E-WASTE DISPOSAL IN KENYA – A CASE OF MOBILE PHONE WASTE DISPOSAL IN LANG'ATA AREA, NAIROBI, KENYA

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Reg. No. C50/64981/2011

A project report submitted in partial fulfilment of the requirements for the Award of the Degree of Master of Arts in Environmental Planning and Management (EPM) of the Department of Geography & Environmental Studies, University of Nairobi, Kenya.

2015

DECLARATION

This project report is my original work and has not been presented for examination in any other university.

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DEDICATION

Jojo Mugele, my beloved brother, out of thee shall come forth greatness.

ACKNOWLEDGEMENTS

Dr. Francis Mwaura, and Dr. John Nyangaga, if anyone ever needed to buy patience, they would only need to come into your hearts, and get it for free. One on the left, the other on the right, thank you for holding my hands to the tunnel's end. Here's the light! Then to my other *pseudo*-supervisors, the many lecturers who permitted me their time for many questions whenever I knocked at their office doors or stopped them along the corridors.

Anne Khisa and Linda Chaba, you are the PhD in the making. You directed my steps, and sometimes literally took them. One on the left, the other on the right, you held my hands and said, 'This is the way, take it!' Then followed me!

Ronnie Trevor, my sweet little brother. You always say it shall rain. I see the clouds your way. May it pour!

My uncle Dr. Gabriel Akura, you have inspired me by your works and by believing in me. Thank you for pushing me. Let's do that PhD! Ms. Christine Msemburi, if every worker had a boss like you, our minds would be littered with knowledge. Darleen, does every researcher find such support for field work? You offered me your car… and fuelled it. May your tank never run dry. Faith you painstakingly encouraged me, where would I have found such inspiration? And Lydia, you marvelled at each of my milestones, oiling my engine. The students who took me out to the field, the friends and colleagues who spared their resources and time for me, my relatives and neighbours; even if you all shared one name, it would never fit in one page. Neither would the simple words of my gratitude.

The most influential women of my life, my Mummy Liza and my sister Belinda. Whenever I close my eyes, and shut my ears to the world, it is never difficult to see your position among the angels. And when the applause fades, two voices live on and are the last ones to go down. I shall always love you.

To God the Father, the Son, and the Holy Spirit; can a pot stand up to the Potter? I have no words to describe what I feel for You. Your Word is enough!

Acronyms/Abbreviations

3R	Reduce, Reuse and Recycle
4R	Reduce, Reuse, Recycle and Recover
ATF	Authorized Treatment Facility
CA	Communications Authority of Kenya
CBD	Central Business District
CSR	Corporate Social Responsibility
DCF	Designated Collection Facility
EARC	East African Compliant Recycling
EEE	Electrical and Electrical Equipment
EMCA	Environmental Management and Co-ordination Act
EOL	End of Life
EPR	Extended Producer Responsibility
ETBC	Electronics TakeBack Coalition
EU	European Union
ICT	Information and Communication Technology
IT	Information Technology
LCD	Liquid Crystal Display
NEMA	National Environmental Management Authority
OECD	Organization of Economic and Cooperative Development
PCB	Printed Circuit Board
RoHS	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment"
SBC	Secretariat for Basel Convention
UNCTAD	UN Conference on Trade and Development
UNEP	United Nations Environment Program
US/USA	United States of America
WEEE	Waste Electrical and Electronic Equipment

ABSTRACT

There has been increased production and use of mobile phones globally, and in the African continent where they have been referred to as 'The New Talking Drums of Africa'. It is predicted that 90% of individuals aged 6 years and above will own a mobile phone by 2020. Meanwhile, Kenya has witnessed exponential growth in the use of these 'Talking Drums', with the Communications Authority of Kenya (CA) reporting that the number of users had surpassed the 31 million mark by mid-2014, against a population of just over 40 million. The advancement of cellular technology has increased the rate of acquisition and replacements of mobile phones and related devices as consumers adapt to the new revelations. The increased use of electrical and electronic equipment (EEE) has led to increased generation of wastes electric and electronic equipment (WEEE) with dead mobile phones and accessories adding to the growing pile.

This study sought to establish the practise of e-waste disposal among consumers in Kenya by establishing the following: sources of mobile phone wastes among urban consumers, modes of disposal of e-wastes from mobile phones, awareness of safe measures and laws on e-waste disposal as well as the factors influencing mobile phones electronic waste production and management in Kenya. It focused on Lang'ata Area of Kenya's capital, Nairobi, targeting consumers across the different socio-economic classes. The study employed a descriptive survey research design and obtained qualitative and quantitative data by use of a questionnaire administered to 385 respondents sampled using the estimating proportions method. The study established that there was no defined mode of electronic waste disposal and there existed low levels of e-waste disposal among consumers who mainly preferred to 'give out' or hoard their waste mobile phones as opposed to recycling. Over 90% of the consumers expressed lack of awareness on the initiatives and laws on e-waste recycling. Left unattended, the future impact of electronic wastes may be dire, with adverse health and environmental implications. This study thus recommends promotion of recycling, introduction of extended producer responsibility and other legislation, and public-private partnerships as some of the initiatives in support of better electronic wastes management in Kenya.

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CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

The Ericson Mobility Report (2014) shows that the number of mobile phones sold globally continued to rise with the number of mobile subscriptions worldwide growing by about 6% every year, and 1.6% each quarter. As at the third quarter of 2014, there were 6.9 billion mobile phone subscriptions globally. It is estimated that by 2020, 90% of the world's population over 6 years old will own a mobile phone. Meanwhile, the manufacturers continue to roll out new technologies and new smart phones to the insatiable demand of the global population. The Mobility reports state that the smart phones accounted for 65 – 70 % of all the phones sold in the third quarter of 2014.

The global phone penetration is at a whopping 95%, with Central and Eastern Europe topping at 145%, followed by Western Europe (127%), Latin America (115%), Middle East (109%), APAC (excluding China and India) (106%), North America (104%), China (91%), Africa (77%), and India (64%).

Kenya has witnessed exponential growth in the use of these 'Talking Drums', with the Communications Authority of Kenya (CA) reporting a mobile penetration of 80.5% as at September 2014, growing from 79.2% in June 2014. The reported rate was higher than the African average of 77% that was reported by the Mobility Report for the third quarter of 2014. The number of mobile phone users in Kenya reached 32.8 million as at end of September 2014 compared to 32.2 million in June 2014 (CA, 2015)[1].

Mobile phone wastes have increased with the measure that mobile phones have been produced and owned by various consumers, globally, continentally, and nationally – in

[1] Communications Authority of Kenya, 4th Quarter Statistics Report for 2014.

Kenya. New and improved electronics and advanced models (cellular phone and personal computers) are coming out in the market everyday making the older models technically and technologically obsolete and less satisfying to consumers thereby contributing to potential electronic waste stream (Carisma, 2009).

It is imperative that there is an understanding of the process of production of wastes from mobile phones and their accessories. Suffice to note that the consumers play a key role in waste generation as they are the users of these phones, and so are the mobile phone technicians and/or repairers who may produce these wastes in their works. This study, however, focused on the consumers and their patterns in the electronic waste management. It sought to comprehend how these wastes are disposed of and their rate of disposal Moreover, it also confirmed if these wastes were linked to the turnaround time of mobile phone ownership by individuals. Questions also abound if consumers were aware of any laws governing electronic waste management, particularly of electronic waste.

It is also important that the type of wastes and risks associated with these wastes, if any, be understood. Some of the mineral components used in the making of mobile phones include arsenic, copper, gallium, gold, indium, niobium, magnesium compounds, palladium, platinum and silver. Some of these components are toxic heavy metals, for example, cadmium, which is used in the manufacture of mobile phone batteries, mount devise chip resisters and infra-red detectors. The heavy metals if ingested or gain entry into human body can bioaccumulate, and pose a risk of irreversible effects on human health' (Babu *et al*., 2006). The same author noted that lead, which is mainly used in circuit boards, may cause damage to the nervous system while mercury contributes to brain damage.

As a result of the rapid and remarkable growth, e-waste or discarded electronic equipment is regarded as the fastest growing waste stream in the industrialized world. E-waste is a crisis born not only out of quantity generated but also from the cocktail of toxic ingredients. Substances such as lead, beryllium, flame retardants found in e-waste pose as both occupational and environmental health threat (Puckett *et al*, 2002). The Lang'ata Area of

Kenya's capital, Nairobi, offers a population spread across the socio -economic divide, constituting the upper class living in Karen, the middle class comprising of the Lang'ata Estate, Nairobi West, Madaraka, South C., and Highrise, and the lower class in Kibera slums. This research therefore sought to answer questions regarding the sources of mobile phone e-wastes in urban Kenya:

i. What are the sources of mobile phone e-wastes in urban Kenya?
ii. What are the practises of mobile phone e-waste disposal in urban Kenya?
iii. What are the consumer levels of knowledge of safe e-waste disposal and the laws governing e-waste management in Kenya?
iv. What are the factors influencing mobile phone waste production and management in Kenya?

1.2 Statement of the Problem

Kenya has witnessed exponential growth in the use of mobile phones, with the Communications Authority of Kenya (CA) reporting that the number of users had surpassed the 30 million mark in September 2013. The number of mobile phones in the country were reported as 10.8 million users against a penetration level of 29% in September 2007 (CA Quarterly Report January 2008), growing to 14.5 million users and a penetration of 41.7% in September 2008 (CA Quarterly Report January 2009). This number was reported at 32.8 million and a penetration of 80.5% as at September 2014, compared to the African average of 65%. In December 2014, the number of users was reported at 33.6 million with a penetration level of 82.6%. These figures meant that with a population of about 42 million, approximately 3 out of 4 persons in the country owned a cellular phone.

Under normal circumstances, it is expected that at some point in use, the mobile phones may be damaged and need repair, or become obsolete and be discarded, generating electronic waste. Some replaceable parts like batteries and earphones may further contribute to the waste mass emitted into the environment unless recycled.

How are these wastes from mobile phones produced and managed? Consumers– as users - play a key role in generation of wastes, and so do the mobile phone technicians and/or repairers who may produce these wastes in their works. Various research, which are explored elsewhere in this report, point to the effects if Waste Electrical and Electronic Equipment (WEEE) on both plant, animal and human life. These include gene toxicity, birth defects, blood diseases, immune system anomalies, organs infections and effects on the nervous systems as well as food contamination dangers. These dangers would abound more based on the management of the WEEE. It is therefore imperative that the consumer patterns, who are the majority of the handlers of WEEE, be properly understood in order to fully inform them on the management of the electronic wastes and protect human health alongside the entire ecosystem and supply chain.

1.3 Objective of the Study

1.3.1 Overall Objective

To overall objective of this study is to raise the importance of e-waste management in Kenya.

1.3.2 Specific Objectives

The specific objectives of the study are to:

i. Establish the sources of mobile phone wastes among urban consumers
ii. Determine modes that consumers use to dispose e-wastes from mobile phones,
iii. Determine the extent of consumer awareness of safe measures of e-disposal and laws governing electronic waste management,
iv. Establish the factors influencing mobile phones electronic waste production and management
v. Make recommendations on sustainable approaches to mobile phone e-waste management in Kenya

1.4 Significance of the Study

The world population is bound to keep increasing and inasmuch as geographical positions may not change much in the near future, the world continues to become more and more of the 'global village' it has been termed. Communication will remain significant even as humanity endeavours to make communication easier and cheaper. The place of mobile phones as a key agency in communication will be further buttressed with the development and increased uptake of mobile phones by consumers, especially the smart phones which are steadily taking up the place of traditional communication equipment such as the television, radio, typewriters, desktop computers and even laptops as these features are increasingly being integrated into the smart phones.

Conversely, increased wastes from mobile phones – such as dead phones, and parts and accessories (such as chargers and ear phones) – will be produced. Meanwhile, some of these items are either/or made or composed of materials which may have associated health risks as a result of their toxic nature, such as lead – mainly used in the manufacture of Printed Circuit Boards (PCB) and said to cause damage to the nervous system.

This study will contribute to the general protection of public health, biodiversity and generation of vital information for promoting sustainability in the mobile telephony industry. Meanwhile, Nairobi is listed among the top 100 urban areas in the world by population numbers, ranking at 82, with an estimate population of 4.7 million in 2015 (Demographia, World Urban Reports 2015). It ranked 8th among the largest populations in Africa after Cairo (Egypt), Lagos (Nigeria), Kinshasa (DRC), Johannesburg (South Africa), Luanda (Angola), Khartoum (Sudan) and Abidjan (Ivory Coast). With most of the countries hosting these cities considered developing countries, the outcome of the study provides a basis upon which reactions may be based on in these urban centres, as well as give a general direction on the patterns that may be experienced in these cities regarding consumer patterns in the management of electronic wastes from mobile phones.

Taking into account the growing numbers of mobile phone users, and that it is likely that electronic wastes from mobile phones, alongside other electronic wastes, are a time bomb that may one day run out of control unless properly managed.

1.5 Scope of the Study

The study focused on the generation and management of mobile phone e-wastes by the consumers. It aimed to focus on the urban dwellers, particularly in a city within a developing economy, characterized by a mix of the upper class, the middle class, and the low class – mainly found in the slums. It did not focus on the manufacturers or the mobile phone technicians who handle more e-waste from mobile phones compared to the consumers. Additionally, while electronic wastes cover a lot of electronic and electrical equipment, the study focused particularly on mobile phones. It however took note that millions of phones, particularly waste mobile phones, are in the hands of the consumers who play a key role in electronic waste management. The selected areas of the study was Lang'ata area of Kenya's capital, Nairobi, which is categorized by the three general classes of socio-economic; Karen area which is generally characterized by the more opulent members of the society, the Lang'ata (including estates such as Madaraka, South C. and Nyayo Highrise) areas, comprised of the middle class and Kibera area, commonly called Kibera and consisting of slum and low class living.

1.6 Limitations of the Study

The study was conducted half a decade after the last national census was taken in Kenya. The population of the Lang'ata Area had certainly registered changes compared to the documented numbers. Population based sampling would therefore not have reflected correct numbers. Nevertheless, the study tackled this by estimating proportions using a general formula that is independent to the size of the population. The study took cognisance of the role played by technicians in the electronic waste management of mobile phones but noted that few technicians were based in the study area compared to within the Central Business District (CBD). Most consumers would therefore focus more on the technicians based in the CBD due to proximity of their places of work and belief in their advancement and ability to

do the work better. The focus of the study, however, was on the generation and management of mobile phones e-wastes by consumers. Finally, in the cases of misrepresented data, available or reliable, estimates were made, but only on a limited level.

1.7 Basic Assumptions of the Study

Given the nature of the methodology that was employed in the research, the study assumed honesty of respondents, especially to ensure adult-only participation, correctness of the given age groups, and that the respondents owned mobile phones at the time of the study. The area was taken as a representation of an urban population, particularly in Kenya.

1.8 Definitions of Significant Terms

E-waste: E-Waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of re-use (Source: Solving the E-Waste Problem (StEP) Initiative)

EEE: Electrical and Electronic Equipment - means equipment which is dependent on electrical currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such current and fields falling under the categories set out in Annex IA to Directive 2002/96/EC (WEEE) and designed for use with a voltage rating not exceeding 1000 volts for alternating current and 1500 volts for direct current. (Source: Directive 2002/96/EC (WEEE))

Waste: any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force. (Source: Directive 75/442/EEC, Article 1(a)

WEEE: Waste Electrical or Electronic Equipment - is waste including all components, sub-assemblies and consumables, which are part of the product at the time of discarding. (Source: Directive (EU, 2002a)

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of existing literature on the growth of the mobile phone industry over the years at different levels; globally, regionally, and nationally. It factors in the dynamics of the consumers regarding their mobile telephony services usage, and the sources of electronic wastes, specifically from the mobile phones usage by consumers. It also presents the modes of disposal of waste mobile phones and their parts and accessories, the awareness levels by the consumers and technicians of safe disposal measures as well as laws governing waste management in different economies. It points out to the factors influencing the waste production and management, while identifying and presenting gaps presented in and by these works, with a framework to the present study.

2.1.1 Historical Framework of the Telephone and Mobile Telephony

'We have stopped communicating like animals', is the humorous title of a commentary blog[2] on mobile and consumer electronic markets. The article walks us down memory lane (**Figure. 2-1**), from the days of Alexander Graham Bell, when he spoke the first words, "Mr. Watson, come here, I want to see you" into a telephone, to his assistant on 10th March, 1876. Then the *Candlestick phone* of the 1890s to the 1930s followed, consisting of different mouth piece and receiver parts. This was followed by the *Rotary*, where the caller had to dial (by swinging the number into an arc) the number they wanted to call and then releasing it. The current generation must wonder how hectic this must have been, especially if one 'dialled' the wrong digit towards the end of the number and having to start again. The *Push-button* came in 1963 when AT&T introduced the Touch-Tone whereby a keypad would be pressed to dial the numbers. Later in the decade, the *Answering machine* was introduced, permitting consumers to leave a message when their callers were absent. Well, this is now integrated

[2] BGR blog, November 2014. www.bgr.com

into our current cellular phones! 1980s came with the first *portable phones*, though these still had to be used within certain areas within certain radius such as inside a house or an establishment.

The world was treated to its first commercial *mobile phone* in 1984 when Motorola produced the Motorola DynaTAC 8000X, followed by other DynaTAC series until 1994. This first phone sold at about 4,000 dollars. Other phones were then produced by different manufactures, with each subsequent manufacture being an improvement of the previous releases. These included the Nokia 5110 and Motorola StarTAC, Sanyo SCP-5300 which was released in 2003 as one of first phones to possess an integrated camera, followed by Palm Treo, Motorola RAZR, and the business world famous BlackBerry, the iOS and Android system based phones.

And now, the mobile phone subscriptions have continued to grow immensely. The Mobility Report (November 2014) reported the figures at 6.9 billion (**Chart 2-1**) as at end of the third quarter of 2014, and that penetration had reached new levels (**Chart 2-2**). The report also pointed to the uptake of smart phones around the world and accounted for about 75% of phones sold during the quarter compared to 55% during the same period in the previous year. 37% of the present subscriptions of associated with smart phones, indicating room for further uptake (Ericsson, 2014).

The Candle Stick phone
Source: Amazon

Rotary phone
Source: Wikipedia

Push button phone
Source: robertopiecollection.com

The Answering Machine phone
Source: Privateline.com

Motorola DynaTAC
Source: actu-smartphones.com

iPhone 6 Plus
Source: Apple Store

Figure 2-1: Historical framework of the telephone; the Candle Stick, the Rotary, Push Button, Answering Machine to the first commercial mobile phone, Motorola DynaTAC and the latest Smartphone from Apple, iPhone 6 plus. Source: Researcher (2015)

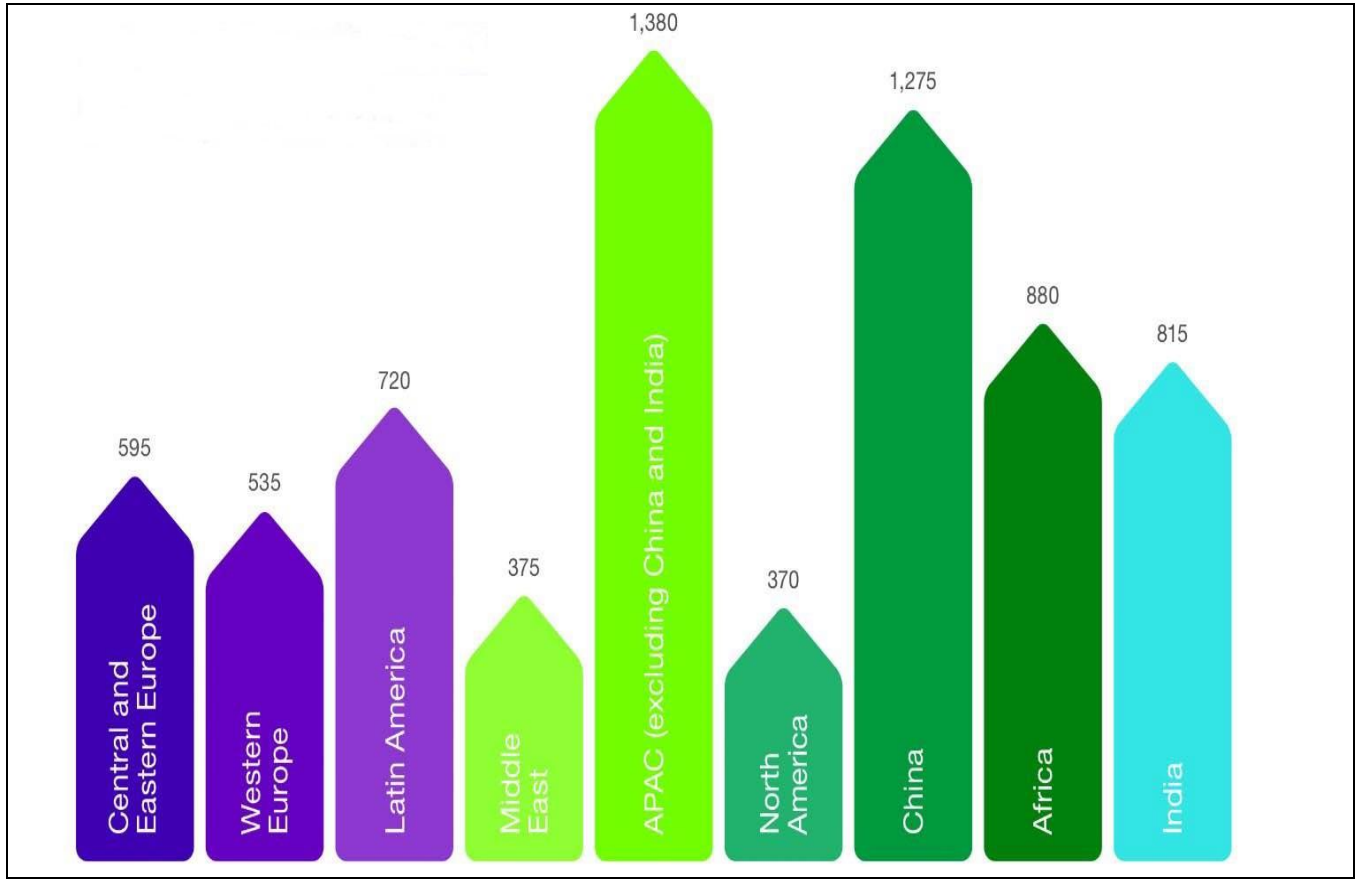


Chart 2-1: Global mobile phones subscriptions (millions) as at 3rd quarter of 2014

Source: Ericsson Mobility Report (2014)

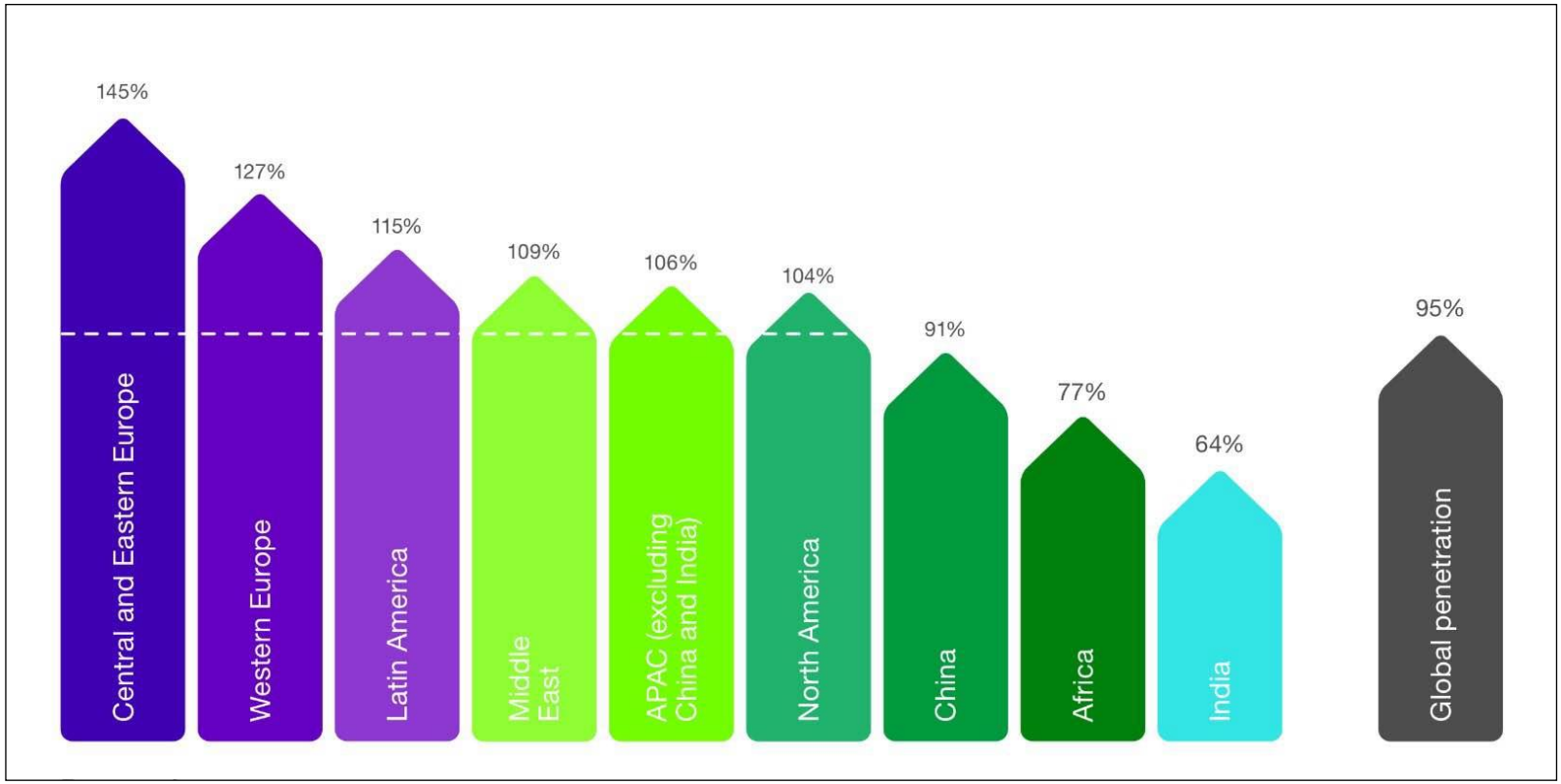


Chart 2-2: Global mobile phones penetration as at 3rd quarter of 2014.

