E-Waste Management at Egerton University Library, Njoro Campus, Kenya

Sally Kiplagat
Senior Library Assistant, Egerton University, Egerton, Nakuru, Kenya
Damaris Odero
Senior Lecturer, Department of Library, Records Management and Information Studies,
School of Information Science, Moi University, Eldoret, Kenya
Sirma Buigutt
Lecturer, Department of Publishing and Media Studies, School of Information Science,
Moi University, Eldoret, Kenya

Abstract:
Electronic waste (e-waste) comprises of discarded computers, office electronic equipment, electronic entertainment devices, mobile phones, television sets and refrigerators. They include electronics equipment that are destined for reuse, resale, salvage, recycle or disposal because they are either old, have reached end-of-life cycle or have ceased to be of any value to their owners. The aim of the study was to establish the state of e-waste management at Egerton University Library for the purposes of promoting conducive and safe working environment for the staff and students. Sustainability helix model was adopted as the theoretical framework. Purposive sampling was used to obtain a sample of 50 respondents from the University Library. Other respondents included the HoDs of Departments of ICT, Procurement and Environmental Science. Data was collected using questionnaires, interviews and observation. Survey research paradigm was used. Tables and texts were used to present the data. Qualitative data analysis method was used to analyze the data. The study established that generation of e-waste is inevitable and libraries and information centres and users of electronics must find a suitable framework that ensures efficient and effective management of all resulting e-wastes. The study proposed sustainability helix model that explains a comprehensive response for dealing with e-waste. The model indicates that upper management support is necessary and the adoption of a formal e-waste policy that would introduce guidelines for responsible management of e-wastes from all premises.

Keywords: E-waste, E-waste Management, Egerton University Library, Kenya

1. Introduction

Rapid changes in technology, including changes in media such as tapes, software, MP3, falling prices, and planned obsolescence have resulted in a fast-growing surplus of electronic waste around the globe. There is a dropping lifespan of electronic and electrical products, high consumption of these products, low recycling rates and illegal trans-boundary movement from developed to developing countries (Puckett et al., 2002; Brigden et al., 2005; Deutsche Umwelthilfe, 2007; Cobbing, 2008) as cited by (Victor and Kumar, 2012). All these facts have triggered the disposal of electronic goods in a planned obsolescence manner and an increasing scientific and political interest for how to safely dispose-off and recycle waste Electrical and Electronic Equipment (WEEE). Solutions have been proposed from the perspective of new industrial product designs, manufacturing and recycling philosophies, for example, the extended producer responsibility (EPR) and various other green procurement policies (Victor and Kumar, 2012).

Electronic equipment such as computers including their peripherals, printers, scanners, photocopiers and projectors are greatly used in libraries today. They are used for information sharing and communication, management and administrative functions, information processing (cataloguing and classification), provision of library services (circulation, selective dissemination of information, current awareness services), acquisition and information storage (databases). Most of these information and communication technologies (ICTs) lose their functionality so fast due to either obsolescence or non-reparable nature and, hence become e-waste. This calls for their disposal because libraries are growing organisms and, therefore, luck space. Secondly, storing WEEE for long within a working environment poses health problems to the people due to lead poisoning and various side effects caused by heavy metals. However, disposal of WEEE is a problem to most institutions due to lack of functional disposal policies and where to dispose them.

The purpose of this research is to consider possible solutions to e-waste management and disposal at Egerton University Library. This is basically because e-waste is the fastest growing waste stream world-wide and a key waste stream under the Basel Convention (www.basel.int). Failure to deal with disposal of electrical and electronic equipment (EEE) properly presents a serious environmental and health challenge for many countries. In Kenya, for example, NEMA observes three major negative impacts. Firstly, environmental

impacts that include air pollution, especially when it is burnt; waste management problem of non-biodegradable equipment; toxicity and radioactive nature of e-waste to humans, water, soil and animals. Secondly, economic impact where there is substantial public spending on health care; investments on complex and expensive environment remediation technologies; loss or waste of resources that can be recycled for reuse; loss of opportunities for recycling industries and employment; ozone depletion leading to unpredictable weather conditions among them prolonged droughts and floods that cause use of resources, which should have been deployed for growth and development in other sectors. Thirdly, social impacts where e-waste affects people's health through lead poisoning and development of cancerous diseases.

A clean and healthy environment is of utmost importance to all people of society. With global developments and innovations in technology, electronic devices are a constant feature of day-to-day life.

