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An In-Depth Analysis and Review of E-Waste Management in Urban Area of Tanzania: A Policy Perspective

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ABSTRACT

E-waste in urban areas of Tanzania presents significant environmental and health challenges, exacerbated by the prevalence of informal recycling practices often seen in many developing countries. Such informal recycling frequently releases hazardous heavy metals, which can contaminate air and soil, posing serious health risks to local populations. This article examines the current state of e-waste management in urban Tanzania from a policy perspective. It analyses existing policies and regulations, identifies the challenges of managing e-waste, and proposes a strategy to improve the situation. Additionally, it explores the roles of decision-makers and the involvement of the private sector in e-waste management. The findings aim to inform policymakers, stakeholders, and the public about the importance of effective e-waste management practices for sustainable development.

Key words: E-waste in Tanzania, Private sector in E-waste in Tanzania, E-waste in urban areas Decision making in E-waste

INTRODUCTION

E-waste, or electronic waste, comprises discarded electronic and electrical devices, including mobile phones, computers, and household appliances. These items present significant environmental and health risks due to their hazardous components (Hsu et al., 2024; Sangwan & Srivastava, 2023). Rapid technological advancement and low production costs have led to an exponential increase in e-waste generation, resulting in millions of tons being produced each year (Goyal et al., 2023). To mitigate the adverse effects of e-waste, including the release of toxic substances and resource depletion, effective management strategies such as recycling and the promotion of green electronics are essential (Goyal et al., 2023; Bahmani & Jeet, 2024). Developing countries, particularly India, encounter unique challenges in e-waste management due to inadequate regulations and the illegal import of waste, underscoring the urgent need for reforms to protect public health and the environment (Taksali & Rathore, 2024; Sangwan & Srivastava, 2023).

Electronic waste (e-waste) poses substantial environmental and health risks to communities in developing countries, primarily due to informal recycling practices. Research indicates that e-waste recycling can

release hazardous heavy metals such as lead (Pb), cadmium (Cd), and mercury (Hg) into the environment, contaminating air, soil, and water, particularly in regions like Pakistan and Bangladesh (Kazim et al., 2024; Parvez et al., 2024). For instance, elevated levels of Pb have been linked to impaired liver and renal functions among workers, with median blood Pb concentrations significantly higher in those exposed compared to non-exposed groups (Parvez et al., 2024). Furthermore, informal recycling activities have been associated with respiratory problems, hormonal imbalances, and increased cancer risks due to cumulative exposure to toxic substances (Eckhardt & Kaifie, 2024; Okeke et al., 2023). Additionally, environmental degradation from e-waste adversely affects local ecosystems, leading to reduced biodiversity and health risks from contaminated food sources (Okeke et al., 2023).

The state of global e-waste management in urban areas reveals a complex relationship between environmental, health, and technological challenges. The escalating volume of e-waste, spurred by rapid technological advancement, necessitates effective management strategies to recover valuable materials and reduce environmental contamination (Kwon et al., 2024). Informal recycling practices, particularly in urban regions such as Pakistan, are associated with significant health risks due to the emission of hazardous heavy metals, underscoring the urgent need for enhanced regulatory frameworks and public health interventions (Kazim et al., 2024). Furthermore, the adoption of advanced technologies can improve waste management efficiency by optimising collection routes and processing, thereby fostering sustainability in urban environments (Addas et al., 2024). Additionally, a systematic taxonomy for e-waste urban mining technology design highlights the necessity of understanding various influencing factors to encourage sustainable practices (Kankanamge et al., 2024). Collectively, these insights emphasise the critical need for comprehensive, technology-driven approaches to e-waste management in urban areas to safeguard public health and the environment (Agbim et al., 2024).

