E-Waste Disposal Challenges and Remedies: A Tanzanian Perspective

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1. Introduction

In recent years we have witnessed the rapid increase of number of mobile subscribers, mobile services providers, internet service providers, data operators and internet users. This is primarily caused by lifting of ban imposed by government on importation of computers and its peripherals in government entities, government decision to remove all taxes and duties on those electronic products and flexibility on regulations for establishment of media and telecommunication companies. All these steps have contributed much on inflow of electronic products particularly computers and its peripherals, mobile phones and television sets. This pose challenges on appropriate methods to dispose end of use electronic products without destroying environment, jeopardize people health and without loss of data and information stored in these products.

Additionally, it's unfortunate that this inflow of electronic products caught government entities, private organizations and the public in general unprepared on how to safely and economically dispose end of use electronic products. This has eventually left piles of unattended end of use electronic products both in streets and in office stores.

This chapter addresses the challenges on e- Wastes disposal steered by proliferations and usage of electronic devices both at homes and offices and propose solutions to the challenges. Also in this chapter we suggest appropriate measures that should be taken categorically, by Government entities, private organizations and public in general to thwart down the challenges.

2. Definition of some key terms

E-waste: Is defined as end-of-use or end-life of electronic products, components and peripherals such as: computers, fax machines, phones, Personal Digital Assistant (PDA), radios and TVs [1]

E-Waste recycling sites: This refers to the space allocated specifically for recycling e-waste or end-of-use ICT assets.

3. Current status of e- waste in Tanzania

The review of existing literature shows that Tanzania has no specific policy or regulation related to e-waste management. However, there are a number of policies and regulations which aim at protecting the environment and human settlements. Examples of these policies are: Environmental Policy [2], the Sustainable Industrial Policy [3], National ICT Policy, [4] among others. An overview of the different e-waste related policies is given in figure 1.

The review of these different policies reveals that there is a need for e-waste specific policies to address the different challenges and issues of e-waste management. There are also a number of regulations and laws that provides an institutional framework for a sustainable management of the environment in general. Among others, the Environmental Management Act (EMA) No. 20 of 2004 [7] is the cornerstone legislation in Tanzania. This legislation provides key principles for environment management, waste management, and impact and risk assessment among other things. A summary of the different regulations, their objectives and impact on waste management is given in figure 2.

4. E – waste management specific regulations

Tanzania lacks e-waste management specific legislation. Nonetheless, e-waste management is carried out through the Solid Waste and Hazardous Management Acts [5, 6] under the Environmental Management Act [7]. E- Waste, and specifically electronic waste, is addressed in section 4 of the Environmental Management Act [7].

Different regulations in the act provide principles and guidelines on how e-waste should be handled. For example, regulation 35 (1), requires that any persons in possession or in control of electrical or electronic goods, to separate or segregate e-waste from other types of waste, and dump them separately as prescribed by different national or local authorities [8, 9]. The separation also applies to collection of waste, its transportation and the final dumping or disposal (refer schedule eight of the regulations). Schedule eight (8) of the regulation also classifies electronic equipments such as large households appliances, IT and Telecommunication equipment, among others. Section 37 (1) of the same regulation allows for manufacturers and/or vendors to set-up and operate recycling systems for electrical and electronic equipments from consumers. The role of local government (local authorities) is detailed in section 39.

The government through the Prime Minister's Office, environment division, has developed a strategy and an action plan [10]. This strategy, among other things, addresses the issue of e-waste management. The plan aims at, as its goal in e-waste management, minimizing of environmental and health risks resulting from improper handling of e-waste through stakeholders' participation. The specific objectives of the strategy and action plan are; to review different policies and regulations related to e-waste management, awareness

creation on e-waste management, and promotion of recycling and material recovery. However, the strategy is yet to be implemented.

5. The institutional framework

The institutional framework for e-waste management in Tanzania is not well developed. However, the existing framework is a result of a number of different policies and regulations which have resulted in the establishment of various bodies dealing with waste management but not directly related to e-waste. These policies and regulations are shown in figures 1 and 2 respectively, while; tables 1 summarizes the respective legal instrument with the corresponding responsible institutions/organization and table 2 summarizes the objectives and roles of the institutions/organization in waste management. As a result of these policies and regulations, the Tanzania government has established a number of institutions to deal with waste management. The key institution involved in waste management is the Vice President's office. In the Vice President's office there is a minister responsible for environment issues and the division for environment and the local government authorities are also responsible for environmental management.

