E-waste management and its health and environmental impact in under-resourced villages of South Africa: A case study

Odwa Gazana[*]
Tembisa Grace Nqgondi[**]

Abstract

The rapid growth of electronic waste (e-waste) has been identified as one contributor to health and environmental risks worldwide. The lack of awareness of the e-waste in the under-resourced villages in South Africa contributes to the environmental risks and health hazards that lead to challenges of climate change due to air and land pollution. It has been established that these villages lack the infrastructure for managing e-waste, which leads to e-waste being disposed in the open land and landfills or burnt or buried underground. Such practices expose communities to toxic chemicals because e-waste is composed of hazardous elements such as lead, mercury and beryllium. If these elements are not properly managed or disposed of, they cause significant danger to the environment and people's health. This study aimed to assess the level of e-waste awareness and management in the under-resourced villages of South Africa, in particular in the Eastern Cape province. The study adopted a qualitative research approach and embraced a purposive case study method which is underpinned by the Social Capital Theory. Thematic data analysis was used to analyse the data. The study findings demonstrated that the villagers had a lack of awareness of e-waste's impact on their health and also of the environmental hazards. The Social Capital Theory approach embraced collaboration between a researcher and communities; it resulted in the development of an e-waste awareness and management solution for the villagers and the local municipalities. This article reports on the e-waste awareness process and management.

[*] Faculty of Informatics and Design, Department of Information and Communications Technology, Cape Peninsula University of Technology, Western Cape, South Africa. Email: 214259684@mycput.ac.za

[**] Faculty of Informatics and Design, Department of Information and Communications Technology, Cape Peninsula University of Technology, Western Cape, South Africa. Email: ngqondit@cput.ac.za

Keywords: e-waste, under-resourced villages, social capital theory, health, environment

1.   Introduction

Technological advancement has improved the ways in which people communicate, work and receive services. This advancement has also increased in institutions such as banking, education and healthcare; it improves access to online services due to the digitisation of industries.[1] The increase in the digitisation of technological advancements is contributing to global consumers' purchasing of new digital products while discarding their old devices.

The electronic devices include, but are not limited to, cellphones, television sets, washing machines, refrigerators and computers. Ylä-Mella et al[2] assert that the improvement of these devices' features is contributing to the increased level of disposal of a large number of old and used devices. In turn, the discarded electronic devices accumulate and increase the level of electronic waste (e-waste), which is not easy to manage.

Avis[3] defines e-waste as 'any electrical or electronic equipment, which is waste, including all components, sub-assemblies and consumables, which are part of the equipment at the time the equipment becomes waste'. E-waste comprises old non-functioning electronic products that no longer serve their purpose and have been disposed of. Wasteaid[4] classified e-waste into six categories: household items, information and communications technology (ICT) equipment, lamps, screens and monitors, cooling and freezing equipment, and large equipment (printers, copy machines, etc). E-waste is classified as one of the contributing factors of pollution to the environment because it contains toxins in the form of such elements such as mercury, cadmium, lead and copper.[5] According to Abalansa et al[6] and

---

[1]   M Javaid et al 'Digital economy to improve the culture of Industry 4.0: A study on features, implementation and challenges' (2024) 2(2) *Green Technologies and Sustainability* 1–19.

[2]   J Ylä-Mella, RL Keiski & E Pongrácz 'End-of-use vs end-of-life: When do consumer electronics become waste?' (2022) 11(18) *Resources* 1–14.

[3]   W Avis *Drivers, barriers and opportunities of e-waste management in Africa* (University of Birmingham, K4D Helpdesk Report No 1074 2021), available at https://doi.org/10.19088/K4D.2022.016 (accessed 14 March 2025).

[4]   WasteAid. *World Environment Day 2021: Spotlight on e-waste*, available at https://wasteaid.org/world-environment-day-2021-spotlight-on-e-waste/ (accessed 4 February 2022).

[5]   S Abalansa et al 'Electronic waste, an environmental problem exported to developing countries: The good, the bad and the ugly' (2021) 13(9) *Sustainability* 1–24.

[6]   Abalansa et al (n 5).

Mor et al,[7] the toxic elements of e-waste endanger the environment and human health when they are not properly disposed of.

E-waste is considered to be the fastest-growing waste stream worldwide.[8] Avis[9] estimated an increase in e-waste accumulation in 2019 to millions worldwide, with a total amount of 53.6 million metric tonnes (Mt), to which Africa's contribution was 2.9 Mt and the lowest in the world. The increase in e-waste in Africa suggests that urgent attention is required to bring solutions that will mitigate and/ or combat the effects of e-waste on the environment.