In developing countries, human populations are primarily exposed to toxic substances from e-waste through various routes, particularly ingestion, dermal contact, and inhalation. Informal e-waste recycling activities release hazardous heavy metals (HMs) such as lead (Pb), cadmium (Cd), and mercury (Hg) into the environment, significantly contaminating air and soil, especially in regions like Pakistan (Kazim et al., 2024). Ingestion is identified as the primary route of exposure, although dermal contact and inhalation also contribute significantly (Kazim et al., 2024). Moreover, emerging contaminants like liquid crystal monomers (LCMs) have been identified in soil samples from e-waste dismantling sites, posing risks to both adults and infants (Zhang et al., 2024). The health effects of such exposures include impaired liver and renal function, hormonal imbalances, and an increased prevalence of respiratory and skin disorders among workers (Parvez et al., 2024; Eckhardt & Kaifie, 2024).

E-waste management in urban areas of Tanzania presents significant challenges and opportunities, necessitating a multifaceted policy approach. The rapid increase in electronic devices has led to a surge in e-waste generation, which poses environmental risks while also containing valuable recoverable materials (Lee et al., 2024). Effective management strategies must address barriers such as regulatory shortcomings, public awareness, and the informal recycling sector, which often exacerbates health and environmental issues (Islam et al., 2024). Community engagement is essential, as illustrated by the Community-Based Willingness to Recycle (CWTR) model, which underscores the importance of societal norms and awareness in fostering recycling practices (Nurcahyo et al., 2024). Furthermore, adopting urban mining technologies can enhance resource recovery; however, this requires supportive policies and technological advancements to overcome existing obstacles (Erdiaw-Kwasie et al., 2024).

The state of e-waste in urban areas of Tanzania is becoming increasingly critical due to rapid urbanisation and the proliferation of electronic devices. The major cities in Tanzania generating the highest volume of e-waste include Dar es Salaam, Arusha, Morogoro, Mbeya, and Mwanza. Dar es Salaam stands out as the primary contributor, with significant amounts of Waste Electrical and Electronic Equipment (WEEE) resulting from rapid economic growth, population increase, and rising household purchasing power. Despite the presence of recyclers, only about 35% of the generated e-waste is processed, leading to environmental concerns as much of it is discarded improperly (Nelson et al., 2021). As urban centres expand, particularly in cities like Dar es Salaam and Mwanza, the generation of electronic waste (e-waste) has surged, intensifying environmental and health challenges. Informal settlements, which constitute a significant portion of urban areas, contribute disproportionately to pollution, with studies indicating that they are major sources of non-point source pollution, including e-waste (Chen et al., 2023). The governance of electricity and waste management systems remains fragmented, complicating efforts to implement effective e-waste recycling and management strategies (Koepke et al., 2023). Moreover, the lack of awareness and infrastructure for proper e-waste disposal further hampers sustainable practices, necessitating educational initiatives and improved collection systems to mitigate the adverse impacts of e-waste in these rapidly growing urban environments (Ghisellini et al., 2023; Duhayyim, 2023).

Developing a robust e-waste recycling sector in Tanzania presents significant economic and environmental benefits. Economically, recycling e-waste can generate substantial revenue by recovering valuable materials such as precious metals and rare earth elements, which are often found in greater quantities in e-waste than in natural ores (Lee et al., 2024). The global market for electronics recycling is projected to reach $65.8 billion by 2026, offering a lucrative opportunity for Tanzania (Seif et al., 2023). Environmentally, effective e-waste management can mitigate pollution and health risks associated with improper disposal, which currently results in hazardous substances contaminating ecosystems (Gupta et al., 2023). Furthermore, the implementation of a circular economy model can enhance sustainability by decreasing reliance on virgin resources and promoting the reuse of materials, thereby contributing to climate change mitigation through reduced emissions (Seif et al., 2023). This article examines the current state of e-waste management in urban areas of Tanzania from a policy perspective.

