Waste picker profiling, operations and training in e-waste: A case study of the City of Johannesburg

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ARO	African Reclaimers Organisation
CoJ	City of Johannesburg
DEA	Department of Environmental Affairs
DEFF	Department of Environment, Forestry and Fisheries
EEE	Electrical and Electronic Equipment
EPR	Extended Producer Responsibility
eWASA	e-Waste Association of South Africa
ICT	Information and Communication Technology
PEE	Personal Protective Equipment
SAWPA	South African Waste Pickers Association
TAB	The Appliance Bank
UCT	University of Cape Town
UJ	University of Johannesburg
UWC	University of Western Cape
WEEE	Waste Electrical and Electronic Equipment
WIEGO	Women in Informal Employment: Globalizing and Organizing
WISA	Waste Integration in South Africa

CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

The world currently faces a number of environmental issues as a result of manufacturing activities, such as plastic pollution and electronic waste (e-waste). However, e-waste is now considered an emerging environmental problem, and the majority of these can be traced back to major developed countries, though contributions from rapidly developing countries are increasing (Abalansa et al., 2021). E-waste is defined as a collection of discarded electronic devices that are meant to enter waste streams (landfills) for various reasons (Clark, 2020). E-waste includes electronic devices such as phones, televisions, computers, printers, electronic toys, refrigerators and so forth. The National Environment: Waste Act (Act no 59 of 2008) defines waste as any unusable or usable rejected material that can be re-used, recycled and recovered but is rejected and disposed (DEA, 2008).

The increase in e-waste disposal is clearly notable in developing countries. Such countries are the recipients of e-waste from developed countries and also generate their own e-waste (Forti et al., 2020). The socio-economic development and consumer demands for technological advancements are the main drivers of this trend (Lydall et al., 2017; Forti et al., 2020). In other words, the way in which people want to own cellphones and computers or any other electrical device is the main reason why there is an increase in e-waste generation in both developed and developing countries.

Exposure to discarded hazardous e-waste have now been recognized as having negative health and environmental consequences globally. It is estimated that 75 to 80% of the 20 million to 50 million tons produced each year in developed countries is shipped to developing countries for recycling and disposal (Perkins et al., 2014). E-waste exports from developed to developing countries can be facilitated by existing e-waste regulations that allow imports for the purpose of donation and recycling. This is a major issue as most developing countries lack space for building more landfills and proper technological facilities to properly process e-waste (Herat & Agamuthu, 2012).

Municipalities are responsible for waste management, and it is difficult for them to provide a reliable and sustainable waste management system to communities. Developing countries face more challenges in managing waste than other countries due to the rapid urbanization they experience (Abalansa et al., 2021). Furthermore, e-waste contains hazardous chemical

components that can potentially impact the environment, ecosystems and human health negatively if not managed properly (Finlay & Liechti, 2008; Perkins et al., 2014; Forti et al., 2020).

In South Africa, only approximately 11% of e-waste is recycled and the majority of e-waste is stockpiled in businesses and households while some ends up disposed in landfills (Lydall et al., 2017; Ichikowitz & Hatting, 2020). As a result, there are potential health and environmental issues. Furthermore, the inadequate recycling infrastructure and poorly managed disposal protocols in African countries are contributing to poor and unsustainable waste management practices (Asante et al., 2019). Some of the factors hindering local governments in managing waste sustainably involve the increase in municipal waste, lack of skilled workers, lack of finances, poor building plans for landfills and low recycling rates (Schoeman, 2018). However, e-waste has the potential to create business opportunities in the recovery and recycling of electronic devices, which can contribute to the circular economy in South Africa. Waste pickers play a important role in waste management but are unfortunately often excluded (Coletto & Bissop, 2017).

