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An Assessment of E-Waste Management Challenges in Zambia

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ABSTRACT

Electronic wastes (E-waste) are wastes which contain harmful and toxic components that can harm the environment and human health. Therefore, proper E-waste management is cardinal for any nation but majority of the developing countries such as Zambia face challenges of managing E-waste. The aim of this research was to assess E-waste management challenges in Zambia. The study employed a descriptive quantitative research design and a sample size of 168 was determined using Yamane formula. A structured questionnaire was used to collect data and the collected data was analyzed using the Software Package for Social Sciences (SPSS). The results revealed that lack of funds and investment, lack of recycling technologies, and inefficient infrastructure are significant challenges in managing E-Waste materials. However, the lack of government policies and regulation was found not to be a significant challenge. The regression analysis conducted showed that the correlation coefficient R (a relationship between E-waste management and E-waste management) indicated a moderately strong positive correlation of 0.76. The coefficient of determination, R Square, was 0.649, meaning that 64.9% of the variance in E-waste management can be explained by E-waste challenges. The recommendations for addressing e-waste management challenges in Zambia based on the results from the study are to develop a comprehensive e-waste management policy, increase public awareness, develop e-waste recycling infrastructure, encourage the circular economy, strengthen the capacity of regulatory bodies, and increase collaboration between stakeholders.

Keywords-- E-Waste, Sustainability, Environment, Management

I. INTRODUCTION

E- waste refers to electronic items that have reached the end of their useful lives or have simply been discarded owing to the availability of newer and more modern products on the market (Devika, 2018).

Several rising megatrends, such as growing global urbanization, interconnection among economies and economic power changes, and climate change, are now acknowledged, all of which affect the need for more efficient and effective technology dispersion and technology transfer. Several major sectors are impacting the occurrence of these developments, ranging from mobile internet and pervasive social media to sophisticated robotics, artificial intelligence, next-generation genomics, and biotechnology. As a result, individual human capacities, as well as humanity's overall capabilities, are swiftly and profoundly altering. E-waste production continues to rise at a rate of 3% to 5% each year on average. E-waste accounts for 5% of global solid waste production, and it degrades three times quicker than other waste categories (World Health Organization, 2023).

II. LITERATURE REVIEW

E-waste is defined by Puckett et al (2014) as "a wide and rising variety of electronic gadgets ranging from big home items such as refrigerators, air conditioners, mobile phones, personal stereos, and consumer electronics to computers that have been abandoned by their owners. E-waste has a complex makeup, comprising over 1,000 distinct harmful and non-hazardous chemicals. Electrical and electronic appliance technical advancements are so rapid that new goods swiftly replace older models or render some electronic equipment obsolete, worthless, or non-functional, resulting in a steady stream of e-waste creation (Schlummer, 2007). E-waste may be divided into two groups, according to Mario and Casey, based on its physical content. Refrigerators and domestic appliances such as cables, bulbs, washing machines, dryers, Air Conditioning (AC) units, vacuum cleaners, coffee makers, water heaters, toasters, irons, and so on are examples of electrical e-waste (Cynthia and Kalyani, 2017).

2.1 Global E-Waste Generation

The largest manufacturers of e-waste are developed and industrialized countries. According to the USEPA, the United States is the world's greatest producer of e-waste, with 3.16 million tons produced in 2008. 3 In addition, in 2009, there were 5 million tons in storage, with 2.37 million tons ready for disposal, a 120 percent increase from 1999. The EU produced 8.9 million tons in 2010, and

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that number is expected to rise by 3–5% annually to 12 million tons by 2022. E-waste output is quickly expanding in the world's largest and fastest-growing countries, such as China and India (Cynthia and Kalyani, 2017). China is ranked second behind the United States, with 2.3 million tons of e-waste produced in 2010 and a surplus expected by 2022. Furthermore, India produced 400,000 tons in 2011. The European Union is also regarded as one of the leading generators of electronic garbage. The EU created 8.9 million tons of e-waste in 2010.