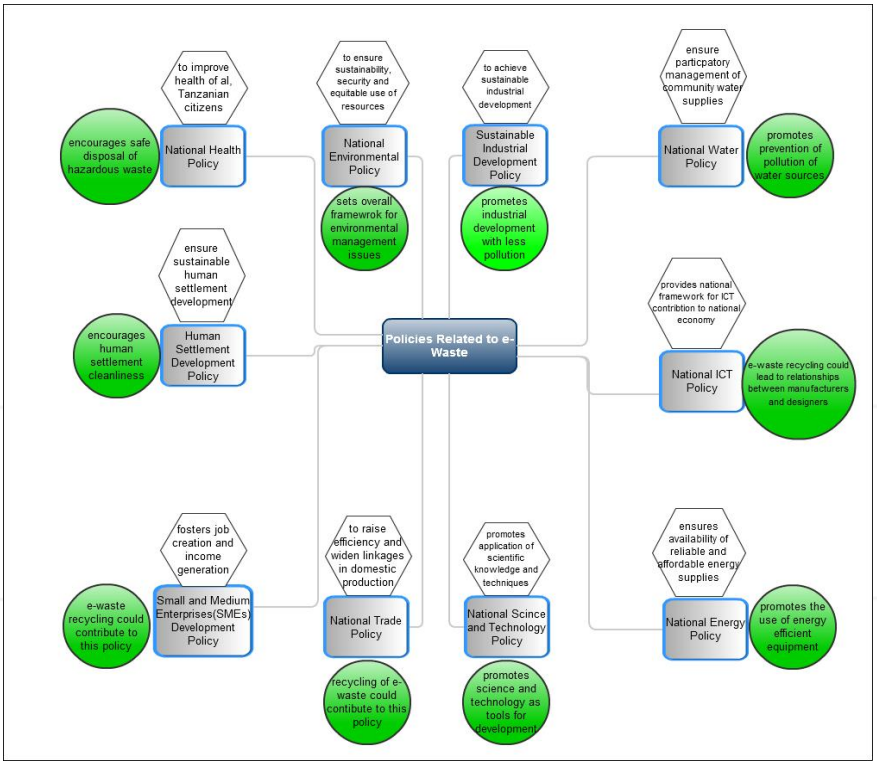

Figure 1. An Overview of Policies related to e-Waste Management in Tanzania: The Policy, Objective and Relevancy.

Figure 1shows a brief overview of different policies related to waste management. The figure summarizes the objectives and the relevancy of each particular policy as it relates to e-waste management. In the figure, the hexagon represents the objectives that a particular policy intends to fulfil, while the circle represents the relevancy of the policy to e-waste and the policy is represented by the smooth rounded rectangle.

