# Practices of E-Waste Management among People Living in African Cities: The Case of Dar Es Salaam, Tanzania

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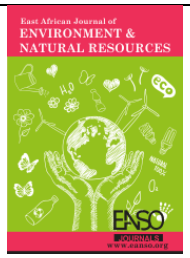

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*Original Article*

# Practices of E-Waste Management among People Living in African Cities: The Case of Dar Es Salaam, Tanzania

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## ABSTRACT

Rapid turnover in technology across the cities of the world creates a rapidly growing e-waste stream. This is the case for the city of Dar es Salaam in Tanzania. Currently, the city lacks the capacity for handling and recycling the hazardous materials contained in e-waste. Further, Tanzania has neither a specific policy nor a law on e-waste management. The paper focuses on e-waste management practices in Dar es Salaam. The key question is what are the practices of stakeholders in e-waste management in the city? This study was conducted in Ilala and Temeke municipalities in the city. Participants for the study were purposively selected. The selection ensured the representation of key stakeholders in e-waste generation and management. The number of participants for key stakeholders was determined by the data saturation point, a point where no new information was obtained. To gain an in-depth understanding, several ethnographic methods were employed. Based, on the study findings, some of the practices on e-waste management in the city of Dar es Salaam include: storing e-waste, landfilling, reusing, selling, and recycling. Overall, the practices of e-waste management in the city of Dar es Salaam remain informal and hence lack any operational legal framework. Although the existing legal framework for the management of e-waste has the potential for operationalization, it has no clear guidelines or procedures. The authors are aware that the Tanzania Bureau of Standards (TBS) has developed operational standards for e-waste management. However, the operational standards remain inaccessible to other key Government entities, the public and other key stakeholders. One, including Government agencies, must pay to access them. The authors strongly recommend that the standards should be made available free of charge and be operationalized at all levels. The authors further recommend the development of suitable frameworks to deal with the management of e-waste, recycling, and circular economy.

 

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## INTRODUCTION

Rapid turnover in technology across the world creates a rapidly growing e-waste stream. The challenge happens not only in industrialized but also in developing countries like Tanzania. Like in other countries, big cities in Tanzania generate a large number of e-waste. E-waste is of greater concern today because it contains toxic substances which pose a threat to the environment as well as to human health. The countries of the world handle electronic waste (e-waste) differently. Countries in the Global North tend to develop more advanced e-waste management systems than those in the Global South. Some countries, especially those in the Global South, do not have e-waste management systems in place (Magashi & Schluep, 2011; Nur, 2015; Maes & Preston-Whyte, 2022). Lu et al. (2015) assert that e-waste is used and discarded by electronic and electrical devices ranging from large household appliances to personal digital assistants (PDAs), and handphones. The devices contain hazardous substances which could create serious pollution and environmental health problems if they are inappropriately managed. More and more, dependence on Information and Communication Technology (ICT) accompanied by a shift in consumption patterns towards a preference for newer electronic devices has led to increased generation of e-waste in many countries (Prasad et al., 2021; EACO, 2022). According to the National Bureau of Statistics (NBS), e-waste generation in Tanzania has increased from about 2000 tonnes in 1998 to 35,800 tonnes in 2017 (URT, 2019). Yet, Tanzania lacks the capacity for handling and recycling the hazardous materials contained in e-waste. The country has neither a specific policy nor a law on e-waste management.

One strategy attempted by Local Government Authorities (LGA) at the major urban centres is the application of non-conventional approaches to the delivery of e-waste management services. There is little information available about their performance in terms of the extent, quality, and capacity of e-waste management services. The magnitude and flow of e-waste generation in such urban centres are not well known. Only a few studies present rough estimates of e-waste generated and only analyse stakeholder set-up in Dar es Salaam city. Tanzania is also not immune to the impact of e-waste generated elsewhere because the Basel Convention has failed to protect developing countries from being treated as dumping sites for e-waste (Widmer et al., 2005; URT, 2012).

 

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Further, information on how stakeholders manage e-waste in Tanzania is limited (Patali et al., 2024). Thus, inadequacy of information may halt efforts of managing e-waste (URT, 2018). As such, the paper focuses on e-waste management practices in Dar es Salaam which is the largest city in the country and the leading producer of e-waste. The key question is what are the practices of stakeholders in e-waste management in the city of Dar es Salaam?