POLICY AND LEGAL STATUS ON E-WASTE ISSUES

In Tanzania, the policies and regulations governing e-waste disposal are notably underdeveloped, reflecting broader challenges within the waste management systems. Currently, there are no clear policies or legislation specifically addressing electronic waste management, despite some existing regulations aimed at protecting the environment and human health. The current e-waste recycling policies and regulations in Tanzania face significant challenges that hinder their effectiveness. Although the global implications of e-waste—both environmental and economic, including the potential recovery of valuable materials—are widely recognised, Tanzania's existing framework lacks comprehensive implementation strategies and community engagement efforts (Lee et al., 2024; Nurcahyo et al., 2024). The absence of robust Extended Producer Responsibility (EPR) mechanisms, as seen in other regions, further complicates the situation, resulting in a substantial volume of unprocessed e-waste (Alqodsi, 2024). Moreover, community-based initiatives, which are crucial for fostering recycling behaviours, are underdeveloped, with limited awareness of the benefits and risks associated with e-waste (Nurcahyo et al., 2024). This gap in community involvement, combined with insufficient policy clarity and enforcement, leads to ineffective e-waste management, mirroring broader issues observed in Tanzania's regulatory landscape across various

sectors (Kegamba et al., 2024; Chuwa & Perfect-Mrema, 2024). Therefore, a coordinated effort to enhance policy frameworks and community engagement is essential for improving e-waste recycling outcomes in Tanzania.

E-WASTE GENERATION IN URBAN AREAS

The primary sources of e-waste generation in urban areas of Tanzania are linked to the rapid proliferation of electronic devices, particularly smartphones and computers. This growth is driven by technological advancements and increased consumer demand (Nurcahyo et al., 2024; Ahmed et al., 2024). As the urban population becomes increasingly reliant on these devices, significant quantities of waste are generated, with global e-waste production estimated at 20-50 million tonnes annually, of which only a small fraction is recycled (Ferreira et al., 2024). Furthermore, improper disposal practices—such as dumping e-waste in non-designated areas—exacerbate the problem, highlighting the need for community engagement in recycling initiatives (Nurcahyo et al., 2024). The absence of effective e-waste management frameworks complicates the situation, as urban centres struggle to implement sustainable practices (Kankanamge et al., 2024; Koshta et al., 2024). Therefore, addressing these challenges requires a multifaceted approach that includes community involvement, regulatory support, and innovative recycling technologies.

IMPACTS OF E-WASTE

E-waste has a significant impact on both the environment and human health in Tanzania, primarily due to inadequate waste management practices. The informal recycling of e-waste, particularly prevalent in areas such as Dar es Salaam, results in the release of hazardous substances, including heavy metals and persistent organic pollutants, into the soil and surrounding ecosystems (Buranovna & IIA-CCSA-Pdf-Dumps, 2023; Okeke et al., 2023). Studies indicate that elevated concentrations of chlorinated paraffins and heavy metals, such as arsenic and lead, are present in soil and food sources, posing serious health risks to local populations (Buranovna & IIA-CCSA-Pdf-Dumps, 2023; Wirtu & Tucho, 2022). These contaminants can cause respiratory issues, cancers, and neurological disorders, particularly affecting vulnerable groups such as women and children involved in informal recycling (Okeke et al., 2023; Ankit et al., 2021). Moreover, the absence of regulatory frameworks exacerbates the situation, underscoring the urgent need for effective e-waste management strategies to address these environmental and health challenges (Wirtu & Tucho, 2022).

The informal e-waste recycling sector in Tanzania poses significant health risks to workers and local communities due to exposure to hazardous materials and environmental degradation. Informal recycling practices often involve manual dismantling and burning of electronic waste, leading to the release of heavy metals such as lead, cadmium, and mercury into the air, soil, and water, which pose serious health threats, including cancer and neurological disorders (Kazim et al., 2024; Owusu-Sekyere et al., 2024). Studies indicate that workers are particularly vulnerable due to direct exposure during processing, with ingestion and inhalation being the primary routes of contamination (Kazim et al., 2024). Additionally, the lack of regulatory oversight exacerbates these risks, as informal operations often neglect safety measures, resulting in higher pollution levels in surrounding areas (Traverso et al., 2024; Owusu-Sekyere et al., 2024). The cumulative effects of these practices not only endanger individual health but also compromise community well-being, necessitating urgent interventions to formalise recycling processes and mitigate environmental hazards (Lee et al., 2024; Kinally et al., 2024).

