

The Electronic Waste Management Crisis- A Situation Analysis of Zambia

DAIZY SHOMA NALWAMBA (✉ nalwambadaizy@gmail.com)

MSc Scholar. University of Lusaka

Research

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THE ELECTRONIC WASTE MANAGEMENT CRISIS- A SITUATION ANALYSIS OF ZAMBIA

Daizy S Nalwamba*

MSc Scholar. University of Lusaka 37413 Mass Media Lusaka, Zambia

Corresponding Author: Daizy S Nalwamba nalwambadaizy@gmail.com

Abstract: Globally, the technological era has seemingly increased the environmental burden of many Low income countries in the management of electronic waste. An increase in the use of electrical and electronic equipment potentially relates to an increase in e-waste in the environment. Poorly managed e-waste degrades the environment in various ways such as through percolation of toxicants into the soils and leaching into aquatic systems. As Zambia steadily develops, the use of EEEs is a major threat in the increased amounts of e-waste thus placing more demand on environmental institutions as well as well-established and sustainable e-waste management systems. Environmental issues are complex and diverse, in this view; waste management is an integral part of a sustainable environment thus making effective electronic waste management categorically fundamental. This study employed a mixed method approach (concurrent nested) to assess the effectiveness of electronic waste management facilities in Lusaka. In this study, the inclusion and exclusion criteria were used so as to select the participants by use of questionnaires and interviews. This study showed that in Zambia, e-waste has not been given the same attention as other waste types. The knowledge base of electrical and electronic equipment users is very shallow as this study indicated that most EEE consumers have little or no knowledge of the toxic components of electronic waste. Further, available environmental institutions do not currently have the capacity to quantify e-waste that is generated in the country. Moreover, the e-waste that is appropriately disposed of is exported to neighboring countries recycling. The study concluded that Zambia lacks the needed expertise and facilities to adequately handle e-waste. However, information obtained from EEE users and e-waste generators clearly indicated that inasmuch as there could be efforts by environmental institutions to manage e-waste, there hasn't been local authority effort to specifically handle e-waste or rather sensitize the users of EEEs on e-waste issues. The study thus recommended the following; creation of e-waste black market, further Studies, Laws to prohibit dumping of e-waste, Promotion of E-waste education amongst EEE users, Promotion of E-waste education amongst EEE users, Repurpose old devices before purchasing new ones.

Key words: Electronic waste, Electrical and electronic devices, toxic, systems and effectiveness

Introduction and Background

Today, the global population increase accompanied by massive technological advancements has drastically led to an increase of e-waste generation also referred to as waste of Electrical and Electronic Equipment (WEEE). Sinha-Khetriwal (2002) stated that, e-waste can be categorically viewed as any electrical powered appliance that has reached its end-of-life". Further, Puckett et al. (2002) point that e-waste range from large electronic devices such as refrigerators, air cons, stereos, phones, microwaves, batteries to other electronics that have been rendered useless by their users. This paper adopted the definition by the latter. Because of its high levels of toxicity, electronic waste leaves devastating impacts on the health of people (Gweme, 2015). Developing nations like Zambia have not been spared of the

seemingly overwhelming need for urgent environmental management tools necessary to preserve the environment and curb the potential impacts of poor electronic waste management. Inasmuch as there is a steady improvement in waste management in Zambia, electronic waste is to a large extent spurned. The direct and indirect consequences of poor handling of e-waste could range from understandable hazardous problems to irreversible major environmental and human threats. While majority of the world's population deems this increase as a sign of economic development, the devastating impacts of the end-life is life threatening. This is due to the fact that when e-waste finds its way to the landfills or even burnt, the hazardous components of these products have potential to bring out health risks as well as environmental degradation. The larger the amounts of electronic devices, the greater the increase of e-waste disposed thus the more susceptibility of humans and the environment. Woodell (2008) points out that electronic waste in comparison to conventional municipal waste contains has more toxicity which can to a larger extent compromise life and environmental sustainability. When WEEE is deposited from developed nations to LDCs, is it dismantled for treasurable metals through unsafe means and thus exposes the dismantlers to long- and short-term health repercussions whilst harming the environment. Today, Zambia among other countries has shifted from the ordinary television sets to the much more modern smart TV. The biggest question therefore is what happened to the old Television sets? A simple explanation as regards the danger of careless handling e-waste is by understanding the 2 constituents of these products. These products contain materials that are very hazardous such as mercury, cadmium and lead among others. Because of the aforementioned, recycling and other e-waste management mechanism are fundamental.