The literature states that some of the e-waste found on the African continent is sourced from developed countries. Authors such as Avis,[10] Bazilian,[11] Williams and Adetuyi,[12] and Perunding Good Earth confirm this.[13] The literature also suggests that the e-waste imported by African countries from developed countries comes in the form of donations. According to Bazilian,[14] donated e-waste has an impact on the ecosystem because its warranty has expired by the time it reaches the recipient. The organisations that donate their used devices use this as support for the historically disadvantaged communities in African countries. According to Avis,[15] several developed countries have proper infrastructure and policies to manage and control e-waste. However, despite such established systems, they opt to export their e-waste to developing countries where there are only limited e-waste policies and infrastructure in place.

According to the Constitution of South Africa, each citizen has the right to live in a clean and safe environment. However, e-waste littering in under-resourced villages breaches the right to a safe and clean environment. Furthermore, the Constitution states that all people should have access to basic services such as clean running

---

[7]   RS Mor et al 'E-waste management for environmental sustainability: An exploratory study' (2021) 98 *Procedia CIRP* 193–198.

[8]   V Forti, CP Baldé, R Kuehr & B Garam *The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential* 3 ed (UNU/UNITAR SCYCLE, ITU, ISWA, 2020) 8.

[9]   Avis (n 3).

[10] Avis (n 3).

[11] S Bazilian *E-waste in developing countries: Treasure to trash?*, available at https://www.borgenmagazine.com/e-waste-developing-countries/ (accessed 27 January 2025).

[12] N Williams & A Adetuyi *E-waste management in Africa – overview and policy developments* (Brooks and Knights Legal Consultants 2022).

[13] Perunding Good Earth *The e-waste inventory project in Malaysia*, available at https://www.env.go.jp/en/recycle/asian_net/Project_N_Research/E-wasteProject/06.pdf (accessed 5 March 2025).

[14] Bazilian (n 11).

[15] Avis (n 3).

water, sanitation, roads and healthcare. According to the researchers, the villagers do not have access to such ideal basic living conditions.

This article reports on a study conducted among South African villagers in the Eastern Cape province of South Africa. The researchers observed that e-waste was disposed of in landfills, open fields and on river banks. The disposal of e-waste in landfills endangers the environment people live in and exposes them to toxic elements that could cause serious illnesses. The study therefore investigated e-waste awareness and management in this region.

In the pursuit of this study, the following questions were responded to:

- What e-waste knowledge do people residing in the two investigated under-resourced villages possess?
- How is e-waste managed in the two under-resourced villages?

The aim of the study was to assess e-waste awareness and management in the two under-resourced villages in the Eastern Cape. The results of the investigation enabled the researchers to collaborate in designing the awareness tool that has improved the awareness and management of e-waste. The solution is to respond to one of the United Nations Sustainable Development Goals 12 (SDG 12). SDG 12 consists of 11 targets for promoting measures towards a healthy environment by providing a green environment through community participation. This study entailed embracing Social Capital Theory (SCT) in alignment with SDG 12, as SCT is designed to advance communities through community networks for collaborating and developing solutions to complex social problems.

To answer the study questions and achieve the study's aim, the SCT was embraced and semi-structured interviews were conducted with the study participants. Thematic analysis (TA) was used to analyse the participants' responses. The suggested theories and approaches are expanded on in section 3.

2.   Summary of the reviewed literature

This section summarises the literature reviewed for the study; it was investigated for the purpose of outlining the gaps through scientific justification. The first section considers e-waste on the African continent, which aims to paint a picture of how e-waste is handled in other African countries. The second part outlines the way in which e-waste is handled in South Africa, where the study was carried out. The third part outlines the impact of e-waste on health. The fourth part describes the impact of e-waste on the environment.

2.1 E-waste on the African continent

Continuous improvements in electronic products increase the demand for new products by consumers. According to Awasthi et al[16] and Zhao et al,[17] e-waste globally is increasing exponentially due to innovations and rapid technological improvements. This worsens e-waste management as millions of electronic devices become obsolete. The obsolete devices then become e-waste, which is dangerous to human health and the environment. The danger of e-waste stems from the raw materials used to manufacture electronic devices; these raw materials contain toxic elements that can affect the environment if not properly managed. Food grown and water found in affected environments can affect those consuming it, leading to health-related issues.

Avis[18] states that Africa is at the receiving end of e-waste exported by developed countries. Bimir[19] states that e-waste exported from first-world countries into Africa has been identified as being one of the contributing factors to environmental pollution in Africa. The export of e-waste is disguised as donations to assist African countries.[20] Furthermore, Avis[21] and Maes and Preston-Whyte[22] assert that most African countries importing e-waste face challenges such as a lack of resources to manage e-waste, a lack of e-waste awareness and a lack of policies to regulate e-waste management. Maes and Preston-Whyte[23] list some of the African countries that have been importing e-waste from developed countries such as Ghana, Tanzania, Nigeria, Senegal, Kenya and Egypt. It is argued that some importing countries have legislation or policies in place to combat e-waste.[24] Furthermore, Forti et al[25] state that out of 54 African countries, only 13 have policies and regulations in place for combating e-waste. The 13 countries quoted to have e-waste policies and regulations are Egypt, Côte d'Ivoire, Ghana,