MANAGEMENT TECHNIQUES OF E-WASTE IN URBAN AREAS

The current state of electronic waste (e-waste) management in urban areas of Tanzania reveals significant challenges and opportunities, primarily driven by rapid technological advancements and increasing electronic consumption. E-waste is recognised as the fastest-growing waste stream globally, posing serious environmental and health risks due to the toxic substances it contains (Ghulam & Abushammala, 2023; Awasthi et al., 2023). In Tanzania, management strategies are often fragmented and heavily reliant on an informal sector that lacks adequate infrastructure and regulatory support (Awasthi et al., 2023). Recent studies suggest that integrating data-driven technologies could enhance collection and classification processes, ultimately improving sustainability outcomes (Kazancoglu et al., 2020). Furthermore, effective recycling techniques, such as hydrometallurgical and bio-hydrometallurgical methods, are essential for recovering valuable materials while minimising environmental harm (Abdelbasir et al., 2018). Overall, a comprehensive framework that includes governmental regulations and community engagement is vital for advancing e-waste management in Tanzania (Vishwakarma et al., 2022; Ghulam & Abushammala, 2023).

PRIVATE SECTOR ENGAGEMENT IN E-WASTE MANAGEMENT

The role of the private sector in e-waste management in Tanzania is increasingly recognised as crucial for addressing the challenges posed by electronic waste. This sector can facilitate the recycling of e-waste, which contains valuable materials, thereby contributing to both environmental sustainability and economic growth (Lee et al., 2024). However, a significant amount of e-waste remains unprocessed, often due to inadequate formal recycling systems and the prevalence of informal practices (Traverso et al., 2024). While the informal sector plays an essential role in managing e-waste, it often lacks the necessary support and formalisation, leading to unsafe practices and adverse social impacts on vulnerable communities (Mohammed & Kaida, 2024). Furthermore, the implementation of circular economy principles by private entities can enhance resource recovery and promote sustainable disposal methods; however, challenges such as consumer perceptions and regulatory frameworks persist (Sharma et al., 2024; Gupta et al., 2023). Therefore, fostering collaboration between the private sector and the government is essential for developing effective e-waste management strategies in Tanzania.

The current state of private sector involvement in e-waste management in urban areas of Tanzania reflects a complex interplay of challenges and opportunities. Despite the growing recognition of e-waste's environmental and economic implications, a significant portion remains unprocessed through formal channels, mirroring global trends (Lee et al., 2024). The private sector's engagement is impeded by economic instability and a lack of tailored financial instruments, which are crucial for stimulating investment in sustainable projects (Bai et al., 2024). Additionally, the adoption of urban mining technologies, which could enhance e-waste recovery, remains underexplored, highlighting the need for a structured approach to technology design and implementation (Kankanamge et al., 2024). Community engagement is also vital, as models such as the Community-Based Willingness to Recycle (CWTR) demonstrate the importance of local participation in promoting sustainable practices (Nurcahyo et al., 2024). Overall, while there are opportunities for improvement, the role of the private sector in e-waste management in Tanzania remains limited and requires strategic interventions to enhance its effectiveness.

Private sector involvement in e-waste management in urban areas of Tanzania is shaped by several key drivers and barriers. The increasing global demand for precious metals and rare earth elements sourced from e-waste presents a significant economic opportunity, encouraging private investment in recycling

technologies and processes that can recover these valuable materials (Kwon et al., 2024; Varsha et al., 2024). However, barriers such as inadequate formal recycling systems, limited government support, and the predominance of informal waste management practices hinder effective participation from the private sector (Mohammed & Kaida, 2024). Additionally, community awareness and willingness to recycle play crucial roles; initiatives that promote understanding of the environmental hazards associated with e-waste can enhance engagement in formal recycling efforts (Nurcahyo et al., 2024). The complexities of e-waste composition and the technical challenges involved in recycling further complicate private sector involvement, necessitating advanced analytical methods and robust frameworks for effective management (Ferreira et al., 2024).