1.1. E-Waste Management at Egerton University

The study was carried out at Egerton University in Nakuru County, Kenya. It is a public university with eight faculties. The faculties have a number of departments. The Faculty of Science houses the Department of Information and Communication Technology, which handles acquisition of electronic equipment and facilities in collaboration with the Department of Procurement. The various departments in the university make their orders for electronic equipment, which mainly include personal computers and their peripherals and visual display equipment, printers, scanners, projectors, television sets and other electronic devices commonly used in offices and, are essential for a university to function and realize its research and education objectives. At least each department has some electronic devices for its day-to-day operations.

Ideally when these electronic devices reach their end of life, they are returned to the Central Store, a section of the Department of Procurement, where they are auctioned as obsolete equipment, or disposed of as scrape materials with other university assets. There is currently no specific policy governing the disposal of e-wastes. Sometimes, small parts like wires, mouse, and replaceable parts like toners are discarded in dustbins. The Department of Environmental Science, to avert such problems emanating from wastes has designed dustbins that direct people to separate recyclable and non-recyclable wastes. The dustbins which have been placed at strategic points within the University have two parts, one part for recyclable and the other for non-recyclable. This though covers all sorts of wastes not necessarily e-waste.

Electrical and electronic equipment contain hazardous substances that include heavy metals such as mercury and lead, as well as endocrine disrupting substances like brominated flame retardant. According to Herat (2007), computers are manufactured from over 1,000 materials, many of which are toxic, which contribute significantly to the e-waste stream. He further laments that the benefits of ICT, especially the use of computers are well known, but their harmful consequences are often ignored or even unknown. The continued accumulation of e-waste in the work place also causes space problems.

Many African countries import or receive as donations electrical and electronic equipment that are second-hand with a certain percentage estimated to be non-functioning and non-repairable, therefore e-waste. Egerton University Library in 1998 benefited from a World Bank's Kenya Universities Investment Project that donated various ICT equipment that included computers, printers, plotters, typewriters, scanners most of which have reached their end-of-life and are still lying un-disposed.

1.2. Objectives of the Study

The aim of this study was to establish the state of e-waste management at Egerton University Library for the purposes of promoting conducive and safe working environment. The specific objectives were i) to establish the types and quantities of e-waste available at Egerton University Library, ii) to assess the policies and guidelines governing e-waste management at Egerton University Library, iii) to determine awareness, attitude and perception of e-waste management strategies and practices by Egerton University community and iv) to investigate opportunities, which could result from efficient and effective e-waste management and recommend efficient and effective e-waste management strategies and best practices.

2. Literature Review

E-waste has been one of the fastest growing waste streams in the world. While e-waste contains valuable materials such as aluminium, copper, gold, palladium and silver, it also contains harmful substances like cadmium, lead and mercury (Wambugu, 2013 and http://www.ecoreco.com/).

In today's era of industrial revolution and information technology, electronic wastes are inevitable and can be found everywhere. Electrical and electronic equipment have become essential in almost every process. This has led to the generation of great amounts of e-waste in society. Wambugu (2013) explains that e-waste is growing at three times the rate of other kinds of waste fueled by gadgets diminishing life span and the appetite for consumer electronics among rapidly increasing middle classes. One of the growing concerns of most environmentalists is that, as technology changes so does the need to get rid of the outdated devices and their related parts. This creates one of the biggest challenges of digital age: how to dispose of e-waste, which contains toxic materials such as lead, mercury and cadmium. Researchers have linked e-waste to adverse effects on human health such as inflammation and oxidative stress, which are precursors to cardiovascular diseases, DNA damage and possibly cancer (Wambugu, 2013).

Egerton University as an institution has greatly invested in ICT equipment, majority being computers in several resource centres and computer laboratories across the University. It is, therefore, imperative that early action to manage e-waste is needed by every department and the institution as a whole.