## LITERATURE REVIEW

> According to Ranasinghe & Athapattu (2019), *"Electronic waste, commonly known as E-waste or waste of electrical and electronic equipment (WEEE), or end-of-life (EoL) electronics, denotes electronic and electrical equipment (EEE), including all components, subassemblies, and consumables, supposed to be out of date, or unwanted by the user."*

In the 2010s, some Global North countries such as the European Union, Japan, Norway and the Netherlands, started to take the lead in developing e-waste management systems (Lye et al., 2017). At that time, e-waste management also received some attention from several stakeholders from across the world including manufacturing companies, NGOs, Governments, and consumers. Even though, the progress towards an environmentally sound management system has been very slow.

Some countries have developed good e-waste management practices. According to Ranasinghe & Athapattu (2019), Sri Lanka has developed a framework to ensure proper e-waste management. The country, among other things, has developed a National Electrical and Electronic Waste management policy. The country has also established an island-wide collection mechanism, organized drop-off events and raised awareness among citizens. Other measures include the adoption of the Basel Convention's notification procedure for the exportation of e-waste; the establishment of a recycling facility; and mandating the "Scheduled Waste Management License" to public and private sector firms for disposing e-waste. The framework has also led to the development of informal sector operations, through a community-based operation, ranging from door-to-door collection, rudimentary dismantling, and metal recovery practices (Ranasinghe & Athapattu, 2019).

Most countries have not developed a proper framework for disposing of e-waste (Martin et al., 2024). Chan & Peng (2010) assert that despite the high consumption rate of electronic and IT devices in Singapore, it appears little has been done in e-waste management, especially with respect to proper recycling, recovery, and disposal of e-waste as well as the reduction of the hazardous content in electronic products. Overall, the Government regulates the collection and handling of toxic industrial waste originating from trade premises and industries but provides no requirements for consumer e-waste. The state, being a part of the Basel Convention, also regulates the transboundary movement of e-waste. At present, e-waste is disposed of together with general waste into incinerators. Recycling of e-waste is uncommon as only few voluntary recycling programmes are available. By and large, there is lack of monitoring on the generation, collection, treatment, and disposal of e-waste in Singapore. Common e-waste practices in the country include storage at homes and offices, secondary market for second-hand and refurbished equipment, voluntary recycling, and final disposal in incineration plants.

### Theoretical Framework

The social network theory guided this study (see Krause et al., 2007). Social network theorists view a community as composed of essentially related individuals (i.e. societal elements, human elements, organizational elements, and physical elements). Social network researchers are interested in natural groupings defined ethnographically through observations in the field. The study concentrated on broader community networks termed 'full relational networks' where everyone is considered in relation

 

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to all the others in the group (Krause et al., 2007). A detailed contextual analysis of a limited number of events or conditions, as required for any case study research, was conducted. It is underscored here that the social network theory has been framed within a case study research design because case study designs assist in the understanding of a complex cultural, local, or specific contextualized issue and can extend experience or add strength to what is already known through previous research (Yin et al., 2013; Opper, 2023).

## MATERIALS AND METHODS

This study was conducted in the city of Dar es Salaam in Ilala and Temeke municipalities, Tanzania (see Figure 1).

**Figure 1: Map of the City of Dar es Salaam**


**Source**: URT, 2018.

Dar es Salaam, with a population of 5,383,728 inhabitants, is the largest city in Tanzania (URT, 2022). Furthermore, compared to others, the city has the highest number of key stakeholders in e-waste generation and management in Tanzania. As such, the city is a good case for studying the practices of e-waste generation and management in the country. The key stakeholders include but are not limited to the importers, distributors and retailers, consumers, repair workshops/technicians (refurbishers), collectors, recyclers, and disposal facilities (Magashi & Schluep, 2011).

The study employed a mixed study methodology consisting of qualitative and quantitative data collection tools (Creswell, 2013). The quantitative data collection focused mainly on collecting descriptive statistics. The main data collection tool for quantitative data was questionnaires with closed-ended questions. Concerning the collection of qualitative data, participants for the study were purposively selected. The selection was done in such a way that each key stakeholder in e-waste generation and management was represented. The number of participants for each key stakeholder was determined by saturation point, a point where no new information was obtained. Data saturation is a qualitative data collection technique originating from grounded theory, referring to collecting qualitative data until no newer information is obtained. There must be sufficient information to

 

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reproduce the answers investigated in a study, that is, a point when the researcher does not get different (new) information from the study participants and/or their context. Data saturation is about the depth of the data accrued, not the number of respondents (Charmaz, 2006). The data saturation for the study was attained after interviewing 80 respondents.