Informal recycling of e-waste in urban areas of Tanzania presents both significant challenges and opportunities. The informal sector plays a vital role in e-waste management, often employing crude methods that pose serious health risks and lead to environmental pollution due to the release of toxic substances from electronic devices (Ghulam & Abushammala, 2023). Despite these drawbacks, informal recyclers contribute to resource recovery and livelihood sustenance, highlighting their potential for positive impact if integrated with formal systems (Yang et al., 2018). Grassroots organisations in Tanzania exemplify innovative approaches to waste management, leveraging local knowledge and networks to enhance recycling practices while addressing socio-economic needs (Campos, 2022). However, inadequate funding and the lack of advanced waste management technologies exacerbate the environmental and health challenges associated with e-waste (Yang et al., 2018). Therefore, fostering synergies between the informal and formal sectors could improve both waste management efficiency and public health outcomes in Tanzania (Yang et al., 2018).

The regulatory framework in Tanzania has a significant impact on private sector participation in e-waste management, presenting both opportunities and challenges. Although the country lacks a comprehensive e-waste management policy, insights from other regions underscore the importance of establishing a structured approach that incorporates Extended Producer Responsibility (EPR) and public-private partnerships. These strategies have proven effective in managing end-of-life waste in countries such as Germany and Japan (Ali et al., 2024).

The informal sector's involvement in e-waste management, as observed in the Maldives, suggests that formalising this sector could enhance resource recovery and safety, presenting a potential opportunity for Tanzania (Mohammed & Kaida, 2024). However, the existing legal and institutional frameworks may restrict the capabilities of local enterprises, indicating a need for reevaluation to create a more enabling environment for private sector engagement (Chuwa & Perfect-Mrema, 2024).

In summary, integrating community-based initiatives with regulatory reforms could improve the effectiveness of e-waste management in Tanzania (Nurcahyo et al., 2024).

ROLE OF DECISION MAKERS IN E-WASTE MANAGEMENT

Decision-makers in e-waste management within urban areas comprise a diverse array of stakeholders, including government authorities, community organisations, and private sector entities. Government bodies are vital in formulating regulations and policies that govern e-waste recycling and disposal, which are shaped by community engagement and awareness of environmental issues (Nurcahyo et al., 2024). Community involvement is essential, as local attitudes towards recycling and environmental concerns significantly influence the effectiveness of e-waste management strategies (Nurcahyo et al., 2024). Additionally, private companies play a crucial role in implementing technological solutions, such as deep

learning classifiers, to optimise e-waste collection and processing, thereby enhancing operational efficiency (Selvakanmani et al., 2024). Moreover, location-allocation models developed for e-waste collection underscore the importance of strategic planning in maximising waste acquisition while minimising costs, indicating that decision-making must also consider logistical factors and community participation (Koshta et al., 2024). Collectively, these stakeholders must collaborate to effectively address the complexities of e-waste management (Islam et al., 2024).

In Tanzania's urban areas, decision-makers are pivotal in e-waste management by integrating community engagement, technological innovation, and strategic policy formulation. The Community-Based Willingness to Recycle (CWTR) model highlights the significance of community involvement in promoting sustainable e-waste practices, emphasising factors such as awareness of recycling benefits and adherence to societal norms (Nurcahyo et al., 2024). Additionally, the adoption of digital technologies, including decision support systems (DSSs), enhances decision-making processes, optimising operations and resource efficiency in waste management (Mohamed et al., 2024). Furthermore, the taxonomy of e-waste urban mining technology design identifies key factors influencing technology adoption, guiding decision-makers in implementing effective e-waste management strategies (Kankanamge et al., 2024). By fostering collaboration among stakeholders and leveraging technological advancements, decision-makers can significantly improve e-waste management outcomes in urban Tanzania.