---

16   AK Awasthi et al 'E-waste management in India: A mini-review' (2018) 36(5) *Waste Management & Research* 408–414, available at https://doi. org/10.1177/0734242X18767038

17   S Zhao et al 'Ultrasonic renovation mechanism of spent LCO batteries: A mild condition for cathode materials recycling' (2020) 162 *Resources, Conservation and Recycling* 105019, available at https://doi.org/10.1016/j.resconrec.2020.105019

18   Avis (n 3).

19   MN Bimir 'Revisiting e-waste management practices in selected African countries' (2020) *Journal of the Air & Waste Management Association* 659–669, available at https://doi.org/10.1080/10962247.2020.1769769

20   Abalansa et al (n 5).

21   Avis (n 3).

22   T Maes & F Preston-Whyte 'E-waste it wisely: Lessons from Africa' (2022) 4(72) *SN Applied Sciences*, available at https://doi.org/10.1007/s42452-022-04962-9

23   Maes & Preston (n 22).

24   Forti, Baldé, Kuehr & Garam (n 8).

25   Forti, Baldé, Kuehr & Garam (n 8).

Nigeria, Cameroon, São Tomé and Príncipe, Kenya, Rwanda, Tanzania, Uganda, Madagascar, South Africa and Zambia.

According to Avis,[26] Ghana, Nigeria and South Africa have policies in place, but there is a lack of implementation of such policies as e-waste is still exported by developed countries to these countries.

To combat e-waste imports, several bodies have been established by African countries. These include: the Bokamo Convention, which was established to stop the import of toxic substances from developed countries. The East Africa Communication Organisation (EACO) is also listed as a body aimed at training national representatives on how to manage e-waste better and develop statistics on e-waste management. The mismanagement of e-waste in Africa is attributed to the lack of enforcement of environmental policies, collection structures and awareness platforms.[27]

Avis[28] lists eight impediments to achieving e-waste management in Africa:

- *Lack of policies* – only 13 countries have policies in place, but they are not being enforced.
- *Infrastructure* – there is limited to no infrastructure for e-waste collection and processing.
- *Lack of transparency and operating standards* – a lack of clarity exists as to what happens to collected e-waste.
- *Imports* – imported e-waste pollutes the environment.
- *Security* – regarding the recycling of e-waste and providing holding places or storage, there is a lack of security and trust from organisations.
- *Informal collection* – informal collection occurs when e-waste pickers collect and process e-waste.
- *Cost* – e-waste is expensive to manage as the costs include its treatment, transportation, employing people and training them on how to manage it carefully.
- *Data gaps* – there are gaps in the amount of e-waste generated, recycled and disposed of carelessly.

Abalansa et al[29] suggest that the African continent is used as a dumping site of e-waste by developed countries due to its lack of technological

---

[26]   Avis (n 3).
[27]   World Economic Forum *A New Circular Vision for Electronics: Time for a Global Reboot*, available at https://www.weforum.org/publications/a-new-circular-vision-for-electronics-time-for-a-global-reboot/ (accessed 23 February 2025).
[28]   Avis (n 3).
[29]   Abalansa et al (n 5).

resources that can advance its agenda of providing services to its people. Avis[30] states that African countries take technological donations from developed countries so that they can bridge the digital gap between people in under-resourced settlements and those in urban settlements.

2.2 E-waste in South Africa

South Africa's democracy is based on the 1996 Constitution that was adopted by the first democratically elected parliament. The documents outline the basic guidelines for the ways in which the citizens are to be treated and how the country is to be run. One of the core areas highlighted in the Constitution is everyone's right to have access to basic services provided by the state.

As stated in the introductory section, this study was carried out in South Africa, particularly in the Eastern Cape province. The Eastern Cape province is considered to be the poorest province in the country.[31] The widespread presence of villages in this province suggests that if e-waste is not managed effectively, this may pose high levels of environmental and health hazards. The impact of e-waste in South Africa is outlined in the following section.

According to Ichikowitz and Hattingh,[32] e-waste is growing rapidly in South Africa. The rapid growth of device disposal threatens the environment and poses different challenges. E-waste in South Africa is categorised as hazardous because it contains toxic elements that are a threat to the environment and health if it is not properly disposed of.[33] South Africa has legislation in place that stipulates how e-waste is to be managed. One of the most well-known pieces of legislation is underpinned by extended producer responsibility (EPR) regulations, which aim to hold producers of electronic goods responsible for the environmental impact caused by their products. Table 1 outlines the legislation approved by the Department of Forestry, Fisheries and Environment (DFFE), which is the regulatory department responsible for waste-related authorising legislation and policies.

---

[30] Avis (n 3).

