

Public awareness and sustainability of e-waste management in Kenya

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Abstract: The increased use of electronic gadgets has proportionately increased the accumulation of e-waste. Currently, E waste in Kisumu is informally managed and it is not known whether the informal management of e-waste is sustainable. The purpose of this study was to assess the public awareness on sustainability of e-waste management in Kisumu City, Kenya. The research adopted a descriptive survey design and data collected using questionnaires, interviews, Focus Group Discussions and observation from a sample size of 425 respondents selected through simple random sampling out of a target population of 148,494 households while analysis involved descriptive statistics. The study concludes that the current e-waste management is not sustainable because: there is no monitoring of the volumes of e-waste generated making it difficult to plan for its disposal, there is a high turnover of e-waste of 78% every 5 years without a corresponding mechanism for reducing, recycling and reusing, the current level of stakeholder awareness on e-waste management is not adequate, policy formulation and enforcement by relevant government ministries remains weak and investors and NGOs are unwilling to invest in this area due to expensive capital infrastructure and technology inadequacy. The study recommends that NEMA e-waste management guideline 2010 should be enforced to ensure proper reduce, reuse, recycling and disposal besides amendments to Public Health Act (1962), Urban Areas and Cities Act No.13 of 2011 (Cap. 265) to comply with the NEMA guideline. MIC should enforce their requirement for Extended Producer Responsibility on ICT Actors. The relevant ministries and the civil society need to create awareness of e-waste and its safe handling. KEBS should train expertise in forensic audit of hazardous components included in electronic equipment and discourage importation of such substances.

Keywords: Public awareness, sustainability, E-waste management

I. INTRODUCTION

The growth in electronic equipment production and consumption has been exponential in the last two decades due to urbanization and the growing demand for consumer goods in different regions of the world (Babu *et al.*, 2007); eventually leading to increased volume of e-waste. Financial constraints on acquiring ICT materials in developing regions has led to consumption of second hand products (Nnorom & Odjango, (2007)) besides internal generation or illegal importation of used goods in an attempt to bridge the digital divide.

About 20 to 50 million tones of electronic waste (“e-waste”) are generated worldwide every year, much of which has been transported to the developing nations (UNEP 2010). In 2007, Kenya, Morocco and Senegal discarded approximately 17,500 tones of IT e-waste (Hewlett-Packard 2009). South Africa generates 100,000 tons annually (Lombard 2004). In Kenya the total e-waste generated from computers, monitors and printers is about 3,000 tons per year (Mureithi *et al.*, 2008) and likely to increase dramatically as the importation and use of computers increases; a 200% rise was recorded in 2007 (Hewlett-Packard 2009). The e-waste concept came to light as far back as in the 1970s and 1980s following environmental degradation that resulted from hazardous waste imported into developing countries (Shinkuma & Huong, 2009). The Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal was instituted in 1992 to control the situation. Although “the Basel Convention does not regulate secondhand items and some e-waste scrap” (Shinkuma & Huong, 2009), it has played a role in banning exportation of obsolete products and engineering waste solutions.

E-waste contains toxic substances and creates serious risks to human health and the environment if not handled properly (Chatterjee, 2008; Li *et al.*, 2008). In the e-waste recycling regions, the improvement of disposal systems is the most cost-effective method to reach the objectives of solid-waste management (Brunner & Fellner, 2007) and calls for proper processing and management methods and enactment of timely regulatory and legislative policies. Current technologies are not particularly cost-effective in many developing countries; and many aspects of recycling depend on informal recycling (Babu *et al.*, 2007). Public awareness of the health and environmental threat posed by e-waste is minimal due to failure to provide up-to-date information by the relevant authorities (Brunner & Fellner, 2007). To best protect public health and the environment, policy makers of all developed and developing nations must be willing to fundamentally redesign the approach to e-waste management (Babu *et al.*, 2007). The absence of a policy and legislative framework and a practical management system, means that much e-waste remains in storage or recycled/disposed of in an unsafe and unsustainable manner putting both the recycler and local population at risk (Hewlett-Packard, 2009). Extended Producer Responsibility (EPR) as a policy strategy was first

proposed by Thomas Lindhqvist in 1988 for a shared responsibility among relevant stakeholders across the product life cycle (Lifset & Lindhqvist, (2002); Lindhqvist, 2000) and is currently being implemented by Nokia Ltd in Kenya as “a take-back strategy” (Nokia, 2010). National and local governments ensure effective EPR programmes by raising awareness of programme requirements and establishing mechanisms to help prevent free riding and anti-competitive behavior (OECD, 2001).