To gain an in-depth understanding of the phenomena under research, the following qualitative data collection tools were used: in-depth interviews, Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), and observation. Targeted key informants are:

- Representatives of Ministries (The Ministry of Information, Communication, and Information Technology)
- Representatives of regulatory authorities (notably, NEMC and TCRA)
- Representatives of local government authorities (Municipal/district environmental officers)
- Representatives of importers of electronic equipment (e.g. TVs, mobile phones, computers, radio, refrigerators, microwaves, electric kettles etc.)
- Representatives of distributors of electronic equipment
- Representatives of retailers of electronic equipment
- Representatives of consumers (eg. Private and government institutions such as academic institutions)
- Representatives of repair workshops/technicians (refurbishers)
- Representatives of e-waste collectors
- Representatives of e-waste recyclers
- Representatives of owners of disposal facilities (if any)

## RESULTS

### Demographic Characteristics of Respondents

The demographic characteristics of the respondents are shown in Table 1 the majority of respondents were below 49 years old (i.e. 57%). Women made up 82% of all respondents. Other details of the demographic characteristics of the respondents are shown in Table 1.

**Table 1: Demographic Characteristics of the Respondents (Age and Sex) (n=80)**

| Demographic Characteristics | Frequency | Percent |
|---|---|---|
| **Age Range** | | |
| 18-28 | 17 | 21.2 |
| 29-38 | 24 | 30.0 |
| 39-48 | 16 | 20.0 |
| 49-58 | 10 | 12.5 |
| 58-68 | 7 | 8.8 |
| Above 68 | 6 | 7.5 |
| **Sex** | | |
| Male | 14 | 17.5 |
| Female | 66 | 82.5 |
| **Education** | | |
| Not attended formal Education | 2 | 2.5 |

 

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| Demographic Characteristics | Frequency | Percent |
|---|---|---|
| Primary | 45 | 56.2 |
| Secondary | 25 | 31.2 |
| College | 5 | 6.2 |
| University | 3 | 3.8 |
| **Marital status** | | |
| Single | 16 | 20.0 |
| Married | 56 | 70.0 |
| Widow/widower | 8 | 10.0 |
| **Occupation** | | |
| Employed | 4 | 5.0 |
| Business | 55 | 68.8 |
| Housewife | 16 | 20.0 |
| Pensioner | 3 | 3.8 |

**Awareness on E-waste**

Awareness of the meaning of e-waste is important in the management of such waste. Past research has called upon all stakeholders to invest in creating awareness of e-waste (Mbeng et al., 2010; Koloseni & Shimba, 2012; Okot-Okumu, 2012). Based on the findings of this research, although 63% of the respondents have a moderate to high level of awareness of e-waste, some of the respondents (50%) could hardly define e-waste. Only 32.1% are aware of the hazardous effects of e-waste. Further, only a few of them (20%) are aware of what happens to the discarded e-waste materials (see Table 2).

**Table 2: Awareness and Convenience of E-waste**

| Awareness of e-waste (n=80) | Frequency | Percent |
|---|---|---|
| Meaning of e-waste | 40 | 50 |
| Awareness of what happens to discarded equipment | 16 | 20 |
| Awareness of the hazardousness of e-waste | 25 | 32.1 |
| Moderate Level of awareness regarding E-waste[1] | 44 | 55 |
| High Level of awareness regarding E-waste | 6 | 7.5 |
| **Convenience in disposing of e-waste (n=80)** | **Frequency** | **Percent** |
| The presence of e-waste collectors in the area | 37 | 46 |
| Convenience of collection of e-waste in the area | 28 | 35 |
| Actual engagement of e-waste collector in the collection of e-waste (do they come to pick e-waste) | 63 | 78.8 |

Before answering the question, respondents were provided with a definition of e-waste to ensure a general understanding of the term. This allowed them to respond meaningfully to items related to **Moderate Awareness of E-Waste** and **High Awareness of E-Waste**. Additionally, the first row specifically assessed their knowledge of the term prior to the introduction of the definition, offering an initial measure of their awareness before guided clarification. A key informant interview with an official of NEMC revealed that:

[1] The respondents were given the definition of e-waste before responding to the question. As such, they had a rough idea of what it means by e-waste when responding to the question.