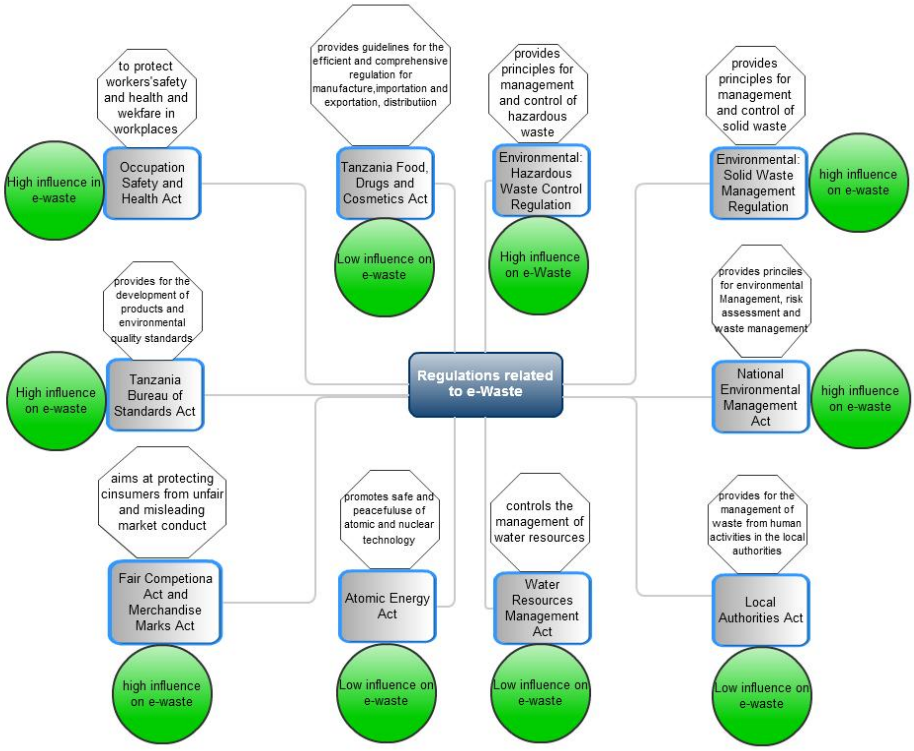

Figure 2. A summary of regulation related to e-waste management, their objectives and impact on e-waste management

Figure 2 shows the different regulations and act related to waste management and how they are related to e-waste and their impact or influence in e-waste management in Tanzania. The regulation or act id represented by a smooth rounded rectangle, the influence of the act is represented by the circle while the objective of the act is represented by octagon. The influence of the act is said to be low when it does not directly address e-waste or e-waste related issues, while a high influence signifies the importance of the act is regulating e-waste and e-waste management by addressing key issues related to e-waste.

These regulations and different bodies responsible for their implementations posses challenges in the management of e-waste. For example local government may decide to enact by laws but these are only applicable in the respective local authority and may be over

ruled by a higher authority. However, this calls for more coordination efforts if e-waste management is to be effectively implemented in the country. From this example of how different institutions which have been given mandate by policy or regulation to deal with environmental management, can come into conflict in their carrying out of their responsibilities; it is clear that the existing policies, regulation and the institutional framework is inadequate. The policies and regulations are insufficient in addressing e-waste management issues and problems. These deficiencies in policies, regulation and institutional framework calls for the need of more effective and efficient framework that will adequately deal with e-waste management issues and problems.

Legal Instrument	Responsible Organ
National Environmental Management Act No. 20 of 2004	Vice President's Office National Environmental Management Council Local Government Authorities
The Environmental (Solid Waste Management) Regulations of 2009	Vice President's Office National Environmental Management Council Local Government Authorities
The Environmental (Hazardous Waste Control) Regulations of 2009	Vice President's Office National Environmental Management Council Local Government Authorities
Tanzania Foods, Drugs and Cosmetics Act of 2003	Tanzania Foods and Drugs Authority Ministry Health and Social Welfare
Occupational Safety and Health Act of 2003	Ministry of Labour, Youth and Culture Occupational Safety and Health Authority
Tanzania Bureau of Standards Acts No. 3 of 1975	Ministry of Industry and Trade Tanzania Bureau of Standards
Fair Competition Act of 2003 Merchandise Marks Act of 1963	Fair Competition Commission
Atomic Energy Act of 2003	Tanzania Atomic Energy Commission
Water Resources Management Act No. 11 of 2009	Ministry of Water Urban Water Authorities River Basins Authorities
Local Government (District Authorities) No. 7 of 1982 Local Government (Urban Authorities) No. 8 of 1982	Local Authorities

Table 1. A summary of regulations and responsible organs in implementation of the acts

Organization	Objective	Role
Vice President's Office: Environment Division	Coordination of all environmental Management issues	Policy formulation Advocacy and implementation Monitoring and evaluation Planning Legislation International cooperation
Local Government Authorities (LGAs)	Waste management and Control	To prevent or minimize e-waste in their jurisdictions
National Environmental Council (NEMC)	Regulatory authority	To oversee the implementation of the environmental management Act. Coordination, evaluation and implementation
Occupational Safety and Health Authority (OSHA)	Ensure occupational health and safety	Safe use and handling of hazardous waste
Ministry of Industry and Trade	Licensing	Registration and licensing of traders and equipment dealers
Tanzania Bureau of Standards	To develop products and environmental quality standards	To ensure that all manufacture or imported products meets the standards