Statement of the problem

Notwithstanding the recognition and a wide spectrum of global concerns for effective environmental management, challenges continue to encumber efforts to effectively manage electronic waste in Zambia. On an annual basis, volumes of e-waste increase thereby increasing the urgency in the creation of more effective and efficient ways of managing this waste. The 21st century has to a larger extent experienced an overwhelming environmental burden due to the impacts of electronic waste. Just as is the case in most LDCs, studies in Zambia are yet to show the extent to which electronic waste generated in homes and industries is managed. Recognizing the significance of working systems to prevent hazards and devastating impacts associated with electronic waste on both the environment and the human health is fundamental. The researcher noted with concern that many studies focused on understanding e-waste issues from a legal, environmental and constitutional perspective. However, there seems to be a focus on managers (policy makers and environmental regulations) of e-waste with little to no inclusion of the EEE users who are in this case the generators of e-waste. However, to date, there is limited empirical evidence in Zambia to show how well the existing e-waste management systems are working. a study by Gweme et.al (2016) conducted in Zambia and Zimbabwe reviewed that the modalities of electronic waste problems remain unknown. However, that study provided limited information as regard the role of EEE users as well existing facilities to quantify e-waste in the said countries. The researcher noted with concern that many studies focused on understanding e-waste issues from a legal, environmental and constitutional perspective. Therefore, there seems to be a focus on policy makers and environmental regulations) of e-waste with little to no inclusion of the EEE users who are in this case the generators of e-waste. This study thus endeavored to strike a balance by making comparisons and contrasts between EEE users and environmental institutions mandated to handle e-waste in Zambia so as to assess the effectiveness of existing e-waste management systems.

Research objective

The major purpose of this study was to assess the effectiveness of existing electronic waste management systems in Zambia.

Literature review

In a quest to combat the growing quantities of e-waste, the need to recycle presents a number of problems, including dealing with hazardous components such as CRT glass and finding consumers for flame-retardant plastics. Moreover, no technology currently exists for recycling certain EEE in sustainable ways. In 2005, more than 2 million tons of e-Waste were generated in the US alone (US EPA, 2005), but only 17 to 18 percent of that waste was collected and sorted for recycling. More than eighty percent was discharged, largely in local landfills. The toxicants of e-waste are discharged to the environment by various means. The hazardous materials in e-waste can leach out of the landfills into groundwater and streams, and if the plastic components are burned, dioxins are emitted into the air (Kuper and Hojsik, 2008). Sthiannopkao (2013) states that in Africa, the infrastructure for e-waste management is very ineffective. More precisely, separation, sorting, storage, collection, transportation, and disposal of e-Waste are not embedded in well-established systems. Furthermore, there is a great absence proactive enforcement of regulations related to e-waste and its disposal. From a realistic point of view, these circumstances are proof enough that Africa has widespread adopted more unregulated and undeveloped e-waste management techniques.