Source: Ericsson Mobility Report (Nov. 2014)

2.2 Sources of Mobile Phone e-Wastes

Like most electronics, mobile phones produce wastes and waste products, especially due to their rather quick consumer replacement cycles. Generally speaking, humans are grappling with the management of continued generation of wastes and how to limit these as well as handle the wastes resulting from human activities in different spheres, particularly in the discharge of wastes into the environment. The impact of the waste disposal is manifested in the negative effects it has on the flora and fauna; impinging on the health of the environment, its various ecosystems, including the loss of biodiversity, as well as on human health. It is therefore prudent to understand such relationships in an attempt to respond to waste management and generation.

The unprecedented increase in usage of mobile phones globally, combined with the rapid obsolescence due either to malfunction or to rapid development of new, desired features, (continues to) create very significant volumes of wastes, posing a very serious global pollution concern both from the standpoint of disposal and recycling as well as from the possibility of transboundary movements of such wastes. It was estimated that 130 million phones were discarded in the United States alone in 2005, resulting in 65,000 tons of waste (Basel Action Network - BAN, 2004). 141 million mobile phones were discarded in the United States in 2009 (EPA, 2010). Meanwhile, approximately 150 million phones are discarded in the US each year (Recycling International, 2014).

While it is generally known that electronic and electrical equipment contain hazardous materials, until very recently there have not been scientifically valid test results, which provide specific data on the toxicity of mobile or cellular phones in particular (BAN, 2004). The average composition of the cell phones tested contain 45% plastics, 40% printed wiring (or circuit) board, 4% liquid crystal display (LCD), 0% solar cell, 3% magnesium plate, and 8% metals – excluding batteries (University of Florida, 2004).

A GSM Association report (2006) analysed research done by the Australian Mobile Telecommunication Association, titled *Mobile Phone Lifecycles: Use, Take-back, Reuse and Recycle.* This paper shows the general treatment on old mobile phones by the economy; including keeping the old phones, whether in a working conditions or not, others gave them away, other either lost or had them stolen, and so on. **Chart 2-3**, below, shows the general treatment of mobile phones by consumers in Australia in 2006.

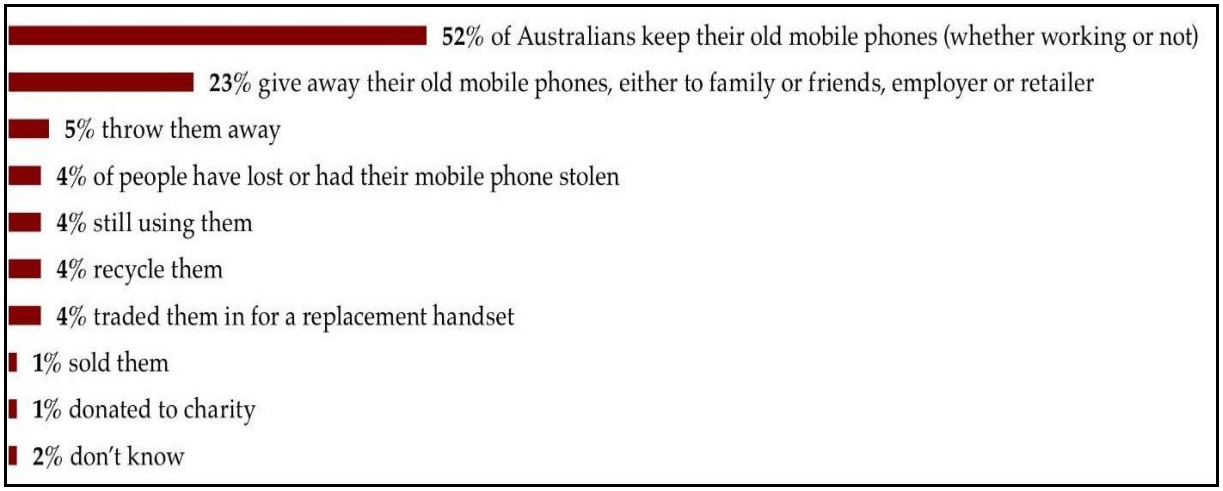


Chart 2-3: The general treatment of old mobile phones by consumers in Australia as at 2006.
Source: GSM Association

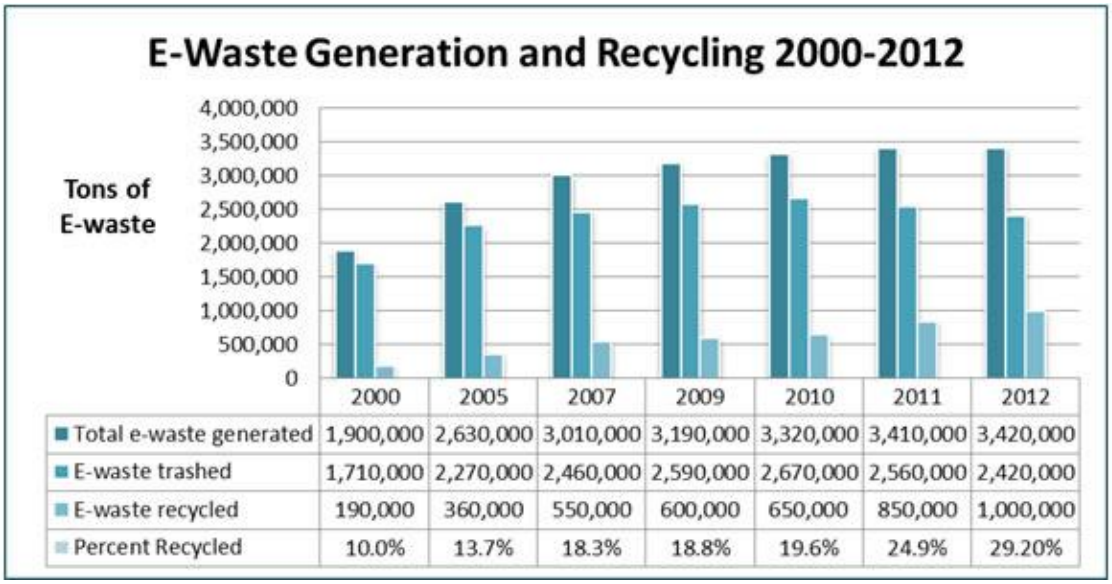
2.3 Disposal of Waste Mobile Phones, Parts and Accessories

Waste generation is an essential part of ecosystem whereby the waste of one species has become the resource of another, and a balance in the system is established (Chopra *et al*, 2005). Yet, this "balance" is being threatened by the dominance of human beings as species especially in terms of its "ability to modify systems and extract and transform materials, and fabricate, use, and transport the new materials" (Chopra *et al*, 2005). The Waste Electrical and Electronic Equipment (WEEE) is regarded as development related, pegged on economic growth, coupled with growing urbanization and changes in lifestyle and growing demand for material goods have led to an increasing production of electronics and consequently the accumulation of electronic waste over time (Babu *et al*, 2006).

With the continued rise in the uptake of mobile phones, so has there been increase in the number of dead phones, and replaced phones with newer and more upgraded versions continually coming up. The Ausie Recycling Programme reported that in 2000, in Australia alone, it was estimated that there were 3.5 million new mobile phones sold and predicted growth in the stockpile due to the uptake of new mobile phones. With the (then) introduction of 3G technology and coloured screens, more mobile phones were expected to be sold (and indeed were). The Australian bureau of statistics figures show that in the year 2000, 61% of Australian households had mobile phones and this number rose to 12.8 million mobile phone connections at the end of 2003, with the average Australian upgrading their phones every 18 – 24 months (ARP, 2001). And while 3.5 million phones were sold in Australia in early 2000s, currently more than 1 million phones are sold in Australia every month, with 10.99 million phones sold in 2009 and 12.74 million phones sold in 2010, that is, over 34,000 phones sold daily (IDC Australia, 2011).

So, millions of tons of electronic wastes are released to the environment each year, many which find their way into the landfills. Electronic wastes already constitute from 2% to 5% of the US municipal solid waste stream **(**Arensman, 2000). European studies estimate that the volume of electronic waste is rising by 3% to 5% per year – almost three times faster than the municipal waste stream. **(**Arensman, 2000). The US Environmental Protection Agency (EPA) pointed out that in 1997 more than 3.2 million tons of E-waste ended up in US landfills. This number was expected to grow fourfold in 'the next few years.' By 2006, 70% of heavy metals in landfills were reported to come from electronics (Silicon Valley Toxic Corporation, 2006). And this waste generation indeed increased over the years with EPA reporting that in 2012, the United States generated 3.4 million tons of e-waste. The EPA further stated that 70% of discarded electronics end up in the trash, even though the hazardous chemicals in them could leach out of landfills into groundwater and streams. Burning the plastics in electronics can emit dioxin. Out of 3.42 million tons of e-waste generated in the U.S. in 2012, 2.42 million tons went into landfills and incinerators (70%) and only 1 million tons (29.2%) was recovered for recycling. However, a significant amount

of that, 29%, was exported (EPA, 2012). **Chart 2-4**, below, shows the amounts of electronic waste generated over the years, against the quantities trashed or recycled.



	2000	2005	2007	2009	2010	2011	2012
Total e-waste generated	1,900,000	2,630,000	3,010,000	3,190,000	3,320,000	3,410,000	3,420,000
E-waste trashed	1,710,000	2,270,000	2,460,000	2,590,000	2,670,000	2,560,000	2,420,000
E-waste recycled	190,000	360,000	550,000	600,000	650,000	850,000	1,000,000
Percent Recycled	10.0%	13.7%	18.3%	18.8%	19.6%	24.9%	29.20%

Chart 2-4: Electronic waste generation and recycling.
Source: EPA, 2014

Chemicals associated with WEEE cause a range of adverse human health effects, including damage to the nervous system, reproductive and developmental problems, cancer and genetic impacts. Cadmium for example is considered the 7th most dangerous substance known to man and harmful to animals that ingest it. It is also carcinogenic. If lead is absorbed into the bloodstream in sufficient quantities it will cause serious liver and kidney damage in adults and neurological damage in children. Nickel and mercury are toxic and are classed as hazardous substances (ARP 2000).

It is argued that the management of E-waste is harder compared to that of the general waste stream, taking into account the complexity of the electronics and electrical products as these usually contain hazardous materials. E-waste can contain more than 1,000 different substances, many of which are toxic, such as lead, mercury, arsenic, cadmium, selenium and

hexavalent chromium (Babu et al, 2006). Such metals are considered as Persistent (i.e. don't degrade in the environment) or Bioaccumulative (i.e. build up in fatty tissue so can reach toxic levels over time) and may leak into the environment and/or food chain and leach into water courses or contaminate soil, such as in the case of ruptured NiCd batteries (ARP 2000) . Due to this multiplicity and complexity of component engagements, E-waste management would certainly require more technologically advanced means in order to effectively conduct an alienation process. UNEP provides a flow chart of E-waste management of Electronic and Electrical products (**Chart 2-5**).

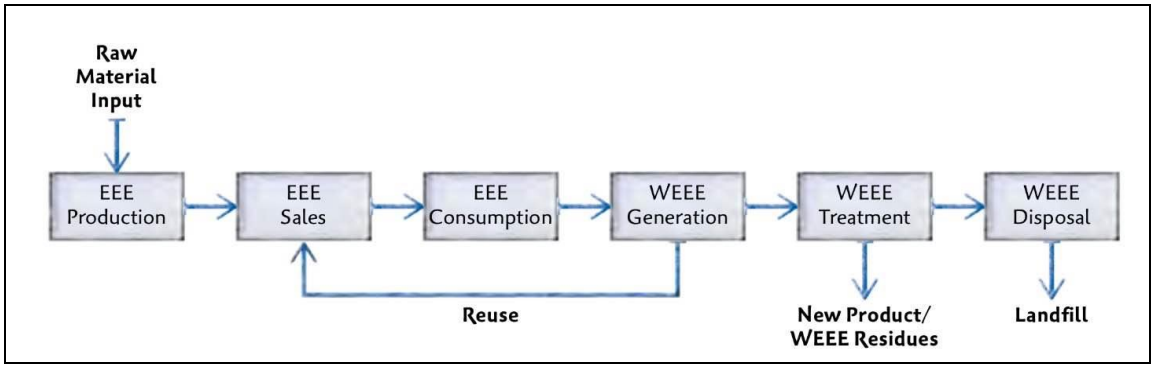


Chart 2-5: Electrical and Electronic Equipment management flowchart.
Source: UNEP. 2007b. E-waste: Management Manual. Volume II

The big question thus remains, how are the 'old' or replaced phones treated? Is this different from the developed countries compared to developing countries? Where are these phones? Different reports indicate that consumers may be hoarding hundreds of millions of phones across the world.

2.3.1 Disposal of e-Wastes in Developed Nations

Well, some of them are finding their way into recycling, especially in developed countries. Australia, for instance, had over 30 million mobile phone as at mid-2012, with more than 23 million mobile phones stashed away in cupboards and drawers at home and work places, (MobileMuster, 2013). 77% of Australians choose to keep or give away their old mobile

phones, 3% throw them out. Mobile Muster[3] urges recycling and argues that it would bring forth greenhouse gas benefits equivalent to planting 111,000 trees or taking over 5,100 cars on the road.

Due to its recycling efforts, Australia has over 4,000 free public drop-off points across Australia among the mobile dealers and participating local councils. Consumers are also provided with reply paid sachets for postage. MobileMuster reported that in 2012/2013, it collected 87 tonnes of mobile phone components, and an estimated 1 million handsets and batteries and 38,479kg of accessories, representing a collection rate of 53 % of available mobile phones. In 15 years, the programme saw 1,014 tonnes of mobile phones components collected and recycled, including 7,791 million batteries and handsets plus more than 518,000 kg of accessories (MobileMuster, 2013).

In the United States, the mobile phone industry is being fuelled by growing cell phone ownership, the emergence of smart phone technologies and rapid rates of mobile phone replacement (Environmental Leader, 2014). While over 150 million phones are thrown away annually, it is reported that for every 1 million cell phones recycled, 35,000 pounds of copper and 772 pounds of silver can be recovered, as well as small amounts of gold and palladium. ReCellular, the world's largest recycler and reseller of mobile phones, based in the US, processes about 300,000 phones a month.

In the United Kingdom, the Mobile Phone Recyclers Code of Practice states, the widespread uptake of mobile phones (and mobile devices) has created a market for the recycling of these products within the United Kingdom. This has led to the development of a thriving, dynamic recycling marketplace which has attracted both established and new players who offer to recycle these devices in a variety of ways.

[3] MobileMuster is the mobile phone industry's official product stewardship program in Australia. It is a not for profit program voluntarily funded by Nokia, Motorola, Samsung Electronics, HTC, Huawei, ZTE, Force Technology, Telstra, Optus, Vodafone and Virgin Mobile.

It is said that over 90 million mobile phones are stored in drawers headed for landfills in the UK. A report by Recycle More[4] suggested that at 5% annual growth, electronics form the fastest growing waste stream in the UK, with the amounts of wastes – at 1.2 million tonnes of electrical wastes – produced annually able to fill the Wembley Stadium six times! Sadly, 75% of these end up in landfill sites (Recycle More, 2014). Meanwhile, 15 million mobile phones are upgraded in the UK annually.

2.3.2 Disposal of e-Wastes in Africa

Africa, as at end of 2014, was reported to have about 77% mobile penetration with the numbers continuing to increase among the 1.111 billion strong continental population of 2013. But this is still a far cry from the 145% penetration registered in Central and Eastern Europe, the 127% in Western Europe and other regions. Actually, continentally, Africa ranks lowest in penetration, and lower than the global penetration of 95%. The Mobility report (2014) lists none of the countries in Africa among the top countries by net annual additions of mobile phones. This list is headed by India with 18 million net annual additions, China at 12 million, Indonesia (5 million), Russia and United States (both 4 million) (Ericson Mobility report, 2014).

It is reported that while growth in developing countries (read most countries in Africa and other regions) is driven by new subscribers, while those in developed nations is as a result of increased number of devices per individual.

The dynamics of waste management in developing countries have been underlined to be anchored on the following drivers; demographic, economic, socio-political, technological, social, cultural, and religious aspects and they vary according to the levels of socio-economic development of countries (Chopra *et al*, 2007).

[4] UK recycling information centre; http://www.recycle-more.co.uk

2.3.3 Disposal of e-Waste in Kenya

While there are definitely works alongside recycling of wastes and electronics wastes in Africa, there are more and available publications regarding the measures taken by developed countries compared to developing countries such as Kenya.

In East Africa, Nokia launched a recycling campaign in 2008 to offer consumers a structured wait to dispose of old mobile phones and accessories.[5] The consumers, given some financial incentive in return of the old phones and accessories, are expected to drop off the phones at different Nokia centres, even if the phones are from other manufactures, which are then sent to the manufacturers for recycling. The campaign, dubbed 'Take back', also launched in South Africa, Cameroun, Senegal, Nigeria and Ivory Coast the same year. Microsoft took over the mobile telephony operations of Nokia in 2014.

In 2007, the United Nations Environment Program year warned against[6] a "growing mountain of e-waste" in Africa, with the fear that used electronics and electrical equipment, including mobile phones, would subject the region into environmental danger. The National Institute of Environmental Health Sciences warned that up to "75 percent of the electronics shipped to Africa is junk." It was in light of these concerns that Microsoft and United Nations Industrial Development Organization (UNIDO) pledged to create a regional e-waste recycling facility in East Africa. This joint venture would involve sending millions of used computers to Africa for recycling[7].

In 2014, Microsoft Mobile Devices Group announced a two year partnership with German based company, Deutsche Gesellschaft fuer International Zusammenarbeit (GIZ) GmbH to research on the reuse of old mobile phones and electronic wastes from mobile phones in Kenya, Morocco and Nigeria. The aim was to seek sustainable recycling solutions of such

[5] Network World, http://www.networkworld.com (Accessed 8th January, 2015).

[6] BBC Technology News (http://news.bbc.co.uk/2/hi/technology Accessed 8th January, 2015).

[7] http://arstechnica.com (Accessed 8th January, 2015).

wastes. At the time of this study, there were no obtainable reports on the successes of the programme.

2.4 Extended Producer Responsibility (EPR)

The EPR concept is described as an environmental protection strategy to reach an environmental objective of a decreased total environmental impact of a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal (Lindhqvist & Swedish Ministry of the Environment,1990).

To implement the EPR programme, the OECD (2001), urged policy formulators to consider the following: environmental effectiveness, economic efficiency, equity and distributional effects, administrative feasibility and costs, concordance with institutional frameworks, political and social acceptability and adjustment costs associated with transactions incentives for innovation of environmentally compatible. It underpinned socio-economic and cultural factors as important elements impertinent to policy, including, highlighting market conditions and outlooks, political environments and structures, administrative structures and cultural and societal responses. All in all, the OECD espouses four principal goals of EPR; source reduction (natural resource conservation/materials conservation, waste prevention, design of more environmentally compatible products and closure of materials-use loops to promote sustainable development.

EPR principles greatly highlight the need for manufacturers to produce environmentally friendly products and take responsibility for the negative impacts their products may cause, especially to the environment. It somehow embraces the ‘cradle to grave’ concept in the management of resources.

The measures here may involve reuse, buy-back, or recycling by the producer or a third party *Producer Responsibility Organization* (PRO) based on agreed terms by the producer or

manufacturer to ‘internalise waste management costs in their product prices and ensuring the safe handling of their products’ (Hanisch, C., 2000).

Regionally, the concept of Reduce, Reuse and Recycle (3R) is being put forward as a policy measure for dealing with waste. Actually, these are now being promoted under the 4Rs tagline to encompass *Recovery*. Along with 4R, the concept of EPR as an environmental policy approach is being promoted to complement it and support the ‘cradle to grave’ system of waste management.

2.4.1 EPR in Africa

In a book, *The Balancing of Interests in Environmental Law in Africa, Faure, M and du Plessis, W., 2012),* points to alternative means of promoting environmental management within different sectors. It urges the adoption of Extended Producer Responsibility in the local context to engage producers and importers in the adoption of strategies that support environmental protection. Internalising environmental costs would encourage producers and importers to adopt a cradle-to-grave approach in waste management (Faure & du Plessis, 2012). In developing countries, the potential application of EPR is being explored theoretically especially in making it operational by taking into account the unique dynamics of the electronics sector (Liu *et al*, 2006, Manomaivibool, 2009).

Some countries have also integrated EPR in their environmental laws. South Africa, for instance, in its *National Environmental Management Laws Amendment Act 25 of 2014*, empowers the minister in charge of the Environment, in consultation with the Minister for Trade and Industry to do the following;

(a) Identify a product or class of products in respect to which extended producer responsibility applies;
(b) Specify the EPR measures that must be taken in respect to that product or class of products; and
(c) Identify the person or category of persons who must implement (the contemplated) EPR responsibilities measures.

The Minister may also – through relevant notices and consultations – specify, among others, requirements in respect of the implementation and operation of an extended producer responsibility programme, including on the reduction, re-use, recycling, recovery, treatment and disposal of waste; the financial arrangements of a waste minimisation programme; institutional arrangements for the administration of a waste minimisation programme; percentage of products that must be recovered under a waste minimisation programme; packaging be designed so that it can be reduced, re-used, recycled or recovered.

2.5 Challenges in E-waste Management

Different countries have adopted ways of E-waste management, and while success stories are told in different places, these countries, and others continue to register challenges in the management of E-wastes – including those from mobile phones and mobile phone accessories.