2.2 The Concept of Sustainability

Sustainability is defined as the ability to maintain an entity, outcome, or process over time (Basiago, 1999). However, most academics, researchers, and practitioners in the development literature (Thomas, 2015) use the term to refer to improving and preserving a healthy economic, ecological, and social system for human growth. Sustainability, according to Stoddart (2011), is defined as the efficient and equitable allocation of resources within and across generations, as well as the functioning of socio-economic activities within the limitations of a finite ecosystem.

Based on the foregoing, contemporary theories of sustainability aim to prioritize and integrate social, environmental, and economic models to address human concerns in a way that is always beneficial to people (Hussain, Chaudhry, & Batool, 2014; UNSD, 2018b).

2.2.1 Relationships among the Spheres of Sustainability (Environment, Economy, and Society)

The idea of sustainability seems to be positioned to continue to shape future development science debates. According to Porter and van der Linde (1995), the optimum options are those that meet societal demands while also being environmentally and economically viable, economically, and socially and environmentally tolerable. As shown in Figure below, this results in three interrelated spheres or domains of sustainability that describe the linkages between the environmental, economic, and social components of Sustainable Development (SD).

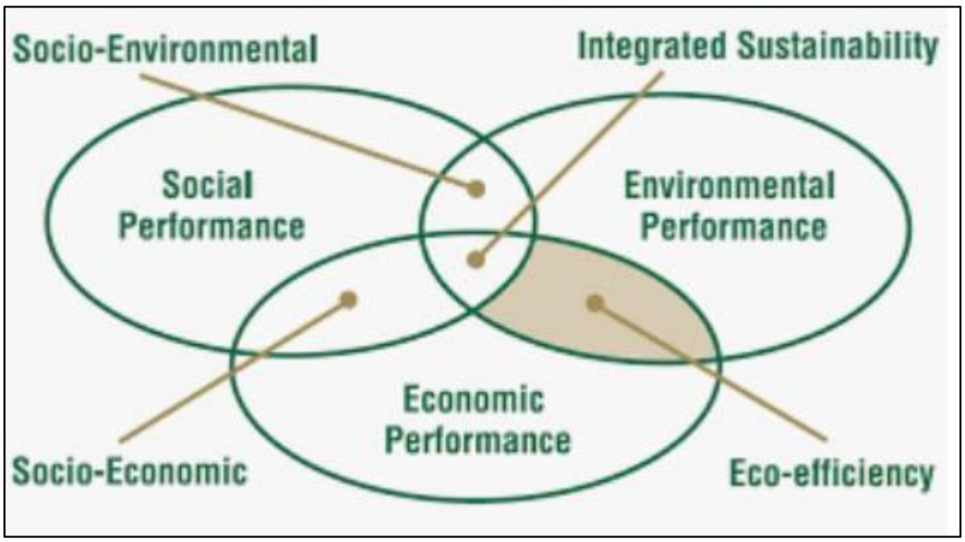

Figure 1: Relationship among the spheres of sustainability

2.3 The Challenges Encountered to Manage E-Waste Materials

2.3.1 Lack of Funds and Investments

In many circumstances, especially in nations with severe environmental rules, the cost of recycling e-waste surpasses the money recovered from materials. As a result, most e-waste is discarded in nations with inadequate or non-existent environmental regulations and bad working conditions. Most poor nations lack the waste removal infrastructure and technical capabilities needed to assure safe hazardous waste disposal.

2.3.2 Lack of Recycling Technologies

Gweme et al (2018) asserts that in Zambia, e-waste is handled by persons who do most of the repairing and reusing of electronic equipment. Their simple processing of electronic waste involves serious health and pollution risks. According to the Zambia Environmental Management Agency (ZEMA), only a small percentage of e-waste is being recycled. Sometimes, Zambia sends its electronic waste to South Africa for disposal.

2.3.3 Inefficient Infrastructure

According to Osibanjo (2016), there is a highly inefficient infrastructure for e-Waste management in Africa. Separation, sorting, storage, collection, transportation, and disposal of e-Waste do not have a well-established system. Worse, there is little or no effective enforcement of e-waste management and disposal standards.