 

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*"There are no specific awareness-raising programmes on E-waste. Instead, we use social media, radio and TV. We have used Radio Maria, and Azam TV to create awareness on e-waste. NEMC also conducts research on e-waste through the Directorate of Research. However, none of the research has been completed. As such, there is no publicly available data"* (Senior Environmental Management Officer, Directorate of Compliance and Enforcement, National Environment Management Council (NEMC), 10th March, 2023).

**Convenience of Disposing E-waste**

The convenience of disposing of e-waste can facilitate proper disposal of e-waste. Overall, it is not convenient to dispose of e-waste in the city of Dar es Salaam. E-waste collectors are not present in some of the areas (see Table 2).

There are also fees that add a burden to waste collectors leading to unnecessary inconveniences in e-waste disposal. An FGD with e-waste community-based collectors arrived at a comprise that the city council should reduce the fees for dumping waste at the dumpsite. The city council also requires the contractors to submit all the monies to the city authorities. Then the contractors are required to request the funds from the authorities to meet day-to-day running expenses. However, the authorities fail to observe the regulations because it takes a relatively long time for the authorities to release the funds. Third, the contracts issued by the city council are short. The contractors are of the opinion that the city authorities should extend the contracts up to three years. In turn, the contractors can ask for loans from the bank to provide reliable services. Overall, the city authorities and politicians should not interfere with the operations of waste collection because they lead to the mentioned complexities.

Further, some of the e-waste collectors do not collect e-waste on time. The challenge increases inconveniences for e-waste management. Unlike past research (Bakari et al., 2012), this research highlights those inconveniences in dealing with e-waste that intensify improper handling of such waste. The present research shows several suggestions to improve e-waste management (see Table 3). The suggestions include the presence of special contractors for collecting e-waste; efforts to increase the frequency of e-waste collection; and an increase in payment for collected e-waste materials.

**Table 3: Strategies for Improving Disposal of E-waste**

| Assorted views | Overall Strategy | Frequency | Percent |
|---|---|---|---|
| There should be special people and specific places to collect e-waste; there should be specialized firms/people to collect e-waste; the e-waste collectors should be registered and recognized by appropriate authorities; there must be special e-waste collectors etc | Special contractors for collecting e-waste | 24 | 30 |
| They should come to pick up the e-waste timely; there should be frequent collection of e-waste; there is a need to increase the frequency of collecting waste. The waste is collected only once per month | Increase the frequency of e-waste collection | 12 | 15 |
| The e-waste collectors should be paying more money to collect e-waste from us; there should be reliable prices for the e-waste; the e-waste collectors should not temper with weighing scale; | Increase payment for collected e-waste materials. | | |

 

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**Key Stakeholders and Their Role in E-waste Management**

The findings from the study highlight several e-waste collectors including technicians, individual e-waste collectors, city council authorities, exporters of e-waste, small-scale recyclers, and industrial recyclers. Although most individual respondents of the questionnaire (56% see Table 4) could not mention any key stakeholders in e-waste management, a few of them mentioned technicians and e-waste collectors as key stakeholders.

Those who mentioned technicians as key stakeholders were 22.5% of all respondents (see Table 4).

**Table 4: Key Stakeholders and Practices**

| **Key stakeholders on e-waste management (N=80)** | **Frequency** | **Percent** |
|---|---|---|
| No response | 56 | 70 |
| Technicians (Repairing e-waste) | 18 | 22.5 |
| e-waste collector (Collecting e-waste) | 6 | 7.5 |
| **Practices of e-waste management (N=74)** | **Frequency** | **Percentage** |
| Store | 36 | 48.6 |
| Landfilling (Throw them away with other waste) | 14 | 18.9 |
| Reuse | 12 | 16.2 |
| Sell | 7 | 9.5 |
| Give them to recyclers | 4 | 5.4 |
| Recycling | 1 | 1.4 |

Only a few respondents (7.5%) mentioned waste collectors as key stakeholders. The waste collectors collect e-waste such as TVs, fridges, and mobile phones. Some of the e-waste collectors pay a small amount of money to the owners before collecting e-waste from them. Some of the e-waste collectors collect e-waste from informal disposal locations in residential areas. Overall, this research disclosed that there is no attitude, among the city dwellers, of sorting solid waste. As such, e-waste is mixed with other solid waste collected from residential and office locations. One of the famous formal e-waste collectors is a company called Steel Com. The findings from observations and key informants revealed that the e-waste collectors gather e-waste from residential areas and sell it to small-scale and large recycling companies in the city of Dar es Salaam. Some of the e-waste are recycled in the city while some are exported abroad for similar purposes.