1.2 Problem statement

In contrast to the formal e-waste recycling practices in developed countries, the informal sector contributes significantly to the recycling of e-waste. For example, many waste pickers in developing countries burn e-waste to recover valuable metals – that puts their health and the environment in danger. In South Africa, most recycling and waste reduction is done by informal waste pickers. Without personal protective equipment (PPE), waste pickers handle waste directly, exposing themselves to health risks (DEA, 2016). The Schoeman (2018) study on the City of Johannesburg (CoJ) trolley pushers also found that majority of waste pickers need to be provided with safety equipment by the municipality.

The informal sector plays a huge role in the waste economy of the CoJ and South Africa. According to the DEFF & DST (2020), waste pickers are individuals who obtain re-usable and recyclable components from residential and commercial waste bins, landfill sites, and open areas in order to revalue them and gain an income. South Africa does not have reliable information on the dismantling, processing, repair or recycling of e-waste by informal waste pickers. Many studies have focused on the health dangers that waste pickers face with picking waste but very little is known about how they conduct dismantling and processing of e-waste (Orisakwe et al., 2019).

1.3 Aim and objectives

The main aim of this study is to investigate the operations of waste pickers regarding e-waste and to determine their willingness for training in the repair of e-waste. In order to achieve this research aim, the following objectives have been set out:

- profiling waste pickers that collect e-waste;
- document their operations regarding e-waste;
- investigate dismantling, processing and repair practices of e-waste by waste pickers; and
- determine the need of waste pickers for training in the repair of e-waste.

1.4 Justification

E-waste management is a global challenge faced by both developed and developing nations, including South Africa (DEFF, 2020a; Forti et al., 2020; Abalansa et al., 2021). It is important to study e-waste management as it is a concern for achieving sustainability and countries have to improve their recycling methods to reduce the amount of e-waste disposed in landfills (Widmer et al., 2005). E-waste is significant because it has value and can be re-used and sold (Ledwaba & Sisibo, 2017) and thus contributes to the preservation of resources and at the same time stimulates the circular economy. This study is of great importance to the CoJ, its residents and municipalities and other cities in South Africa as it draws to problems related to poor management of e-waste. It will give reliable information on the operations of the informal sector in the recycling of e-waste. Hinchliffe et al. (2020) stated that integrating informal workers into waste management systems can help to maintain employment levels, improve working and environmental conditions, and increase e-waste collection.

However, informal stakeholders are frequently overlooked in legislative processes and are underutilized in existing waste management systems. The government is urging municipalities to offer accredited training to the informal sector (DEFF & DST, 2020) and this study can contribute to the body of knowledge on how waste pickers would like their training to be and how willing they are to participate in training.

1.5 Outline of research

This research project is divided into six chapters. Chapter 1 introduces the study, explains the problem statement and indicates the aim and objectives of the study.

Chapter 2 presents a literature review on the major concepts of this investigation. It starts with a discussion on the global concerns regarding e-waste, e-waste generation and legislation in South Africa and ends with the role of the informal sector in e-waste.

Chapter 3 discusses the methodology and approach of this research. It also explains the data collection and analysis methods.

Chapter 4 presents the results and interpretation of the data analysis. This chapter starts with a discussion on the demographics of waste pickers and then their operations regarding e-waste. This is followed by a discussion on the dismantling, processing and repair of e-waste by waste pickers and their need for training. This chapter ends with recommendations by waste pickers to increase e-waste recycling.

Chapter 5: concludes the research with a summary of key findings and recommends measures for future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter starts with a discussion on e-waste as a global concern and developing countries as recipients of e-waste. It also presents e-waste management in Sub-Saharan Africa. This is followed by a discussion on e-waste management in South Africa focusing on generation of e-waste and legislation that governs e-waste. As e-waste contains harmful substances, a brief discussion is done on the impacts of e-waste on the environment and human health. However, e-waste also contains valuable components, and a brief explanation is given on how e-waste can contribute to the economy. This chapter ends with the informal sector and current training available for this sector.