[31] XG Ngumbela, EN Khalema & TI Nzimakwe 'Local worlds: Vulnerability and food insecurity in the Eastern Cape province of South Africa' (2020) 12(1) *Journal of Disaster Risk Studies* a830, available at https://doi.org/10.4102/jamba.v12i1.830

[32] R Ichikowitz & T Hattingh 'Consumer e-waste recycling in South Africa' (2020) 31(3) *South African Journal of Industrial Engineering* 44–57.

[33] T Moyo et al 'Barriers to recycling e-waste within a changing legal environ- ment in South Africa' (2022) 118 *South African Journal of Science* 1–8, available at https://doi.org/10.17159/sajs.2022/12564

Table 1:   E-waste legislation and policies of South Africa[34]

Tool	Details	Year
White Paper on Integrated Pollution and Waste Management	Deals with the proposition of waste management on land pollution	2000
National Environmental Management: Waste Act (NEMWA)	Covers matters such as environmental assessments, air quality, biodiversity and waste	2008
Waste Picker Integration Guidelines for South Africa	These are guidelines for waste pickers, including those who buy from pickers	2020
National Waste Management Strategy	Prioritises waste management and the establishment of a circular economy	2020
Extended Producer Responsibility (EPR) Regulations	Established to ensure e-waste (out life Electrical and Electronics Equipment – EEE) is safely managed to preserve the environment and health	2020

While these pieces of legislation are intended to mitigate e-waste challenges, the country is still rated high for the e-waste illegally disposed of. According to Jefthas[35] and Avis,[36] this renders the legislation and policies ineffective.

South Africa is divided into two settlements: urban and rural. These settlements' provision of services takes place at two different extremes, to the extent that urban settlements have advanced systems whereas rural settlements suffer from receiving only basic support. In rural settlements, resources are scarce, such as access to healthcare, running water and sanitation; in urban settlements, these basic needs are reasonably provided with easy access. While this is a challenge in both types of settlement, the support provided for them is vastly different. The study focused on the rural settlement was prompted by this division in the provision of services. The observation of poor e-waste management also prompted this investigation. The researchers noted that different studies on e-waste management have been carried out with a main focus on urban areas, but none were found that focused on rural settings, especially on the under-resourced villages, particularly those in the Eastern Cape province.

---

[34]   O Gazana & TG Ngqondi 'Co-design, with two South African villages, of a prototype for an e-waste management mobile app' (2024) 33 *The African Journal of Information and Communication (AJIC)* 1–21, available at https://doi.org/10.23962/ajic.i33.17267

[35]   TL Jefthas *E-waste management, practices, knowledge, and behaviour: A case study of Stellenbosch University* (University of Stellenbosch 2023).

[36]   Avis (n 3).

2.3 Impact of e-waste on health

The literature reports that people living in places that are near e-waste dumping sites suffer from various types of disease. In this regard, Table 2 displays the toxins and health issues that affect human life and well-being.

Table 2: Toxins and their health-related issues that affect human life and well-being

Toxic element	Health issues	References
Lead (PB)	Asthma and immune response decline, reduced IQ in children	Olufemi et al[37]
Copper (Cu)	Liver damage, chest pain, diarrhoea	Taylor et al[38]
Arsenic (As)	Lung cancer, skin rash	Sharma et al[39]
Mercury (Hg)	Respiratory infections, brain damage, skin rash	Kahhat et al[40]
Cadmium (Cd)	Kidney-related problems, bone-related issues, lung cancer, renal issues	Yang et al[41]

The e-waste toxin particles listed in the above table are found in the raw materials used to manufacture electronic products. They present health implications for human beings. It is therefore imperative that when electronic devices are no longer working, they are carefully discarded to prevent health hazards and environmental pollution. People from under-resourced villages may unknowingly suffer from one or more of the health issues listed above due to e-waste mismanagement. Conducting the study in the areas mentioned above was necessary to raise awareness among the people with the aim of preserving their lives, their health and the environment they live in.

E-waste's harm to health diminishes the right enshrined in South Africa's Constitution as it harms many aspects of people's lives, in particular in the under-resourced villages studied.

---

[37] AC Olufemi, A Mji & MS Mukhola 'Potential health risks of lead exposure from early life through later life: Implications for public health education' (2022) 19(23) *International Journal of Environmental Research and* Public Health, available at https://doi.org/10.3390/ijerph192316006

[38] AA Taylor et al 'Critical review of exposure and effects: Implications for setting regulatory health criteria for ingested copper' (2020) 65 *Environmental Management* 131–159, available at https://doi.org/10.1007/s00267-019-01234-y

[39] S Sharma et al 'Effect of environmental toxicants on neuronal functions' (2020) 27(36) *Environmental Science and Pollution Research* 1–16, available at https://doi.org/10.1007/s11356-020-10950-6

[40] R Kahhat et al 'Exploring e-waste management systems in the United States' (2008) 52(7) *Resources, Conservation and* Recycling 955–964.