The findings from the FGDs reveal that the key stakeholders in e-waste management are the city council authorities. The authorities oversee the management of waste in the city. However, the present study found that the authorities lack a proper legal framework and facilities for handling e-waste at the Local Government Authority (LGA) level. This finding highlights that the local authorities ought to invest in the management of e-waste by creating a legal framework for e-waste. One of the key informants said:

> *"We do not have a policy for E-waste, what we have is a policy for disposal of ICT equipment. It states what we should be doing with ICT equipment that can no longer be used by the Government. For example, you cannot sell or dispose of ICT equipment with Government data, a hard disc with Government data is removed and we have a Government archive where we normally store them. We only dispose*

 

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*of the computer housing and not the hard disc"* (Key Informant, Head of ICT Dar Es Salaam City Council, 8th March, 2023)

Perhaps the key Government stakeholder in e-waste management is the Directorate of Compliance and Enforcement, of NEMC. A key informant shared that:

The objective of the Directorate of Environmental Compliance and Enforcement (DECE) is to undertake environmental compliance promotion, monitoring and enforcement of Environmental Legislation. The activities are

- Develop and operationalize tools for compliance promotion and monitoring
- Develop and operationalize tools for enforcement
- Facilitate, coordinate and recommend appointment and designation of Environmental inspectors.
- Conduct monitoring and inspection to ensure enhanced environmental sustainability.
- Administer enforcement actions to non-compliance with environmental requirements.
- Provide guidance on handling, management and disposal of waste
- Maintain and operationalize environmental laboratory
- Attend public complaints and incidences reported to NEMC
- Review and provide recommendations on submitted discharge permits and oversee the preparation of the directorate's work plans, budgets, and progress reports and their implementation.
- Collaborate with key regulators and relevant authorities in conducting monitoring, inspections and investigations. (Environmental Management Officer, Directorate of Compliance and Enforcement, National Environment Management Council (NEMC), 10th March, 2023)

Other important stakeholders of solid waste are large industries such as Jambo Plastic, Synergy Battery, Steelcom company and Scania. Of the four mentioned companies, synergy Battery Company and Steelcom are the ones collecting e-waste. Synergy collects worn-out car batteries for recycling. The Steelcom company began more than 20 years ago dealing with scraps. Around 2016, Steelcom started collecting electronic devices like computers, mobile phones and printers following an increased demand for such products. Initially, the company tried to invest and recycle the circuit boards for a short period. Then, the company obtained a more reliable recycling market in Germany and Belgium.

Noteworthy, not all e-waste materials are accessed by the mentioned stakeholders because some of the residences are not aware of where to submit e-waste materials for disposal. There is no proper operational legal framework at the LGA level to oversee such stakeholders putting at risk the lives of citizens and other stakeholders involved in the process (EACO, 2022).

**Practices of E-waste Management**

The practices of e-waste management in the city of Dar es Salaam are generally poor. An official of the national environmental regulatory body said,

"*Generally, the practices of E-waste management in Dar es Salaam are poor. Some of the stakeholders engage in unsafe practices. For example, mobile phone refurbishes do not take any precautions because they are not aware of hazardous material in e-waste. This applies to other informal dismantlers such as the ones at the Machinga Complex in Dar es Salaam."* (Senior Environmental Management Officer, Directorate of Compliance and Enforcement, National Environment Management Council (NEMC), 10th March, 2023)

 

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The present study found that the majority of respondents store (48.6%), throw away (18.9%), and reuse e-waste (16.2%) (see Table 4).

Overall, most respondents (55.9%) store e-waste, for less than a year and then discard them to recyclers or solid waste collectors (see Table 5).