2.2 E-waste as a global concern

Waste electrical and electronic equipment (WEEE) or electronic waste (e-waste) has become a major concern in today's society (Borthakur & Govind, 2017). This is because it is the fastest growing stream globally that contains valuable material. Furthermore, WEEE is an important waste stream with scarce and valuable metals that also endanger the environment and people's health (Shittu et al. 2020). In other words, e-waste can be viewed as valuable and dangerous at the same time. According to Borthakur & Govind (2017), e-waste is growing rapidly due to technological advances and innovations, rapid changes in information and communication technologies (ICT), economic growth, the increasing importance of electrical and electronic equipment (EEE) in our daily lives, and the decline in prices. The higher demand of populations wanting to own different electrical appliances is another reason for the increase in e-waste generation rates.

The e-waste stream is complex and there is lack of general legislation focused only on it (Lundgren, 2012). Moreover, dealing with hazardous e-waste is costly and difficult to treat in an environmentally sound manner. In some developing countries there are lack of waste treatment infrastructure, as well as waste management legislation (Forti et al. 2018; Ahirwar & Tripathi, 2021). In such countries, e-waste is treated by the informal sector in illegal and dangerous ways that can contribute to environmental and health issues. Forti et al. (2020), in The Global E-waste Monitor 2020 report found that in 2019, formal documented collection and recycling rates were less than e-waste generation rates. In other words, recycling activities are falling behind the global growth of e-waste. According to this report, Europe had the highest collection and recycling rate in 2019 with 42.5%, Asia was second at 11.7%, the Americas and Oceania were at 9.4% and

8.8% respectively, and Africa had the lowest rate at 0.9% (Forti et al., 2020). This is an indication of how developing countries are struggling to manage e-waste in a responsible manner. Furthermore, developing countries often have to manage the additional burden of imported e-waste as outlined in the next section.

2.3 Developing countries as recipients of e-waste

Developed and developing countries have an undeniable inequality in e-waste generation and consumption. Large quantities of e-waste are shipped to developing countries like Ghana, Nigeria and South Africa from developed regions such as Europe and North America (Maphosa & Maphosa, 2020). Furthermore, this e-waste is imported to developing countries as second-hand goods and as a form of donation to grow their economies through recycling, repair and refurbishment. Based on estimates, 80% of the e-waste collected for recycling in developed countries ends up at informal recycling sites in developing countries, especially in Africa and Asia (Lundgren, 2012). In the informal sector of developing countries, e-waste is recycled for income and profit. However, e-waste imports to developing countries become a heavy burden as these countries lack technological facilities to deal with e-waste (Acquah et al., 2021). To exacerbate the situation, developing countries themselves are increasingly generating e-waste in large quantities. The increasing generation of e-waste is a global issue and developing countries battle to manage e-waste as discussed in the next section.

2.4 E-waste management in Sub-Saharan Africa

In Sub-Saharan Africa there has been an increase in e-waste generation and the resultant challenge on how to manage e-waste (Asibey et al. 2021). As a region that is characterized by developing countries, e-waste is not managed in a safe and sustainable manner. The poor methods of e-waste management are influenced by poor policy interventions and lack of accessible information on how to dispose used and unwanted electronics (Maphosa & Maphosa, 2020). Thus, the disposal of e-waste in landfills have been increasing yearly. Furthermore, poor e-waste management in Sub-Saharan Africa manifests in the illegal dumping of e-waste or disposal in open dumpsites (Tetteh & Lengel, 2017). Some e-waste components are found in rivers such as in Ghana, Nigeria and South Africa, while some e-waste is disposed in places near residential areas. The African continent is suffering from land pollution and environmental degradation as a result of poor strategies to manage e-waste (Lebbie et al., 2021). Few countries in the Sub-Saharan Africa have policies and frameworks on WEEE.

