). *E-waste fears in Kenya as regulator switches off over 3 million fake phones.* Citizen online, Thursday October 11, 2012

Savage, M. (ed.) (2006). *Implementation of the Waste Electric and Electronic Equipment Directive in the EU 25, Technical Report Series,* Ref: EUR 22231 EN. http://www.jrc.es/publications/pub.cfm?id=1408 (21/04/08)

Sawhney, P., M. Henzler, S. Melnitzky, A. Lung (2008). *Best practices for E-waste Management in Developed Countries.* Adelphi Research, UK

Scheinberg A. (2011). Value *Added: Modes of Sustainable recycling in the Modernisation of waste Management Systems.* PhD Research project. Wageningen University. The Netherlands.

Schluep, M. (EMPA)(2010). *E-Waste Management in Developing Countries – with a focus on Africa.* ITU Symposium on ICTs and the Environment & Climate Change, Cairo, 2-3 November 2010

Shivoga, W. (Ed.)(2010) *E-waste: Impacts, Challenges and the Role of Government, Service Providers and the Consumers Workshop. Communication Commission of Kenya*, Nairobi, Kenya

Streicher-Porte, Martin (2009) *Swiss State Secretariat for Economic Affairs (SECO) Diagnosis of Waste Electric and Electronic Equipment Generation in the State of Minas Gerais, Brazil*

Supriyadi, S., Kriwoken, L.K., & Birley, I., (2000). *Solid waste management solutions for Semarang, Indonesia.* Waste Manage Res 18: 557-566, Terazono, Atsushi, Shinsuke Murakami, Naoya Abe Bulent Inanc, Yuichi Moriguchi, Shin-ichi Sakai Michikazu Kojima, Aya Yoshida, Jinhui Li, Jianxin Yang, Ming H. Wong, Amit Jain, In-Suk Kim, Genandrialine L. Peralta, Chun-Chao, Lin Thumrongrut Mungcharoen, Eric Williams (2006). *Current status and research on E-waste issues in Asia. E-Waste Research Journal.* Springer-Verlag. J Mater Cycles Waste Management, 8:1–12

Trochim, W. M. K. and D. A. Land (1982). *"Designing designs for research." The Researcher*, 1(1), pp. 1-6

UNDP, UNCHS, World Bank & SDC (1996). *Waste Management*, New York

UNEP (2009). *E-Waste. Press Release.* www.unep.org/PDF/PressReleases/E-Waste_publication_screen_Final Version.

United Nations Environment Programme & United Nations University (2009). *Recycling – From E-Waste to Resources, Final Report,* http://www.unep.org/PDF/PressReleases/E-Waste_publication_screen_Finalversion-sml.pdf

Vidanaarachchi, C.K., Yuen, S.T.S., & Pilapitiya, S. (2006). *Municipal solid waste Management in the southern province of Sri Lanka: Problems, issues and challenges.* Waste Management 26

Waema, T. & M. Mureithi (2008). *E-waste Management in Kenya. Baseline survey report*, Nairobi, Kenya

White S., H. Rodney & F. Jones.(1996). *Approaches in Integrated Solid Waste Management*, London, UK.

Widmer R, Heidi Oswald-Krapf , Deepali Sinha-Khetriwal, Max Schnellmann, Heinz Bo¨ni (2005). *Waste Components.* Global Inst.

APPENDICES

APPENDIX A1: INTERVIEW GUIDE

Interview Guide for Households

Please fill in the following spaces

Household No.....

Section A: Personal Information

1. Gender Male ☐ Female ☐

2. What is your age? Under 12 years ☐ 12 – 20 years ☐ over 20 years ☐

3. Are you the head of the household? Yes ☐ No ☐

4. What is your highest level of education?

Post graduate/Graduate and above	
Certificate/Diploma	
Secondary Education	
Primary Education	
Not gone to school	

5. How long have you been living in this community?

Less than six months	
Less than one year	
Less than three years	
Less than five years	
Less than seven years	
Seven years and more	

6. Which of these electronic appliances/devices have your household owned in the last three years?

Television (TV)	
Radio	
Mobile Phone	
Computer/Laptop	

7. Which of the e-appliances owned by the household in the last three years are spoilt and are no longer in use?

Television (TV)	
Radio	
Mobile Phone	
Computer/Laptop	

8. What qualifications do you have in E-waste management?

Certificate training after schooling	
Short training/seminar(s)	
None	

Please specify if yes.....