In China, for instance, the concept of EPR has been introduced but the operationalisation is not well defined. The deficiencies in the regulation, slow implementation and construction of recycling facilities, and defective collection system all contributed to ineffective management of the end-of-life of electronic products (Liu *et al*, 2006). Other challenges pointed out in the implementation of these strategies include the material and financial flow of E-waste, the role of informal recycling, and the reluctance of citizens to pay recycling fee made the management more complicated and difficult.

In India, two main challenges may undermine EPR mechanism; these being the large grey market for some electronic products and the illegal importation of WEEE (Manomaivibool 2009). In a more developed country like South Korea, the implementation of EPR in 2003 has lead to increased recycling and product take-back as electronic manufacturers are mandated to collect and recycle an assigned quantity based on the percentage of electronics sold (Yoon and Jang, 2006).

Other setbacks faced in the EPR programme include lack of harmonization system codes for electronic and electronic wastes export; harmonization system codes which mostly cover the products and packaging is not included, presence of involuntary free-riders, non-harmonized recyclable labels (especially between Japan, US and Korea), no official records in the trans boundary movement of E-waste and illegal trading of E-waste (Wong, 2007). It is also pointed out that the dynamics, such as managing and maintaining accountability, in Asia, make it harder for manufacturers to integrate proper cradle to grave mechanisms.

Other challenges faced by developing economies include the identification of the producers (contract versus in-house manufacturers, local companies versus foreign subsidiaries), cloned products which parts are made of different manufacturers, smuggling, the black market and the importation of second-hand E-waste, delineating responsibility for re-used and modified products, presence of informal sectors in collection and recycling of E-waste and identifying responsibility for imported second-hand electronics where parts are replaced (Kojima, 2005).

Osibanjo and Nnorom (2007) also share these observations and outline a number of management issues in managing E-waste in developing countries including the importation and influx of second-hand electronics which include ‘unusable junks’, rudimentary recycling and backyard recycling activities are prevalent. Discarded E-wastes are disposed the same way as traditional wastes, and there is no separate handling and treatment for E-waste. The authors also point out the absence of infrastructure for appropriate waste management, an absence of legislation dealing specifically with E-waste, an absence of any framework for end-of-life (EoL) product take-back or implementation of EPR as the main challenges for managing E-wastes.

Come to think of it, while most developed economies have provided different waste bins for waste collection, few of these, if any, have been specified for e-waste. These bins are more commonly categorized as recyclables or non-recyclables, or more definitively as for papers, bottles, plastics and cans. Either way, in an instance where e-waste, such as mobile phones,

have reached their end-life (at least in the eyes of the consumers), many are not certain if these are recyclables or not. Alternatively, many are unsure to what category of the waste bins such wastes are meant to go, if as plastics or metal.

2.6 Previous Studies on Mobile Phone E-Waste Kenya

Cherutich (2013) presented the study, E-waste management in Kenya: A Case Study of Mobile Phone Waste in Nairobi. This study mapped out the mobile phone Global Production Network (GPN) in Kenya; investigated the social and economic upgrading that has taken place in the mobile phone GPN in Kenya; examined the E-waste policy framework on mobile phones in Kenya; and interrogate the link between Nokia's design for environment (DfE) and the end of life (EoL) practices of mobile phones in Kenya. The study indicated that the mobile phone GPN in Kenya includes post consumption activities where mobile phone E-waste are recycled and exported and indicated pointed to the continued growth in the sector and adaptation of mobile telephone usage and application such as m-agriculture, m-commerce, m-education, m-governance, and m-health. The study also called on further development of policies and regulations on the management of electronic wastes and for Nokia to design a design a system to sensitize users to 'return' their EoL phones. It also called on the National Environment Management Authority (NEMA) to enlighten the public on the effect of electronic wastes.

The quickly changing global technology landscape and dynamic mobile telephony industry necessitates continuous research in related topics, including on the management of electronic wastes. For instance, since the study presented (Cherutich, 2013), various developments have taken place, including further growth in the mobile telephony industry, while players presented in the study, such as Nokia, may no longer be key players in the market with their market shares usurped by manufactures such as Samsung, and sliced by other players such as Apple, Tecno and Huawei. Taking congnisance of the study's focus on the mobile phone manufacturers, dealers and technicians, there existed the growing need to the present consumer patterns on the management of electronic wastes from mobile phones, including

their knowledge on the effects of electronic wastes, awareness of the laws governing e-waste disposal and factors influencing electronic waste management, which are presented in the current study.

2.7 Theoretical Framework

Lundgren (2002) points out to the general assumption that problem of electronic wastes management is underpinned in the dumping of electronic wastes from the developed countries to the developing countries. Lundgren shares three theories that outline the flow and the justification to the problem. The *"Race-to-the-bottom" theory* is based on the 'race-to-the-bottom, where governments deregulate the business environment in support of Foreign Direct Investment (FDI). The *"Race-to-the-bottom" theory* argues that increased completion for FDI leads to the lowering of standards and regulations, including the necessary environmental standards. Medalla & Lazaro (2005) explain the view that higher taxation rates, strict labour laws and rigorous environmental protection lower profit rates and governments which uphold these standards run the risks of disadvantaged trade environments compared to other governments. The exemptions given in this theory are that certain governments however prime the quality of life for their people and therefore do not compromise on their laws. In addition to these, Konisky (2007) points out that companies moving production from developed to developing countries sometimes bring advanced environmental and labour practices with them.

The "*pollution haven theory"* posits that, when large industrialized nations seek to set up factories or offices abroad, they will often look for the cheapest option in terms of resources and labor that offers the land and material access they require (Levinson & Taylor, 2008). It states that pollution-intensive economic activity will tend to migrate to those jurisdictions where costs related to environmental regulation are lowest (Lepawsky & McNabb, 2010). Lundgren (2002) highlights that the theory overlaps with globalization and north–south issues, the debate over the disparate implications for the developed and developing countries, and whether globalization will lead to "industrial flight" from the north and the growth of

"pollution havens" in the south (Medalla & Lazaro, 2005). Lundgren further points out that in the case of electronic wastes, the "pollution haven" are the developing countries where incentives thrive to avoid taxes and regulation and permit the disposal of electronic wastes. This is in essence related to the "race-to-bottom-theory".

The "*Distancing Theory*" explains the continued separation of everyday consumers with their wastes due to improved waste collection services. Lundgren (2002) considers arguments by Hawkins, 2006; Bekin, Carrigan & Szmigin, 2007, and Vasudev & Parthasarathy, 2007. Contemporary consumers are geographically more distant from their waste than in the past, through waste collection services which create little understanding of what happens to the waste after collection and where. This is exacerbated by consumer culture, waste habits, disposability of products and denial (Hawkins, 2006). Suffice to note that this study focused mainly on consumer patterns in the management of electronic wastes. The characteristics of consumer society, such as excess shopping and wastage, are a symptom of contemporary lifestyles, and abundance and convenience act against more responsible disposal behaviours. Most consumers, therefore, are no longer connected to the environmental meaning of their consumption (Bekin, Carrigan & Szmigin, 2007). This study reveals was expected also reveal the modes of disposal of mobile phones wastes as well as their awareness of safe disposal measures. Vasudev & Parthasarathy (2007) point to the distance from the manufactures to the consumers considering that most electronics (including mobile phones in the case of this study) are produced in developed countries and shipped to developing countries (among other economies) increasing the lack of consumer information. This, Vasudev & Parthasarathy (2007) recall, has been said that will lead to the consumers making decisions which will perpetuate the generation of wastes.

2.8 Summary of Literature Review and Research Gaps

Technological advances have played a key role in the growth of global communication since the development of the first telephone in 1876, and the metamorphosis of this through the candlestick phone, the Rotary, the Push-button, the Answering Machine and to the first commercial mobile phone the Motorola DynaTAC 8000X produced by Motorola in 1984, to the recent cellular phones and the present day Smartphones. This evolution is bound to continue.

The process of mobile phones have also greatly reduced from the highs of 4,000 dollars for the first commercial phone to as low as 10 dollars for a simple basic phone, and a few tens more for the regular smart phones. In the same fashion, the uptake of these phones has increased, from the days where they existed among the wealthy fraternity of the established economies to the present peasant farmer in a least developed country. Mobile uptake has also increased over the years, and currently stands (as at the third quarter of 2014) as high as 6.9 billion across the globe. The penetration levels are at the highs of 145% penetration registered in Central and Eastern Europe to the 77% reported in Africa among its 1.111 billion continental population (2013) during the same period.

Electronic waste production has continued to grow in both developed and developing countries. And man is grappling with the management of continued generation of wastes and how to limit these as well as handle the wastes resulting from human activities in different spheres, particularly in the discharge of wastes into the environment. The impact of the waste disposal is manifested in the negative effects it has on the flora and fauna; impinging on the health of the environment, its various ecosystems, including the loss of biodiversity, as well as on human health. It may therefore be prudent to understand such relationships in an attempt to respond to waste management and generation.

The unprecedented increased usage of mobile phones globally, combined with the rapid obsolescence due either to malfunction or to rapid development of new, desired features, (continues to) create very significant volumes of wastes, posing a very serious global

pollution concern both from the standpoint of disposal and recycling as well as from the possibility of transboundary movements of such wastes.

Different waste management strategies have been adopted in different places, including the *Use, Take-back, Reuse and Recycle*, the 4R was management principles, and Extended Producer Responsibility who principles highlight the need for manufacturers to produce environmentally friendly products and take responsibility for the negative impacts their products may cause, especially to the environment. It therefore embraces the 'cradle to grave' concept in the management of resources.

Meanwhile, consumers have adopted different means of treating their old mobile phones and accessories including keeping them, giving them away, throwing them away, continued use, recycling, or have had them stolen. While there are definitely works alongside recycling of wastes and electronics wastes in Africa, there are more and available publications regarding the measures taken by developed countries compared to developing countries such as Kenya. Manufactures such Nokia (in 2008) and Microsoft (2014) launched recycling campaigns to offer consumers a structured wait to dispose of old mobile phones and accessories.

Challenges in the management of E-wastes – including those from mobile phones and mobile phone accessories include development and implementation of legal frameworks, material and financial flow of E-waste, the role of informal recycling, and the reluctance of citizens to pay recycling fee, the large market for some electronic products and the illegal importation of WEEE, among others.

Meanwhile, most developed economies provide different waste bins for waste collection, few of these, if any, have been specified for e-waste. These bins are more commonly categorized as recyclables or non-recyclables (which sometimes consumers are unable to identify), or more definitively as for papers, bottles, plastics and cans. Either way, in an instance where e-waste, such as mobile phones, have reached their end-life (at least in the eyes of the consumers), many are not certain if these are recyclables or not. All in all though, a number

of developing countries also provide waste bins. Kenya for instance, has these provided by the county governments of most some cities, inasmuch as in most instances these are not specifically labelled for the types of waste, least of all, for e-wastes. Where provided though, the uses seldom look at the labels.

Various gaps exist in the different literature, with most reporting research in developed economies such as the United States, Australia and in Europe, and parts of Asia. Suffice to say though that a lot of work has also been done in huge populations such as in China and India. All in all, there are fewer published literature on mobile phone waste management in developing countries compared to the developed nations. Besides, a lot of literature exists on research done on waste management compared to on waste electrical and electronic equipment. While there exists published materials on the WEEE, most have centred on the general WEEE compared to the research on waste electronics from mobile phones. Additionally, few research has been done focusing specifically on consumers compared to research on the manufacturers, another gap this study aimed to narrow. It might also be worthy to note that there are more organisational reports published compared to individual research. This study was therefore intended to add to the available continental literature as well as offer a comparative study in the electronic waste management between developed and developing nations, as well as provide more information on the consumer patterns in the management of electronic wastes, particularly from mobile phones.

2.9 Conceptual Framework

The framework (**Chart 2-6**) below identifies the key variables of this study, both dependent and independent, and is based on the identification and the relationship among and between these variables. As usual, the prepositions here are taken from empirical observations, based on the 'travel' chain of mobile phones from the manufacturers (which may be considered the 'starting point' of the problem), and in the case of the consumers more specifically from the dealers (sellers and resellers) through to the consumers and their usage, and other interactions such as the mobile phone technicians who handle and repair spoilt phones, as well as other stakeholders, and the environmental protection measures such as reuse and recycling, to the end of life to the independent variable of the management of electronic wastes.

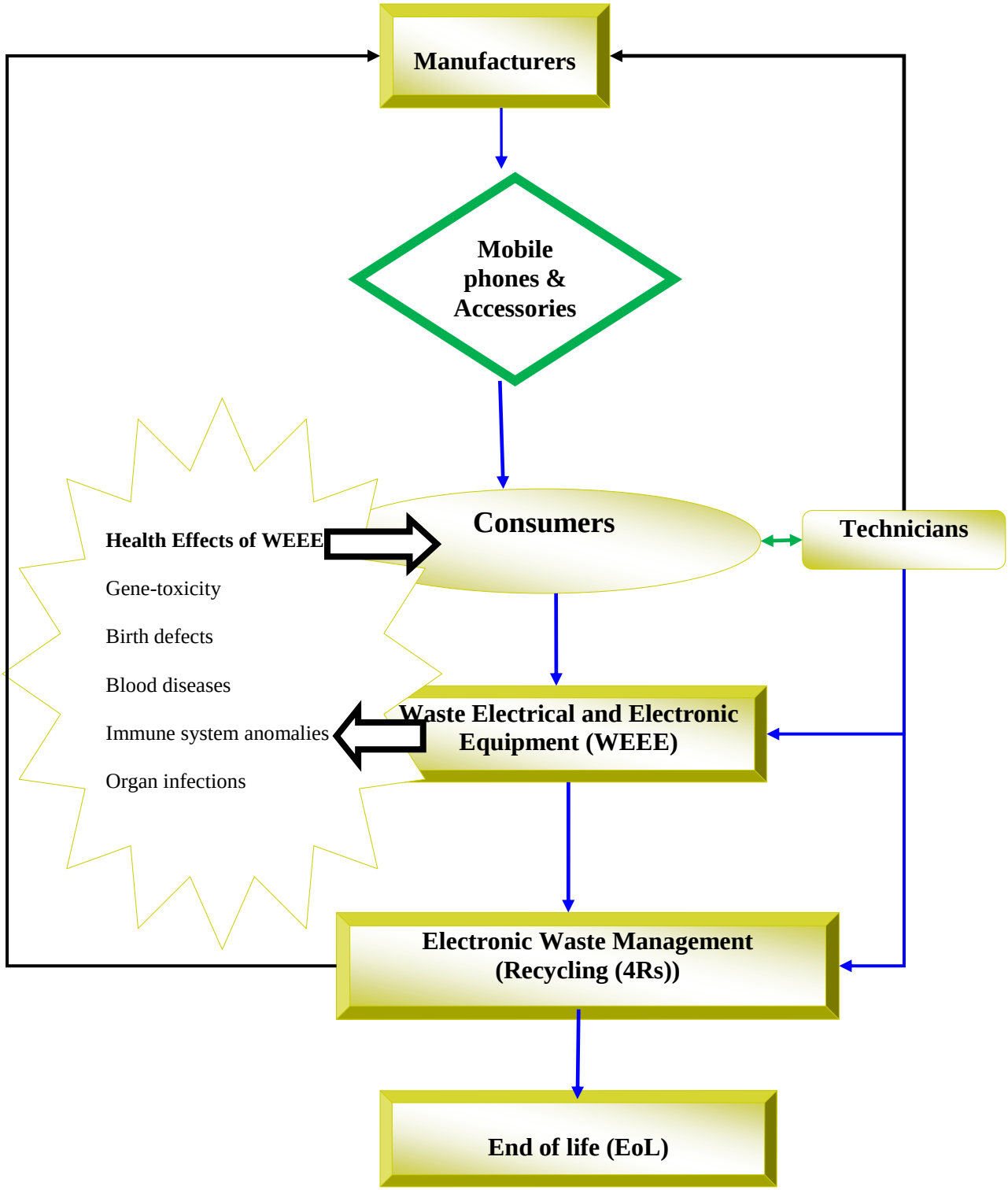


Chart 2-6: Conceptual Framework. Source: Researcher (2015)

CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

This chapter describes the study area and research design for the study, the target population, sampling procedure used in conducting the study, methods of data collection, instrumentation issues with regard to validity and reliability. It provides the operational definition of variables, method of data analysis used in conducting the research and the summary of the chapter.

3.1 Study Area

The Lang'ata area (**Figure 3-1**) is located in Nairobi, Kenya's capital city, and is under the administrative jurisdiction of the Nairobi County Government. It has an area of 223km^2 and comprises of different human settlements (estates) including Kibera, Lang'ata, Nairobi West, South C, Madaraka, Nyayo Highrise, and Karen.

As at 2015, the area consisted of two constituencies, Lang'ata and Kibera. Lang'ata comprised of the following wards: Karen, Nairobi West, Karura and South C. Kibera on the other hand consisted of the following wards: Laini Saba, Lindi, Makini, Woodley-Kenyatta Golf Course and Sarang'ombe.

The Lang'ata area (Lang'ata and Kibera constituencies) was previously an electoral constituency in Kenya (up to 2012), and one of the 8 constituencies in the city of Nairobi (**Table 3-1**). Administratively, it comprised of 1 division; Kibera division, 7 locations and 17 sub-locations. Politically, the constituency had 8 wards as shown in the table below, which also gives the population of the locations as given by the results of the 2009 census.

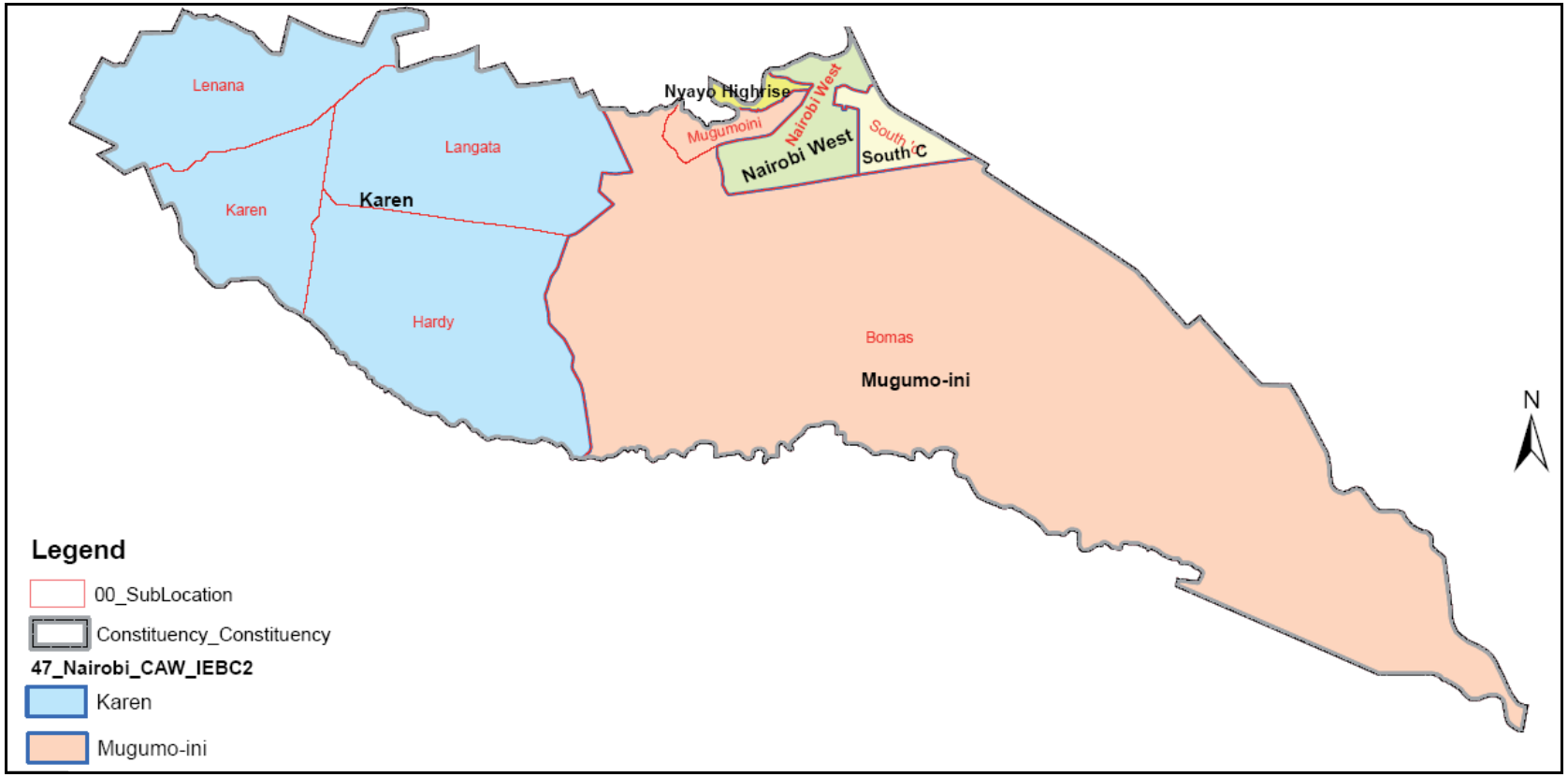


Figure 3-1: Map of the Lang'ata Area

Source: Lang'ata Constituency CDF 2007 report

Location	Sub-Location	Area Population in 2009
Karen	Karen	8796
	Lenana	4992
Kibera	Kibera	9786
	Lindi	35158
	Makina	25242
	Silanga	17363
Laini Saba	Laini Saba	28182
	Nyayo Highrise	24191
Lang'ata	Hardy	9114
	Lang'ata	10401
Mugumo-Ini	Bomas	16646
	Mugumo-Ini	30391
Nairobi West	Nairobi West	33377
	South C	47202
Serangombe	Gatwikira	24991
	Olympic/Kyanda	29356
TOTAL		**355, 188**

Table 3-1: Administrative divisions of the Lang'ata Area with the population as at 2009.
Source: Kenya National Bureau of Statistics

3.2 Research Design

The study employed a descriptive survey research design to establish the management of mobile phones waste in Kenya's urban areas by studying the behavioural and waste management patterns of consumers. The respondents targeted were confirmed as residents of the area of study before the commencement of the cross-sectional (on-time) survey, through direct interaction with the respondents to collect the required information. The study also focused on respondents aged 18 and above and as such did not consider mobile phone owners under the prescribed adulthood age, 18, in Kenya, in order to ensure informed consent among the respondents. Probability sampling was employed across the population based on the population data available from the Kenya National Bureau of Statistics and the sample size determined. The chosen data collection tool was tested and data collected across the different economic clusters; lower, middle and upper classes in the population and analysed.

3.2.1 Data Collection Methods and Tools

Both qualitative and quantitative data were obtained by use of a semi-structured questionnaire administered to mobile phone adult consumers through informed consent. The questions were designed to maintain objectivity, as well as open ended questions to get the respondents' in-depth understanding of different situations in support of the objectives of the study. It focused on obtaining information on; the demographics of respondents, the practice of mobile phones waste management in Kenya's urban areas, particularly the sources of mobile phone wastes among urban consumers, the available modes of disposal of e-wastes from mobile phones, awareness / knowledge of safe measures of e-disposal and laws governing electronic waste management in Kenya and the factors influencing mobile phones electronic waste production and management in Kenya**.** The questionnaire was administered to the respondents by the researcher, working alongside 9 research assistants. Other qualitative data was obtained through key informant interviews with informed individuals in involved in the management of electronic wastes. The three interviewees were from one of

the two registered firms responsible for electronic waste recycling in Kenya and based in Nairobi.

3.3 Target Population

The study involved adult (aged 18 and above) urban dwellers in the Lang'ata Area of Nairobi City County as the respondents. This area provides a rich mix of urban dwellers across the economic clusters of the upper class, bourgeoisie, and lower class. The Karen area is mainly characterized by the more opulent members of the society, and borders the Ngong' Forest and Ngong' Racecourse. It comprises of large family homes and in some of its areas, ranches. The area also boasts of affluent shopping malls and recreational centres, including the Crossroads Mall, Galleria Mall, as well as schools generally associated with the wealthier members of the society.