The roles of decision-makers in Tanzania's urban areas significantly affect the effectiveness of e-waste management strategies through the integration of digital technologies and stakeholder engagement. Decision support systems (DSS) and data automation (DA) are crucial in enhancing decision-making processes, optimising operations, and promoting sustainable practices in e-waste management (Mohamed et al., 2024). Additionally, a taxonomy of e-waste urban mining technology design emphasises the importance of organisational and macro factors that influence technology adoption, suggesting that decision-makers must consider these elements to facilitate effective e-waste strategies (Kankanamge et al., 2024). Furthermore, involving local stakeholders and implementing ICT systems can enhance community participation, leading to better-informed decisions regarding urban services and e-waste management (Jakovics & Szemenyei, 2024). Ultimately, the interplay of technological, organisational, and environmental conditions, along with stakeholder engagement, is crucial for successful e-waste management in urban Tanzania (Tan et al., 2024).

CHALLENGES FACING E-WASTE MANAGEMENT IN URBAN AREAS

E-waste management in urban areas of Tanzania faces several significant challenges, primarily due to rapid urbanisation and inadequate formal recycling systems. The informal sector plays a crucial role in e-waste management; however, it often operates without adequate government support or safety regulations, leading to health and environmental risks (Mohammed & Kaida, 2024). Additionally, the lack of financial incentives and transparency in supply chains hinders the transition to a more organised e-waste management system (Schneider et al., 2024). Economic feasibility remains uncertain, as many studies highlight the absence of comprehensive cost analyses and social considerations in recycling efforts (Lee et al., 2024). Furthermore, socio-economic factors, infrastructural limitations, and cultural attitudes towards waste management complicate the implementation of effective policies (Zhang et al., 2024). Addressing these challenges necessitates a multifaceted approach that includes formalising the informal sector, enhancing public awareness, and integrating e-waste management into broader circular economy initiatives (Kankanamge et al., 2024).

The country encounters significant issues such as inadequate infrastructure, a lack of comprehensive legislation, and insufficient public awareness regarding e-waste hazards (Kibonde, 2024; Eastman, 2024). Current practices often involve rudimentary methods like open burning and informal recycling, which pose environmental and health risks (Eastman, 2024; Solanki & Rathore, 2024). While there are calls for improved management strategies, including the establishment of formal recycling facilities and public education campaigns, implementation remains inconsistent (Solanki & Rathore, 2024). Moreover, the integration of cyber hygiene practices in e-waste disposal is increasingly recognised as essential to mitigate data security risks associated with improper disposal (Raj & Vanaraj, 2024).

Socioeconomic factors significantly influence e-waste management practices in urban Tanzania, reflecting broader trends observed in similar contexts across Africa. The informal sector plays a crucial role in e-waste recycling, often overshadowing formal practices due to economic constraints and limited access to resources (Traverso et al., 2024). This reliance on informal channels can lead to inadequate processing and environmental risks, as many individuals lack awareness of the hazards associated with e-waste (Nurcahyo et al., 2024). Additionally, socioeconomic status impacts community engagement in recycling initiatives; lower-income groups may prioritise immediate economic needs over environmental concerns, complicating efforts to promote sustainable practices (Soesilo & Alfarizi, 2024). Furthermore, the absence of comprehensive policies and financial incentives exacerbates the challenges faced in e-waste management, as communities struggle to mobilise support for recycling efforts (Lee et al., 2024; Zhang et al., 2024). Therefore, addressing these socioeconomic barriers is essential for improving e-waste management in urban Tanzania.