Table 2. A summary of organs responsible for e-waste management, their objectives and responsibilities

6. E-waste, environment and health

E-waste comprises discarded electronic appliances of which computers and mobile phones make the great contribution due to their short life span [11,12] In addition to its damaging effects to the environment and the illegal importation(smuggling) to the developing countries, researches have shown that, e-waste has damaging impacts (effects) to human health [12]. The effects of e-waste to human health and well being includes: respiratory problems, oxidative stress, DNA damage and the possibility of causing cancer.

The reasons for the damaging effects to human health and environment of e-waste is caused by its chemical and physical characteristics which sets it apart from other forms of wastes that are produced by human activities or industrial wastes. These e-wastes contains both hazardous and valuable components that calls for specialized skills in handling, disposing and recycling in order to avoid contamination with the environment and safe guard the human health.

6.1. E-waste environmental contaminants

Table 3 below gives a summary of ingredients of e-waste that are potential environmental contaminants. Examples of the contaminants that can be found in e-waste are such as heavy

metals like copper which are used in manufacture of electronic components. Other contaminants are those which are the results of disposal of e-waste through fire. An example is polycyclic aromatic hydrocarbons (PAHs) which are generated when electronic waste is burnt.

E-waste also contains some components which are distinct from other forms of wastes. An example of these are the batteries such as lithium batteries, contact materials and fire retardants [13], others include monitors (LCD) Chips [11].

Contaminant	Relationship with E waste	Typical E waste concentration (mg/kg)*
Polybrominated diphenyl ethers (PBDEs) polybrominated biphenyls (PBBs) tetrabromobisphenol A (TBBPA)	Flame retardants	
Polychlorinated biphenyls (PCB)	Condensers, transformers	14
Chlorofluorocarbon (CFC)	Cooling units, insulation foam	
Polycyclic aromatic hydrocarbons (PAHs)	Product of combustion	
Polyhalogenated aromatic hydrocarbons (PHAHs)	Product of low temperature combustion	
Polychlronated dibenzo p dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs)	Product of low temperature combustion of PVCs and other plastics	
Americium (Am)	Smoke detectors	
Antimony	Flame retardants, plastics (Ernst et al., (2003))	1700
Arsenic (As)	Doping material for Si	
Barium (Ba)	Getters in cathode ray tubes (CRTs)	
Beryllium (Be)	Silicon controlled rectifiers	
Cadmium (Cd)	Batteries, toners, plastics	180
Chromium (Cr)	Data tapes and floppy disks	9900
Copper (Cu)	Wiring	41,000
Gallium (Ga)	Semiconductors	
Indium (In)	LCD displays	
Lead (Pb)	Solder (Kang and Schoenung, (2005)), CRTs, batteries	2900
Lithium (Li)	Batteries	
Mercury (Hg)	Fluorescent lamps, batteries, switches	0.68
Nickel (Ni)	Batteries	10,300
Selenium (Se)	Rectifiers	
Silver (Ag)	Wiring, switches	
Tin (Sn)	Solder (Kang and Schoenung, (2005)), LCD screens	2400
Zinc (Zn)		5100
Rare earth elements	CRT screens	

Table 3. Potential Environmental contaminants contained in e-Waste (adopted with modification from e-Waste 2009)

Therefore, the impact to the environment of e-waste and the concentration of the contaminants found in e-waste depends on the type of items that are discarded and the time that has elapsed since it was produced. Also the method used to dispose the e-waste impacts the effects that the disposed waste will have on the environment. For example the concentration of elements of e-waste such as Copper, Cadmium, Nickel, Lead and Zinc are of impact to the environment and human health if they were to be released as they pose risk to the ecosystem.

Taking into account that in Tanzania re-cycling is not a well established industry neither is it done properly, the amount of contaminants that could have been averted from leaching to the environment and endanger human health is increased as recycling could have reduced or removed some of the contaminants. Also, since most of the dumping sites in Tanzania either use fire or landfills large amount of these contaminants ends in landfills resulting in high concentration that may leach out into the environment and adversely affect the environment and human health.