E-Waste Composition

Common Toxics Released from E-waste Activities

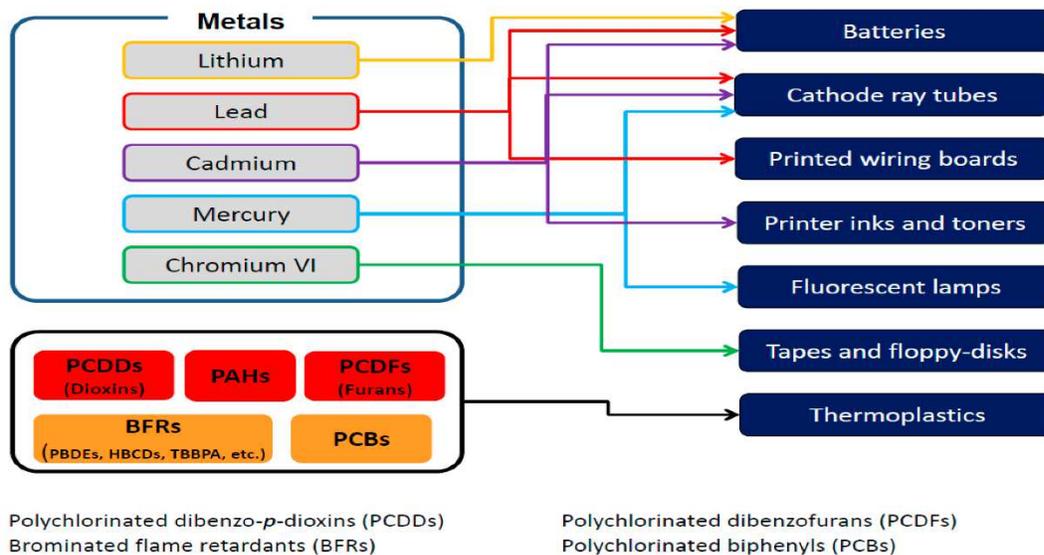


Figure 1: Toxic components of e-waste. Source: Frazzoli et.al (2010).

E-waste Management and regulation in selected countries

E-waste management and regulation in selected Countries Worldwide estimates are that, 67 countries have legislations on e-waste management and that the legislations cover about 66% of the world population. The laws in these countries pay particular attention to safeguarding the environment through legislative and regulatory implementations (Wasswa & Schluep, 2008). It suffices to note that it is common that they reluctantly consider e-waste as a resource that, if sustainably managed, would be a great source of income for small and medium-sized businesses. Nevertheless, there still exists nations Countries like Argentina that by 2007 still did not have any legislations on e-waste. As years went by, a zero waste policy was introduced by the city of Buenos Aires. This was essentially the kick start of the e-waste management journey for the country. The presence of weak institutional environments has been the greatest source of hindrance to the establishment of profitable and sustainable e-waste value chains. According to UNEP (2007), from 2000 going forward, China introduced several series of policies on e-waste such as an import ban as well as a policy to restrict the use of toxic substances in manufacturing of electronics

In Africa, a study by Mtayangu (2017) concluded that in Tanzania, the electronic waste stream remains a serious threat which requires urgent action due to the detrimental toxicants it contains. The study thus concluded that immediate action was needed not only in Tanzania but other nations to prioritize effective management of WEEE. The findings of the study indicated that many developing nations are overwhelmed by the enormous increase of e-waste. Some of challenges include; lack of awareness amongst EEE users and lack of e-waste policies. Additionally, the prevalence of weak e-waste regulatory framework that lack specific provisions on the managing e-waste make the situation more worrisome. Further still there is no clear explanation of articulation on the responsibilities of actors under the regulations on how much waste actually amounts to e-waste.

A Study by Gweme et.al (2016) concluded that for Zambia and Zimbabwe, the modalities of electronic waste problems remain unknown. The handling of electronic waste are embedded in both the Bamako and Basel conventions of 1994 and 1989 respectively. According to these two conventions, countries are banned from trans-boundary movement of hazardous waste of which e-waste fits the category. Unfortunately, in most LDCs, these treaties do have local legislation backup. For countries like Zambia and Zimbabwe, electronic waste actually finds way to landfills and other parts of the environment. The study further reviewed that the recycling of e-waste does not take place in an environmentally friendly manner if it even ever does get recycled. Studies have shown that when e-waste is deposited in 16 neighboring countries, it is simply buried thus exposition the environmental and human life to danger. Nevertheless, Zambia's extended product responsibility estimated that a minimal portion of the said waste is actually sent back to Zambia for recycling. ZEMA in an effort to combat the surge came up with strategies aimed at the promotion of the 3Rs (reduce, re-use and recycle). It is a sad reality that Zambia continues to take EEEs that soon turn to e-waste from the global north (Gweme et.al, 2016).