2.3.4 Lack of Government Policies and Regulations

According to Gweme (2016), there exist no minimum specifications for second-hand equipment in the fields of Information and Communication Technologies. As a result, second-hand computers received in Zambia and Zimbabwe are often not fit for purpose. Even if second-hand electronic goods are usable, their limited lifespan accelerates their descend into e-waste. Shipping of used computers to African countries often represents dumping. Second-hand computers, whether usable or not, often end up in the informal sectors of the economy. Here computers sustain informal employment and a livelihood. Due to its nature, the informal sectors are rather immune to government policies and regulation.

2.4 Sustainable E-Waste Management Strategies for Zambia

-Economic Enablers: Economic enablers are critical to the long-term sustainability of Waste from Electrical and Electronic Equipment (WEEE) management (Singh and Sushil, 2017). However, massive investment and a professional team are necessary to handle the exponential growth of WEEE (Zaman, 2013). As a result, it is critical to reduce the producer's financial burden by introducing new solutions such as incorporating Advanced Recycling Fee (ARF) and openly specifying it in the pricing of the electronic product (Wath et al., 2010). Consumers must be informed about ARF, which makes recycling and disposal easier at the end of a product's life cycle.

-Social Enablers: Consumers are becoming increasingly conscious of environmental protection, green purchasing, WEEE recycling and disposal because of climate change, ozone depletion, and greenhouse gas emissions (GHGEs) (Eltayeb et al., 2011; Pekarkova et al., 2021). Green buying practices reduce environmental effects by reusing products, reducing waste, and eliminating harmful compounds during recycling and disposal (Chan et al., 2012; Kwatra et al., 2014; Zhou et al., 2017). As a result, consumer interaction and participation become critical components in establishing long-term WEEE management (Alves et al., 2021).

-Environmental Management Enablers: The firm's dedication to green practices plays a role in determining its green image (Grisi et al., 2010; Xu et al., 2018). Firms create Electronic Messaging System (EMS) to help them define environmental targets and evaluate their supply chain components on a regular basis to develop a green image (Maruthi and Rashmi, 2015; Zhou et al., 2017). EMS certification, such as ISO 14000, also improves a company's green image in the marketplace (Manomaivibool, 2009; Xu and Yeh, 2017). Aside from EMS, CDM offers a solid management strategy for reducing GHGEs in the environment (Singh and Debnath, 2012).

-Technology & Infrastructure Development: For long-term WEEE management, electronic producers need to be well-equipped with green infrastructure and clean technology. Garrido-Hidalgo et al., 2020; Kannan et al., 2014; Liu et al., 2017; Zuo et al., 2020) include green packaging, accessible collection centers, recycling and recovery plants, supply chain integration with the internet of things, and green logistics facilities. This program will assist developing countries in converting the rising pile of WEEE into economic possibilities while also reducing carbon emissions (Mairizal et al., 2021; Somsuk and Laosirihongthong, 2017).

-Government policies and Regulation Enablers: Government laws and WEEE directives should require electronics manufacturers to take a greater role in reducing the environmental effect of their outmoded goods (Garlapati, 2016). Policy measures relating to EPR, for example, encompass actions like used product recovery, recycling, and safe disposal (Kumar and Dixit, 2018a; Rahman and Subramanian, 2012; Wath et al., 2010). Abdulrahman et al., 2014; Chi et al., 2014; Jafari et al., 2017; Wang et al., 2020) suggest that the government develop liberal policies for informal recyclers by giving financial incentives and tax subsidies. A legislative framework with clear and defined roles for all parties is essential for all such projects, including pollution control boards, local municipal corporations, manufacturers, merchants, consumers, waste recyclers, and non-governmental groups (Garlapati, 2016)

2.5 Existing Sustainable E-Waste Management Practices

-Collection and Recycling: Collection and recycling refer to the return of used electronic equipment for the purposes of e-Waste recycling, reuse, and safe disposal. For e-waste management, a take-back mechanism is critical (Jinglei et al., 2019). The key drivers for e-Waste collection include time delays (Ali and Chan, 2018), a shortage of collection stations (Shih, 2019), and collection costs (Shanshan and Kejing, 2018).