The middle class consists of estates such as Lang'ata, Nairobi West, South C., Madaraka, Highrise, among others. They are made up of mainly housing projects consisting of apartments and maisonettes. It also consists of and/or surrounded by malls and shopping complexes such as the T-Mall, South C. Shopping Centre, Nairobi West Shopping Centres, among others, as well as major establishments such as hospitals, including the Nairobi West Hospital, Gertrude Children's Hospital, Family Health, among others. The second largest airport in the city, Wilson Airport is also found in this area which also hosts a number of hotels such as the Weston, Summerdale, among others. Kenya's second largest sporting facility, Nyayo National Stadium and Sports Complex in also in this area.

Kibera on the other hand, is characterized by slum and low class living and consists of smaller informal settlement areas such as Gatwekera, Lindi, Olympic, Laini Saba, among others. Located about 5 kilometres from the city centre, it is considered the largest urban slum in Africa.[8] The area is characterized by slums, consisting of shanties, mud walled

[8] International Medical Corps. 27 March 2006. https://internationalmedicalcorps.org/sslpage.aspx?pid=1561

Retrieved 04 January 2014.

structures with rusted corrugated iron sheets. Most of the residents live in extreme poverty with a majority of them said to earn less than one dollar a day. The population provides cheap labour to different firms and industries in Nairobi, with huge numbers of able men providing labour in Nairobi's industrial area and other places. Others run low scale businesses within the area, including shops and kiosks, market product sells and services such as tailoring and barber shops, among others. A number of women also serve as domestic workers in the surrounding middle and upper class estates. The areas faces challenges highlighted by the Millennium Development Goals as well as the Sustainable Development Goals, including extreme poverty, hunger and food security, heath and lower educational levels, management of water and sanitation, among others.

The 2009 Kenya Population and Housing Census categorised Nairobi under Nairobi West, Nairobi East, Nairobi North and Nairobi South. The Lanng'ata area, area under study, was listed under Nairobi West's subcategory and referred to as Kibera with a total population of 355,188.

3.4 Sampling Procedure

Probability sampling was employed for the sampling frame, defined as the Lang'ata Area population. Stratified random sampling technique was utilized, by dividing the population across the different sub-locations of the area, 17 in total, which acted as sub-frames of the sampling frame. Simple random (unbiased) samples were then taken from the subpopulations. Non probability sampling was employed in the selection of key informants, purposively selected from stakeholders in the management of electronic wastes, with document referencing from the relevant authorities, particularly the National Environmental Management Authority, Communications Authority of Kenya and the Ministry of Environment and Natural Resources.

3.4.1 Sampling procedure and sample size calculation

The 2009 census gave the population of Lang'ata Area as 355,188, and with more than half a decade since the census was carried out, the population of this area has certainly grown, if only to go by observing the numbers of settlements that have come up in the area. And so, with the next census expected in just about 4 years, it might be improbable to base the population sample on these numbers, unless estimates are built on expected annual growth.

3.4.2 Sample Size Determination

Social research methods provide plausible ways of estimating proportions from different populations. The study employed estimating proportions sampling procedure as elucidated by Bernard (2000).[9] The study required a margin of error (level of precision) of 5% as the range in which the true proportion would be estimated from the sampling frame of about half a million. 95% was chosen as the confidence level, taking cognizance that the margin of error would contain the true proportion. The true proportion is represented by, *P*. The estimate being the regular uppercase P and Q being 1-P.

Table 3-2 shows what happens to the square root of PQ as the true value of *P* goes up from 10% to 90% of the population.

The general formula for sample size when estimating proportions in a large population is;

$$\mathbf{n = z^2 (P) (Q) / (Confidence\ Interval)^2} \qquad \text{(Formula 1)}$$

Where z is the area under the normal curve corresponding to the chosen confidence limit. When the confidence limit is 95%, then z is 1.96, and when at 99%, z is 2.58 and so on.

Without the knowledge of the percentage of estimation, (as is in the case of this study), P and Q are set at .5 each, solving for *n* (sample size) gives;

$$\mathbf{n = (1.96)^2 (.5) (.5) / (.05)^2 = 384.16} \qquad \text{(Formula 2)}$$

[9] Social Research Methods (Qualitative and Quantitative Approaches) by H. Russell Bernard

This is rounded up to **385.**

Table of P and Q and √PQ		
If the value of P is really	The PQ is	And the square root of PQ is
.10 or .90	.09	.30
.20	.16	.40
.30	.21	.46
.40	.24	.49
.50	.25	.50

Table 3-2: Estimating proportions

Source: Social Research Methods (Qualitative and Quantitative Approaches) by H. Russell Bernard

To apportion the sample size (385) to the entire population, the population of each sub-location across all the classes, against the entire population, was distributed to the sample size **(Table 3-3)**.

This was achieved using the following formula:

Sub-location population / Total Population * 385.

Economic Cluster	Location	Sub-location	Area population	Sample size	Sub-Totals	%
Lower Class	Kibera	Kibera	9786	11		
		Lindi	35158	38		
		Makina	25242	27		
		Siranga	17363	19		
	Laini Saba	Laini Saba	28182	31		
		Nyayo Highrise	24191	26		
	Serangombe	Gatwikira	24991	27		
		Olympic/Kyanda	29356	32		
	Sub-population				**211**	**55**
Middle class	Nairobi West	Nairobi West	33377	36		
		South C	47202	51		
	Mugumo-Ini					
		Mugumo-Ini	30391	33		
	Lang'ata					
		Lang'ata	10401	11		
	Sub-population				**132**	**34**
Upper Class	Karen	Hardy	9114	10		
		Bomas	16646	18		
		Karen	8796	10		
		Lenana	4992	5		
	Sub-population				**43**	**11**
	TOTAL		**355,188**	**385**		

Table 3-3: Population distribution to the sample size

Source: Researcher (2015).

3.4.3 Questionnaire Pre-Testing and Piloting

A pilot experiment was done to evaluate the feasibility, time, statistical variability and to pre-test and validate the questionnaire. The questionnaire was pre-tested, taking into consideration the views of the key decision makers and statisticians. Taking into account that

the overall expected number of respondents would be 385, the questionnaire was administered to 38 respondents selected from the population. With the three sub-populations, upper, middle and lower class represented by 11%, 34% and 55% respectively, the number of respondents from each sub location were 4 for the upper class, 13 for the middle class and 21 for the low class. The responses were standardized as part of the pilot study, coded and analyzed before the final revision of the questionnaire.

3.4.4 Instrument Validity and Reliability

There is no direct way to evaluate the validity of a concept and ultimately, we are left to decide on the basis of our best judgment whether an instrument is valid or not (Bernard 2000). Certain tests are conductible for face validity, content validity, construct validity and criterion validity. The initial validity test on the questionnaire was face validity which simply looked at the various operational indicators, with consensus drawn from the supervisors and assistants. 38 of the expected 385 respondents were randomly selected and representing 10% of sample, were used for to pilot the administration of the questionnaire and test of its validity. This revealed areas in the questionnaire which appeared vague and so it was readjusted accordingly to offer clarify for all the respondents. The validated questionnaire enhanced understanding and enabled general consistency in the type of responses gathered.

3.4.5 Data Analysis

Different exploratory data analysis were employed on the data and descriptive statistics generated to understand the data collected. Descriptive and inferential statistics were used for quantitative analysis. Chi square test was used to check if there was any statistically significant difference in qualitative variables while Analysis of Variance (ANOVA) was used to test mean difference. Tests with P-values of >0.05 were considered statistically not significant. The IBM Statistical Package for Social Sciences (SPSS 21) was used to support the analysis.

After the analysis, data was presented in the form of tables, charts, data summary tables and narratives. The results were interpreted and discussed, and also compared with existing literature on similar and related works done. Data presentations were guided by the projects objectives.

3.5 Mobile Phone Market

It is assumed that the mobile phone market in the Lang'ata area has continued to grow alongside the country's steady growth. It is also assumed that the area, being in an urban setting, has a higher rate of penetration than the national average penetration of 80.5% reported for the third quarter of 2014. The principal qualification of the respondents of this study was ownership of a mobile phone among the respondents and all respondents who were sampled responded to the affirmation. Different mobile phone service providers serve the Kenya populace with mobile telephony services, including Safaricom, Airtel, Essar and Telkom. Nationally, among the 32.2 million subscribers reported by the Communication Authority for the third quarter of 2014, Safaricom accounted for 20.8 million subscribers, Airtel 5.5 million, Essar 2.8 million and Telkom 2.2 million. Airtel acquired the subscriber base of Essar's YuMobile during the fourth quarter of 2014.

3.6 Ethical Statement

I conformed to the tenets of research and its processes, while keeping up to the acceptable principles and ethical standards including Informed consent, Confidentiality of information obtained, anonymity of participants in data dissemination and community research results dissemination (so they know what was found out). In this case, I maintained quality and integrity in the research, sought the advice and opinion of various experts while acknowledging the various sources of information. I also sought the consent of all respondents and informants, informing them of my intentions while seeking their voluntary concurrence in participation. I upheld confidentiality and anonymity of my respondents, while taking measures to ensure that they faced no form of harm. I was impartial in my research and its processes, and ensured to uphold the independence of my thoughts, ideas and words.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This study set out to fulfil the following objectives as stated in the introduction chapter of this document;

i. To establish the causes of mobile phone wastes among urban consumers
ii. To determine the modes of disposal of e-wastes from mobile phones
iii. To determine urban consumers' awareness of safe measures of e-disposal and laws governing electronic waste management in Kenya
iv. To establish the factors influencing mobile phones electronic waste production and management in Kenya.

4.2 Characteristics

A total of 385 respondents were randomly sampled during the research from the three areas; the upper, middle and lower class areas of Lang'ata Area in Nairobi, the Kenyan capital. These areas represent the social classes of an urban set up of a developing country. Karen represents the upper class; the middle class is represented by a cluster of estates, including Lang'ata, South C., Nairobi West and Madaraka, and Highrise while Kibera represents the low class. The configuration of the study respondents in accordance with the social class clusters is highlighted below.

4.2.1 Social Class Clusters

The social stratification characteristics of the respondents, based on their residential areas were as highlighted in **Table 4-1**. The figures represent the general population distribution in an urban area of a developing economy where the population distribution thins with increasing economic abilities.

Residential area	Frequency	%
Upper class	43	11.6
Middle class	131	34.0
Lower class	211	54.8
Total	**385**	**100**

Table 4-1: Population distribution in the social classes

Source: Researcher (2015)

Based on the above findings, Nairobi and other urban areas, and developing countries, may therefore be perceived to have a huge part of their population under the low class cadre, with growing middle class, compared to developed countries which are represented by stronger middle class. Australia population, for instance, is dominated by the middle class or middle income earners, majority who live in State and Territory capitals (major cities) and only about 15% reside outside of coastal and urban areas (Skwirk, 2015).

4.2.2 Gender Representation

There were more male respondents sampled, accounting for 4 out of 10 respondents (**Table 4-2**). Though this is not a great divide, it may also not necessarily be a reflection of the gender balance in the area, but that the sampling procedure probably favoured exposure to more men than women. Suffice to note though respondents were approached in open centres such as shopping centres, malls, markets, and roads. In actual sense, the sex ratio of the Kenya population is at 1.0, with women only slightly more than men nationally, and men marginally more than women in Nairobi, but still within the same ratio (National Census, 2009).

Gender	N	%
Male	241	62.6
Female	144	37.4
Total	385	100.0

Table 4-2: Gender representation of the respondents
Source: Researcher (2015)

4.2.3 Age Distribution

Table 4-3 shows that about 80% of the respondents were between 18 and 40 years of age, reflecting the general age structure of the Kenyan population. Actually, 50% of the total number of respondents fell between 18 and 30 years of age, with their counterparts on the next upper decade tier catering for 30% of the population, of the respondents, and just over 10% falling between the ages of 40 and 50 years. These figures continue to buttress the importance of the younger generation and the need for their integration in the national planning processes.

Age bracket	Frequency	%
Under 18	4	1.0
18-30	190	49.2
31-40	126	32.8
41-50	49	12.8
51-60	14	3.6
61 and above	2	.5
Total	385	100.0

Table 4-3: Age distribution of the respondents
Source: Researcher (2015)

4.2.4 Marital Status

A greater percentage of the respondents were married, accounting for 57% and the singles 37% (**Table 4-4**). This, however, is presumed not to have played a significant role in their responses for the research.

Marital status	**No.**	**%**
Single	143	37.2
Married	222	57.6
Widowed	13	3.4
Divorced	4	1.0
Separated	3	.8
Total	385	100.0

Table 4-4: Marital status of the respondents
Source: Researcher (2015)

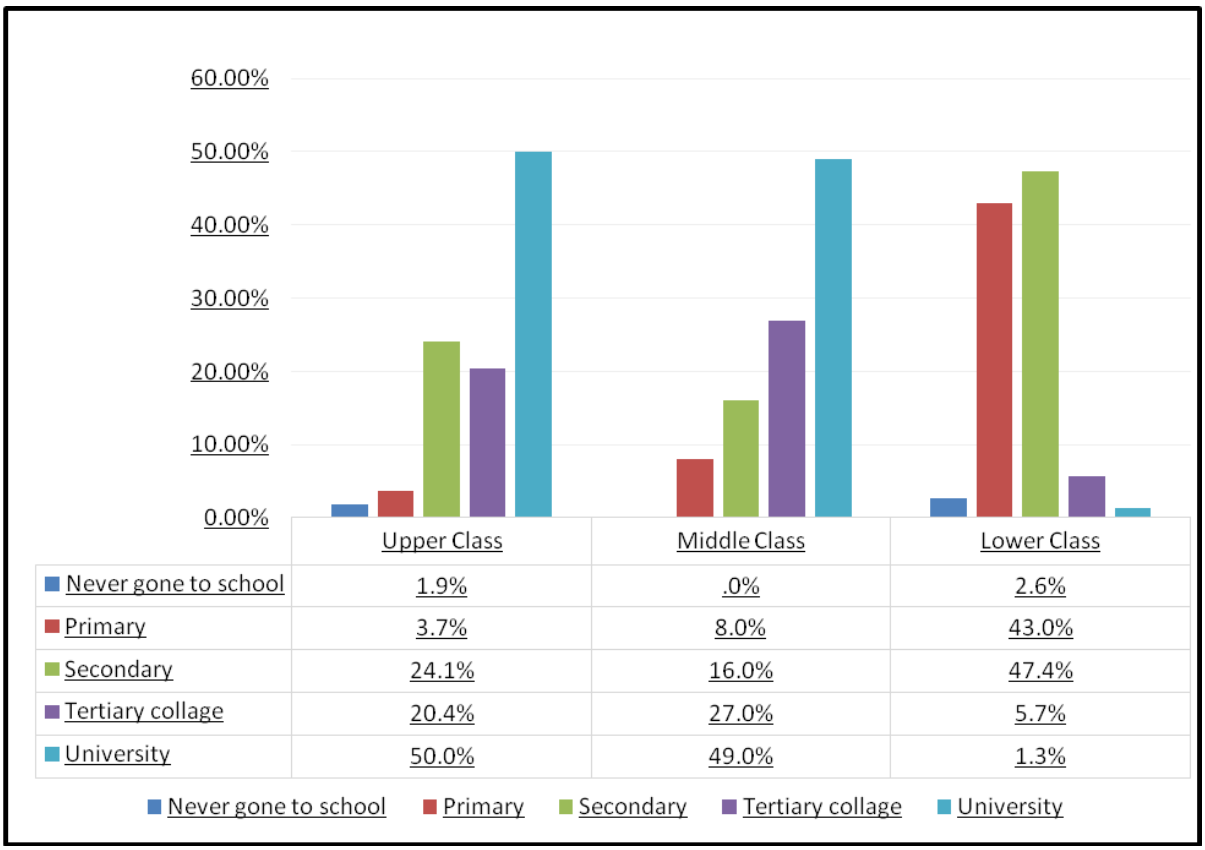
4.2.5 Level of Education

On education level, almost 100% of the respondents on the overall had had some form of education, albeit at different highest levels, through basic primary education (accounting for 28%), secondary education (36%), tertiary college (13%) and university (20%) (**Table 4-5**).

Highest level of education	**No.**	**%**
No formal education	7	1.8
Primary	109	28.4
Secondary	139	35.9
Tertiary college	51	13.3
University level	79	20.6
Total	385	100.0

Table 4-5: Level of education of all the respondents
Source: Researcher (2015)

A cross tabulation of the highest level of education against the areas of residences reveals distinct patterns among the different economic blocks (**Chart 4-1**). About 50% of the respondents in the upper and middle classes have been through university, compared to only 1.3% of the slum residents. The slums also registered lower numbers (5.7%) in tertiary colleges compared to 20% in the upper class and 27% in middle class. However, about 50% of the slum residents have been through secondary education as their highest level, compared to an average of 20% among the upper classes, at 24% and 16% for upper and middle class respectively. A greater percentage, 43% of the slum dwellers had also been through primary education as their highest level, compared to just 3% in the upper class and 8% of the middle class.



	Upper Class	Middle Class	Lower Class
Never gone to school	1.9%	.0%	2.6%
Primary	3.7%	8.0%	43.0%
Secondary	24.1%	16.0%	47.4%
Tertiary collage	20.4%	27.0%	5.7%
University	50.0%	49.0%	1.3%

Chart 4-1: Cross tabulation: Highest level of education versus area of residence of the respondents

Source: Researcher (2015)

4.3 Sources of Mobile Phone E-Wastes in Lang'ata area

The study determined the usage and causes of mobile phones in the area, and among the three social tiers, to reflect the actual representation for the wider urban population. The overall objective in this instance was to determine the major sources of mobile phones electronic wastes. It sought to find out the turnaround time in the ownership of the mobile phones, the numbers of phones previously and currently owned by the consumers, their functionality, and the features they consider when purchasing or disposing of their phones.

4.3.1 Phone Ownership and Usage

In determining the sources of mobile phone wastes and turn-around usage period, the research sought to know the number of phones the respondents has previously owned as well as their present phone possessions. It established that among the respondents who own more than one phone, 96% of the phones were functional with 4% of the phones non-functional (**Chart 4-2**).

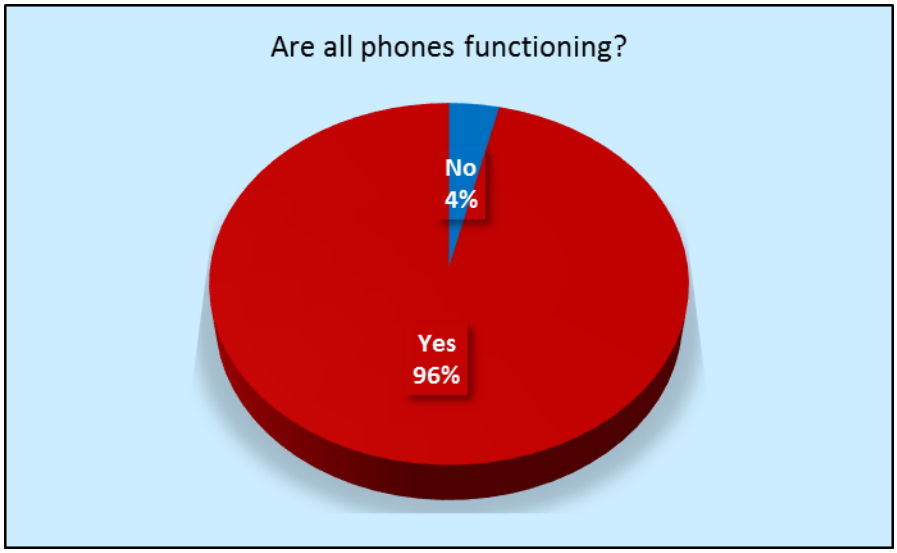


Chart 4-2: Respondents' responses on functionality of the mobile phones they own

Source: Researcher (2015)

For most part, the second phone is normally stored for a number of reasons. The recurrent reasons listed were the following;

i. *Sentimental attachment*; the users were sentimentally attached to the phones and felt the need to hold on to them, either as they were either gifts and felt uncomfortable disposing them, or were their first phones and still held them in high regards.

ii. *Reference backups*: a number of individuals hold on to their alternative phones as reference materials. For some, these still act as storage for the contacts they have not been able to transfer to their later phones, or simply other backup files. Others may also use these to make calls to networks on whose sim card the phones are, especially if existing on different networks from the ones held by the primary phones.

iii. *Hoarding*; some respondents mentioned not having found any reasons or incentives to dispose of the phones and were simply hoarding them 'somewhere in the house' among the unusable items within the households.

iv. *Hope for repair*; some respondents still believed that the phones they held on to, though not functional, were not beyond repair. They therefore hoped to find a technician capable of doing the repair work someday.

v. *Lack of attractive disposal means*; the respondents indicated that they were not aware of any incentives given by the any party in relation to mobile phone disposal. As such, they did not feel obliged to give out phones whose purchases they had self-funded.

On the number of *functional* phones previously owned by the respondents, there are statically significant differences across the economic divide, with the mean number of 10 phones registered among the upper class, 7 for the middle class and 6 for the lower class.

On the number of phones owned by the respondents at the time of study, all areas registered ownership of 2 phones each among most respondents, with the mean increasing up the economic ladder. The lower class registered a mean of 1 phone, with the middle class and upper classes registering 2 in both classes.

Table 4-6 compares the details of the number of phones ever owned by the respondents, across the different classes, as well as the total number currently owed. It measures these details against the mean and standard deviation.

Number of phones	Location	N	Mean	Standard deviation
How many mobile phones have you had in your entire life	Upper class	54	9.50	12.383
	Middle class	100	6.58	10.023
	Low class	230	5.35	7.171
	Total	384	6.26	8.941
How many mobile phones do you currently have	Upper class	54	2.07	1.385
	Middle class	100	1.67	.805
	Low class	230	1.36	.684
	Total	384	1.54	.881

Table 4-6: Comparison of the number of mobile phones owned by location

Source: Researcher (2015)

There was a statistically significant difference between the different social classes and the number of phones ever owned by the respondents as determined by one-way ANOVA (p = .008) (**Table 4-7**). A Tukey post-hoc test revealed that the number of phones ever owned was statistically significantly lower for the lower class (Kibera) than the upper class group (Karen area) (p value = 0.006) (**Table 4-8**). There were however no statistically significant differences between the lower and middle classes and middle and upper class in terms of the number of phones ever owned.

Multiple Comparisons					
Tukey HSD					
Dependent Variable	**(I) In which of the following areas do you live**	**(J) In which of the following areas do you live**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**
How many mobile phones have you had in your entire life	Karen Area	Lang'ata and Nairobi West Area	2.920	1.493	.125
		Kibera	4.162*	1.336	**.006**
	Lang'ata and Nairobi West Area	Karen Area	-2.920	1.493	.125
		Kibera	1.242	1.058	.470
	Kibera	Karen Area	-4.162*	1.336	**.006**
		Lang'ata and Nairobi West Area	-1.242	1.058	.470
How many mobile phones do you currently have	Karen Area	Lang'ata and Nairobi West Area	.404*	.143	**.014**
		Kibera	.715*	.128	**.000**
	Lang'ata and Nairobi West Area	Karen Area	-.404*	.143	**.014**
		Kibera	.311*	.101	**.006**
	Kibera	Karen Area	-.715*	.128	**.000**
		Lang'ata and Nairobi West Area	-.311*	.101	.006

Table 4-7 Difference in social classes and the number of phones owned.

Source: Researcher (2015)

No. of mobile phones		Sum of Squares	df	Mean Square	F	Sig. (P value)
How many mobile phones have you had in your entire life	Between Groups	773.527	2	386.764	4.948	**.008**
	Within Groups	29861.522	382	78.172		
	Total	30635.049	384			
How many mobile phones do you currently have	Between Groups	24.635	2	12.317	17.236	**.000**
	Within Groups	272.991	382	.715		
	Total	297.626	384			

Table 4-8 Difference between groups on number of mobile phones previously owned against the current ones.