Section B: Sources of e-waste

S.No.	Item	V. large quantities	Large	Moderate	Little	None
9	E-waste comes from industries					
	If yes, name of industries.....					
10	E-waste comes from institutions					
	If yes, name of institutions.....					
11	E-waste comes from shops and					

	other commercial enterprises					
	If yes, name of enterprises.....					
12	E-waste comes from private sources (individuals or groups)					
	If yes, details of the individuals and/or groups					
13	E-waste comes from government sources					
	If yes, details of the government sources.....					
14	Other sources:					
Ways in which the e-waste is utilized						
S.No.	**Item/Frequency**	**Very frequently**	**Frequently**	**Neutral**	**Disagree**	
15	Re-fabrication and sale					
16	Re-fabrication and subsequent re-use					
17	Storage and sale					
18	Re-use for the function of the original unit					
19	I/we donate used electronics to friends or/and relatives free of					

	charge				
20	Other uses.....				

Please give reasons for your answer in rows above

.....

The impacts of the e-waste on the livelihoods of the people

S.No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
21	Health – disease spread					
22	Health - Toxicity impacts					
23	None					
24	Other (specify)					

The response of the public administration officers to e-waste disposal (answer appropriate questions)

S. No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
22	Prevent disposal through ensuring fencing of dumping places					
23	Conduct sensitization sessions with the community in various ways					
24	Arrest and prosecution of law-breakers					
25	Other (specify)					

Section C: Knowledge and Skills about E-Waste Management Regulations and Policies

S.No.	Project/programme	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
35	I am aware of government laws and policies about handling of e-waste					
36	Local administrators in your locality provide guidance/information on how to handle and/or dispose e-waste					
37	Government department(s) in the locality provide guidance on how to handle and/or dispose e-waste					
38	Non-government agencies provide information on how to handle and/or dispose e-waste					

39. The government laws and policies deal with:

Safe use of e-appliances only	
Possible re-use of resources including e-appliances only	
Safe disposal of e-waste/e-appliances only	
Safe use of e-appliances, possible re-use of the appliances including their parts and their safe disposal	

40. Which government department is charged with enforcement of the policies and laws on waste management?

National Environment Management Authority (NEMA)	
Public Health Department	

Communication Commission of Kenya	
All the above institutions	
None of the above	

41. A major source of my knowledge about handling and/or disposal of e-waste is

Print media	
Radio	
TV	
Others (Specify)	

42. I keep records of e-waste materials disposal

At all times	
Sometimes	
Rarely	
Not at all	

43. Any other observation.....
.....
.....
.....

Thank you

APPENDIX A2(II): INTERVIEW GUIDE FOR E-WASTE DEALERS, RECYCLERS AND MANUFACTURERS

Tick appropriate category

E-waste dealer ☐

E-waste recycler ☐

E-waste industries/manufacturers ☐

Please fill/tick the following spaces

Section A: Personal Information

1. Gender Male☐ Female☐

2. What is your age? Under 12 years ☐ 12 – 20 years ☐ over 20 years ☐

3. Are you the owner of the business? Yes ☐ No ☐

4. What is your highest level of education?

Post graduate/Graduate and above	
Certificate/Diploma	
Secondary Education	
Primary Education	
Not gone to school	

5. How long have you lived in this community?

Less than six months	
Less than one year	
Less than three years	
Less than five years	
Less than seven years	
Seven years and more	

Section B Electronic waste information

6. Which of these electronic appliances/devices have you owned in the last three years?

Television (TV)	
Radio	
Mobile Phone	
Computer/Laptop	
Other (specify)	

7. Which of the e-appliances owned by you in the last three years are spoilt and are no longer in use?

Television (TV)	
Radio	
Mobile Phone	
Computer/Laptop	
Other (specify)	

8. The electronic appliance waste dealt with

Equipment/Frequency	Mostly	Sometimes	Rarely	Not at all
Television (TV)				
Radio				
Mobile phone				
Computer/Laptop				

9. What training/qualifications do you have in E-waste management?

Certificate training after schooling	
Short training/seminar(s)	
None	

Please specify if yes.....