[41] Y Yang et al 'Effects of cadmium pollution on human health: A narrative review' (2025) 16(2) *Atmosphere*, available at https://doi.org/10.3390/atmos16020225

2.4   Impact of e-waste on the environment

The contamination of air, water and soil by e-waste endangers the environment, people, plants and animals. E-waste's environmental impact is detrimental as nothing can survive without a healthy environment. Burning e-waste pollutes the air that people breathe, leading to respiratory complications. Toxins found where the burning occurred include lead, cadmium and arsenic.[42] The health-related issues associated with these were indicated in the previous section. Through burning and covering e-waste underground, underground water is contaminated, rendering it unsuitable for human use. Underground water ends up as drinking water for under-resourced villages and this has an impact on human beings and their livestock; human beings use the water for drinking, cooking and washing, and also or irrigating their crops.

3.   **Material and methods**

The objective of the study was to investigate the understanding of e-waste awareness and management in two under-resourced villages of South Africa in the Eastern Cape province. It adopted a qualitative research method, which is more aligned to this study since it focuses on textual data and makes more sense of processing social issues through the participants' experiences, feelings and views.[43] In addition, a purposive sampling technique was used to choose participants from the two under-resourced villages studied. The study participants' ages were 18 years old and upwards. The sample group consisted of 13 participants from each village, bringing the total number of participants to 26. Semi-structured interviews were used to collect data embracing the SCT as a theory for data collection. SCT is a theory that uses community networks to produce services for the benefit of parties in the community.[44] The theory enabled the researchers to engage with participants from different backgrounds according to age, education and gender. The group of people who participated in this study comprised 14 males and 12 females.

Ethical clearance was obtained from the research ethics committee of the institution at which the study was registered. Permission letters were obtained from the two chiefs overseeing the studied under-

---

[42]   TS Lebbie et al 'E-waste in Africa: A serious threat to the health of children' (2021) 18(16) *International Journal of Environmental Research and Public Health* 1–25.

[43]   JW Creswell *Research design: Qualitative, quantitative and mixed methods approaches* (SAGE Publications 2009) 152.

[44]   F Garip 'Social capital and migration: How do similar resources lead to divergent outcomes?' (2008) 45(3) *Demography* 591–617.

resourced villages. The permission letters were necessary as the chiefs gave direction as to who or what was allowed to happen in their respective villages.

Data were collected from each village on separate days. The village A participants were convened in their village hall, where the data collection took place. The village B participants assembled at the chief's palace since the community did not have a community village hall. A data-collection tool was used to gather the data and it was developed in English. Despite the data-collection tool being written in English, the researcher posed the questions in isiXhosa, which is the most dominant language in the area. The data collection ended when the data saturation point was reached, that is, the point when no new data was forthcoming from the participants.[45]

A thematic analysis (TA) approach was adopted for the data analysis for this study. Different themes were established to guide and streamline the reporting of the findings of the study. TA enables researchers to make sense of people's views and lived experiences.[46] Six stages of thematic analysis were followed to analyse the data:

- Take notes to familiarise ourselves with the data.
- Generate codes by coding interesting parts of data.
- Group generated codes into themes.
- Perform a themes review to ensure no theme was excluded.
- Finalise and name themes accordingly.
- Produce a final report based on the generated themes.

4.   Study area

The study area is located in the Eastern Cape province in South Africa. The province under study is mostly dominated by under-resourced villages in which many people live. The researchers sampled only two villages for this study. The selection was purposive and was informed by the researchers' observation of how the villagers were handling their e-waste. The investigated villages are approximately 10 km apart. Village A is demarcated under town A and Village B is a town of its own. Although these villages fall under two different towns, they are demarcated under one municipality. The two villages were identified to have common living conditions. Both under-resourced villages lack basic services such as sanitation and clean running water. People in

---

[45]   K Charmaz *Constructing grounded theory: A practical guide through qualitative analysis* (Sage Publications 2006) 113.

[46]   V Braun & V Clarke 'Using thematic analysis in psychology' (2006) 3(2) *Qualitative Research in Psychology* 77–101.

these areas mostly depend on social grants from the government as a form of income. Many young people in these areas have no high-school education as they drop out early from junior secondary school. People in these under-resourced villages own livestock, which they sell for income.

There is a high rate of unemployment in the area. Also, according to the first-listed researcher, there is a tendency for alcohol and drug abuse in both of these under-resourced villages. The researcher attributes this to a lack of employment. Both villages are ruled by traditional leaders, who oversee service delivery in the areas. The two under-resourced villages share the same clinic with other villages surrounding them to cater for their basic health-related needs. Most of the people in these villages are regarded as small-holding farmers because their main source of living is through farming and breeding livestock. E-waste disposal exerts a negative influence on these communities in different ways, such as air pollution, the contamination of water and soil that is used as a source of produce, and the quality of the drinking water for livestock and people.

5.   Results and discussion

Table 3 presents the themes that outline the findings of the study. Based on the engagement with villagers, the identified themes emerged prominently. It was also noted that the two villages experienced similar challenges. The themes presented for this article are not exhaustive but present the main topics that were identified.