Other contaminants are such as poly brominated dipheynl ethers (PBDEs). These are flame retardants which are mixed into the plastic components of electronics. However, these PBDEs have no chemical bond with the plastics and are very likely to escape to the environment from the surfaces of the plastics into the environment. Given the lipophilic characteristic of PBDEs, this causes bioaccumulation in organisms and biomagnifications in food chains [14]. Also, obsolete electronic products such as computers, refrigerators, and air conditioning units contain ozone depleting gases. These gases may escape to the environment from the improperly disposed items in the dumping sites.

6.2. E-waste health hazards

The impact of these toxic elements of e-waste most often impact on the health of humans through improper disposal. Table 4 summarizes the potential health and environmental hazards that are the results of e-waste.

e-Waste Component	Processing	Potential Health hazard	Potential Environmental Hazard
Cathode Ray Tubes (CRT), LCDs	Removal of copper, dumping, breaking	Silicosis, Cuts from the glass, Inhalation of phosphor 8 or contact	Water sources (ground water) contamination by phosphor
Printed Circuit Boards	Removal of chips, de-soldering of the board	Tin or Lead inhalation, Possibility of inhalation of mercury, beryllium and/or brominated dioxin	Air contamination by emitted gases
Chips and other gold plated components	Chemical stripping	Acid contact with skin and/or eyes resulting into permanent injury Inhalation of acid fumes resulting into respiratory problems	Acidification of water sources affecting the flora and fauna of the areas
Plastic components	Shredding, low temperature buring/melting	Exposure to hydrocarbons, brominated dioxins, PAH	Contamination of air by the emitted gases
Steel, Copper and precious metals	Recovering of copper/steel through fire – open burning/furnace	Exposure to dioxins and heavy metals	Contamination of air, water sources and the soil
Mother Board, dismantled printed circuit boards	Burning of the circuit board	Intoxication of dumping sites surrounding residents, workers in the dumping sites from Tin, Lead, Beryllium etc.	Contamination of surroundings and water sources-ground water

Table 4. A summary of potential health and environmental hazards of electronic components [14, 15]

Given the rise of importation of electronic products in Tanzania, and the nature of e-waste and how it is disposed in Tanzania, and the difficult in determining its mass and flux in the country, the health and environmental hazards that are the results of e-waste are likely to be considerable. The impact of this are degraded environment, and negatively affected human health.

7. Research approach

The study employed descriptive research design since the study is seeking for more detailed and accurate information on e- wastes management practices to uncover the challenges and come up with sound and workable solutions to the challenges. The aims of this study were: to establish if organizations have e-waste management plan disposal policy in place and whether asset disposal policy include electronic products, to understand how do organizations store or treat end of use electronic products to establish if there exist collaboration between organizations (consumer of electronic products) and recycling industry to recycle electronic products, to understand whether waste management practitioners are trained on e-waste management practices and understand methods used by waste management companies or organizations to destroy e- wastes in damp sites.

Target population of the study was people working in operational level and managers in companies which are major vendors of electronic products in Tanzania and firms which are major users (buyers) of electronic products. Sample size used in this study was fifteen (15) for major vendors of electronic products and fifteen (15) for major users of electronic products (as per Tanzania Revenue Authority records). The sample sizes were selected using simple random technique from a list of eighty one (81) and eighty (83) for major users and major vendors of electronics products respectively. The study took place in Dar es Salaam as all respondents companies (which were randomly selected from the list of major vendors and consumer of electronic products) have their headquarters in Dar es Salaam.

In line with that semi- structured interviews along with the questionnaires were used as data collection tools. We distributed two (2) sets of questionnaires. The first set of survey targeted companies dealing with waste management and the second set of questionnaire targeted companies which are major consumer of electronic products. Questionnaires were hand delivered to respondents and followed up. The survey was stopped after reaching 13 out of 15 targeted respondent companies for the first set of questionnaire and 10 respondent companies out of 15 targeted respondent companies due time constraint. Structured interviews were conducted to either Operation Managers or Estate Managers or Training Managers to gather their views on e-waste management practices. In addition, four (4) dumping sites and two (2) recycling industries were visited to observe e- waste management practices on site.