10. Where do you obtain the e-waste materials?

Within the local residence/area	
Both within and outside the local settlement area	

Main supplies of the e-waste materials

S. No.	Item/Frequency	At all times	Sometimes	Rarely	Not at all
11	Obtain the e-materials from household sources				
12	Obtain the e-materials from other e-waste dealers				
	Item/Frequency	**At all times**	**Sometimes**	**Rarely**	**Not at all**
13	Obtain the e-materials from industries				

Storage of e-waste materials

S. No.	Item/Frequency	At all times	Sometimes	Rarely	Not at all
14	I store in a room that is meant to store for e-waste only				
15	I store together with other items/non-e-waste materials in a room				
16	I store the e-materials in the working room/workshop				

Handling

S. No.	Item/Frequency	At all times	Sometimes	Rarely	Not at all
17	I use Personal Protective Equipment (PPE) while handling e-materials under my care				
18	I collaborate with other dealers, recyclers or manufacturers in dealing with e-materials				
19	I keep records of the e-waste management activities under my jurisdiction				

Thank you

APPENDIX A2(III): GUIDE FOR GOVERNMENT WASTE POLICY INSTITUTIONS

Local Administration, NEMA, Ministry of Communication, Ministry in charge of Public Health and Medical Services, City Council of Nairobi

Specify the type of institution:

Please fill the following spaces

Section A: Personal Information

1. Gender Male □ Female □

2. What is your age? 12 – 20 years □ over 20 years □

3. What is your highest level of education?

Post graduate/Graduate and above	
Certificate/Diploma	
Secondary Education	
Primary Education	
Not gone to school	

4. What qualifications do you have in E-waste management?

Certificate training after schooling	
Short training/seminar(s)	
None	

Section B: Institutional Framework

Existence of laws

Specific laws are required for addressing issues related to the handling of e-waste-waste minimization, re-use, material recovery and landfilling

S.No.	Item/Choice	Agree	Not sure	Disagree
5	There are specific laws or/and policies that address production of e-waste materials			

If sure, cite the law(s).....

S. No.	Item/Choice	Agree	Not sure	Disagree
6	There are specific laws or/and policies that address the use of e-waste materials			
7	There are specific laws or/and policies that address the management of e-waste materials			
9	Standards have been established for the implementation of e-waste-related laws.			
10	Infrastructure has been established for the implementation of e-waste-related laws			
11	There are regulations requiring the development short, medium and long-term policies on e-waste management			
12	There is technical capacity to develop short, medium and long-term policies on e-waste management			
13	There is economic capacity to develop			

	short, medium and long-term policies on e-waste management			
14	There is financial capacity to develop short, medium and long-term policies on e-waste management			
15	There is adequate capacity to disseminate information about available e-waste management options sources and the impacts of alternative management options.			

If you strongly agree for 1st and 2nd rows above, cite these law(s).....

16. Cite the weaknesses in operationalizing the legal instrument in 10 above

.....
.....

17. What is the institutional framework for addressing issues related to the handling of e-waste?

.....

18. Cite the weaknesses in operationalizing the institutional instrument in 12 above

.....
.....

Health impacts

19. What are the health impacts of the e-wastes within the community?

.....
.....
.....

20. How is the government addressing the potential health hazards.....

.....

.....

21. Suggest ways of strengthening the legal and institutional frameworks for better overall management and safety

.....

.....

Section C: Response of the public administration officers to e-waste disposal

S.No.	Item	Agree	Neutral	Disagree	Strongly Disagree
22	Prevent disposal through ensuring fencing of dumping places				
23	Conduct sensitization sessions with the community in various ways				
24	Arrest and prosecution of law-breakers				

25. Any other comment on administrative management of e-waste in the informal settlements.....

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Thank you