Effective e-waste management in urban areas of Tanzania encounters significant policy gaps and regulatory challenges, primarily due to inadequate infrastructure, a lack of public awareness, and insufficient regulatory frameworks. Current policies do not adequately address the complexities of e-waste, including the need for Extended Producer Responsibility (EPR) programmes and specific recycling targets essential for promoting responsible disposal and accountability among producers (Kumar et al., 2024; Khanal et al., 2024). Furthermore, the informal sector dominates e-waste management, employing rudimentary methods that pose health risks and environmental hazards, highlighting the absence of formalised recycling processes (Maphosa & Mashau, 2023). The influx of second-hand electronic equipment, aimed at bridging the digital divide, exacerbates the e-waste problem without corresponding regulatory measures to manage its disposal (Maphosa & Mashau, 2023). Additionally, the lack of public awareness campaigns hampers community engagement in sustainable practices (Kumar et al., 2024; Bajaj et al., 2024). Addressing these challenges through comprehensive policy reform and infrastructure development is crucial for mitigating the environmental and health impacts of e-waste in Tanzania (Khanal et al., 2024).

TANZANIA'S PATH TOWARD SUSTAINABLE E-WASTE MANAGEMENT

Managing e-waste in an environmentally responsible manner is crucial for achieving sustainable management. Various strategies can be employed to accomplish this goal, including reducing the use of electronic materials and reassessing the need for new products to minimise e-waste. Additionally, implementing energy-saving measures—such as recycling batteries and electronic devices, strategically placing recycling bins for e-waste in easily accessible locations, refurbishing large appliances, donating used electronics to charitable causes, selecting environmentally friendly electronics, and enhancing the durability of electronic devices—are vital steps in promoting responsible e-waste management. However,

swift action is necessary to curb the rising production of e-waste and ensure a healthy environment for future generations.

Initially, strict legislation and regulations governing the production of e-waste and its subsequent processing must be established. It is essential to create and enforce specific legislation concerning regular waste collection, particularly for uncollected refuse. These laws should also encompass procedures to ensure regular collection from informal settlements and provide discounted waste pickup rates. Establishing a central collection point within informal communities and incentivising residents to utilise it are other critical steps that should be considered. Moreover, closely monitoring the disposal and segregation of waste at designated locations is advisable.

Furthermore, improving the recycling process is essential. To tackle the growing risks associated with dumpsites caused by inadequate segregation practices, it is important to promote waste segregation at the source, particularly within residential settings, by engaging stakeholders in collaborative workshops. Households should be encouraged to separate their organic waste from plastics and adhere to a shared pickup schedule. For instance, recyclables that are not biodegradable could be collected four to five times a week, while organic kitchen waste should be picked up daily. Governments might implement a rewards programme that offers incentives for returning empty plastic containers or other recyclable items to encourage recycling, reuse, and waste sorting. It is the responsibility of local communities and organisations focused on Science, Technology, and Society (STS) to collaboratively manage the disposal process for both compostable and non-compostable materials. Key participants in this initiative have proposed viewing waste as a resource and exploring the potential for generating gas from organic waste in landfills. Additionally, they recommend rooftop gardening as an effective solution for managing compost waste.

Furthermore, creating focused awareness campaigns is an effective strategy for influencing public behaviour and promoting sound waste management practices. These campaigns should emphasise the importance of home waste segregation, providing clear regulations on the allocation of financial and human resources, as well as the establishment of a regulatory authority. Residents living near waste management facilities are often curious and concerned about waste handling. It is crucial to ensure that all stakeholders are well-informed about the risk assessment policy and can engage in discussions based on shared knowledge and analysis. This fosters public participation in the environmental decision-making process.

These residents seek waste management practices that are reliable, safe, and do not pose risks to the environment or public health. Decisions grounded in sound reasoning and science stem from thorough risk assessments. Before making any choices, governments, tribes, facilities, and other stakeholders should engage in dialogue. It is also important to highlight the need to mitigate the negative impacts of waste management on the environment. This involves promoting strategies to reduce the generation of solid waste and wastewater, enhancing the efficiency of e-waste processing, and minimising energy consumption. Additionally, for waste management policies to be effective, it is essential to prioritise waste prevention over landfill disposal and incineration, while clearly defining the roles and responsibilities of all parties involved, including the recycling sector, manufacturers, retailers, and consumers.