The first Medium Term Plan (2008-2012) of Vision 2030 stating the government’s commitment to improve ICT infrastructure as a foundation for a knowledge economy further raises an alarm because to bridge the digital gap there will occur exponential importation of ICT and Telecommunication equipments which will eventually turn into e-waste but the existing legislative Acts and by-laws do not recognize e-waste in specific and the e-waste management systems are informal. Capacity constraints hindering the disposal of e-waste as well as the collection system and recycling infrastructure are the major challenges facing all the East Africa nations. In Kenya a huge quantity of e-waste is handled by the informal (jua kali) sector. In addition, many developing countries have been caught up in the web of global e-waste dumping (Waema & Muriuki, 2008). The major source of e-waste is the disposal of the hardware and electronic items from Government offices, public and private sectors, academic and research institutes and Household consumers (Chatterjee and Krishna, 2009). Many of these products can however be refurbished, reused, or recycled in an environmentally sound manner so that they are less harmful to the ecosystem and public health i.e. to reduce leaching, radiations and emission of toxic gases (William, 2010).

The generation of solid waste in Kisumu is on the increase due to the rising population and high rates of resource consumption while the handling capacity of the council has been exceeded (KARA, SANA & Ilishe Trust, 2007); the legal framework and the Municipal Council By-laws of 2008 on solid waste management, is held captive by inadequate capacity of the county council resulting in illegal dumping on road reserves (Obera & Oyier, 2002). The dumpsite at Kachok on the Kisumu-Ahero Road, 2 km from the town centre, receives unsorted solid waste mixed with toxic e-waste (Carl Bro Report, 2001; Ecoforum, 2001; World Bank, 1995). People from nearby informal settlements use the dumpsite as a source of income, oblivious of the harmful fumes from waste burning and methane fires in it. Only 17% of households in Kisumu have access to private collection and 47% by county council while the rest are just disposed off roadsides (KARA, SANA & Ilishe Trust, 2007).

In general the consumption of secondhand, cloned and refurbished electronic equipments has led to the generation of e-waste even though locally recording has not been done to track the quantities generated per source. On policy issues, Despite NEMA’s development of e-waste management policy guidelines in 2010, the relevant ministries have not amended the necessary Acts and by-laws to comply with the policy

guideline i.e. EMCA (1999); Articles 42; 60-70 of the new Constitution; Urban Areas and Cities Act No.13 of 2011 (Cap. 265) and the 2008 city by-laws and Public Health Act (1962) do not specifically address e-waste management since it’s a recent phenomenon even though currently the council is considering drafting specific by-laws and also engage in public-private partnership. The inexistence of recycling facilities and the unwilling nature of NGOs and the private sector to cooperate with the City Authority in recycling of e-waste due to the huge capital and technology requirements has left the authorities in a limbo. The study aimed to contribute valuable knowledge on sustainable e-waste management policy formulation for a healthy environment in general. The study therefore endeavored to highlight mechanisms of creating public awareness on sustainable e-waste management. Formal e-waste management would ensure recovery of valuable resources such as gold, silver and aluminum; employment creation both formal and informal; revenue generation to the local authorities through taxation of registered recyclers and refurbishers and improved health and environment. The study also provides a reference and vital information to the databank on sustainable e-waste management for other researchers and development agencies interested on the issue.

II. LITERATURE REVIEW

2.1 Awareness on e-waste management

To realize tangible progress in e-waste management, public awareness on effects and e-waste management system is paramount. Waema & Muriuki (2008) recommended awareness creation and training programmes development and implementation at consumer level. Globally, the data on e-waste are poor and insufficient, limiting our understanding of the issues and therefore solutions (Hewlett-Packard 2009). Given the very limited data on amounts of e-waste collected and treated through “official” e-waste channels, it is clear that the recycling of significant proportions of e-waste currently goes unreported in different parts of the world (Hewlett-Packard, 2009).