Table 3: Generated themes

Themes	Village A sub-categories	Village B sub-categories
E-waste knowledge	They heard for the first time about e-waste and did not have previous knowledge of e-waste	They had never heard of e-waste and did not have any idea of what e-waste is
Environmental pollution	Did not have an idea of e-waste's impact on the environment; no knowledge of e-waste in landfills	Did not have an understanding of the safety of the land; or of polluted environment and water
Health hazards		Did not have an idea of e-waste's health impact
Education	Develop radio and television adverts; roadshows, and community gatherings to spread the word	Introduce the integration of e-waste topics in schools' curricula, and roadshows
Incentives	Provide incentives for e-waste handling to authorities	

5.1   E-waste knowledge

It was noted that the village communities we investigated recorded a generic lack of understanding and knowledge of the e-waste concept and its dangers to the environment. This was observed when the participants struggled to define e-waste and give examples of e-waste items. It was also established that much of the e-waste disposed in landfills ends up back in households. The type of e-waste existing in the area included refrigerators, television sets, radios, car batteries, cellphones, cellphone batteries and electric irons, stoves, hairdryers, kettles, cables, washing machines, wall plugs and light bulbs – most of which was simply dumped on vacant land without any awareness of the consequences of doing so.

To provide an engaging environment and to make progress in engaging with the interview participants, the researchers explained the e-waste concepts and provided examples of e-waste devices and objects. After having e-waste explained to them, the participants were able to respond to the follow-up questions. The participants stated that throwing e-waste in landfills was acceptable to them since they were not aware of the dangers it presents. Burning e-waste devices and throwing them in the backyard gardens were other forms of disposal presented by the villagers. Regrettably, the villagers use the same gardens to plow and grow their produce. The participants confirmed that they knew of only one type of waste and that is general waste or refuse. The introduction of different kinds of waste was new knowledge to them.

5.2   Environmental pollution

The findings of this theme indicated that the communities from both villages did not know about the negative impact of e-waste on the environment. The villagers did not have any knowledge or understanding of the e-waste disposal protocols and the effect of e-waste emissions on environmental elements such as air, soil, rivers and other related factors. They did not relate the illegal disposal to the danger it poses to their livestock, tilling the land, human health, and water for drinking and watering of their vegetation. The researchers therefore explained the impact of e-waste on the environment.

Gaining knowledge and a better understanding of the impact of e-waste on the environment raised some concerns in these community members. It was also indicated that illegal e-waste disposal posed several hazards and health dangers to children, as they sometimes use the illegally disposed devices as toys. The participants confirmed that they disposed of the e-waste illegally out of ignorance, because they did not know about the effects it has on the environment or about its hazardous effects on human beings.

5.3   Health hazards

The participants demonstrated a lack of knowledge of the health hazards of e-waste and their impact on communities. This was demonstrated by their responses: the participants from village A made no mention of how e-waste has an impact on their health; those from village B indicated that they were unaware of any e-waste health hazards or dangers, because they did not know about e-waste in the first place. The e-waste health hazards were identified as high risk in the villages since it was established, for instance, that some families dispose of devices such as refrigerators when they are no longer working, repurposing them to store their food. The participants had no knowledge of the chemicals contained in the e-waste equipment and how they affect their lives and those of their livestock.

5.4   Education

With regard to the idea of integrating aspects of e-waste awareness into education, this was expressed as a key and urgent activity that the municipalities should consider implementing. This was suggested because e-waste management is considered to be the responsibility of both young and old equally.   The participants from one village suggested that the subject of e-waste should be integrated as a subject at schools. Its integration would ensure that children become aware of e-waste early on and grow up knowing about how they should handle e-waste and its impact on their lives and the environment.

The participants also suggested different possible awareness modalities that could be embraced, such as roadshows, workshops and talk shows to educate communities about e-waste. They suggested different platforms of awareness, such as radio, flyers and television adverts, to spread the word. They also proposed that e-waste should be part of the agenda for their regular community meetings.

5.5   Incentives

While engaging with the participants from village A, it was argued that they could not hand in their e-waste for free, because they bought these items at great expense while they were working. They argued that incentives are critical, because incentives can be used as a motivating factor and also as a kind of rebate for their devices. Paying incentives would also improve e-waste management. They agreed that the e-waste management project could incentivise the communities. In addition, the view was expressed that collaboration between the communities and the municipality overseeing the area is vital to providing suitable solutions, and it could possibly even lead to job creation for those in their communities who were unemployed. It was commendable to learn

that these communities did not consider incentives to be in the form of money only, but could take the form of diverse possible incentives that could contribute to the development of the communities and their respective municipalities.

6.   Summary

The study aimed to assess e-waste awareness and management in two under-resourced villages in the Eastern Cape province. To achieve the study's aim, the researhers employed a qualitative research method with purposive sampling in which 26 participants from the two villages were interviewed. Semi-structured interviews were used to gather data, embracing SCT as a lens. The data were analysed using Thematic A (TA). Below is a summary of the study's findings.