The management of e-waste is a financial and professional process that underscores the importance of producing products sustainably. It necessitates the adoption of a circular economy, achievable only through collaboration between consumers, businesses, and governments. Both consumer economics and technological consumer behaviour are crucial for the long-term health of the global economy. This

highlights the need for improved developmental techniques to enhance e-waste management and create a suitable professional economy.

The concept of the circular economy aims to reduce consumption by limiting the manufacture of electrical items and gadgets through innovative business structures and efficient product design. It encompasses strategies and regulations that prioritise waste minimisation while maximising the use and value of product components. The 7R principles—reuse, reduce, reject, rethink, redesign, and recycle—underscore the importance of considering social, economic, and environmental factors in waste management. However, various obstacles may impede progress, including inadequate data collection methods, technological limitations, insufficient training in the informal sector, and budget constraints. The circular economy promotes cleaner, renewable, and sustainable technologies through developmental models, planning techniques, and regulations that emphasise waste reduction while maximising the use and value of product resources.

It is advisable to dispose of e-waste using proper chemical and physical processing methods. Governments should designate specific areas for the safe disposal of e-waste. Effectively promoting and advertising these disposal facilities is essential to raise public awareness about the dangers of e-waste. Technological competence and a thorough understanding of the associated risks are vital for the owners and operators of e-waste disposal facilities. Securing approval from local governments and regulatory bodies, such as the Department of Energy, is crucial in this context.

Equipping owners and operators with the necessary knowledge and skills regarding e-waste and its impacts is essential. Consequently, considering future factors and implementing potential solutions—such as using innovative adsorbents to recover e-waste, employing advanced technologies to manage hazardous components and extract valuable metals, conducting economic analyses to explore appropriate recycling methods, establishing suitable guidelines and regulations, and raising awareness—can help mitigate environmental hazards, reduce risks, and minimise health threats associated with e-waste processing.

Strong rules and regulations specifying the operation of waste management systems and the responsibilities of the primary implementing authorities must be strictly enforced. Successful implementation of these policies requires stakeholder cooperation, adequate funding, and close monitoring. Key components include effective communication, education, and information sharing. Additionally, it is essential to address the health and safety concerns of waste handlers within these regulations and to allocate sufficient resources for protective gear.

The government can facilitate this by providing health insurance and safety training for waste management professionals. Stakeholders advocate for the implementation of a reward-punishment system to incentivise residents at each stage of the waste management cycle. Public-private partnerships should be employed to develop policies, strategies, or action plans, fostering strong connections across various sectors of waste management. Finally, a central authority should oversee the entire waste management process, coordinating the efforts of all authorised institutions involved, from waste generation to disposal, to streamline and enhance solid waste management methods.

CONCLUSION

E-waste presents significant hazards to both the environment and human health; however, several nations stand to benefit from organised recycling and metal recovery methods for e-waste. The management of e-waste in urban areas of Tanzania requires urgent attention and comprehensive policy implementation. By establishing advanced product monitoring systems and adopting innovative service and take-back business

models, global value chains can move closer to circularity. Enhancing electronic material efficiency, strengthening e-waste recycling infrastructure, and increasing the use of recovered materials to meet the demands of the electronics supply chain are critical for long-term growth in this sector.

The current situation necessitates a coordinated effort from the government, the private sector, and the community to address the growing e-waste problem. Effective policies focused on collection, recycling, and proper disposal are essential to mitigate the environmental and health risks associated with e-waste. If managed properly, the industry could create millions of quality jobs worldwide. The use and manufacture of electrical and electronic products require a new perspective. Electronic waste is often viewed as a post-consumer issue; however, it encompasses the entire lifecycle of everyone's electronic devices. Policymakers, consumers, raw material producers, miners, merchants, investors, manufacturers, designers, and others must collaborate to reduce e-waste.

Moreover, public awareness campaigns and educational programmes can play a crucial role in promoting responsible e-waste management practices among the population. Sustainable solutions and strict enforcement of regulations will be instrumental in ensuring a sustainable and healthy urban environment for Tanzania.

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