**Table 5: Period for Storing E-waste**

| Period for storing e-waste | Frequency | Percent |
|---|---|---|
| Less than a year | 19 | 55.9 |
| One year | 7 | 20.6 |
| More than five years | 5 | 14.7 |
| Two years | 1 | 2.9 |
| Three years | 1 | 2.9 |
| Four years | 1 | 2.9 |
| **Total** | **34** | **100.0** |

One of the key informants stated that:

> *"…in general, the Dar es Salaam city…I have not seen a proper way of e-waste disposal…my expectation would be waste is sorted but unfortunately, all wastes are piled in the same place including e-waste. We do not have a proper way of e-waste management…this is not a problem for Dar es Salaam alone…I think countrywide we do not have proper ways of managing e-waste..."* (Key Informant, Head of ICT Dar es Salaam City Council, 8th March, 2023)

Another key informant argued that:

> *Nothing is happening and I think it is because of a lack of awareness…people do not know if e-waste is dangerous and should not be handled anyhow. I think from now I will be educating citizens on this…now that I am aware* (Ward Environmental officer, Ilala, 9th March, 2023)

The findings from FGD, key informant interviews and observations revealed that the major dumpsite for the entire city of Dar es Salaam is located at Pugu - a few kilometres outside the city. The location used to be a site for the extraction of sand for construction. The city council authorities oversee the dumpsite even though. There are no proper mechanisms to handle e-waste. The present study highlights that there is a huge amount of e-waste deposited at the dumpsite. This is because there are no proper mechanisms for sorting out e-waste from the rest of the solid waste at the dumpsite and the collection locations.

Overall, the following activities take place at the dumpsite: first, every transporter of e-waste must weigh the waste and pay the appropriate fees to the city authorities. Second, the authorities show the location for off-loading the waste. Third, a bulldozer, owned by the city authorities, spread the waste.

The solid waste collectors at residential and industrial sites face several challenges including lack of protective gear; wearing out of waste collecting vehicles due to gases emanating from the waste; and delaying waste offloading of waste at the dumpsite. Some may spend the whole day waiting to off-load waste at the dumpsite; conflicts from some of the customers; absence of special bags or containers for the storage of the e-waste at the household level; and an inaccessible dumpsite. It is always not accessible throughout the year. It often takes a long time to offload waste during the rainy season.

Most residential respondents (75%) did not respond to the reasons for not disposing of e-waste. Only 21% of the respondents do not dispose of e-waste materials properly because of poor awareness. They

 

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are not aware of the need for separating e-waste from other solid waste materials. Some respondents also store e-waste at their residences because they find it unnecessary to dispose of them. Some respondents keep e-waste to decorate their premises but there are no e-waste collection centres to promote the collection of such waste when they deteriorate. Overall, there is a need for educational campaigns on recycling, reusing, or reducing to encourage appropriate disposal of e-waste.

Although residences do not separate e-waste from the rest of solid waste, some waste collectors separate them during collection. The metallic waste including e-waste is separated from organic waste. The metallic as well as plastic waste, are then sold to recyclers. Organic waste is dumped at a dump site. The metallic and plastic waste, are referred to as valuable waste i.e. *"taka mali" or "taka rejea."* Such waste has a value attached to it and it can be sold. Paper waste and dried grass are also separated for making charcoal. One of the solid waste collectors has a special machine (carbonizer) for converting waste into charcoal. Some of the members of the company attended a special training for such purposes. Although the company separates some of the metallic e-waste, some of the e-waste has been assigned low value. Low-value e-waste (without a value in the existing market) is dumped at the dump site.

### Factors Influencing E-waste Management Practices

Based on the present study, the factors influencing e-waste management include the lack of incentive schemes for proper disposal of e-waste; the influence of knowledge on how to manage e-waste; the inadequate number of e-waste collectors; the influence of family income; lack of special e-waste dumping centres; and limited enforcement of environmental laws or regulation on e-waste. Other factors include lack or limited access to recycling facilities; influence of concern for community safety; influence of concern for environment safety; and influence of occupational background. Even though, the four main factors (with the highest number of respondents) include a lack of incentive schemes for proper disposal of e-waste; the influence of knowledge on how to manage e-waste; the lack of e-waste collectors; and the influence of family income (see Table 6).