Source: Researcher (2015).

One- way ANOVA also revealed a statistically significant difference between the different social classes and the number of phones currently owned by the respondents ($p < 0.001$) (**Table 4-8**). A Tukey post-hoc test shows that the number of phones currently owned was statistically significantly lower for the lower class (Kibera) compared to the middle and the upper classes. Middle class also owned statistically significantly lower number of phones compared to the upper class.

4.3.2 Mobile phone turnover/change of mobile phones

The findings revealed that over half of all the respondents changed their phones every 2 years; 52.6%. Specifically, 32.3% of the respondents change their phones between one and two years, and 20.3 do so every year. 21.1% indicated replacing their phones every five years, while 4% indicated having never replaced their phones (Chart 4-3).

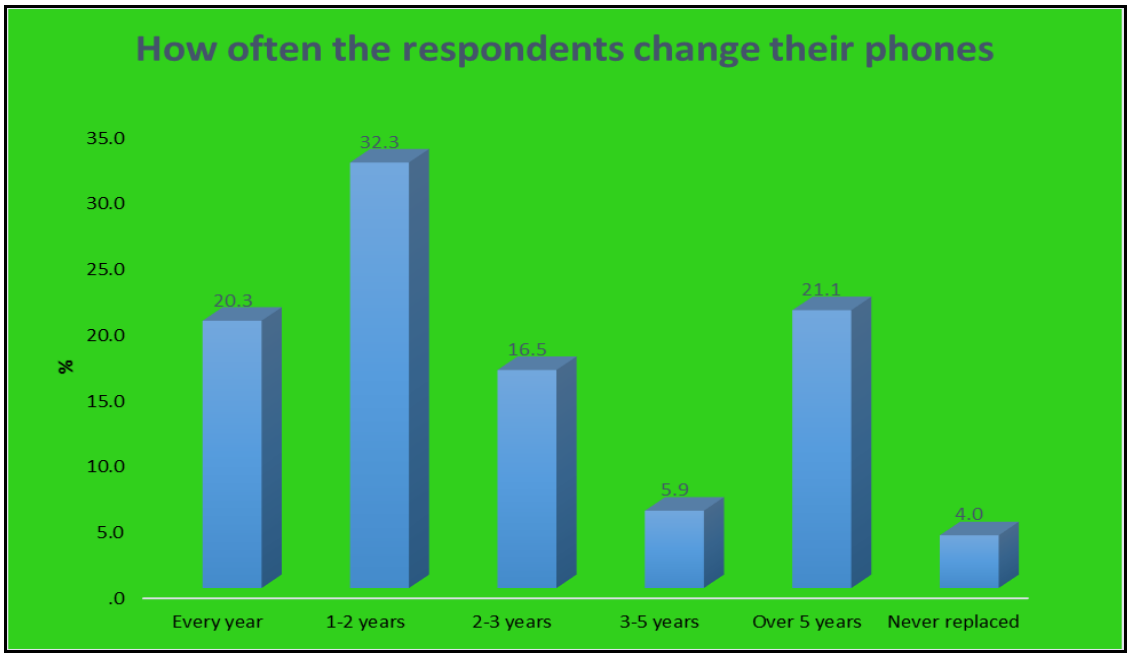


Chart 4-3: Frequency of change of mobile phones by the respondents

Source: Researcher (2015)

However, distinct economic differences begin to appear on studying the spending patterns on different societal classes. **Table 4-9** shows the results of the "**Pearson Chi-Square**" row. The Chi-Square test reveals that there is statistically significant association between social classes and the number of times the respondents change their phones (P value <0.001).

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.606[a]	10	.000
Likelihood Ratio	31.199	10	.001
Linear-by-Linear Association	12.171	1	.000
N of Valid Cases	376		

Table 4-9: Association between social classes and the times the respondents change their phones

Source: Researcher (2015).

The upper class reported higher margins of phone replacement, with just about 46.3% changing their phones every year, compared to 14.4% in the middle class and 16.4% in the lower cadre, with both groups changing their phones more often between one and two years. These higher figures are reflected at 36.1% and 32.6% for the middle and upper classes respectively, compared to 24.1% of among the upper class respondents (**Chart 4-4**).

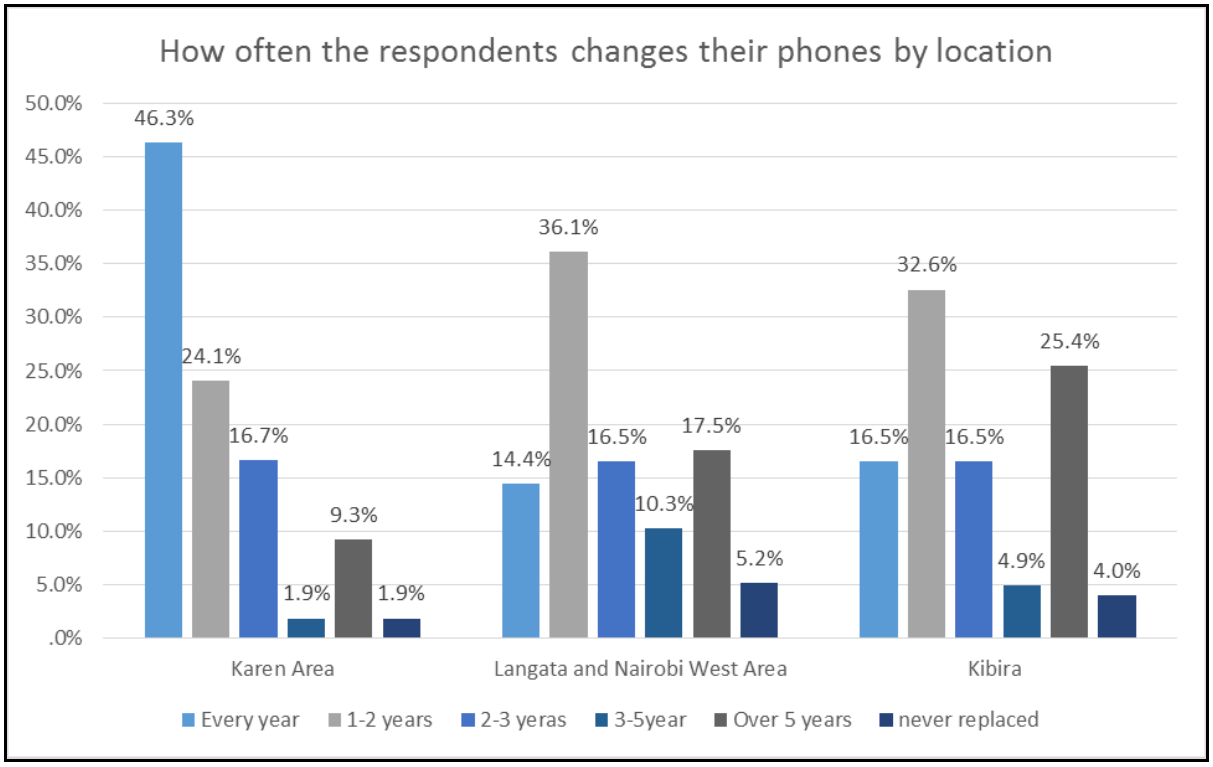


Chart 4-4: Frequency of change of mobile phones by the respondents by location
Source: Researcher (2015)

The degrees to which the different urban social classes consider different attributes when purchasing new phones, and towards disposal of the older phones was analysed. Respondents were asked the question, what do they consider in choosing a mobile phone and/or replacing your old phone? The options provided for the respondents were 1 to 5, with 1 representing the lowest degree in consideration and 5 the highest. **Table 4-10** shows the frequency of the respondents and the percentages (bracketed).

	Upper Class			Middle Class			Lower Class			Average
	N (%)			N (%)			N (%)			
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	
Functionality	4 (7.7)	0 (0)	48 (92.3)	6 (6.1)	1 (1)	91 (92.9)	11 (5.2)	1 (0.5)	198 (94.3)	5
Brand	7 (14)	3 (6)	40 (80)	14 (15.6)	9 (10)	67 (74.4)	62 (29.8)	8 (3.8)	138 (66.3)	4
Look	10 (21.3)	6 (12.8)	31 (66)	28 (30.4)	8 (8.7)	56 (60.9)	79 (41.6)	10 (5.3)	101 (53.2)	3
Application	10 (20.4)	1 (2)	38 (77.6)	9 (10)	7 (7.8)	74 (82.2)	72 (36.2)	16 (8)	111 (55.8)	4
Pricing	11 (22)	2 (4)	37 (74)	11 (12.2)	11 (12.2)	68 (75.6)	21 (9.7)	6 (2.8)	189 (87.5)	4
Advert	32 (68.1)	2 (4.3)	13 (27.7)	52 (59.8)	7 (8)	28 (32.2)	136 (70.1)	21 (10.8)	37 (19.1)	2
Design	16 (34)	6 (12.8)	25 (53.2)	28 (31.5)	13 (14.6)	48 (53.9)	89 (43.6)	24 (11.8)	91 (44.6)	3
Battery	2 (4.1)	3 (6.1)	44 (89.8)	7 (7.8)	4 (4.4)	79 (87.8)	13 (6.5)	9 (4.5)	179 (89.1)	5
Display	20 (41.7)	7 (14.6)	21 (43.8)	35 (39.8)	13 (14.8)	40 (45.5)	131 (67.2)	11 (5.6)	53 (27.2)	3
Internet	7 (13.7)	2 (3.9)	42 (82.4)	6 (6.7)	6 (6.7)	78 (86.7)	87 (40.8)	30 (14.1)	96 (45.1)	4
Camera	8 (16.7)	4 (8.3)	36 (75)	10 (11.4)	15 (17)	63 (71.6)	85 (40.9)	25 (12)	98 (47.1)	4
Music	11 (22.4)	5 (10.2)	33 (67.3)	23 (25)	15 (16.3)	54 (58.7)	73 (35.4)	30 (14.6)	103 (50)	3
Warranty	15 (31.9)	5 (10.6)	27 (57.4)	25 (31.6)	3 (3.8)	51 (64.6)	87 (50)	12 (6.9)	75 (43.1)	3

Table 4-10: Respondents consideration in choosing a mobile phone and/or replacing old phone. Source: Researcher (2015)

The study also established that the lower class changes the phones more often than the middle class. Incidentally, respondents across the board did not consider warranty and advertisements among their top choices.

The study established that *advances in mobile phone technology*, with new phones regularly coming into the market, especially with the influx of smart phones, causing the members of the upper class to be attracted more to the look and feel of new releases. Aside from that, many of these individuals pledge *loyalty to specific brands of phones*, usually smart phones, and with specific operating systems, such as the iOS or the Android, alongside *internet*, *functionality* and *battery life*. The middle class focus more on the *functionality* of the phone and *battery life*, *internet* and the available *applications*, but also still driven by commitment to certain brands. *Pricing* remains an important aspect of their purchase, probably due to the midlevel purchasing power. The lower class, on the other hand, highlights *functionality*, *pricing*, and *battery life* as key to their purchasing potential. The high consideration given to pricing is likely due to their low purchasing power, therefore focus more on affordability.

Advertisements were considered least across the all the areas, with 68% of upper class respondents giving it lower consideration compared to 60% in the middle class. The lower class recorded the highest percentage (70%), consideration of advertisements, when purchasing a phone.

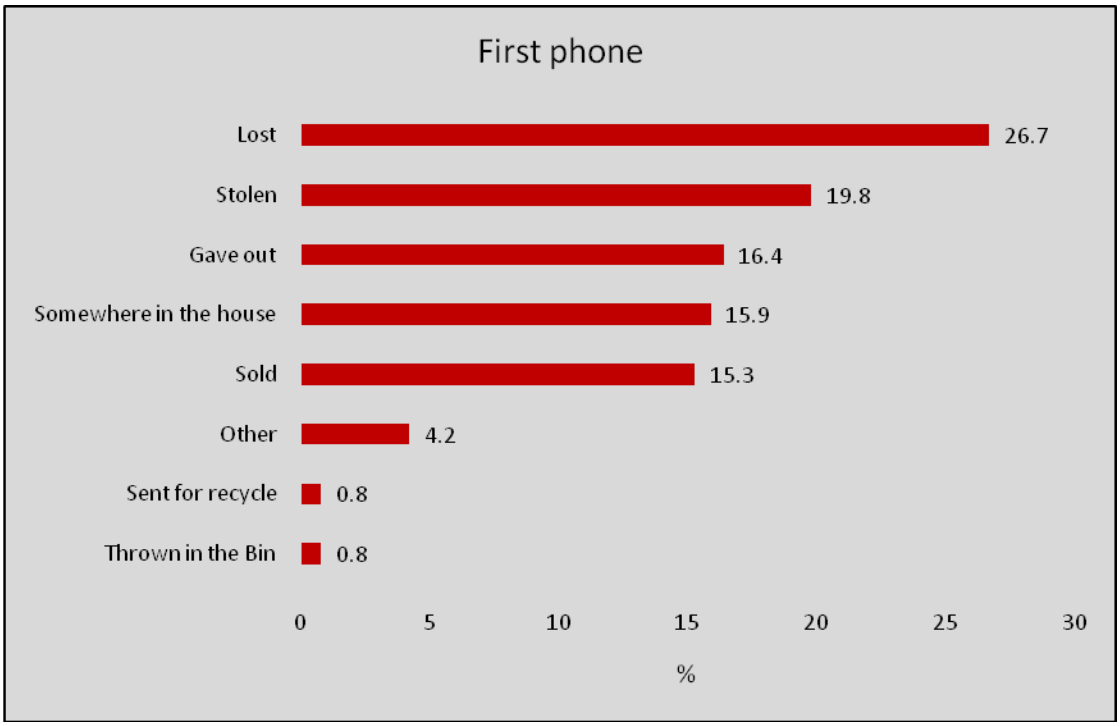
4.4 Mobile Phone Waste Disposal Practices

The study analysed the practises of mobile phone and accessory waste disposal.

4.4.1 Mobile Phone e-Waste Disposal

The respondents were asked the mode of disposal of their first mobile phones and the last ones that they had used. **Chart 4-5** presents the fate of the first phone owned by the consumers. 26.7% of the respondents indicated that they had *lost the phone*, followed by

19.8% who stated that their phones had been *stolen*. Well, it is possible that the phones reported as lost may have as well have been stolen. As such, the pointers of lost and stolen may as well to offer a convergence that a majority of the lost phones where either lost or stolen. Examples on which there phones may have been lost or stolen included losses whilst using public transportation or walking along crowded areas through theft from handbags and pockets. Others lost their phones in robbery instances such as during carjacking incidences, burglary or house robbery instances. 16.4% of the respondents gave out the phones, either by passing them on to your children, workers, friends or relatives, while 15.9% still had the phones 'somewhere in the house'. 15.3% sold their phones. Less than one percent sent their phones for recycling (**Chart 4-5**).



Chat 4-5: Mode of disposal of the respondents' very first phone owned
Source: Researcher (2015)

On handling of their last phones, 25.3% reported giving out their phones followed by 24.7% who still had these phones 'somewhere in the house'. 17.6% reported losing their phones as stolen, compared to 15.4% who sold their last phones while 13.3% had lost their phones.

0.8% threw their phones in the bins. There were no respondents who reported taking their phones to recycling **(Chart 4-6)**.

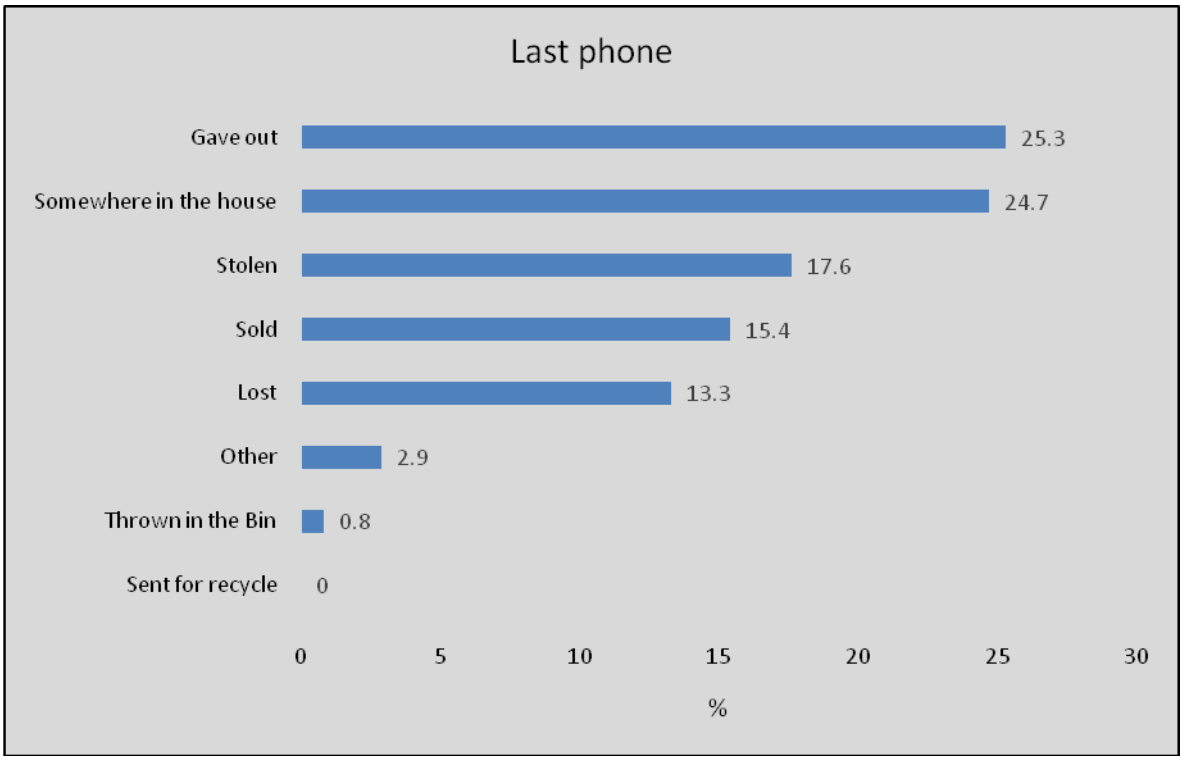


Chart 4-6: Mode of disposal of the respondents' very last phone owned.
Source: Researcher (2015)

4.4.2 Management of phone accessories

The respondents were asked what phone accessories they have changed in the course of using mobile phones (**Chart 4-7**). Across the board, *batteries* and *chargers* were the most commonly changed accessories, which 44% of all respondents reporting having ever changed their batteries, and 42.2% reporting changing their phone chargers. 23.7% reported changing their *ear phones*, with a similar number changing their *phone screens*. 21.4% reported not changing any of their phone accessories. **Table 4-11** shows the changing of phone accessories by location.

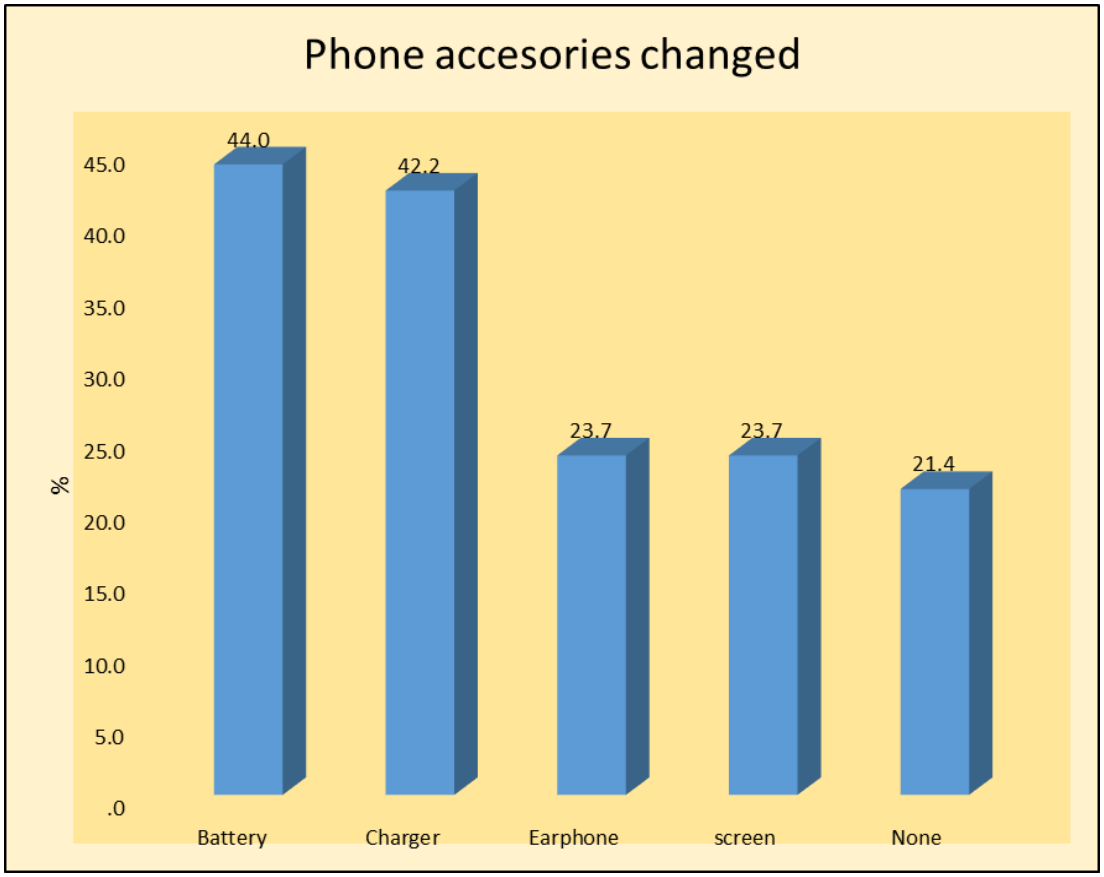


Chart 4-7: Representation of change of mobile phones' accessories

Source: Researcher (2015)

Phone accessories	Upper Class N (%)	Middle Class N (%)	Lower Class N (%)	Total N (%)
Battery	24 (44.4)	43 (43)	102 (44.3)	169 (44)
Charger	17 (31.5)	32 (32)	113 (49.1)	162 (42.2)
Earphone	17 (31.5)	22 (22)	52 (22.6)	91 (23.7)
Screen	11 (20.4)	34 (34)	46 (20)	91 (23.7)
None	17 (31.5)	24 (24)	41 (17.8)	82 (21.4)

Table 4-11: Phone accessories changed by location

Source: Researcher (2015)

A near similar percentage of respondents reported changing their batteries across the locations, with 44.4% in the upper class, 43% in the middle class and 44.3% in the lower class. More respondents, 49.1% however, changed their chargers in the lower class, compared to 32% and 31.5% in the middle and upper classes respectively. Earphone changes were higher in the upper class, 31.5%, compared to 22% and 22.6% in the middle and lower classes respectively. The screens reported higher changes in the middle class, 34%, compared to 20.4% in the upper class and 20% in the lower class.

4.4.3 Phone Repairs and Disposal of Spoilt Phones

The study sought to determine the treatment of spoilt mobile phones, whether the respondents took them for repair or simply discarded them, and the successes of the repairs of phones taken to mobile phone technicians. The responses are presented in **Chart 4-8**, below. 72% of the respondents reported ever taking their phones for repairs to different technicians or back to the manufacturer's repair stores, compared to 28% who did not send the phones for repairs, for various reasons, mainly the belief that the phones were irreparable. 91% of those who took their phones for repairs reported successful repairs to the phones, while 9% had the phones regarded as irreparable (**Chart 4-9**).