2.1. Theoretical Framework

Davis and Wolski (2009) using the sustainability helix explained that to develop a comprehensive response to deal with e-waste, upper management support is necessary and the adoption of a formal-waste policy, would introduce guidelines for the social and environmentally responsible management of used and waste electronic equipment from all premises. The policy should indicate top-down support and assign responsibilities for the management of e-wastes. The aim of the policy should reflect the organization's requirements and their commitment for sustainability. This approach includes the formulation of an e-waste policy, which seeks to address the key factors including; definitions, legal requirements (including guidelines for the disposal of assets and consumables), data and software security, protection of the environment, and social responsibility.
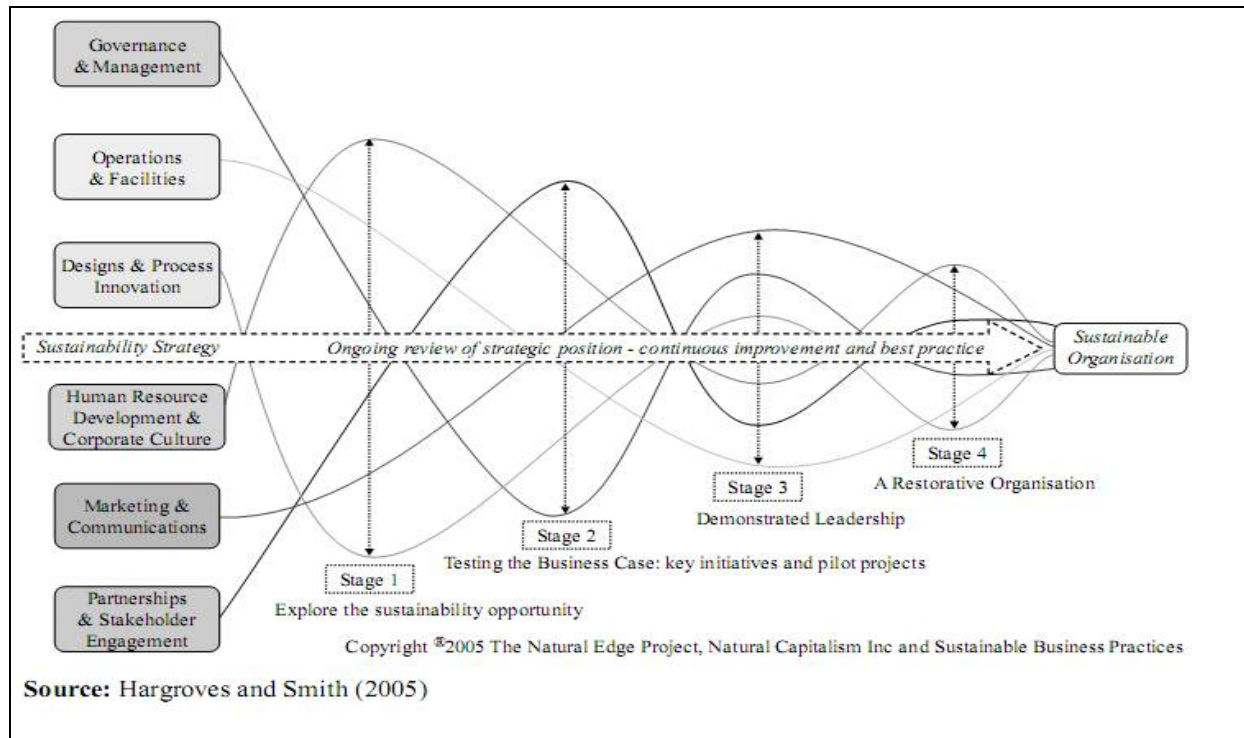

Figure 1: Sustainability Helix (Source, Hargroves & Smith, 2005)

2.2. E-waste Components and their Hazardous Effects

The significant quantity of e-waste generated is not the only issue faced by the solid waste managers but also its composition. E-waste contains more than 1000 different substances, many of which are toxic metals such as lead, arsenic, cadmium, hexavalent chromium and flame retardants used in the plastics (Herat (2007). The Association of Cities and Regions for Recycling (ACRR), (2003) further alleges that WEEE equipment are made up of a number of components that include metal, motor/compressor, plastic, glass, wiring, transformer, circuit board, fluorescent lamp, batteries, external electric cables, liquid crystal display and flame retardants or brominated flame retardants. These components are assembled to produce electronic equipment. Some of them contain toxic substances which can have adverse impact on human health and the environment if not handled properly.

Gaulon et al., (2005) as cited by Muoria (2009) explains that the presence of elements such as lead, mercury, arsenic, cadium, selenium, hexavalent, chromium and flame retardants in e-waste and their components beyond threshold quantities are what make e-waste to be classified as hazardous. When disposed carefully in a controlled environment, they do not pose any serious health or environmental risk. Due to this, therefore, e-wastes with their hazardous materials must be taken to a designated handler or recycler.

Land-filling of e-waste, one of the most widely used methods of disposal, is prone to hazards because of leachate, which often contaminates water resources. Mercury, cadmium and lead are among the most toxic leachate. Mercury, for example, will leach when certain electronic devices such as circuit breakers are destroyed. Lead has been found to leach from broken lead-containing glass. In addition, landfills are also prone to uncontrolled fires, which can release toxins. Wambugu (2013) explains that if e-waste is left in a landfill or incinerated, the harmful chemicals will leak into the ground and the atmosphere causing multiple problems to people and the environment. They also do not just disappear. Old printers, monitors and phone cords among other electronic parts, for instance, continue to stay in the landfills for centuries creating problems for the surrounding communities. This is reiterated by Chacha (2013) who reports that, a study in South Africa concluded, "… if disposal of e-waste will continue unregulated, lead and other dangerous substances could leach into the agricultural soils posing a threat to human health and the environment...."