8. Results analysis and discussion

In this survey, twelve (12) organizations responded out of fifteen (15) yielding an effective respond rate of 87% for Waste management Organizations and ten (10) Organizations which

are major consumers of electronic products out of fifteen (15) yielding an effective respond rate of 67% .

The study shows 75 % of respondents have been using electronic products in their Organizations for more than ten (10) years. This increases the reliability of study results because the majority of respondent are experienced consumers 'of electronic products and therefore are thought to be more familiar with electronic products. Additionally, 65.7% of respondents have more than ten (10) years experience in waste management.

The study found that, 37.5% of Companies that are major consumers of electronic products do not have electronic products disposal plan and policy that include electronic products. This is a challenge as electronic products disposal policies and procedures provide guidelines for disposing electronic products within the Company [16].These guidelines help determine assets to be disposed and reveal procedures for disposing of electronic products with value for money in mind. Without these policies and procedures, disposing of electronic products will be handled improperly, or the decision to dispose of the assets may be delayed and therefore this may keep the organization in stalemate of either to re-deploy or dispose the electronic products. Similarly, there is a possibility of disposing of electronic products which are still of value to the Organization.

Further, this study found that storage of e-waste in general needs special attention. 75 % of Organization surveyed had not special allocated rooms with enough space to store end of use electronic products. This increases the chance of leakage. Standard operating procedures for e-waste for companies in India for example require organizations to allocate sufficient storage space with each type of e-waste placed differently to ensure safety [17]. Some components of electronic products are made up of hazardous chemicals such as batteries of phones and cartridges which contain carbon, lithium and other chemical elements [18]. Likewise Cathode Ray Tubes (CRT's) found in televisions and computer monitors contain mercury, phosphorous, cadmium, barium and lead that may leak if stored carelessly. In this regard, sensing mechanisms to detect any leakage should be installed in storages of end-of-use electronic products.

Another challenge is lack of well trained personnel in waste management and allocation of dumping sites. It is shocking to find out that none of waste management Organizations surveyed has trained personnel in waste management. It should be noted that handling of e-waste is different from other wastes; therefore it requires well-trained personnel and specialized equipments. Further, it requires strategic allocation of recycling, landfills or dumping sites to decrease the effect on the environment. Unfortunately this is not the case in Tanzania. The study found, many recycling, landfills and dumping sites are found near residential areas. This poses a very dangerous situation to health and environment as most of Waste management Companies prefer fire (55.6%) to destroy wastes (including e-wastes).

Tanzania has few Institutions specialized in the recycling of waste products. Most of them target plastics (plastics containers), and metal related products. But there are no recycling centers specialized in recycling e-waste products. This is evidenced by the fact that we have not even managed to deal effectively with household waste. Therefore to deal with

categorized waste such as e-waste will be more difficult. This situation could have been improved if consumers of electronic products could forge partnerships or collaboration with Waste management Companies, National Environmental Commission and other stakeholders to recycle end of use electronic products. In line with that, this study found that 100% of Organizations surveyed has no partnerships with recycling industry to recycle end of use electronic products. Another type of collaboration can be forged between vendors and users through an end of use take back programme.

In addition to that due to rapid increase in users of mobile phones, televisions, internet, internet hosts [1] increase in importation of computers, photocopiers, printers ,other computer peripherals, fridges, air conditioners and other electronic products to Tanzania, it is obvious that the existing recycling capacity is not sufficient to absorb the potential e-waste caused by all of this.

Finally the study observed that, privacy and confidentiality of information is in jeopardy as only 8.3 % of respondents sanitize storage devices such as hard disk to wipe out permanently data. If these devices hard drives are not wiped effectively or destroyed, privacy, confidentiality and security of information stored in may fall in wrong hands and cause disaster.

9. Suggested solutions

In this section we suggest solutions to the challenges identified in Section 3 above as follows, Companies should: craft electronic products disposal policies and procedures, improve of end of use electronic products storage facilities, provide training and improve disposing infrastructures and equipments, revisit legal framework, launch of awareness campaigns to the public, and properly clean hard drives of computers in order to secure privacy and confidentiality of information.