In Africa, a disproportion exists between the consumption of EEE and efforts and resources required to manage these products after they reach their end-of-life (Tetteh & Lengel, 2017). As a result of a lack of infrastructure, expertise, and regulations to manage e-waste, many poor nations in Africa manage outdated electrical and electronic equipment using primitive techniques such as manual dismantling, open-air burning, and landfilling. Furthermore, e-waste is managed in the informal sector by inexperienced and untrained persons who are unaware of the environmental and health risks associated with their operations (Asante et al., 2019). In Ghana, for example, e-waste is handled informally by children under minimal conditions of health and environmental safety (Tetteh & Lengel, 2017; Grant & Oteng-Ababio, 2021). Legislation for dealing with e-waste in Africa is nonexistent or less strict, which promotes illegal dumping. The majority of African countries have legislation governing general waste, the environment, air, water, and health and safety issues, but there are few laws pertaining specifically to e-waste (Tetteh & Lengel, 2017; Grant & Oteng-Ababio, 2021; Lebbie et al., 2021). The Basel Convention that was adopted in 1989 by 172 countries, the 2003 European Union Waste Electrical and Electronic Equipment (WEEE) Directive that was updated in 2012, and the 1991 Bamako Convention on the Export of Hazardous Waste to Africa that came into force in 1998 and it prohibits the import of e-waste into African countries, are examples of international and regional efforts to regulate e-waste (Maphosa & Maphosa, 2020, Twagirayezu et al. 2021).

2.5 E-waste in South Africa

Studies conducted and research reports state that management strategies for e-waste should make it possible to recover, recycle, and properly dispose of precious metals contained in EEE products so that health and environmental impacts are minimized while economic gains are increased (Lydall et al., 2017; Tetteh & Lengel, 2017; Forti et al., 2020). In South Africa, e-waste has emerged as the fastest growing stream (DEFF, 2020a). This section discusses e-waste generation and briefly outlines the legislation in South Africa that pertains to e-waste.

2.5.1 E-waste generation

Lydall et al. (2017) express the opinion that accurate data regarding WEEE is largely lacking in South Africa. Conflicting numbers are given for e-waste generation in South Africa. According to Forti et al. (2020), 321 000 tonnes of e-waste was generated in South Africa in 2016. In contrast Lydall et al. (2017) estimated that only 74 923 tonnes of WEEE were produced in South Africa in 2015. The Global E-waste Statistics Partnership state that 416 000 tonnes of e-waste was generated in 2019 in South Africa or 7.1 kg per capita and gives an e-waste collection rate of only 5% (Global E-waste, 2019).

In waste management, accurate data are required to facilitate planning for landfills, collection services, equipment needed, recycling programmes, etc. Thus, the uncertain and contradicting e-waste generation data in South Africa makes the sustainable management of e-waste difficult. This is further exacerbated by the numerous legislative requirements as discussed in the next sub-section.

2.5.2 Legislation

In all Sub-Saharan countries, the leading country regarding effective management of e-waste is South Africa (Tetteh & Lengel, 2017). South African legislation aims at encouraging proper recycling of waste. Furthermore, in South Africa there is the National Environmental Management Act (Act 107 of 1998) and the National Environmental Management: Waste Act (Act 59 of 2008) that encourage general waste to be managed properly, commends re-use and refurbishing of e-waste (Finlay & Liechti, 2008; Perry et al., 2018). To put this into action, eWASA (e-Waste Association of South Africa) was formed in 2008 to manage the establishment of an e-waste management system for South Africa that is sustainable and environmentally sound. In the eWASA blueprint for e-waste, the private sector is encouraged to manage the e-waste problem through imposing on producers, importers and distributors to take back old electronic products (eWASA, 2013). Such EPR (Extended Producer Responsibility) scheme for WEEE has been under discussion by the Government since 2014 (Godfrey & Oelofse, 2017) and the EPR regulations were published on 5 November 2020 (DEFF, 2020b) and amended on 5 May 2021.