2.3. Challenges of E-Wastes Management

Volumes of waste equipment needing processing are increasing rapidly in both the industrialized and un-industrializing countries. According to Basiye (2008), in Kenya no funds or resources are set aside for managing e-waste. Additionally, there is no financial

infrastructure for e-waste recycling. The financial model in Europe is based on "extended producer responsibility" (EPR), with the producing organizations bearing responsibility for waste electronic and electrical equipment (WEEE) take-back and treatment.

3. Methodology
The study will be carried out at Egerton University in Nakuru County, Kenya. It is a public university with eight faculties. Each faculty has a number of departments. All the departments use different types ICTs in their day to day activities with some departments having resource centres or computer laboratories. The increased number of computers especially in the departments with resource centres is large enough to call for their organized management and disposal when they reach their end of life (EOL).

Survey research design was used in the study. Both qualitative and quantitative data were collected to establish the flow of e-waste and the subsequent methods of disposal. Interviews were conducted with key persons in policy, regulatory and operational areas related to the acquisition and disposal of electrical and electronic equipment and their subsequent disposal as e-waste. The research targeted fifty three (53) respondents from the selected departments, who were purposively sampled. Library Department with a target of fifty (50) was purposively selected, because of its role as a user of electronic equipment. Departments of Procurement and ICT with a target of one (1) respondent each were purposively selected because of their role in acquisition and disposal of electronic equipment. The Department of Environmental Science with a target of one (1) respondent was also purposively selected because of its role in the management of the University's environment.

Data was collected from the selected respondents using questionnaires and interview schedules Each data collection instrument aimed at collecting specific information from the targeted respondents. Observation was also used. The items considered are the available policies/regulations governing e-waste, types of e-waste generated, methods of e-waste disposal in use, levels of awareness on effects of poor disposal of e-waste to human health and the environment. The interviews provided qualitative information. The questionnaires and observation on the other hand were used at the Library Store to collect quantitative information. Observation also involved a site visit to the University's dumpsite to ascertain the amount of e-waste and their potential hazardous effects on human health and the environment.

4. Results and Discussions
Based on the study objectives, the results and discussions were as presented in the next sections:

4.1. The Study Population
The respondents were drawn from the University Library, ICT Department, Procurement Department and Environmental Science. Forty-five (45) staff from the University library out of the intended fifty (50) from a total of 83 staff were interviewed. Three (3) staff from each of the other three departments with a total of 54, 38 and 14 staff, respectively were successfully interviewed as presented in Table 1:

Department	Target Population	Sample Size
University Library	83	50
ICT Dept	54	1
Procurement Dept	38	1
Environmental Science	14	1
Total	**189**	**53**

Table 1: Summary of Respondents

4.2. Designation of the Respondents
The study managed to interview a total of 45 staff out of the intended 50 library staff comprising of professionals, paraprofessionals and cleaners. Other 3 staff from the Departments of ICT, Procurement and Environmental Science were also interviewed. The total number of respondents was, therefore, 48 as exemplified in Table 2.

Designation	No. of the Respondents
University Librarian	1
Senior Assistant Librarian	1
Senior Library Assistants	31
Library assistants	10
Cleaners	2
ICT Manager	1
Deputy Chief Procurement Officer	1
HoD, Environmental Science	1
Total	**48**

Table 2: Designation of the Respondents

The respondents from the University Library included the library assistants as the para-professionals, senior library assistants, assistant librarian and the University Librarian as the professionals. These personnel are responsible for the management of library services and operations and are, therefore, involved in ICT application in the library. The ICT Department respondent was the ICT Manager. While the Procurement Department respondent was the Deputy Chief Procurement Officer. This cadre of staff is involved in policy making issues of the University among them ICT and Procurement policies.

From the findings, the majority of the library staff who were interviewed are; senior library assistants followed by the library assistants who are directly involved in the usage of ICT equipment and are, therefore, able to give first-hand information on the sources, types and quantities of e-waste at Egerton University Library. The rest of the respondents, the University Librarian, Senior Assistant Librarian, ICT Manager, Deputy Chief Procurement Officer and the HoD, Environmental Science were the key respondents who provided information on the policies regarding e-waste management in the University.