**Table 6: Factors Influencing E-waste Management Practices**

| Factor | Frequency | Percent |
|---|---|---|
| Lack of incentive schemes for proper disposal of e-waste | 42 | 52.5 |
| Influence of knowledge on how to manage E-waste | 40 | 50.0 |
| Lack of E-waste collectors | 39 | 49.4 |
| Influence of family income | 38 | 48.7 |
| Lack of special E-waste damping centres | 31 | 40.8 |
| Limited enforcement of Environmental laws or regulation | 22 | 29.3 |
| Lack or limited access to recycling facilities | 22 | 29.7 |
| Influence of concern for community safety | 19 | 24.7 |
| Influence of concern for environment safety | 18 | 24 |
| Influence of occupational background | 8 | 10.5 |

Findings from Key informant interviews and FGDs demonstrate that there are no specific awareness-raising programmes on E-waste. Occasionally, some Government entities use social media, radio, and TV. NEMC uses Radio Maria, and Azam TV to create awareness of e-waste. NEMC also conducts some research on e-waste through the Directorate of Research. However, none of the research has been completed. As such, there is no publicly available data.

Key informant interviews revealed that there are few capacity-building programs. However, the

 

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licensed entities have some knowledge of the management of e-waste. There is also another group of informal dismantlers whom NEMC cannot regulate. For example, mobile phone refurbishes are one of such dismantlers who are regulated by the Tanzania Communications Regulatory Authority (TCRA) (Raudha, and Msolla, 2021). Even though, there are not aware of hazardous material in e-waste. This applies to other informal dismantlers such as the ones at the *Machinga* Complex in Dar es Salaam.

## DISCUSSION

### Awareness on E-waste

Efforts of the Government and other stakeholders in creating awareness on e-waste, have not been fruitful (Turaga et al., 2019). The current research reveals that although the Government has developed some guidelines and regulations to manage e-waste, it fails to enforce them. This is in line with past research highlighting that the Government has failed to enforce e-waste-related legislation and e-waste awareness campaigns (Koloseni & Shimba, 2012). As such, there is a need for the Government and other stakeholders to increase awareness of e-waste to all stakeholders.

### Convenience of Disposing E-waste

Unlike past research (Bakari et al., 2012), this research highlights those inconveniences in dealing with e-waste that intensify improper handling of such waste. Further, the present research shows several suggestions to improve e-waste management (see Table 5). The suggestions include the presence of special contractors for collecting e-waste; efforts to increase the frequency of e-waste collection; and an increase in payment for collected e-waste materials.

### Key Stakeholders and Their Role in E-waste Management

This study has revealed that the key stakeholders are technicians and e-waste collectors. Bakari et al. (2012) assert that the key stakeholders in e-waste management are in two categories: informal and formal stakeholders. The formal stakeholders are managerial staff, ICT experts, Supplies officers, and environmentalists. Those from the informal sector include computer vendors, refurbishers, recyclers, collectors, and repairers (Bakari et al., 2012). Unlike past research (Koloseni & Shimba, 2012; Okot-Okumu, 2012; Bakari et al., 2012; Kaijage & Mtebe, 2017; Ntapanta, 2021), this study provides details on electronic gadgets that Tanzanian technicians are skilful in repairing them. The technicians repair electronic gadgets such as Fridges, TVs, radios, mobile phones, ceiling fans, ironing bars, fridges; rice cookers, jugs, and blenders. The technicians either repair or extract parts from the electronic gadgets. The findings highlight that the technicians largely delay the production of e-waste. The process also limits the importation of electronic gadgets. The findings suggest that the Government and other stakeholders should invest in boosting the capabilities of the technicians to repair electronic gadgets. The measure can assist e-waste management in the short term. However, in the long term, the Government needs to operationalise its mechanism for e-waste management by enacting guidelines and regulations for e-waste management (Mbago, 2018).

### Practices of E-waste Management

Consistent with past research (Mbeng et al., 2010; Bakari et al., 2012; Gumbo & Kalegele, 2015;), the practices of e-waste management in the city of Dar es Salaam include storing, throwing them through landfilling (at public dumpsite), reuse, selling, as well as donating them to recyclers.

The findings highlight that it is extremely difficult to access e-waste kept in households for at least a year. This finding, however, is in contrast with a study by (Nelson et al., 2021) suggesting that e-waste is kept in households in the city of Dar es Salaam indefinitely. The finding implies that door-to-door recyclers have somewhat done an outstanding task of collecting e-waste from

 

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households. As such, there is a need to devise mechanisms to promote them.