A legislative framework plays a major role in influencing the e-waste management. In the South African context, Godfrey & Oelofse (2017) identified 41 National Acts that have a direct or indirect bearing on waste management. Municipalities also added regulations that makes the legislation system a complex one. The 2020 National Waste Management Strategy makes producers responsible for their products entire value chain and end of life management through EPR schemes (DEFF, 2020a). However, most producers raised concerns regarding the EPR regulations. This led to amended regulations (DEFF, 2021). Thus, managing and recycling e-waste requires compliance to numerous legislation and regulations. As Godfrey & Oelofse (2017:6) state “This flood of waste regulation over the past decade has place a huge burden on the private sector to keep pace with ever changing regulatory requirements and ensure compliance and legal operations”. Furthermore, the 2014 Waste Amendment Act (Act 27 of 2014) classifies e-waste as hazardous waste that involves additional regulatory requirements.

E-waste contains hazardous materials and components and the incorrect disposal and processing of e-waste cause pollution and add pollutants such as heavy metals, acids and greenhouse gases to the environment (Gangwar et al., 2019).

2.6 Impacts of e-waste

E-waste affects both the environment and health. In line with this, Orisakwe et al. (2019) argues that e-waste is hazardous and dangerous to people and the environment they live in. In this part of the chapter, a brief discussion on the impacts of e-waste on health and the environment will be presented.

2.6.1 Impact on the environment

Large quantities of e-waste are being generated worldwide and is often wrongly disposed or processed in developing countries. E-waste ends up being burned in landfills thereby polluting the environment and releasing toxins into the atmosphere and ecosystems (Umesi & Onyia, 2008; Orisakwe et al., 2019). E-waste recycling in African countries lack proper skills and facilities to handle e-waste. The practice of burning of e-waste discharge hazardous materials that damage the environment (Maphosa & Maphosa, 2020). Informal processing of electrical cables is one example of open burning of e-waste. Moreover, harmful materials such as lead, mercury and some inorganic acids are being released to the environment due to poor disposal and recycling methods of e-waste (Tetteh & Lengel, 2017). These hazardous materials released pollute the soil, water and air which further impacts ecosystems. Thus, unregulated e-waste recycling and processing contribute to environmental degradation and issues like global warming (Lebbie et al., 2021). Furthermore, environmental degradation disrupts ecosystems of wild animals and loss of water quality also disrupts the habitat of aquatic animals (Machete, 2017).

2.6.2 Impact on health

It is undeniable that e-waste can have serious impacts on human health as it contains toxic components such as mercury, arsenic, lead and cadmium (Robinson, 2009; Gutberlet & Uddin, 2017). E-waste recycling sites built near residential areas leave communities prone to health concerns such as inhaling toxic chemicals and being exposed to radiation (Jibiri et al., 2014). A study by Machete (2017) in South Africa revealed that human exposure to toxic metals have a negative effect on their organs. Pollutants released during e-waste processing trigger respiratory infections, eye infections and asthma (Acquah et al., 2019). In studies on waste pickers' health, Asampong et al. (2015) found that waste pickers who dismantle e-waste suffer from acute respiratory infections and chest pains, while Peluola (2016) found that they suffer from skin and

eye irritation and persistent coughing. Thus, it is not only processing e-waste such as burning of cables that affects human health but also e-waste dismantling. Furthermore, informal waste pickers that rely on stones, hammers, chisels to dismantle e-waste are at risk of musculoskeletal injuries (Maphosa & Maphosa, 2020).

E-waste does not only contain hazardous material, but also valuable material such as gold, silver and copper to name a few. Therefore, if e-waste is managed properly, it can contribute to the circular economy and create sustainable green jobs as outlined in the next section.

2.7 E-waste as a problem and opportunity

The literature is becoming more aware of the problems associated with e-waste (Umesi & Onyia, 2008; Herat & Agamuthu, 2012; Acquah et al., 2019; Orisakwe et al., 2019; Maphosa & Maphosa, 2020). WEEE contains a number of different materials, some of which are highly toxic. E-waste does not only contain hazardous material, but also valuable material such as gold, silver and copper to name a few. Therefore, if e-waste is managed properly, it can contribute to the circular economy and create sustainable green jobs.