4.3. Types and Quantities of E-Waste at Egerton University Library

The first objective of the study was to assess and ascertain the types and quantities of e-waste available at the Egerton University Library. The study sought information on the availability of any obsolete electronic equipment in the library. The respondents gave information on various electronic equipment, which have since been replaced or discarded due to obsolescence or breakdown (Appendix I) and Table 3 shows the summary:

S/No	E-waste (Obsolete/broken down ICT Equipment)	Quantity	Estimated Current Value (Kshs)
1.	Photocopiers	4	300,000.00
2.	Printers	12	485,000.00
3.	Typewriters	5	72,500.00
4	UPs	24	288,000.00
5.	Computers (Pentium II)	24	1,680,000.00
6.	Plotter	1	100,000.00
7.	Server	1	600,000.00
	Total	**72**	**3,525,500**

Table 3: Obsolete/discarded electronic equipment

The high amount of discarded equipment has led to the generation of e-waste in the library. The available obsolete electronic equipment is attributed to the obsolescence of electronic equipment. Majority of these equipment are still lying in the library's store, because there is no library guiding policy for their disposal. The estimated value of Kshs. 3,525,500 of all the obsolete/discarded electronic equipment shows significant fiscal implications and, the figure could even be higher considering the fact that electronic equipment are generally expensive and prices also keeping rising. Troll (2001) explains that operating expenditures have increased significantly to meet automation and electronic resource needs and that current library budgets are insufficient to keep pace with the skyrocketing cost of materials, the increasing burden of capital expenditures for technologies that rapidly become obsolete, and the need for retraining or recruiting and retaining staff with the skills required to use and maintain the technologies.

4.4. Policies and Guidelines Governing E-Waste Management and Disposal

The second objective of the study was to assess the *policies and guidelines governing e-waste management and disposal at Egerton University Library.* There are three guiding policies that the University applies in electronic equipment acquisition, use and disposal as indicated in Table 4.

Departments	Guiding Policies
Library Dept	(Nil)
ICT Dept	Egerton University ICT Policy ICT Standards and Guidelines
Procurement Dept	Public Procurement and Disposal Act

Table 4: Guiding Policies for Technological Changes

The study revealed that Egerton University ICT Policy alongside the Government of Kenya, ICT Standards and Guidelines and the Public Procurement and Disposal Act (PPDA) have policies and guidelines for e-waste management. The PPDA for instance is an Act of Parliament that establishes procedures for efficient public procurement and for the disposal of unserviceable, obsolete or surplus stores, assets and equipment by public entities and to provide for other related matters (Laws of Kenya, 2005).

The Information and Communications Technology (ICT) Department is guided by the Egerton University ICT Policy and the Government of Kenya ICT Standards and Guidelines. The Procurement Department on the other hand is guided by the Kenya Government PPDA. The University Library is guided by the two departments (who use their respective policies) in its acquisition of ICT equipment as it has no approved guiding policy of its own.

Egerton University ICT Policy alongside the Government of Kenya ICT Standards and Guidelines guide the University Library and the Procurement Department through the provision of the specific policy statement 'ICT Procurement Policy', which states that procurement of ICT systems will comply with the following:

i)   Establishment of detailed desirable specifications, standards and features of the product(s) as a means of for technical evaluation.
ii) N Inclusion of a comprehensive maintenance policy for the equipment.
iii) Negotiation of a replacement policy that should preferably include a buy-back arrangement.
iv) Inclusion for arrangements for any necessary upgrade in the technology.

All the above policy statements ensure the acquisition of quality products that will last longer and reduce rate of e-waste generation, prolonged usage of electronic equipment through the comprehensive maintenance policy, beneficial disposal through replacement policy, and continued utilization of electronic equipment through upgrading of obsolete technologies. The study revealed that implementation of these policy statements has not been comprehensively followed. The Library, for instance, has a lot of un-disposed electronic equipment, which could otherwise have been taken care of by one or all of the above policy statements. Comprehensive implementation of the policy statements would have ensured elimination of any existing e-wastes in the Library and the University at large.

4.5. E-waste Disposal Methods

To further probe on the *policies and guidelines governing e-waste management and disposal*, a question on the e-waste disposal methods was posed to the respondents. The study established that there was no approved disposal method for obsolete electronic equipment in the library. Almost all of the respondents reported that there was no approved disposal method that is why available obsolete or discarded electronic equipment have been kept in the Library's store. This also applies to almost all other University departments. Few departments return their obsolete or discarded electronic equipment to Procurement Department, who with the advice from the ICT Department, dispose such equipment through resale though some equipment are too old/written-off to be resold and have been left outside as waste in Procurement Department. Minor electronic equipment like parts of mobile phones, subscriber identification module (SIM) cards and storage devices such as flash disks, CDs and floppy disks were reported by cleaners as some of the e-wastes that are usually disposed of with other garbage to the University's dumpsite from the library.