-Rules and Regulations: The sort of legal structure necessary for efficient e-Waste management is referred to as rules and regulations. One of the most critical aspects of e-Waste management is having enough norms and regulations. e-Waste management may be enhanced by putting final treatment and landfilling at the end of the disposal process (Shih, 2019).

-Government support: Government help refers to the assistance that the government is expected to provide at various levels to effectively manage e-waste. The government should help recycling facilities to manage e-waste (Gupta, 2012). The informal sector is a critical and rising issue that the government must better understand and manage (Tienhua and Yenming, 2018). Inadequate technical infrastructure for processing and managing garbage, as well as the shift of e-Waste dismantling from

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the formal to the informal sectors (Jain and Sareen, 2016), are all major factors in E-Waste management.

-Initiatives: Initiatives refer to programs or schemes required to promote effective collection, recycling, and disposal of E-Waste. It is important for the government and manufacturers of electronics devices to take various types of initiatives to promote e-Waste management.

-Responsibility: Responsibility means all stakeholders of e-Waste should understand and play their role in a responsible manner so that e-Waste can be managed effectively. It is important to have a clear definition of roles and demarcation of responsibilities (Sinha-Khetriwal et al., 2015). Consumers may bring their E-Waste to designated drop-off collection points (Susan et al., 2018). Manufacturer to reduce toxicity in material used for making electronics equipment's (Thiel and Neeli, 2016).

III. THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 Theoretical Framework

The Waste Management Theory (WMT) was developed to help engineers incorporate environmental science into their designs. Waste Management Theory is a unified corpus of waste and waste management expertise, and an attempt to organize the various factors of the current waste management system. It is to be constructed under the paradigm of Industrial Ecology as Industrial Ecology is equally adaptable to incorporate waste minimization and resource use optimization goals and values (Prevention of waste creation is the main priority of waste management), which corresponds to the principal goal of waste management: conservation of resources. Moving toward waste minimization requires that the firm commits itself to increasing the proportion of non-waste leaving the process.

3.2 Conceptual Framework

Figure 2 depicts the conceptual framework developed from the literature reviewed and the theories that were adopted in this study. It shows the relationship between E waste challenges and E-waste management. The independent variable is E-waste challenges, and the dependent variable is E-waste management.

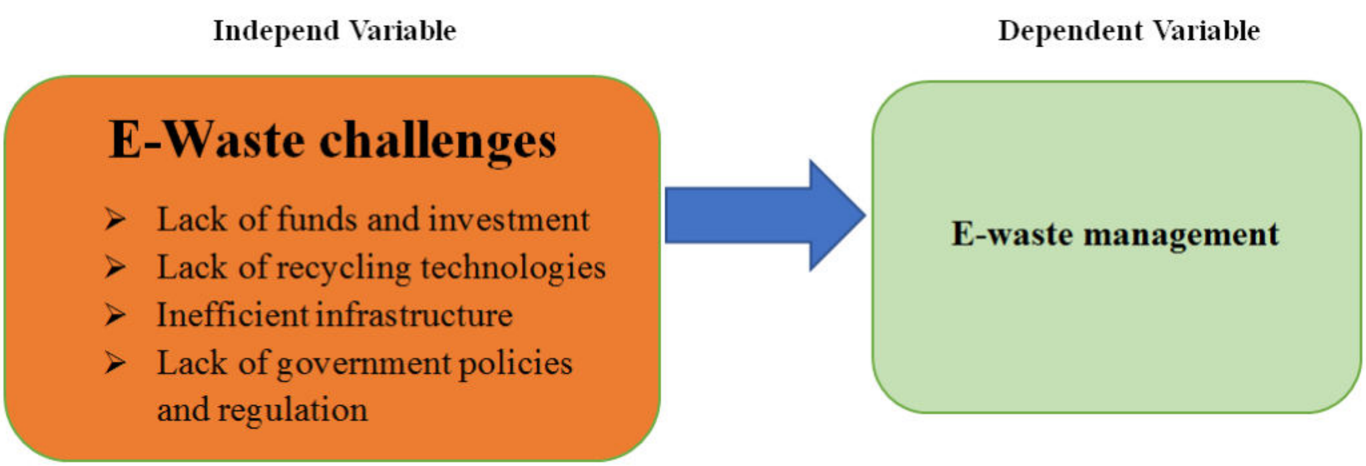

Figure 2: Conceptual framework (relationship between E-waste challenges and E-waste management)

Hypothesis

H1: E-Waste challenges have a significant impact on electronic waste management.