The lack of awareness that recycling is even possible and knowledge on existing recycling programs and locations are the main obstacles for consumers (Liu, 2009) and this shows why globally only 10% of people have recycled their old mobile phones while the rest are in stores at home. In the United States, increased awareness on e-waste potential dangers to human health and the environment has led to increased efforts to divert e-waste from landfill disposal (Brunner & Fellner, 2007). Awareness of the e-waste risks in European Union has led to calls for legislation of “Directive on Waste from Electrical and Electronic Equipment (WEEE Directive)” and “Directive on Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment”, (OECD, 2001). In Korea despite enacting regulations such as “Waste Management Act” and “Act on the Promotion of Saving and Recycling of Resources” (Lifset & Lindhqvist, 2002); information on handling and disposal of e-

waste remain limited, resulting into mixed solid waste disposed of in municipal landfill sites and incineration facilities.

E-waste is receiving a relatively high priority in South Africa at the moment (Lombard, 2004), and there are good management and monitoring systems governing waste streams. Some waste practitioners, such as Lombard (2004) see e-waste as an opportunity to significantly scale up local refurbishment processes and a way of developing effective recycling industry offering opportunity for socio-economic development. East Africa countries are aware of the e-waste implications and are signatories to multilateral environment agreements (Basel, Bamako conventions) but these agreements have so far had little impact on overcoming the problem at a national level (Waema & Muriuki, 2008).

In Kisumu awareness and information on dangers of e-waste has not been documented (Mang'eli, 2010) due to failure to provide up-to-date and accurate, environmental information to communities to enable them to effectively participate in decision making despite improvements in waste legislation (Ecroignard, 2005). Active engagement of communities can help engender local 'ownership' of schemes enhancing participation (Petts, 2001; Watson & Bulkeley, 2005a). To increase awareness of waste reduction and encourage changes in society, government needs to carefully consider the appropriate forms of intervention like environmental activism and participatory engagement and media information dissemination i.e. moving beyond surface responses to the issues: small scale, local and intensive schemes with a high degree of community ownership in reduction, re-use, recycle and proper disposal (Waema & Muriuki, 2008). Consumers and policy makers think e-waste is a distant issue (Waema and Muriuki, 2008); hence there is need to sensitize the public on the negative effects of e-waste on health and environment (Liu 2009) and opportunities on recoverable valuable secondary materials and other social-economic gains (Waema & Muriuki, 2008).

III. METHODOLOGY

The study was conducted through descriptive cross-sectional survey design and data collected using questionnaires, interviews, Focus Group Discussions and observation from a sample size of 425 respondents selected through stratified random sampling out of a target population of 148,494 households while analysis involved descriptive statistics of percentages and cross-tabulation at a significance level of 0.05 to establish the relationship between the variables under investigation. A reliability and validity tests were done amongst 10% of the respondents and a coefficient value of 0.87 obtained.

IV. FINDINGS AND DISCUSSION

The questionnaire return rate was 87%. The study assessed the level of awareness on sustainable e-waste management. Household Respondent's awareness on risks and opportunities is average as shown in Table 4.7. About 55% of the

respondents were aware of the environmental hazards; 52% were aware of health hazards; 45% were aware that e-waste needed special treatment before disposal; 60% were aware of recycling possibility and 48% were aware of the opportunities arising from properly managed e-waste. Despite e-waste being an emerging issue slightly above 50% of the respondents was aware of its risks; this in view of the research is an encouraging trend and with slight advocacy an informed society will be realized. The most identified hazards to the environment included heavy metals finding their way into the underground water thus destabilizing biodiversity. The fumes released into the atmosphere pollute the air.

Table 4.1: Awareness on hazards and opportunities of e-waste

awareness level				
		Percent		
		Yes	No	Total
E-waste risk & opportunity awareness	Environmental hazards	55.0%	45%	100%
	Health hazards	52.0%	48%	100%
	E-waste special treatment	45.0%	55%	100%
	E-waste recyclability	60.0%	40%	100%
	E-waste opportunities	48.0%	52%	100%

A record 48% of the respondents knew of the opportunities and mentioned some such as; employment creation, revenue generation for the government, and resource recovery besides environmental and health protection. Similar findings were made by waste practitioners, such as Lombard (2004) who saw e-waste as an opportunity to significantly scale up local refurbishment processes and a way of developing effective recycling industry offering opportunity for socio-economic development. The 60% knowledge on recycling possibility would make it easier for channeling of e-waste to recycling facility should one be established, but currently due to lack of a recycling plant, the respondents were left with little options and some opt to burn the waste or dispose into the dumpsites and road reserves. The findings contradicts Liu (2009) argument that lack of awareness that recycling is even possible and knowledge on existing recycling programs and locations are the main obstacles for consumers but it is rather the inefficiency of policy enforcement and lack of recycling infrastructure and technology.