Egerton University through the ICT Department has a policy on maintenance and repair services as well as electronic waste disposal but most departments, library among them, still prefer keeping all their obsolete and out-of-use electronic equipment in their stores. The ICT department should fully implement the ICT policy to include effective disposal methods with timelines for usage and disposal of electronic equipment such as negotiation of a replacement policy that should preferably include a buy-back arrangement with the suppliers. In concurrence, Ogbomo, Obuh and Ibolo (2012) opine that large companies should purchase the used equipment back from the customers and ensure proper treatment and disposal of e-waste by authorized processes.

Developing countries receive second-hand ICT equipment from developed countries as donations. These donations must be rejected because they have become avenues through which e-waste is exported from the developed countries into the developing countries. There is need for governments to formulate and enforce policies, laws and invest in infrastructure to address e-waste management in developing countries (Sunday, 2013). Kenya, for its part, has formulated e-waste guidelines under the leadership of NEMA and is currently formulating an environmental management law on e-waste management.

The National Environmental Management Authority (NEMA) guidelines for e-waste management in Kenya identified producers, manufactures, importers, assemblers, distributors, consumers, government institutions and refurbishers or recyclers as target groups for managing e-waste (NEMA, 2010)
. The guidelines further proposed mechanisms such as municipal collection; designation of collection centres; producer take-back schemes; producer responsibility organization (PRO); storage on site or off site; transportation; training of handlers and licensing of collection centres for consideration when coming up with an e-waste legislative framework.

It was further suggested in these guidelines that, in terms of storage facilities, e-waste take-back, municipal transfer stations, sorting (streams), technical specifications and capacity to handle e-waste should be taken into consideration. Furthermore, there was a need for the establishment of a treatment facility that encompasses operational requirements, treatment and disposal unit, storage, dismantling and segregation, recycling and recovery, disposal sites and licensing requirements (Magari, 2010).

The Ministry of Information and Communication is also proactive regarding e-waste. The ICT policy that was promulgated in 2006 takes cognizance of e- waste and states "… as a prerequisite for grant or renewal of licenses, applicants must demonstrate their readiness to minimize the effects of their infrastructure on the environment. This should include provision of appropriate recycling/disposal facilities for waste that may contain toxic substances."

4.6. Awareness, Attitude and Perception of E-Waste Management Strategies and Practices

The third objective of the study was to determine awareness, attitude and perception of e-waste management strategies and practices by Egerton University Library staff. The level of awareness on the effects of e-waste on human health and the environment was analyzed descriptively and the Table 5 presents the results.

Level of awareness	Frequency	Percentage
No awareness	18	37.5
Low	13	27.1
Medium	11	22.9
High	6	12.5
Total	**48**	**100**

Table 5: Level of Awareness on the Effects of E-Waste on Human Health and the Environment

4.7. E-waste Management Opportunities
Many opportunities can result from efficient and effective management of e-wastes. The forth objective of the study was to investigate opportunities, which could result from efficient and effective e-waste management and recommend efficient and effective e-waste management strategies and practices. Table 6 illustrates the various benefits/opportunities of efficient and effective e-waste management.

E-waste Management strategies & Practices	Opportunities
Recycling/ Reuse	Recovery of useful products such as gold, silver, copper
Refurbishment	Reduced cost of electronics budget
Incineration	Healthy and Clean environment
	Creation of job opportunities

Table 6: Benefits/Opportunities of Efficient and Effective E-waste Management

WEEE is a loss category of surplus, obsolete, broken, or discarded electrical or electronic devices. In India most of the waste e-items are stored at households as people don't know how to discard them. Some useful products such as gold, silver, copper can be recovered and brought back into the production units. For this purpose, the companies can hire people thus creating employment opportunities (Mittal, Goel & Rani, 2012). The obsolete electronic equipment lying in most departments, because of lack of adequate disposal procedures at Egerton University is not only causing space and health problems, but also hindering employment opportunities in the form of recycling ventures and recovery of useful metals. According to Harford (2001), over 97 percent of computer contents can be reused or recycled. This offers a great opportunity to significantly reduce the amount of e-waste that ends up as trash being sent to landfills. It is also important to think of e-waste as valuable and reusable, rather than junk. Millions of computers, computer monitors, and televisions ending up in a landfill, which is not only a waste of resources, but it, could be a threat to the environment because e-waste contains hazardous materials.

The results obtained indicate that majority of the staff had low level of awareness (37.5%) on the effects of e-waste on human health and the environment. 27.1% had low awareness levels, 22.9% had medium level awareness while only 12.9% had high level of awareness.

The Library has a substantial amount of e-waste in its store that has accumulated over time. The Library received a consignment of a variety of electronic equipment from World Bank's Kenya Universities Investment Project that donated various ICT equipment, which included computers, printers, plotters, typewriters, scanners, server among others most of which have reached their end-of-life and are still lying un-disposed (see appendix I). Their estimated current value is Kshs.3,525,500.00. This implies that their replacement could be very costly for libraries as indicated in Table 7.