H0: E-Waste challenges have no significant impact on electronic waste management.

IV. RESEARCH METHODOLOGY

Positivism, a philosophical approach emphasizing empirical observation and scientific methods for acquiring knowledge, plays a crucial role in the context of electronic waste (e-waste) management in Zambia.

According to Comte (1848), a key figure in positivist philosophy, empirical evidence is essential for understanding societal phenomena. In the case of Zambia,

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a positivist perspective will encourage the collection and analysis of data to gain insights into the current state of electronic waste management.

A descriptive quantitative research design was used to find out Electronic Waste management challenges in Zambia. The research strategy used in this study is a case study. A questionnaire was used to gather the necessary primary data from all the research participants. The data analysis process involved coding responses in the Statistical Package for the Social Sciences (SPSS) to conduct multiple regression analysis and to obtain the descriptive statistical results.

V. RESULTS AND DISCUSSIONS

The study depicted in figure 3 indicates the most common sustainable E-waste management practices currently being used in Zambia. Recycling (27%) is the most common sustainable practice for managing E. Waste. The major drivers of formal recycling are low recycling rates (Gullett, 2018)

Second is Education (15%), followed by rules and regulations (13%). and incineration (10%). The least common practices mentioned were responsibility (3%) and initiative (6%). According to Hanks (2018) promoting renewal and reuse are some important drivers for effective e-Waste management.

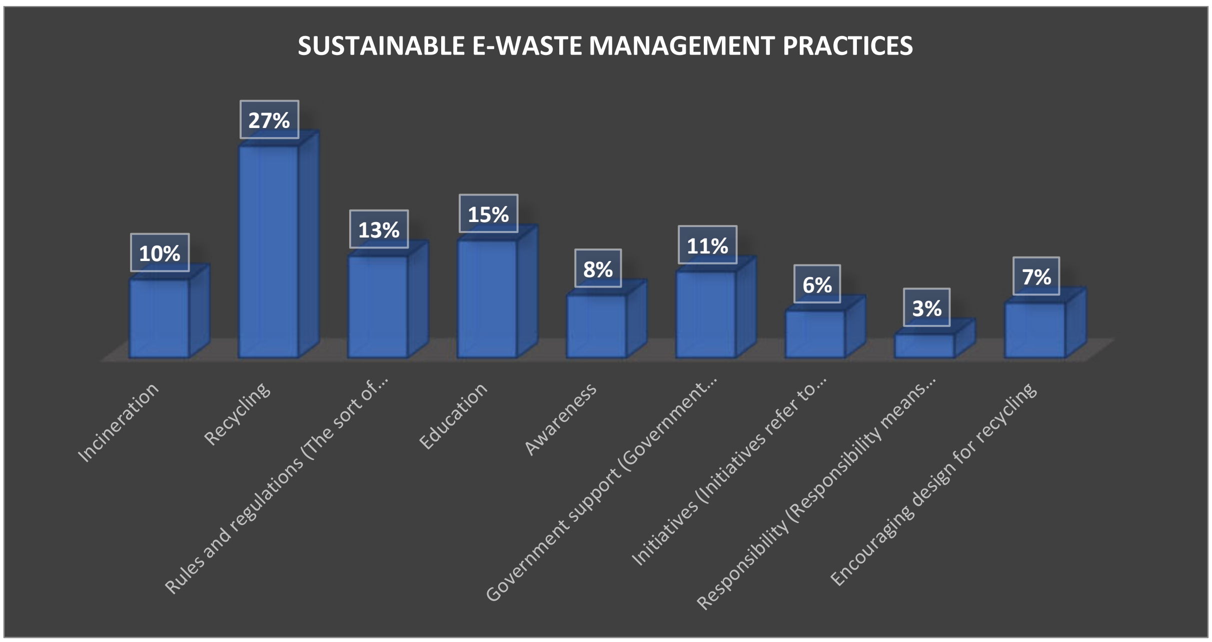

Figure 3: Sustainable E-waste management practices

5.1 E-Waste Management Challenges

Table 1 depicts the E-waste management challenges faced in Zambia. The study found that lack of funds and investment, lack of recycling technologies, and inefficient infrastructure are significant challenges in managing E-Waste materials. However, lack of government policies and regulation is not considered a significant challenge by the respondents.