E-waste is a valuable resource for several precious and strategic metals (Herat & Agamuthu, 2012). There is a growing need for the recovery of e-waste resources due to scarcity, restricted global trade and price fluctuations for some of these metals. Noteworthy benefits of harvesting e-waste resources are substantially less energy used and significantly less greenhouse gas emissions compared to mining of these resources (Mudali et al., 2021).

Furthermore, the Mohammadi et al. (2021) study noted that e-waste recycling is contributing to economic growth by creating jobs. In line with this, the unemployed youth and adults in developing countries often work as waste pickers to earn income through waste and e-waste recycling. WEEE recycling has the potential to be an important employer as 25 jobs can be created for every 1 000 tonnes of e-waste managed (Lydall et al., 2017).

In many developing countries, and in South Africa, the informal sector plays a significant role in e-waste recycling. However, the e-waste recycling industry has a need for semi-skilled and skilled workers and skills training can contribute to unlocking the potential economic benefits held by the e-waste industry. The next sections discuss the informal sector and training of the informal sector in e-waste.

2.8 Informal sector in e-waste

In South Africa, the informal e-waste sector consists of collectors and recyclers who are unlicensed and not registered with any official entities (Lundgren, 2012). According to Lydall et al. (2017), these informal waste pickers collect waste from landfills, dustbins, shopping malls, industrial malls and suburbs. Furthermore, most of them practice dismantling and processing of e-waste and sell their materials frequently to local recyclers via exploitative intermediaries (UJ-PEETS, 2020). However, the International Labour Organization (2014) noted that informal waste pickers collect, dismantle and process e-waste due to the lack of formal and public collectors, the high demand for secondary raw materials, and to allow themselves to make a living. In summation, the rising rates of unemployment and high volumes of e-waste are the main drivers of the informal waste recycling.

2.9 Integration and training of informal sector

Informal waste pickers in the city of Johannesburg are facing numerous challenges in the collection, transport and processing of waste and e-waste for recycling. A report commissioned by the DEA (2016), confirms this view and also note that the lack of formalization is a challenge. In the CoJ, the Environment, Infrastructure and Services Department launched a Waste Pickers Empowerment programme in 2011. This programme consisted of the formulation of a database for the waste pickers in the CoJ for which the pickers had to register, skills training and organizing them into co-operatives (Baker et al., 2016). Baker et al. (2016) states that more than 500 waste pickers have benefited in the programme. However, only South African or foreign waste pickers that had the necessary documentation could register for this programme. Schoeman (2018) found that 78% of trolley pushers that participated in her study were foreign nationals and the majority did not possess the necessary documentation to make their status legal in South Africa. Thus, many waste pickers are not able to register and participate in integration projects and therefore also not have access to the associated skills training.

Baker et al. (2016:172) state that “The CoJ recognized the Waste Pickers form [the] integral part of waste minimization”. However, it seems that the CoJ did an about-turn. Samson (2021) expresses the opinion that Pikitup, the waste management service provider in the CoJ, do not incorporate the waste pickers in recycling. She further states that waste pickers are the real recycling experts and Pikitup designs charity-style projects for them and contracted private companies to collect recyclables – which is in direct competition with the waste pickers and threatens their livelihoods. Pillay (2017) has a similar opinion that the CoJ has not made waste pickers part of their waste strategy. She states that the CoJ developed programmes and projects

without consulting the waste pickers and the reason given is that they cannot consult waste pickers as they are not organised. This view by the CoJ is contradicted by findings of the Waste Integration in South Africa (WISA) project that found that waste pickers are organized (WIEGO, 2021). The lack of recognition cumulated in large-scale protest organized by the African Reclaimers Organisation (ARO) in May 2019. Waste pickers marched against the CoJ's refusal to recognize them, answer their demands and offer fair compensation and treatment (WIEGO, 2021).