The investigated villages were found to be lacking a fundamental understanding of e-waste. Their lack of awareness extends to areas such as: (1) landfill littering that damages the soil, causes water and air pollution and poses a danger to children; (2) burning e-waste, which causes air pollution that poses a danger to human health; (3) burying it underground, which can destroy both the soil and the vegetation (either natural or cultivated) that grows in it; and (4) keeping e-waste together with general waste indoors or using it as storage.

It was also established that e-waste disposed in landfills ends up back in households. The type of e-waste existing in the areas included refrigerators, television sets, radios, car batteries, cellphones, cellphone batteries and electric irons, stoves, hairdryers, kettles, cables, washing machines, wall plugs and light bulbs.

The participants displayed enthusiasm in response to being informed about the dangers of e-waste to their health and to their environment. This showed that the people in these rural communities are willing to learn and to help curb the current hazardous circumstances they live in.

7.   Conclusion

The findings of the research show that there is a considerable lack of awareness of e-waste and the hazards it presents in the communities who inhabit the two villages that were investigated. The study also presented some of the common instances of e-waste in the villages. The villagers were found to engage in similar practices for managing their e-waste, such as littering in landfills and streams, burning and burying it underground as forms of disposal. The literature review highlighted that disposing of e-waste in the way it is done in the villages that were investigated has serious consequences such as land

pollution, air pollution, human and livestock health-related issues and dangers to children's lives if they use these devices as toys. It was found that if there had been an awareness of e-waste and its dangers among these communities, the handling of e-waste could have been different. People's lives in these areas were identified as being in danger. The different types of e-waste that were identified were found to contain toxic elements. Moreover, the absence of an e-waste collection system by the municipality overseeing the under-resourced villages has a high impact on the environment and poses health challenges.

Through their participation, the communities were able to suggest diverse platforms and solutions that could be used to raise awareness of e-waste and its dangers. These included using radio, flyers and television adverts. The municipal roadshows and teaching e-waste as a subject in the curriculum at both junior and secondary schools were also identified as innovative ways of bringing e-waste awareness to children as early as possible. The participants valued the lessons they learnt from the study as they had their level of awareness raised about the dangers of e-waste and its impact on their health and the environment. Based on these findings, the study recommends the following:

- The government should intervene by placing containers in these under-resourced villages where e-waste can be stored and collected by the municipality after its disposal by residents.
- The municipality should roll out an educational programme on e-waste dangers and how it should be managed.
- The youths in these areas should be engaged with to ensure that e-waste is safely managed and that the e-waste scattered around the environment is collected and stored in a safe place.

The study contributes to educating people from under-resourced villages about what e-waste is and how it should be managed to preserve their health and the environment they live in. The study adds to the body of knowledge on e-waste awareness and management in under-resourced villages in developing countries.

8.   Future study recommendations

Future research could investigate e-waste awareness and management in the urban areas of the Eastern Cape province. This would provide an overall picture of e-waste awareness and management in the province. Another point of departure for a new study in the longer term could be to consider e-waste awareness across the country. Although this could be cumbersome, it has the potential to provide a holistic overview of e-waste awareness and management by South Africans nationwide. E-waste awareness and management should be a

concern of every citizen as it has the potential to endanger lives and
place the environment at risk.

This study provides a rather bleak picture of the way people in
under-resourced rural villages live without knowing the dangers
inherent in the careless disposal of e-waste into landfills, rivers,
etc. The recommended future studies could produce a framework
for or a solution to the way the country could implement effective
mechanisms for combating e-waste. As stated in the literature review
section, although legislation and policies are in place, e-waste is still
disposed of illegally. According to Jefthas[47] and Avis,[48] this renders the
legislation and policies ineffective; therefore, a holistic study might
yield positive results for the country as a whole.

References

Avis, W 'Drivers, barriers and opportunities of e-waste management in Africa'
(2021), available at https://doi.org/10.19088/K4D.2022.016 (accessed
14 March 2025).

Abalansa, S, El Mahrad, B, Icely, J & Newton, A 'Electronic waste, an
environmental problem exported to developing countries: The good, the
bad and the ugly' (2021) 13(9) *Sustainability* 1–24.

Awasthi, AK, Wang, M, Wang, Z, Awasthi, MK & Li, J 'E-waste management in
India: A mini-review' (2018) 36(5) *Waste Management & Research* 408–414.

Bazilian, S *E-waste in developing countries: Treasure to trash?*, available at https://
www.borgenmagazine.com/e-waste-developing-countries/ (accessed
27 January 2025).

Bimir, MN 'Revisiting e-waste management practices in selected African
countries' 2020 *Journal of the Air & Waste Management Association* 659–669,
available at https://doi.org/10.1080/10962247.2020.1769769

Braun, V & Clarke, V 'Using thematic analysis in psychology' (2006) 3(2)
Qualitative Research in Psychology 77–101.