Table 1: E waste management challenges

Challenges	N	Mean	Std Deviation	Skewness	Kurtosis
Lack of funds and investment	143	4.78	1.115	0.765	1.238
Lack of recycling technologies	143	4.51	0.817	1.261	0.754
Inefficient infrastructure	143	4.64	0.919	0.746	0.610
Lack of government policies and regulation.	143	2.38	-0.890	0.693	0.410

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5.2 E-Waste Management Enablers

The results shown in table 2 depict the enablers to E-waste management. The respondents were asked to what extent do they agree to the following E-waste management strategies under each enabler which Zambia should use? Where 1= strongly disagree, 2=disagree, 3= neutral, 4=agree and 5= strongly agree

The results show that the highest-rated item under economic management enablers was to inform consumers about advanced recycling fee (ARF). This fee is to be added to the price of goods to reduce the financial burden on the suppliers. ARF is to be explicitly indicated on the product so that the consumer has full information on the pricing of the product. The customer will be incentivized by reimbursing the charge paid at the time of purchase after the outmoded product is returned to a professional recycler (Garlapati, 2016; Khetriwal et al., 2009; Wath et al., 2010), followed by incentivizing customers through reimbursement and creating tax incentive policies that encourage eco-design.

Social management enablers refer to the consumers being conscious of environmental protection, green purchasing, WEEE recycling and disposal because of climate change, ozone depletion, and greenhouse gas emissions (GHGEs) (Eltayeb et al., 2011; Pekarkova et al., 2021)., according to the research, education was the highest-rated item. This entails that, there is need for the Public to be taught concerning the need for proper E-waste management, its effects of on the environment, health etc. According to Ann et al. (2015), a green training program can help workers embrace cleaner technology while simultaneously protecting their health.

Under environmental management enablers, recycling was the highest-rated item. Recycling refers to converting waste materials into new materials and objects. This reduces the use of natural elements for future use as these elements are wasting assets.

All manufacturers providing green logistics facilities was the highest-rated item under technology and infrastructure enablers. It is costly to provide green logistics but if this is provided by Manufactures, the costs are shifted accordingly. In China, only a small proportion of WEEE is completed using the official recycling system due to high recycling costs and a lack of consumer incentives (Yoon, 2016).

Under government policies and regulation enablers, a legislative framework with defined roles for all parties was the highest-rated item. lack of relevant laws to adjust or control the selling behaviors of waste from electric and electronic equipment's (Wen et al., 2016) are some important drivers in effective e-Waste management.

Table 2: E-waste management enablers

Economic management enablers	**N**	**Mean**	**Std deviation**	**Kurtosis**	**Skewness**
Consumers must be informed about ARF, which makes recycling and disposal easier at the end of a product's life cycle.	143	4.83	1.309	0.918	0.716
Incentivize customers by reimbursing the charge paid at the time of purchase after the outmoded product is returned to a professional recycler	143	4.69	0.610	0.820	0.843
Create tax incentive policies that encourage electronic producers to use green practices like eco-design to reduce harmful emissions	143	4.73	1.317	1.410	0.995
Recovering precious and rare earth metals can minimize the usage of virgin material in manufacturing, resulting in resource conservation and economic advantages	143	4.56	-1.201	0.774	1.127
Social management enablers					
Education	143	4.55	1.421	1.332	0.710
The government must aid at various levels to effectively manage e-waste	143	4.08	1.220	1.329	0.626
All stakeholders of e-Waste should understand and play their role in a responsible manner so that e-Waste can be managed effectively	143	4.26	1.032	0.884	0.776
Programs or schemes required to promote effective collection, recycling, and disposal of E-Waste	143	4.18	-0.923	0.532	0.912