Petts (2001), and Watson and Bulkeley (2005) cited that active engagement of communities can help engender local 'ownership' of schemes enhancing participation. Similarly Waema and Muriuki (2008) concurred with the fact that to increase awareness of waste reduction and encourage changes in society, government needs to carefully consider the appropriate forms of intervention i.e. moving beyond surface responses to the issues: small scale, local and intensive schemes with a high degree of community ownership in reduction, re-use, recycle and proper disposal. Consumers and policy makers think e-waste is a distant issue (Waema and

Muriuki, 2008); hence there is need to sensitize the public on the negative effects and opportunities of e-waste (Liu, 2009).

4.1 Sources of Information on E-waste management

The respondents mentioned various sources that have contributed towards their knowledge exposure on how E-waste needs special management system distinct from the rest of solid waste. The main source of information on e-waste management mentioned by the respondents is print media at 25% followed by brochures attached with the product at purchase at 13% and then electronic media at 11%, 6% through public posters, 7% through mobilization while 3% through the internet. About 35% of the respondents did not have the information on e-waste. This means that electronic and print media could be used to disseminate the information on e-waste management better since they reach a large majority at 36%. More advocacies and sensitization on this issue would probably improve the information sink in the respondents and reduce the 35% margin of those who do not have the information at all.

Table 4.2: Information sources on e-waste management

	Percent
print media	25.0
electronic media	11.0
internet	3.0
brochures	13.0
Public posters	6.0
Mobilization	7.0
None	35.0
Total	100.0

In United States increased awareness on e-waste potential dangers to human health and the environment has led to

increased efforts to divert e-waste from landfill disposal (Brunner & Fellner, 2007). Awareness of the e-waste risks in European Union has led to calls for legislation of “Directive on Waste from Electrical and Electronic Equipment (WEEE Directive)” and “Directive on Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment”, (OECD, 2001). In Korea despite enacting regulations (Lifset & Lindhqvist, (2002)), information on handling and disposal of e-waste remain limited resulting into mixed solid waste disposed of in municipal landfill sites.

4.2 Relationship between Awareness and Basic e-waste management practices

Despite awareness on dangers, opportunities and management practices, Record keeping on electronic products remains low (8%-10%). The respondents felt that the record was of no consequence as its use could not be obviously identified. This according to research would make it difficult to track the quantity of e-waste flow which usually informs of the capacity of a recycling facility to be established in an area. Respondents who were aware of environmental hazards and e-waste opportunities had a better developed culture of sorting waste (16%-19%) before disposal than those who were aware of health hazards, e-waste special treatment need and recyclability. Respondents who were aware of e-waste recyclability (18%) were more willing to give their obsolete equipments for free than the lot that had knowledge on hazards (16%) and opportunities (12%). This can be transposed from the fact that those who were aware of e-waste opportunities believed the waste could still be recycled and the money gotten be used to finance the management instead of paying directly for their disposal while those who were aware of the hazards were more ready and willing to pay provided the disposal was effective.

Table 4.3: Relationship between awareness and basic management practices

		E-waste management practices							Total
		Sorting	Inventor y	E-waste training	Ready market	Willingness to pay	Ready to give free	Disposal condition	
Awareness on E-waste	Environmental hazards	17.0%	9.0%	2.0%	20.0%	17.0%	16.0%	19.0%	100.0%
	Health hazards	16.0%	9.0%	2.0%	21.0%	18.0%	16.0%	18.0%	100.0%
	E-waste special treatment	14.0%	8.0%	2.0%	25.0%	21.0%	14.0%	16.0%	100.0%
	E-waste recyclability	15.0%	9.0%	2.0%	20.0%	15.0%	18.0%	21.0%	100.0%
	E-waste opportunities	19.0%	10.0%	2.0%	22.0%	16.0%	12.0%	19.0%	100.0%

On the proper disposal need above 16% of the respondents who had information on e-waste management exercised care. Under all categories of awareness the respondents had ready market for their e-waste products (20% and above). Even though awareness on the market readiness for the repaired or obsolete equipments remained high above 20%, the market remained informal and the sellers were less likely to get the actual market value of their equipments. Respondents who were aware of e-waste dangers (17%) and special treatment (21%) were more willing to pay for the proper disposal of the waste than their counterparts who were aware of e-waste recyclability (15%) and opportunities (16%).