Theoretical Framework

This study mainly adopted two theories; Value-Belief-Norm theory of environmentalism (VBN) and the Planned behavior theory (TPB). These two theories were of great relevance in understanding the role both EEE users and environmental institutions play in mitigating the effects of ineffectively managed electronic waste.

Value-belief-norm theory of environmentalism (Stern, 2000)

The VBN theory was first established by Stern (2000) to explain the influence of human values on behavior in an environmentalist context. For those behaviors not strongly constrained by contextual forces, individual choice about pro-environmental actions can be driven by personal norms - an internalized sense of obligation to act in a certain way. Norms are activated when an individual believes that violating them would have adverse effects on things they value and that by taking action, they would bear significant responsibility for those consequences. Personal values (e.g., altruistic values, egoistic values) are antecedents of environmental. Problems related to the environment-for example, e-waste, air pollution and the degrading biodiversity have turned into pressing issues for many parties, including the government and business firms as well as individual consumers. As depicted in numerous studies, green behaviors of consumers are related to individual factors such as socio-demographics, values, beliefs and norms . According to VBN theory, green behaviors are more likely to occur when a causal series of variables (i.e., values, beliefs and personal norms) is present. For example, Sanchez et al. (2018) used VBN to examine how personal values determined the willingness to pay for the reduction of noise pollution. Accordingly, this study extends VBN theory by using social norms to attempt in explaining the behavior of EEE users who are in this case e-waste generators. In the VBN framework, awareness of consequences precedes the second belief construct, i.e., ascription of responsibility. Ascription of responsibility is a belief that an individual's actions can either prevent or promote potentially undesirable consequences.

The theory of planned behavior (Icek Ajzen 1985)

The Theory of Planned Behavior (TPB) established by Icek Ajzen (1985) started as the Theory of Reasoned Action in 1980 to predict an individual's intention to engage in a behavior at a specific time and place. The theory was intended to explain all behaviors over which people have the ability to exert self-control. The key component to this model is behavioral intent; behavioral intentions are influenced by the attitude about the likelihood that the behavior will have the expected outcome and the subjective evaluation of the risks and benefits of that outcome. Today, we are experiencing a global shift towards technological advancements. We are now at iPhone 13 Pro Max, what happened to that Nokia, Motorola phone we once used? As society is evolving, the environment is receiving what we no longer need but pose danger to our natural environments. People today deem it fancy to upgrade with little or no care where the trash is discarded and finally ends up.

The TPB is comprised of six constructs that collectively represent a person's actual control over the behavior.

1. Attitudes
2. Behavioral intention
3. Subjective norms
4. Social norms
5. Perceived power
6. Perceived behavioral control

Research Methods

This study mainly adopted a descriptive case study to understand the complex nature of e-waste from various end-points. In determining the existing e-waste management facilities as well as perspectives of EEE Users, the researcher used the qualitative approach. Because the researcher intended to access a specific subset of people and entities suitable for this study type, the probability technique through systematic sampling was used. This entailed the inclusion of not only e-waste generators and handlers but also non- EEE users, non- environmentalists as well as both private and public waste management facilities. In this study, the researcher introduced an element of randomness in which random numbers were used to pick up the unit with which to start. The instruments for data collection included questionnaires, interviews and examination of records. In analyzing data, the researcher used Statistical Package for Social Sciences (SPSS) so as to effectively come up with quantitative interpretations of the findings. Cross-tabulations were conducted so as to make comparisons links between variables.