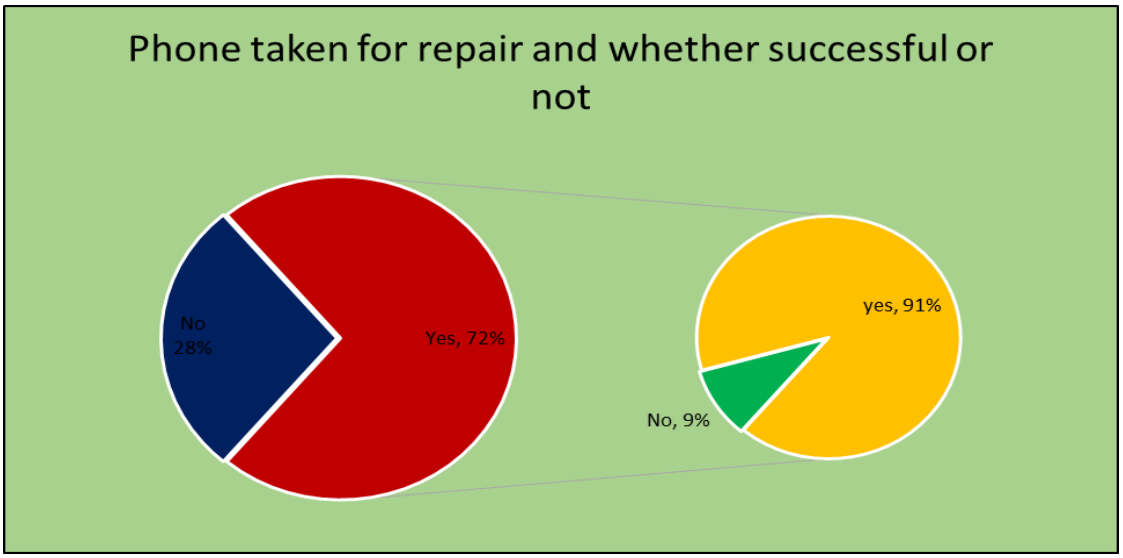


Chart 4-8: Repairs of mobile phones and the successfulness of repairs

Source: Researcher (2015)

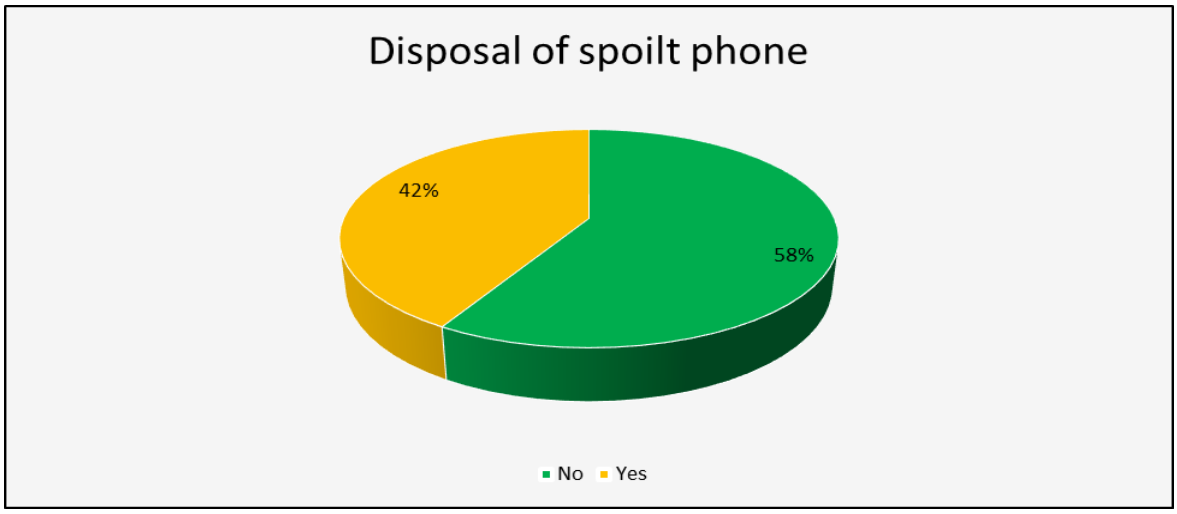


Chart 4-9: Percentages of respondents who have disposed of mobile phones
Source: Researcher (2015)

When asked if the respondents had ever disposed the spoilt mobile phones, 42% reported doing so. On the discarded phones, 52.2% of the respondents *threw these phones in the normal dustbins*, while 34.65 *gave them out*. 10.1% *sold* the phones. 1.9% reported sending their phones for *recycling*, while 1.3% reported throwing them in a separate set aside for electronic waste only. **Chart 4-10** shows the modes of disposal of mobile phones used by the respondents.

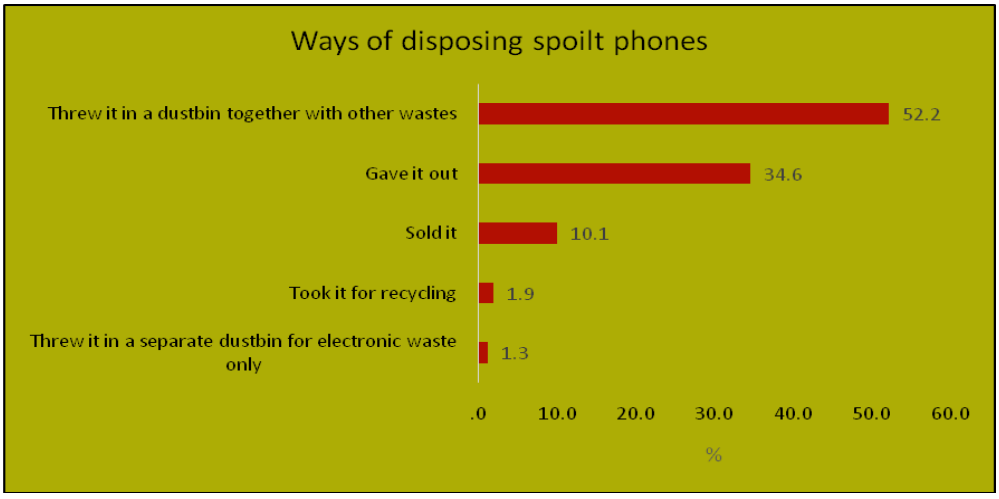


Chart 4-10: Ways used by respondents in disposing of mobile phones
Source: Researcher (2015)

One the ways of disposing these mobile phones in the different socio economic realms, over 55.3% of all low class respondents reported throwing the spoilt phones in the regular dustbins alongside other wastes, compared to 50% in the upper class and 46.5% of the middle class. The middle class, 46.5%, reported giving out their spoilt mobile phones, compared to 36.4% in the upper class and 28.7% in the lower class. 11.7% of the lower class sold the spoilt phones, compared to 9.1% of the upper class and 7% of the middle class. The upper class reported a considerable higher percentage, 4.5%, – compared to the other classes – on the use of special electronic bins, compared to 0% in the middle class and 1.1% in the lower class. On recycling, only the lower class registered any respondents, 3.2%, with the other classes registering none. (**Chart 4-11**).

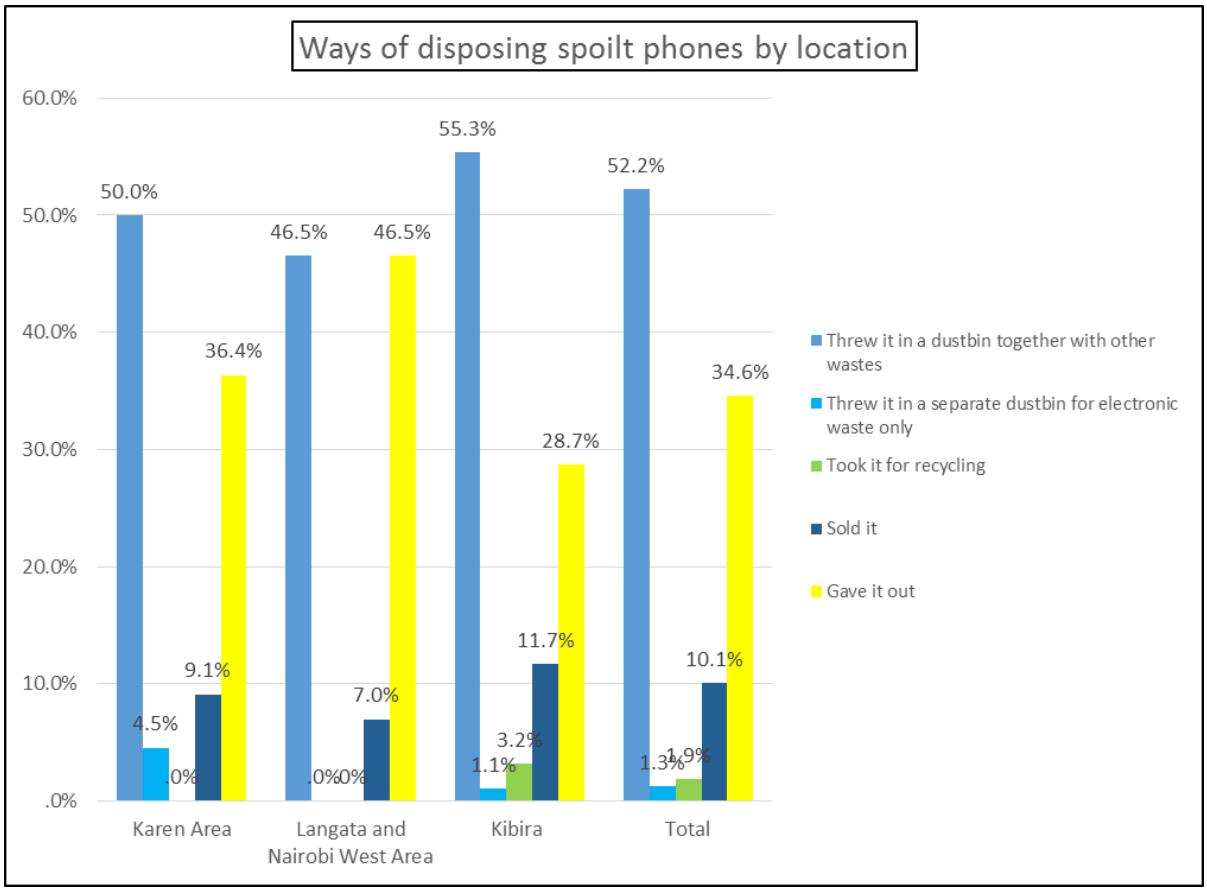


Chart 4-11: Ways used by respondents in disposing of mobile phones by location
Source: Researcher (2015)

4.4.4 Disposal of Phone Accessories

More respondents, 56%, reported disposing their phone accessories compared to 44% (**Chart 4-12**). More respondents therefore reported disposing of mobile phone accessories compared to the 42% that reported disposing the spoilt mobile phones.

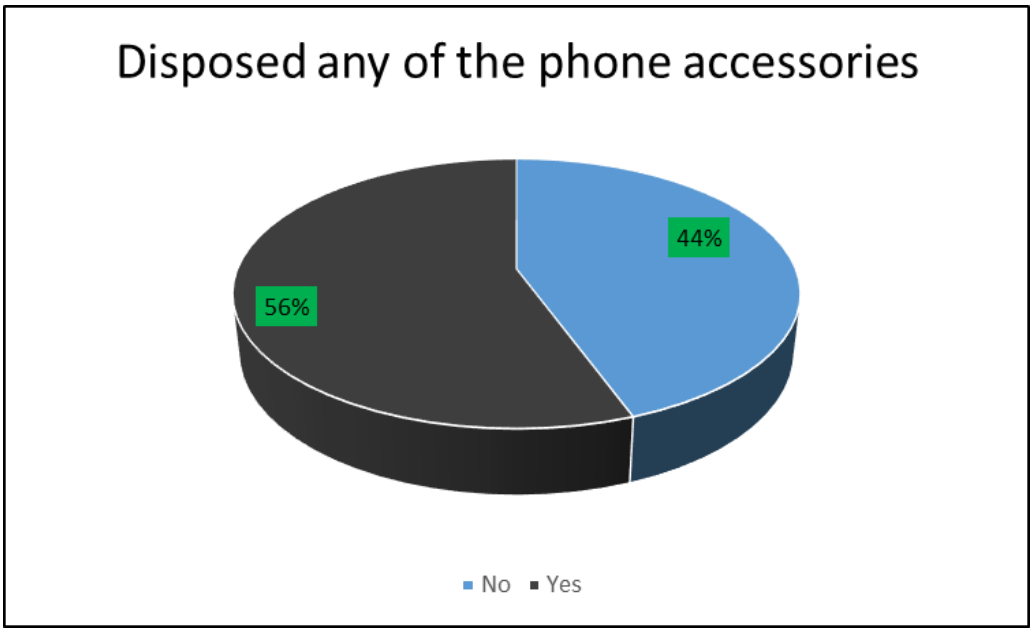


Chart 4-12: Percentages of respondents who have disposed of mobile phones' accessories
Source: Researcher (2015)

77.9% threw these accessories to the regular dustbins, alongside other wastes, compared to 12.2% who gave them out and 5.6% who sold them. 2.8% mentioned that they threw these in separate dustbins for electronic wastes while 1.4% reported taking them for recycling (**Chart 4-13**).

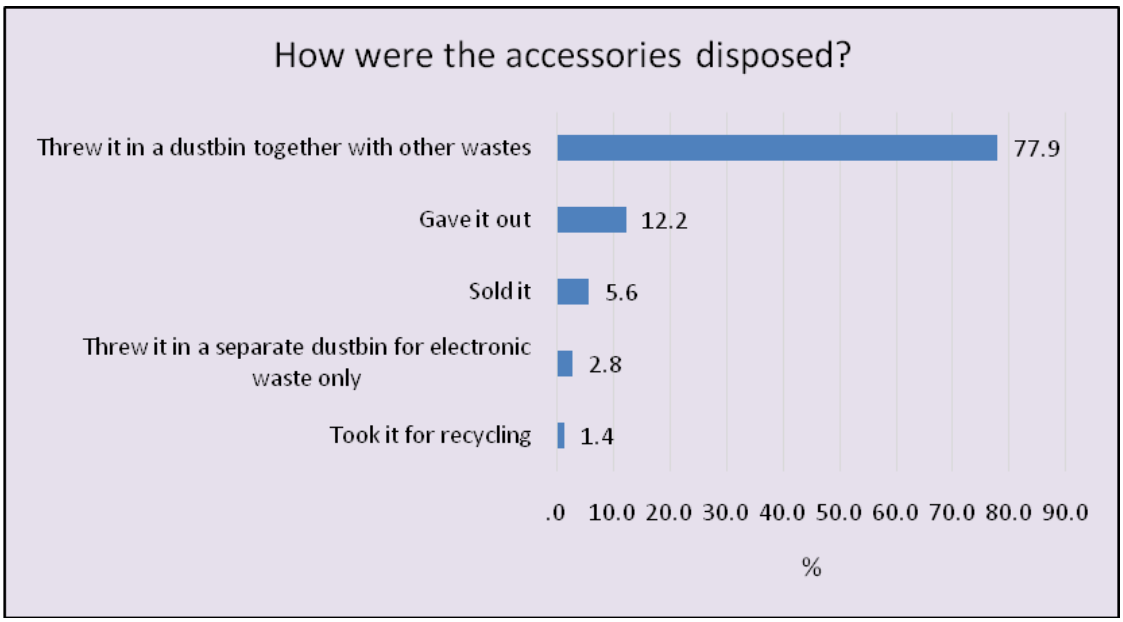


Chart 4-13: Ways used by respondents in disposing of mobile phones' accessories

Source: Researcher (2015)

4.5 Knowledge of e-waste, safe disposal and the laws governing e-waste management in Kenya

The study sought to determine the consumers' knowledge of electronic waste, safe methods of electronic waste disposal and the laws governing electronic waste disposal.

4.5.1 Knowledge of electronic wastes or waste electrical and electronic waste equipment

The respondents were asked if they knew what e-waste or waste of electronic equipment was. A majority, 55% percent of respondents reported that they did not know what these were, against 45% who indicated knowledge (**Chart 4-14**).

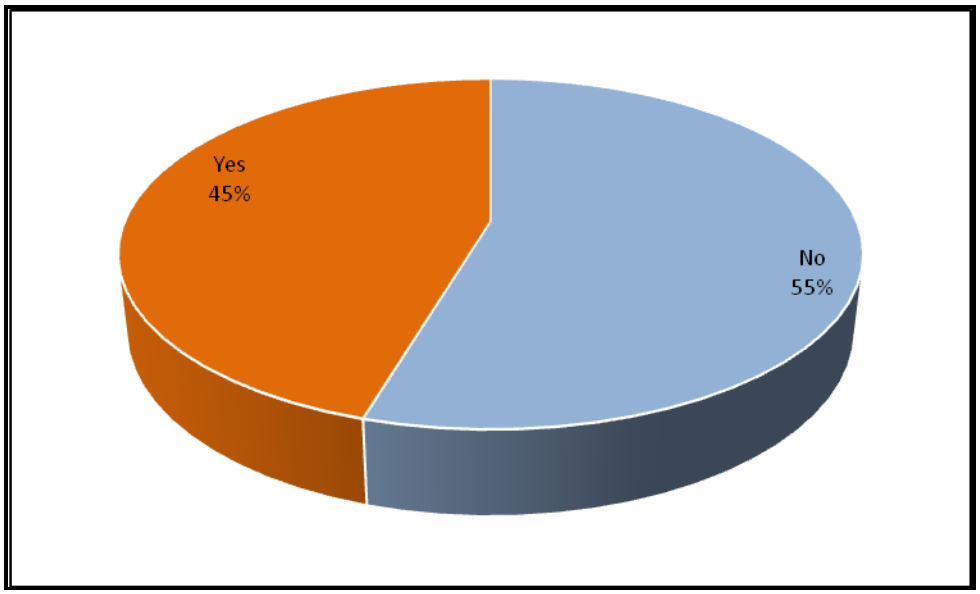


Chart 4-14: Percentile representation of the knowledge of electronic wastes or waste electrical and electronic waste equipment

Source: Researcher (2015)

The lower class indicated least knowledge on what electronic wastes are, at 36.7%. The knowledge of the middle class was just slightly higher than the upper class, at 59.8% compared to 57.4%. It may thus be inferred that education levels plays a key role in the knowledge and information on electronic wastes, as the lower class recorded lower levels of education as well. By and large, almost 60% of the middle and upper class populations know what electronic wastes are (**Table 4-12**).

Do you know what e-waste or waste of electrical and electronic equipment is?		Upper Class	Middle Class	Lower Class	Total
	No	23 (42.6)	39 (40.2)	145 (63.3)	207 (54.5)
	Yes	31 (57.4)	58 (59.8)	84 (36.7)	173 (45.5)
	Total	54 (100)	97 (100)	229 (100)	380 (100)

Table 4-12: Knowledge of electronic wastes or waste electrical and electronic waste equipment by location

Source: Researcher (2015)

4.5.2 Recycling

The study sought to know how much the respondents knew about recycling of electronic wastes, presented in **Chart 4-15**. 46.2% of respondents reported knowing nothing, while 25.9% stated knowing very little on the subject. 20.3% of the respondents reported knowing moderately while 7.7% indicated knowing very much about the recycling.

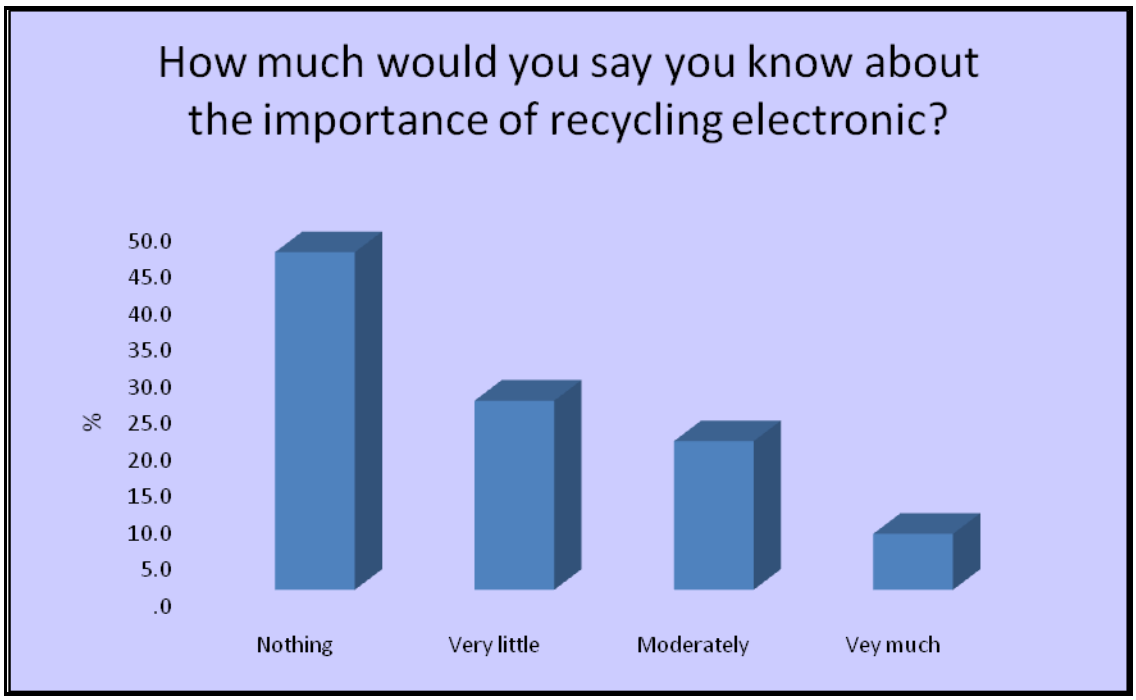


Chart 4-15: Knowledge of recycling by the respondents
Source: Researcher (2015)

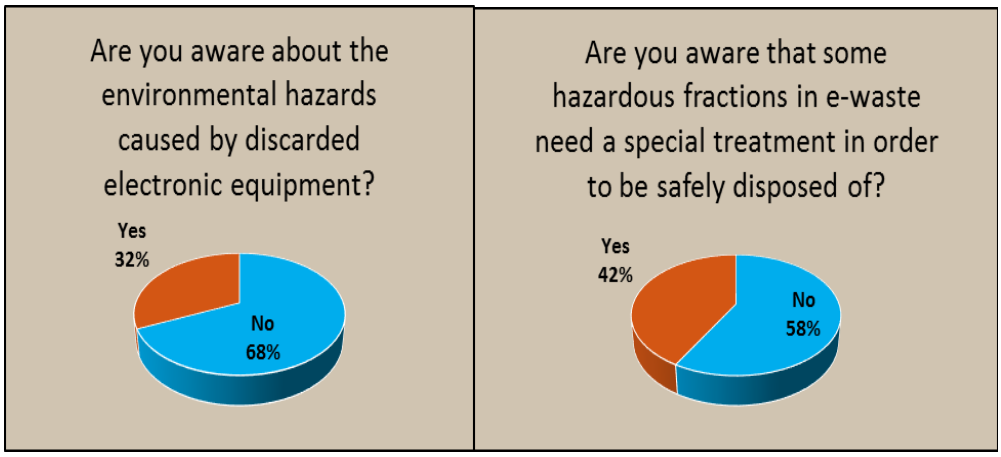
As **Table 4-13** shows, breaking down the number across the populations, over 50% of the low class population indicated that they knew *nothing* about the importance of electronic wastes recycling. The actual percentage of this group was 55.5%, while the middle and upper classes against reported similar ranges, at 32% for the middle class and 31.5% for their upper class counterparts. These proportions were also mirrored among the respondents who knew *very little* about the importance of the recycling. 26.2% of these respondents belonged to the lower class, compared to 25.8% and 24.1% in the middle and upper classes respectively.