The record keeping trend remains minimal (8%-10%) despite awareness on both hazards and opportunities and this similarity is found in Hewlett-Packard (2009) report which recognized that globally, the data on e-waste are poor and insufficient, limiting our understanding of the issues and therefore solutions. To realize tangible progress in e-waste management Waema and Muriuki (2008) advocated for public awareness on effects and e-waste management system at consumer level. At the same time they argue that knowledge without enforcement has less impact on e-waste management.

4.3 Link between Awareness and Disposal condition of obsolete equipments

Of those who were aware of Environmental hazards 54% disposed of obsolete electronic equipments in broken-unfixable condition; 28% in broken but fixable condition while 18% disposed them in a working condition. Those who were aware of health hazards 48% disposed obsolete electronic equipments in broken-unfixable condition; 27% in broken-fixable condition while 29% disposed them in working condition.

Table 4.4: Relationship between awareness and disposal condition

Awareness on e-waste disposal condition					
		Disposal condition			Total
		Broken - unfixable	Broken-fixable	Working condition	
Awareness on E-waste	Environmental hazards	54.0%	28.0%	18.0%	100%
	Health hazards	48.0%	27.0%	25.0%	100%
	E-waste special treatment	43.0%	30.0%	27.0%	100%
	E-waste recyclability	57.0%	24.0%	18.0%	100%
	E-waste opportunities	52.0%	35.0%	13.0%	100%

Those who were aware of the need for e-waste special treatment 43% disposed obsolete electronic equipments in

broken-unfixable condition; 30% in broken-fixable condition while 27% disposed them in working condition. Those who were aware of e-waste recyclability 57% disposed obsolete electronic equipments in broken-unfixable condition; 24% in broken-fixable condition while 18% disposed them in working condition. Those who were aware of e-waste opportunities 52% disposed obsolete electronic equipments in broken-unfixable condition; 35% in broken-fixable condition while 13% disposed them in working condition.

Based on the findings those who were aware of the e-waste recyclability and opportunities were less likely to dispose the waste even if they were broken and unfixable due to the commercial value attached to the equipments unlike their counterparts who knew the hazards and the need for special treatment of e-waste since this group only identified the waste as a danger. On the part of disposing obsolete equipments in a broken but fixable condition the respondents almost gave a universal disposal percentage (28%) irrespective of their knowledge on hazards and opportunities. Less than 25% of the respondents disposed their electronic equipments in working condition. This shows that over three quarters had strong commercial value attachment on their equipments in working conditions and therefore were more unwilling to dispose. To increase awareness of waste reduction and encourage changes in society, government needs to carefully consider the appropriate forms of intervention i.e. moving beyond surface responses to the issues: small scale, local and intensive schemes with a high degree of community ownership in reduction, re-use, recycle and proper disposal (Waema & Muriuki, 2008). Consumers and policy makers think e-waste is a distant issue, hence there is needed to sensitize the public on the negative effects of e-waste on health and environment (Liu 2009).

4.4 Relationship between Awareness and methods of final disposal

Respondents aware of Environmental hazards had various ways of disposal such as: disposed of as mixed rubbish 4%; 30% kept in store; 6% burnt; 21% sold as second hand; 10% given to recyclers; 16% donated; 8% returned to seller for subsidy on new product while 5% disassembled for reuse of parts. The rest of the findings of Table 4.11 follow the same procedure as described above. The argument was that the toxic substances would pollute the environment and be detrimental to health. Respondents who were aware of e-waste opportunities (2%) refrained from burning e-waste more than the rest of the group due the fact that had commercial value attachments to the e-waste. Respondents who were aware of e-waste need for special treatment (2%) were less willing to sell them as second hand as they did not trust the receivers with their final disposal as this could turn to be hazardous to the environment. Respondents who were aware of e-waste opportunities (4%) were less willing to give e-waste to recyclers as they believed they still contained valuable resources that could be extracted for commercial gains and for that they could not give them for free. There was no large discrepancy on the willingness of respondents to donate their

e-waste. Respondents who were aware of e-waste opportunities (22%) were more willing to return the used

equipments to the seller at a price than the rest of the group; this was a form of commercial satisfaction.