9.1. Formulation of disposal policies and procedures

As the research results have shown, most Companies lack e-wastes disposal policies and procedures.

Therefore e- waste disposal policies and procedures will lay down principles, guidelines and procedures in disposing of end of use electronic products in Companies and will clearly pave the way for the whole process in disposing of end-of-use electronic products. . In order to address this inadequacy; the authors suggests that, Tanzania government adopts the Durban declaration on e-waste management in Africa [19]. This declaration calls each country to develop its own process and define its own roadmap towards e-waste management.

The result of implementing the declaration; the government in collaboration with stakeholders should develop e-waste management guidelines for different stakeholders and organizations. The objectives of the guideline should be to:

a. enhance environmental and health protection from e-waste,
b. formulate a basis for policy and regulatory framework for e-waste management for the different players, and
c. to create/raise awareness towards sustainable e-waste management in Tanzania and both the national, organizational and household level.

The guidelines should address issues such as: approaches towards enhanced environmental and health protection, policy, regulatory and institutional framework for e-waste management, awareness creation, categories of e-waste, e-waste treatment and treatment methods and technologies, and disposal procedures for e-waste.

This will build a sense of responsibility and accountability related to management of electronic products within companies in order to make sure that value for money concept is realized during electronic products disposal exercise. Further, electronic products disposal policies and procedures will build a sense of responsibility and accountability related to management of electronic products within Companies in order to make sure that value for money concept is realized during electronic products disposal exercise. Formulation of these policies and procedures should involve all stakeholders in Companies and accommodate all electronic products used in the Company. To make them effective, the policies and procedures of disposing end of use electronic products should be enforced the same way as other policies. Since technology is changing very fast, periodic review of these policies and procedures is inevitable.

9.2. Improved storage facilities

Storage of end-of-use electronic products needs to be addressed seriously. Therefore to tackle this challenge, organizations and institutions need to make sure enough storage space is allocated for storing end-of-use electronic products. Storage facilities need to be equipped with sensing mechanisms to detect any leakage or emission of radioactive materials found within end-of-use electronic products. Meanwhile we recommend Companies to cut off time taken to keep in stores the end-of-use electronic products before they are taken for disposal. Reduction of delay-time will mean that organizations will save storage costs and space for storing end of use electronic products. This will ultimately help to mitigate all risks associated with storage for long term end-of–use and decommissioned electronic products including leakages and emissions of radioactive materials found in electronic products.

9.3. Training and improvement of disposing infrastructures

Training of people working in waste management sector and improvement of infrastructure for disposing e- wastes is a crucial step towards curbing e-wastes disposal challenges. The waste management sector is not getting the attention it deserves. Workers in this sector are not trained, equipped and are lowly-paid. Techniques related to personal protection, handling of hazardous products, first aid and combating fire and flames are essential for people working in this sector. E –wastes is still treated as any other waste. For example,

currently, Tanzania has no specialized plant to destroy e- wastes. All wastes are disposed using the same method- fire. Partnerships or collaboration between Companies with electronic products major vendors or producers can help in improving e-waste disposing infrastructures.

Considering the electronic products growth trends in Tanzania there is no doubt that within the next few years these challenges will be realized, and therefore building and improving infrastructure is not an option any more, it is a necessity. Kenya, Nigeria, and South Africa, Egypt and many other West African countries have already started shaping their waste treatment infrastructure to accommodate e-waste[20],[21], and [22].

9.4. Deliberate support for recycling initiatives

Due to rapid increase in importation of electronic products and usage at homes and offices, it is clear that e-waste is becoming a "time ticking bomb". Recycling activities in Tanzania are mainly focusing on plastic and metal scrap recycling only. Van de Brink and Szrimai's study of the Tanzania scrap recycling showed that Tanzania have large surplus of scrap and the players in metal scrap industries are not capable of utilizing all available scrap. [23].Additionally little has been done to support plastic recycling. This can be evidenced by the fact that few plastic products producers are engaging in recycling activities. From Van de Brink and Szrimai's study we can realize that deliberate support for recycling initiatives and recycling activities is urgently needed to extend recycling initiatives and activities to accommodate e-waste products in order to curb this alarming problem before is too late. The Government through National Environmental Commission (NEMC), Municipal and City Councils, Non- Governmental Organizations and other stake holders has to take charge in launching recycling campaigns and initiatives.