S/No	ICT Equipment (Obsolete/broken down)	Quantity	Estimated Current Value (Kshs)
1.	Photocopiers	4	300,000.00
2.	Printers	12	485,000.00
3.	Typewriters	5	72,500.00
4.	UPs	24	288,000.00
5.	Computers (Pentium II)	24	1,680,000.00
6.	Plotter	1	100,000.00
7.	Server	1	600,000.00
	Total	**71**	**3,525,500.00**

Table 7: Obsolete/Discarded ICTs from 1999-2013

The fact that these equipment are still lying in the library store is an indication that most of the staff lack sufficient information on the dangers of accumulating e-wastes within work places and, this complements the high percentage of low level of awareness by the staff. The respondents indicated that sensitization programs on e-waste management strategies and practices had been carried out by the ISO Secretariat but implementation has not taken place. Due to this, staff awareness level is, therefore, low leaving their attitude and perception of e-waste management strategies and practices very secondary. This shows that the Library and the University Management need to enhance their efforts in e-waste management strategies and practices through the ISO Secretariat for the staff members to know the dangers of poor e-waste management on human health and the environment.

4.8. E-waste Management Strategies and Practices
To further enhance the findings on the e-waste management opportunities, the study recommended a theoretical framework known as 'Sustainability Helix' by Hargroves and Smith (2005). Through this framework, Davis and Wolski (2007) explain that a comprehensive response to deal with e-waste can be developed where top management support is necessary and the adoption of a formal-waste policy would introduce guidelines for the social and environmentally responsible management of used and waste electronic equipment from all departments. A policy should indicate top-down support and assign responsibilities for the management of e-wastes. The aim of the policy should reflect the organization's requirements and their commitment for sustainability. This approach includes the formulation of an e-waste policy, which seeks to address the key factors including; definitions, legal requirements (including guidelines for the disposal of assets and consumables), data and software security, protection of the environment, and social responsibility.

E-waste management in all learning institutions should be coordinated from the Ministry concerned with the environment through its organs such as NEMA, down to the individual learning institutions throughout the country. This will mean a policy indicating top-down support and assignment of responsibilities for the management of e-wastes be in place. The individual learning institutions should in turn implement the policy through a relevant department, for instance, the Department of Environment Science in the case of Egerton University. This may include exploring opportunities from e-waste that will ensure a sustainable environment in the institution.

5. Conclusion
The study based its conclusion on the study objectives, research questions and data analysis and established the following research as presented below:

1) Types and Quantities of E-waste at Egerton University Library
   The highest quantity of e-waste in the University Library is generated by computers. The printers are next in amount of quantity while the least generated e-waste is plotter, server and typewriters. Based on the researcher's knowledge of the institution, this trend basically applies to most departments in the University.

2) *The Policies and Guidelines Governing E-Waste Management and Disposal at Egerton University Library*
   Guiding Policies are in place in the Library and the University and they include Egerton University ICT Policy, ICT Standards and Guidelines, Library ICT Policy and Public Procurement and Disposal Act. These guidelines unfortunately have not been comprehensively implemented and updated to include new trends – that is why the Library and majority of other University departments still keep obsolete electronics in their stores without any clear plans for their disposal. E-waste management strategies and guidelines are also still non-existent in most learning institutions, Egerton University included.

3) Awareness, Attitude and Perception of E-Waste Management Strategies and Practices by the University Library staff
   Staff awareness level is low and this has made their attitude and perception towards e-waste management strategies and practices less significant. Action would have been taken if the staff were fully aware of the dangers of poor e-waste management on human health and the environment. To-date the Library and equally other University departments are still stocking obsolete electronics.

4) Opportunities Resulting from Efficient and Effective E-Waste Management
   – *Employment opportunities:* Some useful products from e-waste such as gold, silver, copper can be recovered and brought back into the production units. The recovery process of these useful products creates employment opportunities as companies have to hire people.
   – *Realization of a clean healthy environment:* efficient e-waste management through EPR ensures a clean healthy environment in the Library and the University at large.
   – It is important to think of e-waste as valuable and reusable, rather than junk. Millions of computers, computer monitors, and televisions ending up in a landfill are a waste of resources.

6. Recommendations
The study presented the following recommendations on e-waste management at Egerton University Library based on the above conclusions.