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Environmental management enablers					
Recycling	143	4.78	0.687	0.768	0.587
Firms create EMS to help them define environmental targets and evaluate their supply chain components on a regular basis to develop a green image	143	4.44	0.820	0.682	0.982
EMS certification, such as ISO 14000	143	4.42	1.439	1.779	0.895
Incineration	143	4.12	1.272	0.510	0.973
Technology and infrastructure enablers					
Electronic producers need to be well-equipped with green infrastructure and clean technology	143	4.61	0.871	1	0.761
Include green packaging, accessible collection centers, recycling, and recovery plants, supply chain integration with the internet of things	143	4.53	1.255	0.746	0.810
All manufacturers to provide green logistics facilities	143	4.66	0.784	0.891	0.702
Promoting green industrial operations, digitizing statutory files, investment in R&D, e-waste segregation, and encouragement for refurbished items are all critical for sustainable WEEE management in Zambia, according to a panel of experts	143	4.32	0.995	0.818	1.209
Government policies and regulation enablers					
Policy measures relating to EPR, for example, encompass actions like used product recovery and recycling.	143	4.21	0.509	0.739	0.910
Integration of the informal and formal sectors to help developing nations enhance livelihoods, environmental protection, and occupational health and safety	143	4.24	1.376	0.900	0.665
A legislative framework with clear and defined roles for all parties is essential for all such projects, including pollution control boards, local municipal corporations, manufacturers, merchants, consumers, waste recyclers, and non-governmental groups	143	4.28	1.420	1.308	0.569

5.3 The Regression Analysis

The purpose of regression analysis is to estimate the strength of the relationship between the independent and dependent variables, as well as to make predictions about the dependent variable based on the values of the independent variables (table 3).

E- waste management is dependent on the challenges involved in undertaking the management of electronic waste. There is a strong relationship between the Dependent and the independent variables (75.6 %), signifying that indeed managing of electronic waste is dependent on the challenges faced in undertaking the same.

According to a report done by Lui et al. (2017; Gullet (2018) done in Metropolitan China, a significant amount of dumped waste is not recycled or disposed of by professional recyclers. This is due to the low recycling rates charged to consumers, failure to obtain enough e-waste to continue regular operations and the high cost involved in recycling.

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Table 3: Regression analysis results

Model	R	R Square	Adjusted R Square	Std. Error of the estimate
1	.756	.649	.681	.3021

a. Dependent Variable: E-waste management
b. Predictors: (Constant), E-waste challenges

5.4 Anova Analysis

The table below shows the results of a linear regression analysis, with the dependent variable being E-waste management and the predictor variable being E-waste challenges.

The results confirm that indeed Management of E. waste is dependent on the challenges involved in service provision.

Table 4: Anova Analysis

Model	Sum of squares	Df	Mean Square	F	Sig
Regression	5.809	1	.605	4.867	.0002[a]
Residual	31.710	142	.127		
Total	37.519	143			

5.5 Results of Multiple Linear Regression Analysis

The first section of the output displays the unstandardized coefficients, which represent the raw or unadjusted effects of each predictor variable on the dependent variable. The coefficient for the constant term is 2.270, which is the predicted value of E-waste management when all predictor variables are equal to zero. The second section of the output displays the standardized coefficients, which represent the effects of each predictor variable on the dependent variable after controlling for the effects of all other predictor variables.

The third section of the output displays collinearity statistics, which assess the degree of multicollinearity (high intercorrelations between predictor variables) in the model. The Tolerance value is a measure of how well each predictor variable can be predicted by the other predictor variables in the model. Values below 0.2 indicate a high degree of collinearity, which can affect the reliability of the coefficient estimates.

In summary, the output provides information about the strength and direction of the relationships between the predictor variables and the dependent variable, while also assessing the potential impact of multicollinearity on the reliability of the results. These results can be used to identify which factors have the strongest impact on E-waste management and to inform policy and intervention efforts aimed at improving E-waste management practices.