Results and Discussion

EEE users and E-waste generation

This study revealed that the most common electrical devices that accumulate as e-waste on the Zambian environment include the following; TVs, phones, laptops, baby toys, phone batteries, remote control batteries as well as kitchen appliances. Additionally, the knowledge base on most EEE users on e-waste is extremely low thus clearly indicates a lack of sensitization on e-waste. These statistics clearly indicated that the larger part of the community is not aware on the appropriate ways to handle e-waste. The fact that most respondents indicated that for smaller devices, the bin was an easier way to discard electronics with little or no concern as regards to where it eventually ends up proves the need for intensified sensitization on e-waste. With the fast-growing technological shift, in a space of 2 decades 2000 to 2020, a larger number of respondents had used more than 6 phones and had little or no idea where the old devices ended up. The reality is that low-income countries are slowly becoming the fastest growing markets for electrical and electrical equipment and also generate large quantities of e-waste WEEE (Widmer, et.al. 2005). The faster we advance technologically, the faster our environments are overburdened by impacts of improperly managed e-waste. There clearly seems to be something newer and better on the market, but what happens to those that have reached their end-life. One can look back at a few years back when the latest phone on the market was iPhone 5, fast forward to 2020 there is the iPhone 12 on the market. What happens to those devices that are of no use, and just have to be discarded? Many EEE users as shown in this study reviewed that they had little or no idea what happened to their old devices, for lack of a better term, those devices simply 'disappeared'. Can the environment be spared? The toxic metals of e-waste such as mercury, lead, cadmium and beryllium among others make it the biggest source of toxic metals found at the landfill.

Until now, majority of cellphones on the market had removable batteries and unfortunately these batteries had a short life cycle. Similarly, a study by Mtayangu (2017) conducted in Tanzania concluded that major e- waste management challenges included; lack of awareness amongst EEE users, lack of e-waste policy, awareness of the e-waste related issues is also a big challenge and there are no regulations in the country regarding the importation of used electrical and electronic devices. Based on the fact that studies have reviewed that the battery is the most toxic part of a phone, how many batteries have found their way to the environment, carelessly handled. Borrowing the conclusions by Sivanthanu (2010) in his

study on electronic waste management in India when he states that 'there is a direct correlation between consumer awareness and their willingness to effectively manage e-waste, this survey notes with concern that the higher the levels of ignorance on e-waste, the greater the risk at hand. Clearly, if an EEE user was fully aware of the fact that e-waste is highly toxic, discarding it in the bin or worse off burning it should never be on the option list. 5.3 E-waste management facilities. Additionally, based on a survey specifically conducted at Zambia's only landfill (Chunga dumpsite), results indicated that as of December 2020, waste collected in homes and industries is regarded as general waste. Whilst attention seems to be given to medical waste of which incineration is the most common disposal method, little or no attention has been given to electronic waste in Lusaka. When waste is collected, it is regarded as general waste and this already poses great risk on the broader environment as well as human life. The separation of waste is particularly done by waste pickers implying that only the waste of interest is picked for recycling. On a daily basis, approximately 450 tons of waste is collected and taken to the landfill. However, there is no specific e-waste company that collected e-waste for recycling in Lusaka. When waste is collected from homes and the township to the landfill, it is not treated thereby exacerbating potential adverse impacts of improperly discard waste products. A study by the US EPA pointed out that in 2005, more than 2 million tons of e-Waste were generated in the US alone but only 17 to 18 percent of that waste was collected and sorted for recycling. The rest, more than 80 percent, was disposed of, largely in local landfills. The Chunga landfill was approximately designed to be used for more than 100 years as it is placed on a large piece of land. However, the improper management of e-waste in Lusaka can be partly be as a result of lack of adequate equipment to handle such waste. Inasmuch as there exist associations through which non-hazardous waste recyclers pick the waste from the landfill, there are no specific operational entities that pay particular attention to e-waste. Nevertheless, the collection of waste from the landfill are necessitated by various cooperatives and associations formed by waste pickers.

E-waste collection

It was observed with concern that where there is a lack of a working waste collection and segregation mechanism, it is impossible to effectively quantify e-waste both in home or industries and at the landfill. Whilst literature reviewed that in some countries, the larger chunk of e-waste is incinerated and only a small portion ends up at the landfill, this study reviewed that it is difficult to measure the percentage of e-waste in its totality, how much ends up at the landfill and essentially what proportion is incinerated. Additionally, this survey compared data collected from households and that which focused on e-waste in industries. The study established that industries effectively manage e-waste better than households. The absence of clear figures on the amount of EEEs on the market as well as the quantity of generated e-waste remains a clear indication of the e-waste crisis in Zambia. In terms of the e-waste collection intervals, this study noted that the Environmental management agency responsible for handling e-waste which is classified as 'hazardous waste' is overwhelmed by the alarming increase of e-waste on the Zambian environment. This study concluded that the agency has limited control on the collection intervals of e-waste. However, the practice on the ground is that e-waste collectors have installed waste receptacles in different collection points where communities and industries deposit the e-waste which is later collected when a significant quantity has accumulated. The downside to this initiative is that majority of the Zambian population is unaware of the aforementioned receptacles thus making the efforts 'fruitless'.