The WISA project was established by WIEGO (Women in Informal Employment: Globalizing and Organizing) in consultation with the South African Waste Pickers Association (SAWPA) and the environmental justice organization groundwork. This project operated between 2016-2020 in the CoJ, Tshwane and Sasolburg municipalities and built capacity of waste pickers' organisations to negotiate with city managers for the integration of waste pickers in the formal sector and waste management systems. This was done by assisting waste pickers with policy research, organizing, worker education and training in negotiation skills (WIEGO, 2021).

The Waste Pickers Guideline for South Africa (DEFF & DST, 2020) notes that training is provided by municipalities and industry but does not provide detail of the training. Regarding the pilot project to integrate waste pickers in Sasolburg, the report allude that the training provided to waste pickers was in the area of data gathering and keeping of financial records. A finding of this pilot project to integrate waste pickers states that "a training programme more specifically tailored for this type of initiative is likely required" (DEFF & DST, 2020:48).

It seems that training of waste pickers in South Africa is mostly in the entrepreneurial and business side of recycling. The training provided by The Appliance Bank (TAB) is an exception. Starting with a pilot project in 2015, TAB has a two-year training programme for unemployed men that not only includes the business side of WEEE, but also in repairing household appliances. Recently there is a focus on e-waste and a recognition that it can contribute to the circular economy. At the time of writing, formal qualifications are being developed to increase skills in the WEEE sector. These are in the areas of WEEE collection, processing and managing. However, for any training programme in e-waste to work, more information is needed on who are the waste pickers that collect e-waste, what is done with this e-waste and is there a need to train them in the repair of e-waste. The next chapter outlines the research methodology used to collect and analyse the data for this study.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter will first present a brief description of the study area. The methods used for data collection and the type of data which was required to achieve the objectives of this research are discussed. This chapter ends with an outline of how the collected data was analyzed.

3.2 Description of the study area

This research project was conducted in the City of Johannesburg Metropolitan Municipality. The City of Johannesburg (CoJ) is the capital of Gauteng Province (Figure 3.1). The CoJ covers an area of 1 646 km^2 and is located on the eastern plateau of South Africa (Ayeleru et al., 2016). The CoJ has one official waste management service provider (Pikitup) that is responsible for keeping the city clean. The study of Alao et al. (2021) found that there is no recorded data for the e-waste generated in the CoJ annually. However, the CoJ is the economic hub of South Africa and has the highest consumption of EEE and produces the most e-waste.