Charmaz, K *Constructing grounded theory: A practical guide through qualitative
analysis* (Sage Publications 2006).

Creswell, JW & Creswell, JD *Research designs: Qualitative, quantitative and mixed
approaches* (Sage Publication, 2018) 186.

Forti, V, Baldé, CP, Kuehr, R & Garam, B *The Global E-waste Monitor 2020:
Quantities, flows and the circular economy potential* 3 ed (UNU/UNITAR
SCYCLE, ITU, ISWA 2020) 8.

Garip, F 'Social capital and migration: How do similar resources lead to
divergent outcomes?' (2008) 45(3) *Demography* 591–617.

---

47   Jefthas (n 35).
48   Avis (n 3).

Gazana, O & Ngqondi, TG 'Co-design, with two South African villages, of a prototype for an e-waste management mobile app' (2024) 33 *The African Journal of Information and Communication (AJIC)* 1–21.

Ichikowitz, R & Hattingh, T 'Consumer e-waste recycling in South Africa' (2020) 31(3*) South African Journal of Industrial Engineering* 44–57.

Javaid, M, Haleem, A, Singh, RP & Sinha, AK 'Digital economy to improve the culture of Industry 4.0: A study on features, implementation and challenges' (2024) 2(2) *Green Technologies and Sustainability* 1–19, available at https://doi.org/10.1016/j.grets.2024.100083

Jefthas, TL *E-waste management, practices, knowledge, and behaviour: A case study of Stellenbosch University* (University of Stellenbosch 2023).

Kahhat, R, Kim, J, Xu, M, Allenby, B, Williams, E & Zhang, P 'Exploring e-waste management systems in the United States' (2008) 52(7) *Resources, Conservation and Recycling* 955–964.

Lebbie, TS, Moyebi, OD, Asante, KA, Fobil, J, Brune-Drisse, MN, Suk, WA & Carpenter, DO 'E-waste in Africa: A serious threat to the health of children' (2021) 18(16) *International Journal of Environmental Research and Public Health* 1–25.

Maes, T & Preston-Whyte, F 'E-waste it wisely: Lessons from Africa' (2022) 4(72) *SN Applied Sciences*, available at: https://doi.org/10.1007/s42452-022-04962-9

Mor, ZRS, Sangwan, KS, Singh, S, Singh, A & Kharub, M 'E-waste management for environmental sustainability: An exploratory study' (2021) 98 *Procedia CIRP* 193–198.

Moyo, T, Sadan, Z, Lötter, A & Petersen, J 'Barriers to recycling e-waste within a changing legal environment in South Africa' (2022) 118 *South African Journal of Science* 1–8.

Ngumbela, XG, Khalema, EN, & Nzimakwe, TI 'Local worlds: Vulnerability and food insecurity in the Eastern Cape province of South Africa' (2020) 12(1) *Journal of Disaster Risk Studies* a830.

Olufemi, AC, Mji, A & Mukhola, MS 'Potential health risks of lead exposure from early life through later life: Implications for public health education' (2022) 19(23) *International Journal of Environmental Research and Public Health*.

Perunding Good Earth 'The E-waste Inventory Project in Malaysia', available at https://www.env.go.jp/en/recycle/asian_net/Project_N_Research/E-waste Project/06.pdf (accessed 5 February 2022).

Sharma, S, Wakode, S Sharma, A, Nair, N, Dhobi, WM, Wani, M & Pottoo, F 'Effect of environmental toxicants on neuronal functions' (2020) 27(36) *Environmental Science and Pollution Research* 1–16.

Taylor, AA, Tsuji, JS, Garry, MR, McArdle Jr, MW, Adams, WL & Menzie, CA 'Critical review of exposure and effects: Implications for setting regulatory health criteria for ingested copper' (2020) 65 *Environmental Management* 131–159.

WasteAid *World Environment Day 2021: Spotlight on e-waste* (2021), available at
https://wasteaid.org/world-environment-day-2021-spotlight-on-e-waste/
(accessed 4 February 2022).

Williams, N & Adetuyi, A *E-waste management in Africa – Overview and policy
developments* (Brooks and Knights Legal Consultants 2022).

Ylä-Mella, J, Keiski, RL, & Pongrácz, E 'End-of-use vs end-of-life: When do
consumer electronics become waste?' (2022) 11(18) *Resources* 1–14.

Yang, Y, Hassan, MF, Ali, W, Zou, H, Liu, Z & Ma, Y. 'Effects of cadmium
pollution on human health: A narrative review' (2025) 16(2) *Atmosphere*,
available at https://doi.org/10.3390/atmos16020225

Zhao, S, Zhang, W, Li, G, Zhu, H, Huang, J & He, W 'Ultrasonic renovation
mechanism of spent LCO batteries: A mild condition for cathode materials
recycling' (2020) 162 *Resources, Conservation and Recycling* 105019.