How much would you say you know about the importance of recycling electronic?		Upper Class	Middle Class	Lower Class	Total
	Nothing	17 (31.5)	31 (32)	127 (55.5)	175 (46.1)
	Very little	13 (24.1)	25 (25.8)	60 (26.2)	98 (25.8)
	Moderately	20 (37)	31 (32)	27 (11.8)	78 (20.5)
	Very much	4 (7.4)	10 (10.3)	15 (6.6)	29 (7.6)
	Total	54 (100)	97 (100)	229 (100)	380 (100)

Table 4-13: Knowledge of the importance of recycling by location
Source: Researcher (2015)

Consequently, the numbers of those who reported knowing very much or moderately on this matter were higher among the middle and upper classes compared to the lower class. The reports on knowing *very much* on the matter included 10.3% in the middle class, 7.4% in the upper class and 6.6% in the low class. Those who reported *moderate* knowledge included 37% in the upper class and 32% in the middle class. The lower class moderate knowledge was supported by 11.8% only.

On awareness about the environmental hazards caused by discarded electronic equipment, 68% of respondents were not aware of these hazards compared to 32% who knew **(Chart 4-16)**. A higher percentage, 58% were also not aware that some hazardous fractions in e-waste need special treatment in order to be safely disposed of **(Chart 4-17).**



Charts 4-16 & 4-17: Awareness of environmental hazards caused by discarded electronic equipment and the awareness that some hazardous fractions in e-waste need treatment before disposal

Source: Researcher (2015)

By location, more than 50% of respondents in all locations indicated that they were not aware of the environmental hazards caused by discarded electronic equipment. This number on lack of awareness was highest in the low class, at a whopping 78.2%, and at 52.7% and 53.7% in the middle and upper classes respectively (**Table 4-14**).

Are you aware about the environmental hazards caused by discarded electronic equipment?		**Upper Class N (%)**	**Middle Class N (%)**	**Lower Class N (%)**	**Total N (%)**
	No	29 (53.7)	49 (52.7)	179 (78.2)	257 (68.4)
	Yes	25 (46.3)	44 (47.3)	50 (21.8)	119 (31.6)
	Total	54 (100)	93 (100)	229 (100)	376 (100)

Table 4-14: Awareness about the environmental hazards caused by discarded electronic equipment by location

Source: Researcher (2015)

The respondents were asked if they were aware that some electronic parts, specifically of mobile phones, may be profitably recycled. **Chart 4-18** shows that 75% responded in the affirmative.

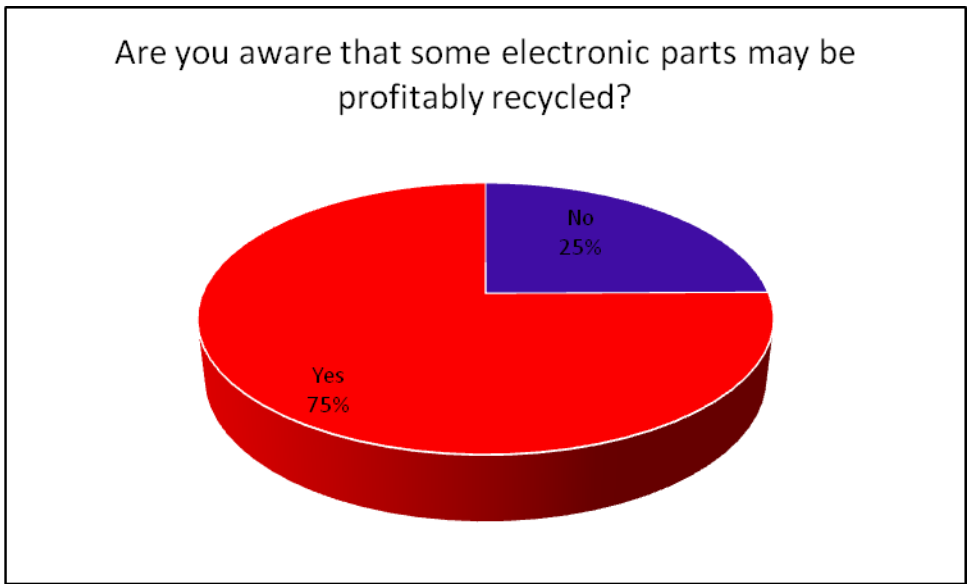


Chart 4-18: Awareness of possibilities of recycling of parts of electronics
Source: Researcher (2015)

4.5.3 Waste Collection

The respondents were asked to indicate the presence of waste collectors in their areas, to which 86% responded to the affirmative (**Chart 4-19**).

Chart 4-19: Presence of waste collectors in all areas. Source: Researcher (2015)

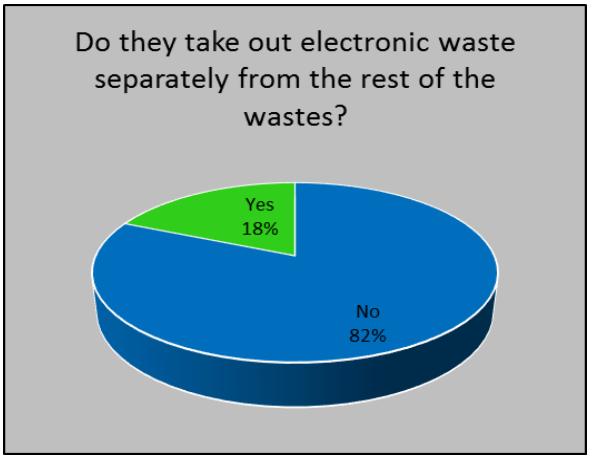


Chart 4-20: Separation of electronic wastes from other wastes. Source: Researcher (2015)

The waste collectors, however, generally, do not offer only form of separation of the wastes, specifically, separating electronic wastes from the other household wastes. Only 18% reported that separation of these wastes (**Chart 4-20**).

4.6 Knowledge of Laws Governing Electronic Wastes Management

The study sought to know if the respondents know any organisations that regulate the management and/or disposal of electronic wastes. Cumulatively, 88.5% of the respondents did not know to which authority or authorities the responsibilities of electronic waste management, specifically from mobile phones, were bestowed. They were also asked about their awareness of any laws governing electronic waste management in Kenya, to which equally high numbers of 90.1% reported lack of awareness of these laws. Their knowledge of the Communications Authority of Kenya (CA) was tested. 60.7% of the respondents were not

aware of the regulatory authority, compared to 39.3% who did. These results are presented on **Table 4-15**, below.

Waste management knowledge and awareness	**N**	**Yes N (%)**	**No N (%)**
Do you know any organisation that regulates the management / disposal of mobile phone waste?	384	44 (11.5)	340 (88.5)
Are you aware of any laws governing electronic (mobile waste) management in Kenya?	374	34 (9.1)	340 (90.1)
Do you know the Communications Authority (CA) of Kenya	374	147 (39.3)	227 (60.7)
Are you aware of any mobile waste recycling programme in Kenya	375	23 (6.1)	352 (93.9
Would you offer your old mobile phones and accessories for recycling?	379	333 (87.9)	46 (12.1)

Table 4-15: Awareness of organisations that regulate e-wastes, governing laws, recycling programmes in Kenya and willingness to recycle.

Source: Researcher (2015)

4.6.1 Knowledge of mobile phone recycling in Kenya

The respondents were asked if they were aware of any mobile phone recycling programmes in Kenya, and 93.9% did not know of any programmes. Only 6.1% mentioned knowing of the existence of such programmes, but a majority could still not go ahead to list them.

4.6.2 Willingness to give phones for recycling

A majority of respondents, 87.9% had a positive attitude towards offering their phones for recycling, and were quick to point out that they would gladly do this if offered any form of incentive or a small reward. However, 12.1% stated categorically that they would not give away their phones for any recycling programme.

4.7 Discussion

The objectives of this study were to establish the causes of mobile phone wastes among urban consumers, to determine the modes of disposal of e-wastes from mobile phones, to determine urban consumers' awareness of safe measures of e-disposal and laws governing electronic waste management in Kenya and to establish the factors influencing mobile phones electronic waste production and management in Kenya. This section discusses the findings of the results obtained, and related them to other studies conducted in relation to the objectives of the study.

4.7.1 Causes of mobile phone e-wastes production in urban Kenya

The electronic wastes generated by mobile phones are considerably lower compared to other electrical and electronic equipment including computers, monitors, hard copy devices, keyboards and mice and televisions (ETBC, 2014). Nevertheless, the numbers of mobile phones has continued to increase across all regions (Ericsson, 2014) including in developing countries. This study confirmed that a number of respondents own more than one phone, with the second phone in a functional state even if for not for regular usage, just like in other developing economies. There is, however, a significant difference in the numbers of phones owned across the social classes, with more respondents in the high class owning more than one phone, compared to the middle class, and further down to the lower class. This is an indication that economic power among the population plays a key role in the number of phones owned, and that more affluent consumers are likely to own more phones compared to the less affluent ones.

It was noted that the majority respondents generally changed their phones every two years. There therefore seems to be recurring patterns in the duration it takes for the populations of both developed and developing economies to change their phones, with the developing countries following the patterns seen in the developed world a decade earlier. Literature showed that the Australian, for instance, changes their phones every one and half to two

years (ARP, 2001), which compares favourably to the patterns experienced among the respondents as at the time of this study (2015).

The study looked at the possible reasons for the significant differences in the phone change patterns. To do this, the study sought to know what the respondents looked at when purchasing new phones, and with that, contributing to the sources of mobile phone wastes from the replaced phones. The upper class generally considers functionality, brand of the phone, look and feel and internet as the keys to their purchases. The middle class focus on functionality, internet and pricing, while the lower class has pricing as its first priority, alongside functionality and battery life. This is because as they focus on affordability, they have to settle on cheaper less durable phones which have to be replaced after considerably shorter periods.

Actually, in the book *A Whole New Mind: Why Right–brainers will Rule the Future* by Daniel H. Pink, the author discusses four 'ages' Agricultural Age (farmers), Industrial Age (factory workers), Information Age (knowledge workers) and Conceptual Age (creators and empathizers), urging that the world is moving from the Information Age to the Conceptual Age. Pink points out those consumers have numerous choices and that trends are moving beyond matters such as *functionality* to engaging the *senses*. He refers to this as *Design*! If this is anything to go by, then it explains the increasing growth in the smart phones and their stylish designs which are appealing to most consumers. This study revealed that over 50% of consumers highly consider *look and design* of their phones.

4.7.2 Factors influencing mobile phones electronic waste production and management in Kenya.

A number of factors stood out as influencing consumer patterns and behaviour in their production and management of the electronic wastes from mobiles in Kenya, from their choice of purchases of the phones, and/or need to change into new phones, disposal of the phones and their knowledge of recycling and laws governing the management of the waste products in Kenya. These factors centred on their economic abilities of the various

respondents which influenced their social status and residential locations, either in the more affluent areas, or in the upper or lower classes of the society. The following are the factors that stood out as influencing these patterns:

4.7.2.1 Socio-economic status and mobile phone e-waste production

Recall that in the analysis of the turnover of mobile phones, or how often the respondents replaced their phones, over half the respondents reported replacing their phones every two years. However, on the social class clusters, about 50% of the upper class reported changing their phones each year, compared to other classes. And while this may be attributed largely to the economic potential, the social status are highlighted as well by the fact that the upper class reported higher concentration in brand consideration, at 80%, compared to 76.4% in the middle class and 66.3% in the low class. The choice of phone continues to be a status symbol in the society, which more elaborate smart phones being the choice of the majority of the upper class.

On the contrary, the lower class also reported higher margins of phone turnaround time, well below the upper cadre, but marginally higher than the middle class. These figures were at 16.4% of the lower class changing their phones every one to two years compared to 14.4% in the middle class. The reasons adduced for these changes were based on less durability of phones purchased by the lower class, which focused more on the affordability of phones, thereby settling on much cheaper yet less durable phones. With the higher populations of the lower class therefore, that is about 60% of the population, there is certainty of higher releases of waste mobile phones into the environment.

4.7.2.2 Education levels and mobile phone e-waste production

While analysis the education levels of the respondents, education levels were seen to be higher in the upper classes compared to the low class. About 50% of the respondents in the upper and middle classes went through university, compared to only 1.3% of the slum residents who also reported lower numbers in the tertiary colleges (5.7%) compared to 20% and 27% in the upper and middle classes respectively. While analysis the knowledge of the consumers on electronic wastes, the upper classes reported higher knowledge, at 57.4% for

the upper class and 59.8% for the middle class compared to 36.7% for the lower class. As such, the higher classes, with higher education levels, are more likely to take cognizance of mobile phones as electronic wastes and consider better treatment on them, compared to the low class.

4.7.2.3 Sentimental attachment and mobile phone e-waste production

The study pointed out that a number of users across the social divide still held on their non-functional phones and listed sentimental attachment to their phones as the reasons for not disposing of the waste phones. As such, many consumers still have either spoilt phones or alternative phones somewhere in the house for the reasons of attachment to them. This therefore limits the number of waste mobile phones that would ideally be disposed and or made available for mobile recycling programmes.

4.7.2.4 Low Awareness of Laws Governing Electronic Waste Management

The study revealed that 90.1% of the respondents did not know any laws governing electronic wastes in Kenya while 88.5% of the respondents did not know to which authority or authorities the responsibility of electronic waste management was bestowed. The National Environmental Management Authority (NEMA) represents the government of Kenya in the implementation of environmental policies in Kenya and has a host of laws to uphold the integrity of the environment, including the effects of the electronic wastes and their management. The Communications Authority of Kenya, on the other hand, is the regulatory authority for the communications sector in Kenya and responsible for facilitating the development of the Information and Communications sectors including; broadcasting, multimedia, telecommunications, electronic commerce, postal and courier services.

In summary, many of the factors affecting the production and management of electronic wastes from mobile phones are cross cutting and interrelated, for example in the economic strengths of different groups which may also reflected on the social status of the communities. These bring about different levels of production based on varied reasons, and different approaches in the management of waste mobile phones. The economic power of the different classes also reflected on the education levels among the social classes. This is noted,

particularly in the slums which registered a higher numbers in primary education, which is generally free in Kenya public schools, with the number diminishing up the academic ladder, which is costlier and less affordable for the low class communities. The education levels have cascaded in the knowledge of the people on the importance of recycling, impinging on the lower cadre compared to the middle and higher classes. There were hover low knowledge of recycling programme in Kenya across the divide, which may be attributed to actually low numbers of these programmes and lower campaigns on the recycling, as well as other laws governing recycling of electronic wastes in Kenya.

4.7.3 Mobile Phone Waste Disposal Practices in Kenya

Namias (2009) points out the discarded electronic wastes comprise the fastest growing waste stream in the United States. In Kenya, low levels exist in the direct disposal of electronic wastes, especially mobile phones where hoarding remains a practice of most consumers. These phones are either 'somewhere in the house', reported as lost or stolen, given out, thrown in the bin and less than 1% reported as taken for recycling. In the case of the study, a 25% reported giving out their old phoned while 24.7% reported having their old mobile phone 'somewhere in the house'. 13.3% reported them as lost and 17.6% as stolen. Less than one percent reported throwing their old phones to the bin or recycling them. These reasons can be compared with reasons adduced by the respondents, representative of a developing economy to Australia, a developed nation, as reported in the **Chart 4-21** below.

Generally, the key means of desposal among both economies is either by giving away or hoarding the phones 'somewhere in the house' (GSM, 2006). Well, more phones are still found in cupboards among the developing countries, as in the case of Australia, with 52% of Australians who still kept their phones in 2006, with higher percentage, 77% reported by Mobile Muster (2013). These figures are lower in developing countries, goining by the 24.7% recorded in the study. MobileMuster (2013) reported that a majority of Australians still stashed their phones in cupboards and drawers, seven years after the GSM (2006) report. The developing economies seem to follow similar patterns as followed by the developed

nations about a decade before. Suffice to note, however, that still, populations in developing economis prefer to give away their phones (25.3%) compared to 23% in the developed world.

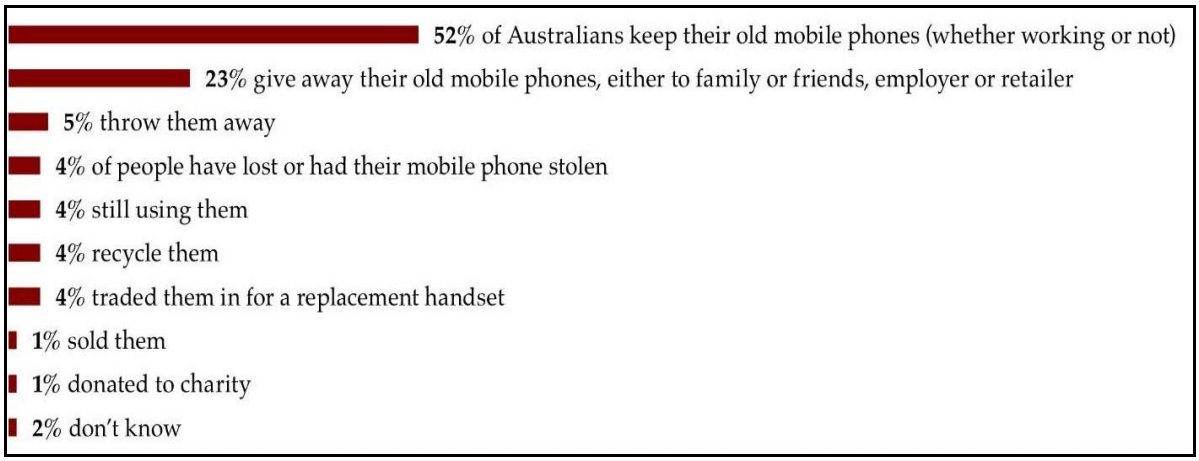


Chart 4-21: The general treatment of old mobile phones by consumers in Australia as at 2006.

Source: GSM Association

On preferrences to selling, more persons in the developing world, 15.4% reported selling their phones compared to only 1% in the developed world. It therefore seems that market for used phones were much greater in developing countries compared to developed countries where used phones are seldom bought. Actually, 5% of the respondents listed in the developed nations literally throw away their old phones compared to less than 1% in the developing world. More persons, 30.9% of the respondents of the developing nations reported losing their phones or having them stolen, cases which were not reported in the Australia.

On the practise of management of mobile phone accessories, the most disposed of accessories are the batteries, chargers, earphones and the screens. It apprears economic factors causes the lower class to settle for cheaper phones and accessories, thereby leading to high replacement levels, especially for the accessories regarded as critical such as the phone batteries and the charges. The upper class on the other hand, make regular changes on accessories ear phones possible indicating more usage of earphones in the upper class compared to the lower class.

4.7.4 Knowledge levels and laws governing e-waste management in Kenya

A majority of respondents are neither aware of safe disposal methods for electronic wastes nor the environmental hazards caused by the discarded electronic equipment. This dearth of information grows up the socio-economic ladder, in concurrence with Chopra *et al* (2007) that aspects of waste management vary according to different levels of socio-economic development of countries, alongside demographics, technological, political and religious aspects. It may thus be inferred that education levels plays a key role in the knowledge and information on electronic wastes, as the lower class recorded lower levels of education as well. It this therefore likely that while inasmuch as the entire population is at risk on the harmful effects of waste mobile phones, the lower cadre of the society is more vulnerable to these effects. Among those who presented awareness, however, the recurrent hazards mentioned were human health risks, particularly against children, and environmental damage, specifically on the soil pollution.

The EU though has the most advanced laws on electronic laws and legislations in the world (Abdelshafie, 2014) with higher rates of understanding of these laws among the citizens. Adelshafie (2014) shares the impact of the "Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment" (RoHS) to support enforcement and implementation of the policies using this directive (which took effect on 1st July 2006) as a guideline. The directive "aims to prevent the high volume of e-waste, reduce the hazardous materials in the electronic equipment, and create an efficient recycling system to solve the issue of electronics waste." The directive further points to the acceptable levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl and polybrominated diphenyl to the EU market. In support of these legislations, the EU governments have allocated a financial support in order to encourage producer to follow e-waste legislation and eliminate e-waste dumping (Zoeteman, Krikke, & Venselaar, 2010).

4.7.5 Electronic Wastes Recycling

In regard to Recycling, this study concurs with other studies (Namias, 2009; Jiang *et al* 2012) that the rate of recycling of electronic wastes is still low globally as in Kenya. 1.9% of the Kenyan city respondents reported ever taking their spoilt mobile phones for recycling, compared to 4% of the Australians. Be reminded though of the major recycling efforts spearheaded by Australia which as at 2012/2013 had over 4,000 free public drop-off points for phones, encouraging recycling (MobileMuster 2013). The country also encouraged posted by providing postage paid replies to consumers to post back their spoilt phones and accessories, thereby bringing about the 53% success rate in the collection of available phones. Unlike is Australia therefore, where 1,014 tonnes of mobile phone components, 7,791 million batteries and handsets plus more than 518,000 kg of accessories were collected, low levels of collection of electronic wastes as still experienced in Kenya.

Jiang *et al* (2012) reports that the global rate of e-waste recycling was at 13% and in the US for instance, ranging from 13.6% (ATMI) and 26% (EPA). Note though the references here are for all electronic wastes and not just mobile phones. Namias (2009) decries the lack of regulatory infrastructure as hindrance to e-waste recycling, a scenario shared by Kenya where regulatory frameworks on the management of electronic wastes have not been fully developed. Namias (2009), while calling for greater adoption of recycling, points to the various options of the end-of-life management of electronic wastes; including reuse of functional electronics, refurbishment and repair, reuse and recovery, end-processing for recovering materials and disposals. These options may be easily adopted for the management of electronic wastes from mobile phones, alongside other e-wastes, in Kenya. The general treatment of these wastes, as described by Namias (2009) include collection; sorting/dismantling/mechanical processing (such as shredding and magnetic separation); and end processing.

In spite of the low global rates of recycling, certain regions have greater advances in recycling. The EU, for instance, will seek to recycle at least 85% of electrical and electronics waste equipment by 2016 (Zoeteman, Krikke, & Vensellar, 2010) unlike Kenya, or the

regional economic communities to which the country belongs which do not have specific legislations on electronic waste management.

The MobileMuster Report (2013) highlighted the recycling efforts of Australia, indicating that the country has over 4,000 free public drop-off points for waste mobile phones. There have been heightened campaigns over the year to encourage the people to drop off these phones for recycling. An estimated 87 million tonnes of mobile phone components were collected, an estimated 1 million handsets and batteries were collected, and 38, 479 kg of accessories, all in one year. These were fruits of the campaigns carried out over a fifteen year period.

In Kenya, however, most respondents did not report knowledge of any known recycling programmes, with 93.9% indicating that they are not aware of any mobile phone recycling initiatives in Kenya. 1.9% of the Kenyan city respondents reported taking their spoilt mobile phones for recycling, compared to 4% of the Australians. What this means is that while the population of Australia has done a lot in recycling, there is still a rich niche of population yet to embrace recycling. It might be prudent to point out though that the mobile phone penetration in Australia in 2014 was reported at 133% (ACMA Communications 2012) compared to 75.4% during the same period in Kenya (CA, 2012). Nevertheless, during the same period, the numbers of phones reported in Australia were 30 million for a population of 22 million, and 28 million phones in Kenya (2 million less than Australia) for a population of 42 million. It therefore means that with increased campaigns, Kenya also provides a rich niche for recycling of mobile phones. All in all though, the gulf in the economic abilities of the two economies are higher, and as such, the relevant bodies may need to do a lot more, and offer certain incentives supporting recycling.

4.8 Electronic Waste Recycling Initiatives in Kenya

Certain initiatives have come up in support of electronic wastes in Kenya, mainly through the East Africa Compliant Recycling (EACR) and the Waste Electrical and Electronic Equipment Centre (WEEE Centre) in Nairobi. This study conducted a Key Informant Interview of The East Africa Compliant Recycling (EACR) establishment. The EACR was set up by the support of Dell and HP, in Mombasa in 2011 and later moved to Nairobi which the aim of increasing the numbers of waste collections. The manufactures, Dell and HP, assisted with the setting up of EACR in their environmental care initiatives of their Corporate Social Responsibility (CSR). To facilitate the collection of electronic wastes, the EACR has established collection centres in different areas in Nairobi including Dandora, Eastleigh, Kibera, Mukuru and at the Nakumatt Mega supermarket along Kenya's Uhuru Highway. **Plates 4-1** and **4-2** are pictures of the collected electronic wastes at the EACR premises.