Table 4.5: Relationship between awareness and final disposal method

		Final disposal									Total
		Dispose of as mixed rubbish	Keep in store	Burn	Sell as second hand	Give to recycler	Donate	Return to seller at a price	Return to seller for subsidy on new product	Disassemble for reuse of parts	
Awareness on E-waste	Environmental hazards										
		4.0%	30.0%	6.0%	7.0%	10.0%	16.0%	14.0%	8.0%	5.0%	100%
	Health hazards										
		4.0%	30.0%	4.0%	6.0%	10.0%	17.0%	16.0%	11.0%	3.0%	100%
	E-waste special treatment										
		17.0%	30.0%	10.0%	2.0%	12.0%	11.0%	14.0%	1.0%	5.0%	100%
E-waste recyclability											
	11.0%	26.0%	8.0%	7.0%	10.0%	11.0%	13.0%	7.0%	7.0%	100%	
E-waste opportunities											
	7.0%	30.0%	2.0%	4.0%	4.0%	14.0%	22.0%	10.0%	9.0%	100%	

Respondents who were aware of the need for e-waste special treatment (1%) were less willing to return the obsolete electronic products to the seller for a subsidy for a new product as compared to the rest of the group as they were not assured whether the seller had developed mechanism of their disposal. Respondents who were aware of e-waste hazards and need for special treatment were less willing to disassemble the obsolete products for reuse of parts than those who knew of opportunities and recyclability because they feared the being exposed to the environmental and health hazards posed by toxic substances contained in the obsolete equipments. According to the findings, awareness on both the dangers and opportunities of E-waste has greater gravity on the way respondents indicated they disposed of their end-of-life electronic equipments. Averagely 30% of the respondents were keeping the waste in store due to the perceived commercial value they still hold, 20% donate and 15% return to seller at a price as compared with other disposal methods which are below 8%. This is an indication that the respondents not only attach commercial value to the equipment but do not also want to contaminate the habitat thus they either store, sell at a price or donate the electronic equipments.

Active engagement of communities can help engender local 'ownership' of schemes enhancing participation (Petts, 2001; Watson & Bulkeley, 2005a). To increase awareness of waste reduction and encourage changes in society, government needs to carefully consider the appropriate forms of intervention i.e. moving beyond surface responses to the issues: small scale, local and intensive schemes with a high degree of community ownership in reduction, re-use, recycle and proper disposal (Waema & Muriuki, 2008). Public

sensitization provides adequate information on the negative effects of e-waste on health and environment and opportunities on recoverable valuable secondary materials and other social-economic gains (Liu 2009).

V. FINDINGS AND DISCUSSION

Despite e-waste being an emerging issue slightly above 50% of the respondents was aware of its risks and opportunities; this in view of the research is an encouraging trend and with slight advocacy an informed society will be realized. The main source of information on e-waste management was print and electronic media (36%), which makes it a better mode of information dissemination to reach the majority. Awareness has greater gravity on the way respondents managed their e-waste, for example, those who were aware of the e-waste recyclability and opportunities were less likely to dispose the waste due to the commercial value attached to the equipments unlike their counterparts who knew of the hazards and the need for special treatment of e-waste.

VI. CONCLUSION

The study investigated sustainable management of e-waste in Kisumu city. The study concludes that: There is a high turnover of e waste since 78% of the respondents purchased electronic equipment every 5 years without a corresponding mechanism for reducing, recycling and reusing the e waste making e-waste management unsustainable. Such a scenario indicates that if nothing is done there will be an increasing accumulation of e-waste over time thus endangering the environment and its users. The current level of stakeholder awareness on e waste management is not adequate to make e-

waste management sustainable. The study concludes that the current situation on e-waste management and policy formulation and enforcement by relevant government ministries remains weak. The unwilling nature of investors and NGOs to invest in this area due to expensive capital infrastructure and technology inadequacy render the management of e-waste unsustainable. E-waste management therefore remains informal leading to resource wastage and minimal health and environmental safety observation, thus it remains unsustainable.

Arising from the conclusions the following recommendations are proposed: The relevant ministries and related stakeholders need to create awareness of e-waste and its safe handling i.e. dispose unusable equipment through sorting of waste at the source, organized collection and disposal system separately from solid waste by e-waste collectors. NEMA should set training standards for personnel handling e-waste to be enforced by the County Government. Awareness and training programmes for consumers and technicians handling e-waste should be developed and implemented after establishing a recycling facility/infrastructure. KEBS should train expertise in forensic audit of hazardous components included in electronic equipments and discourage importation of such substances. Consumers should be made aware and encouraged to buy brand new equipments to discourage acquisition of short lifespan equipments. County Government should establish disposal sites far from residential areas due to health concerns. MENR should encourage and acknowledge the role of civil society stakeholders in creating awareness and conducting research on e-waste.

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