9.5. Proper cleaning of hard drives and memory

Proper hard drives cleaning is essential for guaranteeing privacy and confidentiality of information stored in end of use electronic products. Deleting a file or formatting a hard drive does not sterilize completely computer hard drives. When a hard drive is formatted, information stored in is still alive and can easily be recovered using data recovery software. There is a lot of software available that are capable of deleting a file permanently. They clean hard drives without destroying the sectors and leave no trace of information. This makes it impossible for information stored to be recovered. Therefore in order to safeguard privacy and confidentiality of information we recommend organizations to apply secure data cleaner software that conforms to DoD 5220.22-M standard, which requires overwriting of all addressable locations with a character, its complement, then a random character and verify[24]. Secure wiping of data and information should be conducted regardless of whether the electronic device is decommissioned or destroyed. This is crucial because data and information stored in hard drives or memory of these devices can be accessed and used illegally by unauthorized people.

9.6. Enforcement of e-waste related legislation and e- waste awareness campaigns

Having legislation without enforcing it is useless. It is therefore the responsibility of the Government through its law enforcement units to make sure these e- waste legislations however do not in full adhere to the Basel Convection Basel Convection on the control of trans-boundary movements of hazardous wastes and their disposal are enforced. This will largely help to stop few culprits to transport and dispose irresponsibly e- wastes.

The study conducted by UNIDO e- waste initiatives for Tanzania in 2011 indicated that, 80% of people interviewed are unaware of e-wastes and its hazardous impact on the environment [25]. This suggests the need of e- waste awareness campaigns to the public in order to safeguard the environment and public health in general.

10. Conclusion

This chapter has discussed various challenges on e- Wastes disposal in Tanzania and proposed remedy to the challenges. These challenges are:

a. Lack of ICT asset disposal policy
b. Lack of storage facilities for end of use electronic products
c. Lack of trained personnel in e- waste management
d. Lack of proper re-cycling initiatives and partnership and
e. Privacy and confidentiality of data and information in end of use electronic products such as phones and computers.
f. Lack of enforcement of e- waste related legislation.

We suggest that, Government and non government organizations should set and enforce electronic products disposal policy and work in collaboration with recycling industries to recycle end of use electronic products safely. Further, the main importers of electronic products should be involved in raising awareness to users of electronic products regarding safe disposal of electronic products and be involved in e- waste recycling initiatives.

Our findings illustrate that disposing of end of use electronic products is alarming situation and therefore needs special attention. It is essential that all key players be involved in thwarting down e-waste issue. Different regulations provide principles on handling of e-wastes and provide room for producers and vendors of electronic products to set up recycling systems of electronic products from consumers. These regulations are not enforced and therefore not followed. The intention of these regulations is to involve consumers of electronic products in different levels in disposing e- waste safely. The existence of these regulations is seen as important and crucial, but is not executed. Even the strategy and action plan on e- waste has not been implemented while things are getting out control.

Tanzania is one of the signatories of Basel Convection on the control of trans-boundary movements of hazardous wastes and their disposal which was ratified on 7 April, 1993. Unfortunately, Tanzania has not dealt seriously with the problem of importation of sub-

standard electronic products which are donated to majority of African countries as means of off-loading e-waste from developed countries.

It is now high time for the Government of United Republic of Tanzania to amend and enforce Environment Law to accommodate the Basel Convection. This will prevent Tanzania from becoming a dump site for end-of-use electronic products. Amendment of environmental law will make Tanzania part of world-wide team who prevents illegal e-waste trade and at the same time help hold responsible people importing sub-standard electronic products and disposing of them irresponsibly. Our desire to stimulate development of ICT industry in Tanzania by slashing all taxes and duties on computers and their peripherals needs to be revisited in order to save our environment for present and future generations.

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