Platess 4-1 & 4-2: WEEE consolidated by the EACR
Source: Researcher (2015)

With is main operation facility in Athi River Kenya, the company aims to offer total solution to the Waste Electrical and Electronic Equipment, including mobile phones. It focuses on orderly separation of different parts of the various electronic equipments, consolidating and bailing for exportation to the various companies that reclaim the high-tech wastes and isolate

precious metals and minerals from these parts. **Plate 4-3** shows different parts of electronic wastes, separated, bailed and weighed, ready for exportation.

Plate 4-3: WEEE separated, bailed and weighed for exportation by EACR
Source: Researcher (2015)

In June 2014, the Kenyan President signed into law regulations on disposal of e-waste, requiring that such disposals be made in licensed facilities. Such licensed facilities usually included collection and treatment centres, referred to as Designated Collection Facility (DCF) and Authorised Treatment Facility (ATF). As at May 2015, the EACR had participated in the drafting of an incoming legislation on the management of electronic waste. This legislation, upon coming into force, may be entrenched in the Environmental Management and Co-ordination Act (EMCA). The Act will see to it that manufacturers of all such equipment provide solutions to their imports as part of the Extender Producer Responsibility. NEMA, or other regulatory agencies, may thus be empowered to set up a monitoring system (watch tower) for all the electronic and electrical imports coming into Kenya, as well as track their disposal leading to their disposal. Is this vision is achieved, Kenya is expected to be one of the lead nations in Africa in the management of electronic wastes.

4.8.1 Role of the Communications Authority of Kenya

The Communications Authority of Kenya[10] is the regulatory authority for the communications sector in Kenya. Established in 1999 by the Kenya Information and Communications Act, 1998, the Authority is responsible for facilitating the development of the Information and Communications sectors including; broadcasting, multimedia, telecommunications, electronic commerce, postal and courier services. This responsibility entails: Licensing all systems and services in the communications industry, including; telecommunications, postal, courier and broadcasting; Managing the country's frequency spectrum and numbering resources; Facilitating the development of e-commerce; Type approving and accepting communications equipment meant for use in the country; Protecting consumer rights within the communications environment; Managing competition within the sector to ensure a level playing ground for all players; Regulating retail and wholesale tariffs for communications services; Managing the universal access fund to facilitate access to communications services by all in Kenya and Monitoring the activities of licensees to enforce compliance with the license terms and conditions as well as the law.

4.8.2 Implications for the National Environment Management Authority (NEMA) and the Environmental Management and Co-ordination Act (EMCA)

In Kenya, different ministries, authorities and organs play various roles in the management of environment in Kenya. Ministry of Environment and Mineral Resources is responsible for the overall management of the environment and tasked with different objectives including the provision of policy, legal and integrated planning framework for sustainable management of environment, water and natural resources. The National Environment Management Authority (NEMA)[11], is established under the Environmental Management and Co-ordination Act No. 8 of 1999 (EMCA) as the principal instrument of Government for the implementation of all

[10] Description of CA courtesy of the CA website.

[11] Description of NEMA and EMCA courtesy of NEMA website.

policies relating to environment. EMCA 1999 was enacted against a backdrop of 78 sectoral laws dealing with various components of the environment, the deteriorating state of Kenya's environment, as well as increasing social and economic inequalities, the combined effect of which negatively impacted on the environment. The supreme objective underlying the enactment of EMCA 1999 was to bring harmony in the management of the country's environment.

EMCA, 1999 provides for the establishment of an appropriate legal and institutional framework for the management of the environment and related matters. It is a framework environmental legislation that establishes appropriate legal and institutional mechanisms for the management of the environment. It provides for improved legal and administrative co-ordination of the diverse sectoral initiatives in order to improve the national capacity for the management of the environment. This is in view of the fact that the environment constitutes the foundation of national economic, social, cultural and spiritual advancement.

CHAPTER FIVE
SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

This study focused on the disposal of electronic wastes in Kenya, specifically in the Lang'ata Area of the capital city, Nairobi. The objectives were to determine the following: sources of mobile phone wastes among urban consumers; the modes of disposal of e-wastes from mobile phones; consumers' awareness of safe measures of e-disposal and laws governing electronic waste management in Kenya; and, the factors influencing mobile phones electronic waste production and management in Kenya.

It was established that a majority of respondents across all locations (52.6%) replaced their phones every two years. The socio-economic status however played a significant role in the sources of electronic wastes, with the upper class expressing a higher turnaround time in the use of mobile phones compared to the middle and lower classes. This was attributed to the economic might of the upper class and their ability to afford new phones. The main reasons attributed to upper class higher rates of disposal were mainly the introduction of newer and/or updated brands to the market and functionality of their mobile phones. The middle class rate of disposal was considerably lower than the middle class, and they considered functionality and battery life and key to their use and disposal of mobile phones. The lower class on the other hand, had a lower rate of disposal compared to the upper classes but a majority still disposed of their phones within two years. They mainly considered pricing as key to their usage and disposal, alongside battery life.

On the practise of disposal of the End of Life (EoL) mobile phones, a majority of respondents (52%) threw the EoL phones to the general waste bins alongside other household wastes, while a considerable high number (35%) gave out their spoilt phones to secondary parties. Few respondents (10%) sold their completely damaged phones while an insignificant

number (2%) took their EoL phones for recycling and an even lower number (1%) disposed them in waste bins set for electronic waste disposal.

On the disposal of damaged or secondary phones, not necessarily EoL, most respondents either gave out (25%) their damaged phones to secondary users or still held them somewhere in the house (25%). The other means of disposal of damaged phones were that the phones had either been stolen (18%) or sold (13%) to third parties. Fewer respondents (13%) reported losing their phones while a minority (less than 1%), if any, reported throwing these phones to the bins or sending them for recycling. On the phone accessories, the most disposed accessories were the phone batteries (44%) and the chargers (42%). Others included the ear phones and broken screens 9both at 24% each). Almost 80% of respondents threw away the accessories in the waste bins alongside other wastes. Other means of disposals of these accessories were giving them out (12%) and selling (6%). Insignificant proportions threw these wastes in separate bins for e-waste disposal or took them for recycling.

On the awareness of safe measures of electronic waste disposal and laws governing electronic waste management in Kenya, a majority (55%) of the respondents reported that they did not know what electronic wastes were. Among those who had information on electronic wastes, the upper and middle classes registered higher percentages (43% and 40% respectively) compared to 63% of the lower class population. Regarding the laws on electronic wastes, 90% of respondents pointed out that they were not aware of any laws of e-waste management. The majority, 88%, also reported that they did not know the organisations which were responsible for the management of electronic wastes in Kenya.

On the awareness of environmental hazards caused by discarded electronic equipment, a majority of respondents (68%) indicated ignorance on the hazards. Among those who knew that electronic wastes were hazardous, a majority (58%) did not know that hazardous fractions in electronic wastes needed treatment in order to be safely disposed of.

On recycling, about half the respondents (46%) reported knowing nothing about recycling, compared to 26% who knew very little on the subject. 20% who knew moderately while 8% reported knowing very much on recycling. In these instances, the upper and middle classes registered higher numbers compared to the low class. Incidentally, a majority of the respondents, 75%, were aware that electronic parts from damaged mobile phones could be profitable recycled. Among those who had some sought of knowledge on recycling, 94% reported lack of awareness on any mobile waste recycling in Kenya. Nevertheless, almost 90% of the respondents expressed willingness to give away their phones for recycling.

5.2 Conclusions

Through a developing economy, Nairobi is considered a techno-city, with one of the best developed Information and Communication Technology sector in Africa. The use of mobile phones has spurred the integration of technology in the day to day lives of the people of Nairobi, and Kenya, where mobile phones are popularly used for money transfers, alongside the general use and later uses such as in the uptake of internet by consumers serviced by different service providers. The exponential growth in the mobile telephony market has generally complimented the uses of mobile phones.

The growth and penetration of mobile phones and mobile telephony services across the country has continued to grow and is expected to increase over the next years, as a result of a number of factors, including population growth, and increased ownership of mobile phones by younger generations such a children, as a result of the need for parents to keep in communication with their children and/or those under their care. Besides, manufactures have continued to appeal to the emotions of the consumers by the development of smarter phones, known as smart phones, which integrate more features, with more attractive functionalities and applications, and whose popularity and uptake continues to rise. Actually, it is reported that globally, the greater percentage of mobile phones sold are smart phones. The following conclusions may be drawn under the different objectives of the study.

5.2.1 Causes of mobile phone wastes among urban consumers

There are various causes and/or sources of electronic wastes from the mobile phones and their accessories. Generally, similar causes of waste production may cross cut across the different locations in an urban set up, but this happens at different levels, among the different social classes, and is influenced by the needs of the consumers. The study established that socio-economic status on consumers is responsible for the sources of wastes among consumers whereas the upper class, regarded as more economically empowered, have a higher rate of replacement of phones compared to the lower classes. Nevertheless, consumers hold to their non-functional phones attributed it to different reasons including sentimental attachment, hoarding, the desire and hope to find successful repairs of the phones and lack of attractive disposal means.

All in all, in the upper class, *advances in mobile phone technology*, especially the uptake of smart phones are leading to disposal of older phones which are increasingly being considered rudimentary. Other reasons are *loyalty to specific brands of phones*, *internet*, and *functionality* and *battery life*. The middle class focus more on *functionality* and *battery life*, *internet* and the available *applications*, and *pricing*. The low class, on the other hand, highlights *functionality*, *pricing*, and *battery life* as key to replacement of their phones.

5.2.2 Modes of disposal of e-wastes from mobile phones and their accessories

Consumers exhibited different patterns in the disposal of their waste mobile phones and mobile phone accessories. These patterns, though cross cutting across the various societal classes, are varied among the classes. The socio-economic and education levels play minimum role in the modes of disposal of mobile phones with the general similar modes of disposal across all populations, including throwing the EoL phones in general waste bins alongside other wastes, in addition to giving them out or selling.

Recycling of electronic wastes in Kenya is still at insignificant levels, and therefore a rich haven for programmes targeting recycling of waste mobile phones. The numbers of those

who prefer to sell their old phones is considerably higher compared to 1% in the developing world. This may be attributing to low income levels fuelling the need to cash in on old or waste mobile phones. Only 1% of the respondents in throw away their phones, compared to 5% in the developing economies such as Australia.

Meanwhile, mobile phone repairing is significant among consumers with 72% of the consumers reported ever taking their phones for repairs to different technicians or back to the manufacturer's repair stores, with 91% success rate.

5.2.3 Knowledge of e-waste, safe disposal and the laws governing e-waste management in Kenya

Educational levels among the population are key to the knowledge and disposal of electronic wastes. Nevertheless, a majority of the population still did not have an understanding on what electronic wastes or waste of electronic equipment are. A majority also expressed lack of knowledge the laws and management of electronic wastes. Most respondents have minimal knowledge on recycling and recycling initiatives with insignificant number of respondents not participating recycling. This is mainly attributed to low presence of recycling initiatives by the various stakeholders in the mobile telephone industry. Besides, there are fewer campaigns and dissemination of knowledge on the importance of recycling of electronic wastes.

Meanwhile, a majority of the population is served by waste collectors which may point out to potential successes of e-waste recycling should the initiative be adopted and measures put in place in support of recycling. Actually, a huge majority of respondents are willing to give out their phones for recycling.

5.2.4 Factors influencing mobile phones electronic waste production and management in Kenya

Various factors influence the production and management of electronic wastes from mobile phones and their accessories. These include the socio-economic status, education levels, sentimental attachment to the mobile phones, fewer mobile phones recycling programmes and lack of knowledge by consumers on these programmes.

Social and Economic status is a key influencer in the production of wastes in that more economically sound members of the society have a higher turnover of phones due to their purchasing power, and hence easily dispose of old phones as new ones come to the market, and are quicker to replace aging, spoilt or lost phones. Incidentally, the low cadre of the society also produce more electronic wastes, primary because they focus on purchasing cheaper phones with lower life spans. As such, more than 50% of the population replace their phones every two years.

On education levels, high classes, with higher education levels, recorded better understanding of electronic wastes compared to the lower classes a majority who are nevertheless literate. As such, they are likely to embrace initiatives in support of better electronic wastes management if this knowledge is well disseminated. Meanwhile, a significant number of consumers have their waste mobile phones, ‘somewhere in the house’, just like in other developing economies. This is mainly attributed to their sentimental attachment to these phones, which would easily be made available for recycling.

In addition to these factors, there are fewer mobile phones recycling programmes and/or lack of knowledge by consumers on these programmes. Initiatives such as the East African Compliant Recycling (EARC) have made advances in the collection and management of electronic wastes, but they are still now well known to most consumers. A majority of consumers, 87.9% are willing to give out their phones for recycling, and which is a potential market for tapping into.

5.3 Recommendations

The study gathered results under the various objectives of the study, across the supply chain from the manufacturers to consumers. The results also pointed to certain aspects of the relevant authorities of the government responsible for licensing of the various parties in the supply chain, and in the management of the electronic wastes. The study recommends the following;

5.3.1 Promotion of Recycling

Collection and Recycling centres of electronic wastes should be set up in different centres and all parties be made aware of these, particularly consumers and the mobile phone technicians. The relevant authorities and manufacturers should borrow and adopt best practices, integrate and support their implementation in the country. Countries such as Australia may form a plausible case study, with its MobileMuster programme, which is the Australian mobile phone industry's official product stewardship program in Australia. This non-profit program voluntarily funded by Nokia, Motorola, Samsung Electronics, HTC, Huawei, ZTE, Force Technology, Telstra, Optus, Vodafone and Virgin Mobile. These are some of the players in the mobile telephony market in Kenya and may easily adopt the workable measures that have succeeded elsewhere, such as Trade-Ins adopted in countries such as the United States. Where possible, incentives should be identified to encourage deliveries of phones for recycling. Such incentives may be offers of accessories such a power banks, chargers, pouches or cases, and so on. All in all, recycling holds a rich niche for revenue generation and plenty of opportunities including employment, academic research and skills transfer.

5.3.2 Supporting the Existing E-waste Management Initiatives

Support should be given to establishments that have set up such programs, such as the East African Compliant Recycling (EACR) which was set by HP in 2011 in Mombasa and which has its industry in Machakos Country and collection centres in different areas including Mukuru, Kibera, and Eastleigh areas of Nairobi and at the Nakumatt Mega in Nairobi West.

Such support may include easier taxation regimes or incentives, infrastructure improvements, and utility breaks.

5.3.3 Extended Producer Responsibility (EPR)

The government should focus on making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal. This may be encouraged by the 4R principle focusing on Reduce, Reuse, Recycle and Recover, for the various mobile phone parts and accessories. More so, the manufactures should be urged to consider the principal goals of EPR; source reduction (natural resource conservation/materials conservation, waste prevention, design of more environmentally compatible products and closure of materials-use loops to promote sustainable development.

5.3.4 Public Awareness Campaigns & Education

This study revealed the sorry state of awareness by the public on recycling, environmental hazards caused by discarded electronic equipments, organisations that regulate the management and/or disposal of electronic wastes and the laws governing electronic waste management in Kenya. Experience has shown that concerted campaigns by the government, its leadership and various stakeholders are yielding, such as during Kenya's migration of from the analogue to the digital terrestrial platform. Public awareness of the electronic wastes focus areas will improve environmental safely and management of the e-wastes by the public, as well as foster a sense of responsibility among the manufactures. The campaigns targeting consumers should also focus on phones 'somewhere in the house' to increase the uptake of recycling initiatives.

Meanwhile, topics on Electronic Waste Management should be introduced at earlier levels of educations such as in primary schools, while more universities may need to continue to focus on such courses and more core units on electronic waste management.

5.3.5 Laws, Policies, Regulations and Guidelines

As awareness campaigns are spearheaded, the relevant authorities and arms of the government should ensure that clear, relevant and updated laws are put established and their details disseminated to all the parties, including the manufacturers and consumers. With increasing vulnerability in the security systems, and acts such as of theft (especially with the advent of more smart phones), tighter controls must be ensured to maintain integrity of telephony services. Such laws should also support the leveraging on mobile technology platforms to spur economic growth and service delivery in different sectors of the economy such money transfer and online service portals.

5.3.6 Public–Private Partnerships (PPPs)

The different parties involved in the supply chain of the mobile phones, their usage and management is encouraged to spearhead partnerships at different levels, nationally, in the counties and among communities, between the private sector and the governments, as well as the consumers. This will foster greater relationships in support of the management of electronic wastes.

5.3.7 Further research

A lot of research exists in the area of solid waste management compared to specific focus on electronic waste management. It is noteworthy though that research is increasing in the management of electronic wastes. This should be buttressed with increased support through facilitation and funding, and encouragement to researchers to focus on broader areas of electronic wastes, and parties such as consumers, technicians, and manufactures. In addition, more works may be done to centre on finer aspects of electronic wastes from mobile telephone, and other related products such as pads and pods, tablets and their accessories.

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APPENDIX I

QUESTIONNAIRE

THE MANAGEMENT OF MOBILE PHONES E-WASTE IN URBAN AREAS; A CASE STUDY OF (CONSUMER PATTERNS) IN LANG'ATA AREA, NAIROBI, KENYA

CONSENT INFORMATION SHEET

Dear respondent,
My name is Larry Liza, I am a student at the University of Nairobi, and as part of my studies, I am conducting a survey on Mobile phones and accessories waste management. You are invited to participate in this survey as a consumer of mobile phone services, for which the attached questionnaire has been developed. You participation is voluntary, and you are free to decline participation. The information collected here is purely for academic purposes and will be treated in confidence. It will take about 15 minutes of your time to respond to the questions. If you would like to know the results of this study, feel free to give me your contacts at the end of the questionnaire and I shall invite you to a forum where the key findings with of the study will be shared these with you. Thank you for your consideration.
Do you have any questions regarding your participation in the study?
May I proceed?

QUESTIONNAIRE

Section A: Socio-demographics

For question 1-5, tick one most appropriate answer

1. Age group / bracket?
   - ☐ Under 18
   - ☐ 18 – 30
   - ☐ 31 – 40
   - ☐ 41 – 50
   - ☐ 51 – 60
   - ☐ 61 and over
2. Gender
   - ☐ Male
   - ☐ Female
3. Marital status
   - ☐ Single
   - ☐ Married
   - ☐ Widowed
   - ☐ Divorced
   - ☐ Separated
4. Highest level of education
   - ☐ Never gone to school
   - ☐ Primary
   - ☐ Secondary
   - ☐ Tertiary college
   - ☐ University

5. In which of the following areas do you live?

☐ Karen area
☐ Lang'ata & Nairobi West areas
☐ Kibera
☐ Other, specify_____

Section B: Mobile phone information

6. How many mobile phones have you had in your entire life? _____(Numerals)

7. a). How many mobile phones do you currently have? _____ (Numerals)

b). are they all functional (in working condition)?
☐ Yes ☐ No

c). If **No**, why do you still keep the ones that are not working?

_____

_____

8. How often do you change/replace your mobile phone?
☐ Every year
☐ 1 – 2 years
☐ 2 – 3 years
☐ 3 – 5 years
☐ Over 5 year

9. What phone accessories do you have (you may choose more than one option(s))

☐ Cases
☐ SD Card
☐ Chargers
☐ External batteries
☐ Power backups
☐ Earphone / Headsets
☐ Hands free
☐ Others (please specify)

10. On a scale of 1 to 5, what do you consider when choosing a mobile phone? (1 being the lowest consideration and 5 being the highest)

	1	2	3	4	5
Functionality					
Brand					
Look and Feel					
Applications Store					
Pricing					
Advert					
Design					
Durability					
Battery life					
Display					
Internet					
Camera					
Music					
Warranty					

11. How frequently do you use the following features if they are present on your phone?

Feature	Frequently	Rarely	Never
Internet			
Camera			
Games			
Messages (including WhatsApp)			
Other (specify)			

12. Where is your very first mobile phone?
    - ☐ Somewhere in the house
    - ☐ Lost
    - ☐ Stolen
    - ☐ Sold
    - ☐ Gave out
    - ☐ Thrown in the bin
    - ☐ Sent for recycling
    - ☐ Other, specify_____

13. Where is your last phone(s) i.e. the one you had before the present one?
    - ☐ Somewhere in the house
    - ☐ Lost
    - ☐ Stolen
    - ☐ Sold
    - ☐ Gave out
    - ☐ Thrown in the bin
    - ☐ Sent for recycling
    - ☐ Other, specify_____

SECTION C: E-Waste disposal

14. On a scale of 1 to 5 what do you consider when disposing of a mobile phone? (1 being the lowest consideration and 5 being the highest)

	1	2	3	4	5
Functionality					
Brand					
Look and Feel					
Applications Store					
Pricing					
Advert					
Design					
Durability					
Battery life					
Display					
Internet					
Camera					
Music					

15. What parts have you ever replaced in a phone (Tick all that apply)?
    - ☐ Battery
    - ☐ Earphone
    - ☐ None
    - ☐ Charger
    - ☐ Screen,
    - ☐ Other(specify)
16. Have you ever taken your mobile phone for repair?
    - ☐ Yes
    - ☐ No
17. Was it successfully repaired?
    - ☐ Yes
    - ☐ No
18. Have you ever disposed of a spoilt or old mobile phone?
    - ☐ Yes
    - ☐ No
19. If yes, how did you dispose it?
    - ☐ Threw it in a dustbin together with other wastes
    - ☐ Threw it in a separate dustbin for electronic waste only
    - ☐ Took it for recycling
    - ☐ Sold it
    - ☐ Gave it out
20. Have you ever disposed of a spoilt or old mobile phone accessory e.g. chargers, cases, etc?

☐ Yes
☐ No

21. Is yes, how did you dispose it?

☐ Threw it in a dustbin together with other wastes
☐ Threw it in a separate dustbin for electronic waste only
☐ Took it for recycling
☐ Sold it
☐ Gave it out

Section D: General awareness and behaviour

22. Do you know what e-waste or waste of electrical and electronic equipment is?

☐ Yes ☐ No

23. How much would you say you know about the importance of recycling electronic waste?

☐ Nothing ☐ Moderately
☐ Very little ☐ Very much

24. Are you aware about the environmental hazards caused by discarded electronic equipment? (E.g. mobile phones, computers, etc.)

☐ Yes
☐ No

if yes, specify them

_____

Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?

☐ Yes ☐ No

25. Are you aware that some electronic parts may be profitably recycled?

☐ Yes ☐ No

26. a). Do you have waste collectors in your area?

☐ Yes ☐ No

b). If yes, do waste collectors come and pick-up waste at your door?

☐ Yes ☐ No

27. Do they take out electronic waste separately from the rest of the wastes?
☐ Yes ☐ No

28. In your opinion, who is responsible for management of wastes from mobile phones and their accessories? _____

29. Do you know any organisation that regulates the management / disposal of mobile phone waste?
☐ Yes, if yes name it_____
☐ No

30. Are you aware of any laws governing electronic (mobile waste) management in Kenya?
☐ Yes ☐ No

31. a). Do you know the Communications Authority (CA) of Kenya
☐ Yes ☐ No

b). If yes, what do you understand is the role of the Communications Authority?
_____

32. a). Do you know the NEMA
☐ Yes ☐ No

b). If yes, what do you understand is the role of the NEMA?
_____

33. a). Are you aware of any mobile waste recycling programme in Kenya?
☐ Yes ☐ No

b). If yes, kindly name some_____

34. a). Would you offer your old mobile phones and accessories for recycling?
☐ Yes
☐ No

b). If no kindly give reasons for your answer_____

If you wish to get the results of this survey, please provide details in the separate sheet provided and hand back to the researcher with the following details. If not, please ignore this portion.

Name: _____

Phone Number: _____

Email address: _____