Based on findings from key informant interviews and FGD, other key stakeholders in e-waste management including government entities such as the Tanzania Bureau of Standards (TBS), National Environment Management Council (NEMC), Tanzania Communications Regulatory Authority (TCRA), and Vice President Office (VPO). Also, there are agencies collaborating with private entities and NGOs such as New Tabosh Co. Ltd, Chilambo Co. Ltd and GIZ. Overall, the findings of the study highlight key stakeholders not mentioned in past research (Bakari et al., 2012; Okot-Okumu, 2012). Even though the Government has made some attempts to manage e-waste by creating a legal national framework, there is weak operationalization and poor coordination of the framework to the extent that the contribution of the key stakeholders remains insignificant. As such, the handling and collection of e-waste have become problematic. This has been the case in Tanzania and elsewhere in developing countries as shared in past research Schluep et al. 2008; Bakari et al, 2012; Okot-Okumu, 2012; Gumbo and Kalegele, 2015).

A second explanation of the finding is that the city lacks proper mechanisms for sorting and collecting e-waste from households. As such, most of the inhabitants across the city are exposed to toxicants inherent in e-waste (Ntapanta, 2021). Concerning landfilling waste disposal, there is a dump site. Unlike past studies on e-waste in the city (Kaijage, and Mtebe, 2017; Nelson et al, 2021; Ntapanta, 2021), this study highlights the role of the dumpsite in the city.

There are no proper mechanisms for sorting out e-waste from the rest of the solid waste at the dumpsite and the collection locations. In the absence of proper legal framework and facilities, the collection of solid waste remains to be done unprofessionally (Magashi & Schluep, 2011). The findings imply that the city authorities do not take any precautions to sort e-waste (Koka, 2017). As such, the city council employees and other stakeholders are exposed to hazardous substances from e-waste such as mercury, lead, nickel, cadmium, zinc, and beryllium (Gumbo and Kalegele, 2015; Kaijage and Mtebe, 2017).

Based on findings from key informant interviews, the Government does not have a specific policy dedicated to e-waste management (Koloseni and Shimba, 2012). The city government authorities have some regulations on solid waste management but there is none dedicated to e-waste management. As such, some government offices do not have proper ways of e-waste disposal. Unfortunately, all wastes, including e-waste, are piled up and dumped at the same place. TBS has developed standards for Electrical and electronic waste management: handling, collection, transportation, refurbishment, dismantling, recycling, storage and disposal (TBS, 2017). Even though, the present study found that the TBS standards are neither known nor fully implemented in the city. This is the case for the private and public sectors. Key informant interviews, observations and FGDs showed that the e-waste stakeholders including collectors, transporters, refurbishers, dismantlers, and recyclers do not adhere to such standards. Generally, the practices of E-waste management in Dar es Salaam are poor. Some of the stakeholders engage in unsafe practices.

**Factors Influencing E-waste Management Practices**

One of the major outputs of the present study is providing details on the factors influencing e-waste management practices in the city of Dar es Salaam. The factors include a lack of incentives schemes for proper disposal of e-waste; influence of knowledge on how to manage E-waste; lack of E-waste collectors; influence of family income; lack of special E-waste damping centres; limited enforcement of Environmental laws or regulation; lack or limited access to recycling facilities; influence of concern for community safety; influence of concern for environment safety;

 

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influence of occupational background. Past studies have mainly focused on the extent of the challenges of e-waste management in the city (Nelson et al, 2021; Kaijage and Mtebe, 2017; Ntapanta, 2021).

## CONCLUSION AND RECOMMENDATIONS

Some of the practices on e-waste management in the city of Dar es Salaam include storing e-waste, landfilling, reusing, selling, and recycling. Overall, the practices of e-waste management in the city of Dar es Salaam remain informal. Although the legal framework for the management of e-waste is present, the operationalisation of the framework and its enforcement is still a challenge. There are neither specific policies nor regulations on e-waste management to ensure effective management of e-waste. The Government has revised the National Environmental Policy of 1997 to form the National Environmental Policy of 2021. The Government, among other things, created a new policy to address challenges with e-waste management in the country. However, the findings of the study revealed that the policy is yet to be operationalized since there are no clear guidelines (Gumbo & Kalegele, 2015). This paper advocates the enactment of a National Environmental Policy (NEP) which enables the Government to form other instruments such as National Electronic Waste Management Strategies (NEWS) as well as National Electronic Waste Management Guidelines. The authors are aware that TBS has developed standards for Electrical and electronic waste management: handling, collection, transportation, refurbishment, dismantling, recycling, storage, and disposal (URT, 2019). However, they remain inaccessible to other key Government entities, the public and other key stakeholders. The authors strongly recommend that the guidelines should be made available and operationalized at all levels in a holistic approach.

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