1. The Library and the University should scale up its efforts in e-waste management by implementing effective strategies and practices to manage all e-wastes generated in the Library and in the whole University, so as to ensure a sustainable environment for its community. Inclusion of an EPR arrangement and joining other organizations that promote innovations in the management of e-waste should be considered.
2. Institutions should be updating their policies and guidelines to include new trends, like in this case, e-waste management.
3. E-waste management strategies and guidelines should be coordinated from the Ministry concerned with the environment through its organs such as NEMA, down to the individual learning institution throughout the country. This will mean a policy indicating top-down support and assignment of responsibilities for the management of e-wastes being in place. The individual learning institution should in turn implement the policy through a relevant department, for instance, the Department of Environment Science in the case of Egerton University. This may include exploring opportunities from e-waste that will ensure a sustainable environment in the institution.
4. The Library as an information centre and Egerton University should create adequate awareness on the dangers of poor e-waste disposal and build an attitude and perception that all Staff and all members of Egerton community work towards

having a sustainable environment. This can even call for the incorporation of environmental education with an aspect of e-waste management in the curriculum.
5. The Library together with the University management should consider taking advantage of the above mentioned opportunities resulting from efficient and effective e-waste management.

7. References

i. About e-waste. Available at: http://www.ecoreco.com/. (Accessed 21/6/2013).
ii. Association of Cities and Regions for Recycling (ACRR), (2003). Management of electrical and electronic equipment. Available at: http://www.acrr.org. (Accessed 21/6/2013).
iii. Basiye, Karen Khayanje (2008). Extended Producer Responsibility for the Management of Waste from Mobile Phone. Lund, Sweden: IIIEE, Lund University.
iv. Chacha, Gardy (2013, July 23). Kenya's e-waste junk rises significantly, says report. The Standard. Nairobi: The Standard Group.
v. Georgina Davis, Malcolm Wolski, (2009). E-waste and the sustainable organisation: Griffith University's approach to e-waste. International Journal of Sustainability in Higher Education, 10 (1): 21-32, https://doi.org/10.1108/14676370910925226. (Accessed 21/6/2013).
vi. Harford, Jim (2001). Electronic Waste: A New Challenge For A New Millennium. Lincoln, Nebraska Nebraska Department of Environmental Quality. Available at: (Accessed 29/5/13).
vii. Hargroves, K. and Smith, M. (2005). The Natural Advantage of Nations: Business Opportunities, Innovation and Governance in the 21st Century. The Natural Edge Project, Earthscan, London.
viii. Herat, Sunil (2007). Sustainable Management of Electronic Waste (e-Waste). Wiley, Verlag. Available at: www.clean-journal.com. (Accessed 25/6/2013).
ix. Magari W. (2010), "Guidelines for e-waste management in Kenya", paper presented at the National Stakeholder's Workshop on E-waste Management, 7 September 2010, UN Gigiri. Available at: http://www.icwe.co.ke (Accessed 14/7/2013).
x. Mittal Deepti, Goel Navnish, Rani Renu. E-Waste: A Hidden Threat to Global Environment & Health. VSRD-International Journal of Computer Science and Technology 2012; 2 (3): 271-275.
xi. Muoria , E. W. (2009). Assessment of electronic waste management: A case study of Nakuru Municipality, Kenya; Msc. Thesis, Egerton University.
xii. National Environment Management Authority (NEMA) (2010). Guidelines for e-waste management in Kenya. Available at: http://www.merunationalpolytechnic.ac.ke/images/policies/E-WasteGuidelines_final27jan2011.pdf. (Accessed 25/6/2013).
xiii. Ogbomo, Monday Obaidjevwe; Obuh, Alex Ozoemelem and Ibolo, Elizabeth (2012). Managing ICT Waste: The Case of Delta State University Abraka, Nigeria. Library Philosophy and Practice (e-journal). Paper 736. (Accessed 21/6/2013).
xiv. Sunday, Frankline (2013, July 1). Used computer dealers face uncertain future over e-waste. The Standard. Nairobi: The Standard Group.
xv. Troll, Denise A. (2001). How and Why Are Libraries Changing? Available at http://old.diglib.org/use/whitepaper.htm. (Accessed 29/5/13).
xvi. UNEP (Press Release 2012, February 22). Urgent Need to Prepare Developing Countries for Surge in E-Wastes. Available at: http://www.unep.org/Documents.Multilingual/Defaul... (Accessed 7/6/2013).
xvii. Victor, S. P. and Kumar, S. Suresh (2012). Planned obsolescence: roadway to increasing e-waste in Indian governments sector. In: International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue-3, July.
xviii. Wambugu, Sam (2013, July 14). How to tame the problem of digital dumping. In: The Standard. Nairobi: The Standard Group.

Appendix I

E-Waste /Obsolete/Discarded (Mainly Due to Technological Changes) Electronic Equipment at Egerton University Library Store

Source: Author