Table 5: Results of multiple linear regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	T	Sig	Tolerance	VIF
1 (constant)	2.270	.113		21.560	.000		
Lack of funds and investment	.140	.052	.153	1.867	.002	.301	3.309
Lack of recycling technologies	.058	.039	.178	1.947	.004	.417	3.630
Inefficient infrastructure	.186	.068	.143	1.421	.006	.423	2.451
Lack of government policies and regulation	.132	.077	.423	1.126	.002	.220	2.398

a. Dependent Variable: E-waste management
b. Predictors: (Constant), E-waste challenges (Lack of funds and investment, Lack of recycling technologies, Inefficient infrastructure, Lack of government policies and regulation)

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VI. CONCLUSION

The study found that lack of funds and investment, lack of recycling technologies, and inefficient infrastructure are significant challenges in managing E-Waste materials. However, lack of government policies and regulation is not considered a significant challenge by the respondents. The study found that the most common sustainable e-waste management practices currently being used in Zambia are recycling (27%), followed by rules and regulations (13%), education (15%), and incineration (10%). The least common practices mentioned were responsibility (3%) and initiative (6%). The results showed that the highest-rated item under economic management enablers was to inform consumers about Advanced Recycling Fee (ARF,) followed by incentivizing customers through reimbursement and creating tax incentive policies that encourage eco-design. Under social management enablers, education was the highest-rated item, and under environmental management enablers, recycling was the highest-rated item. All manufacturers providing green logistics facilities was the highest-rated item under technology and infrastructure enablers. Under government policies and regulation enablers, a legislative framework with defined roles for all parties was the highest-rated item. The regression analysis conducted showed that the correlation coefficient R indicates the strength and direction of the relationship between two variables, in this case, E-waste management and E-waste challenges, and has a value of 0.756, indicating a moderately strong positive correlation. The coefficient of determination, R Square, was 0.649, meaning that 64.9% of the variance in E-waste management can be explained by E-waste challenges.

6.1 Recommendations

i. Increase public awareness: There is a need to educate the public about the dangers of e-waste and the importance of proper disposal. According to Ali et al, "The awareness level of the respondents is significant poor and strongly associated with several complex factors indicating that there is wide knowledge gap between the different stakeholders of e-waste issue including the major role-players in the e-waste business, and the need to take crucial measures by the government bodies.

ii. Develop e-waste recycling infrastructure: Zambia needs to develop e-waste recycling infrastructure to support the proper management of e-waste. This can be done by creating specialized e-waste recycling facilities and providing incentives to private sector organizations that invest in e-waste recycling. A study done by Nalwamba 2022, observed with concern that there is a lack of a working waste collection and segregation mechanism and, it is impossible to effectively quantify e-waste both in home or industries and at the landfill.

iii. Encourage the circular economy: Zambia should encourage the circular economy approach to e-waste management, which involves recycling and reusing electronic components. Shah (2022) asserted that the circular economy was the best approach to manage E-waste effectively in California.

iv. Strengthen the capacity of regulatory bodies: Zambia needs to strengthen the capacity of regulatory bodies responsible for e-waste management. This can be done by providing training, resources, and equipment to these bodies to enable them to effectively carry out their mandate. According to the Office of the Auditor General (2020) the Ministry responsible for environment had not conducted institutional capacity building training, public awareness and/or educational campaigns to introduce the hazardous effects of e-waste to the waste handlers from institutions and the public at large.

v. Collaboration between stakeholders: Collaboration between stakeholders, including government, private sector, civil society organizations, and the public, is essential in addressing e-waste management challenges. Through collaboration, stakeholders can share knowledge, resources, and expertise to develop effective e-waste management strategies.

During the United Nations Development Program (UNDP) seminar in China (2018). It was discovered that, "the world is reaching a phase where the walls between government and other institutions are fading because of the open global markets and the need to face common global problems with our hands joined. The modern problems we face are such that we must come up with innovative solutions for which there is a need for divergent thinking. There needs to be more participation from experts of all the sectors to address these issues as exemplified by the UNDP-Ministry of Environment Protection (MEP) e-waste seminar."

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