E-waste residues after incineration

Information provided by key informants comprehensively indicated the insufficient knowledge base of what really remains off e-waste. This can strongly be attributed to the fact that Zambia does not categorically handle e-waste rather as general waste by scavengers. This study noted with concern that the country depends on neighboring countries like Namibia and South Africa for the recycling of e-waste.

Conclusions

This study concluded that electronic waste is slowly becoming a major environmental concern in Zambia. This can solely be premised on the fact that there is a drastic technological advancement and everyone wants to get the newest device or electronic on the market. However, the growing amounts of e-waste points out that there is increased planned obsolescence. Planned obsolescence can simply be understood as a situation in which electronic devices are made to be replaced. This entails that in the business world, it is beneficial to replace a device with a newer one, whilst in environmental cycles, it is only generating e-waste at a faster rate thus threatening the environment. Moreover, this also showed that the knowledge base on EEE users is very limited in the sense that most users have little or no knowledge of the toxic components of e-waste and their consequences. This study also essentially reviewed that many EEE users have what can be termed as 'phone graveyards' in their homes. These phone graveyards come in form of drawers, plastic bags and handbags where non-operating devices are placed and forgotten. Unfortunately, the study also reviewed that many users of electronics do not appropriately discard their e-waste in an environmentally friendly manner.

E-waste is the fastest growing source of waste because it is the global stream of all old TVs, computers, phones, toys and other electrical devices. Zambia seems to be performing well in managing waste, however, e-waste has proved to be one of the most challenging waste types to manage. It is clear that at the time of this study, there was no specific company that collected e-waste for recycling within the country. When municipal waste is collected, all waste is mixed and only separated at the landfill by waste pickers and scavengers. This becomes extremely difficult to account for the e-waste that is generated and finds itself in the landfill. There seems to exist alarming gaps between the amount of electronics that are imported in the country and the amount of those electronics that turn out as e-waste. Because e-waste is generally handled as a form of hazardous waste, it is imperative yet complex to effectively manage it.

RECOMMENDATIONS

Zambia can implement the following measures

1. Establish a sustainable e-waste black market
2. Equip the Chunga landfill with facilities and equipment to dismantle and separate e-waste
3. Introduce identifiable waste collection points for WEEE
4. Comprehensive sensitization on e-waste separation in local communities
5. Policies that require EEE sellers to provide buy-backs or return systems for used equipment
6. Importation of only energy star rated electronic devices
7. Monitoring of electronics imported to the country
8. Machinery for the quantification of e-waste generated in the country.

List of abbreviations

EEEs- Electronic and electrical equipment

LDCs- Less developed countries

WEEE- Waste of electronic and electrical equipment

ZEMA- Zambia Environmental Management Agency

Ethical consideration

A research clearance to conduct this study was sought from the University of Lusaka Ethics Committee and written authorization was issued by the Lusaka City Council to aid the research with the much-needed information. Essentially, all the participants in the study were informed about the study and participated on voluntary basis. Prior to the interviews, the purpose and importance of the study was explained to the selected participants to be interviewed. Consent was obtained from each of the selected organizations and participant in the survey. When answering the questionnaires confidentiality was maintained by ensuring that each participant did so at their convenience.

DECLARATION

I DAIZY SHOMA NALWAMBA hereby declare that this work is originally mine and that all other sources used therein have duly been acknowledged.

Availability of data and materials

All data generated in this study are available from the sources listed in this document by the author.

Competing interests

The author declares that they have no competing interests.

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Authors' contributions

The author; Daizy Nalwamba independently worked on the following;

- Conception or design of the work
- Data collection
- Data analysis and interpretation
- Drafting the article
- Critical revision of the article
- Final approval of the version to be published

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