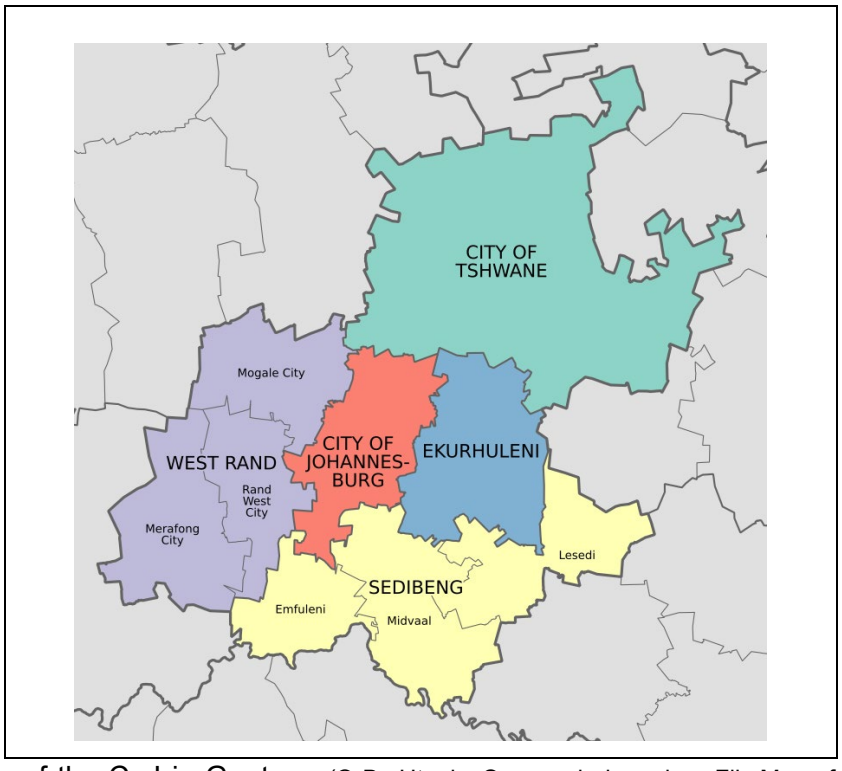

Figure 3.1: Location of the CoJ in Gauteng (© By Htonl - Own work; based on File:Map of Gauteng with municipalities blank (2016).svg, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=55873900)

The CoJ population size in 2021 is estimated to be 5.5 million (Murwirapachena, 2021) making it the most populated city in South Africa. The CoJ is characterised by high buildings, highly industrialised formal businesses, informal businesses and a mixture of cultures from both foreigners and South African citizens. The increasing population has resulted in an increasing waste generation rate within the city. The unofficial waste managers – the waste pickers – in the city are seen daily in the streets of CoJ collecting waste for recycling purposes (Schoeman, 2018).

3.3 Desktop study

Desktop study focused on gathering information from published literature that was beneficial for this project. The researcher utilized previously published journals and articles, published reports and guidelines to obtain the background information of the study that was carried out in the study area. Moreover, the desktop study prepared the researcher to select methods that were necessary to use on this research.

3.4 Research design

The study adopted a mixed method approach involving triangulation of both qualitative and quantitative designs. The researcher chose to utilize this method because it is flexible and provides the best opportunity for addressing research questions. A mixed method approach is an approach where the researcher bases their knowledge claims on practical grounds (Malina et al., 2011). It is a flexible method that is problem centered and involves more than one strategy of understanding research problems.

The data collection in mixed method approach involves gathering information that is both numeric and textual for the final database to represent both qualitative and quantitative data (Creswell & Creswell, 2017). A mixed method is basically an integration of both qualitative and quantitative information within a single investigation. An interaction between these two methods allows the researcher to have a complete and interactive data collection and analysis (Wisdom & Creswell, 2013).

Qualitative approach refers to the systematic collection of textual data derived from a conversation whereas quantitative approach is the employment of strategies on enquiries such as experiments and surveys to achieve statistical data (Creswell & Creswell, 2017). Qualitative method can be expressed in any medium of a conversation and it is more like telling a story from a conversation obtained from interviews, surveys or even focus groups. In contrast, quantitative method emphasizes on generalization to ensure that that the gained knowledge represents the population

from which the sample was drawn. Using both of the different methods allows researchers to provide additional insights into the meaning of the findings (Gibson, 2017).

3.5 Setting and study population

The setting of the study was the CoJ focusing on informal waste pickers in Johannesburg. The respondents were purposively selected from different areas under the municipality of Johannesburg. All respondents were informal waste pickers. Purposive sampling refers to a non-probability sampling technique that identifies and choses participants that have knowledge or experience about the phenomenon of interest by the researcher (Campbell et al. 2020). As this study investigated waste pickers that collect, transport and process e-waste, only waste pickers that work with e-waste was interviewed.

3.6 Materials and procedure

In this research project, interviews were conducted using a questionnaire (Addendum A), allowing for face-to-face interaction with informal waste pickers in the field, as they collected recyclables. The questionnaire was developed by the UJ, UCT and UWC South African e-waste research group that the researcher's supervisor is part of. The different sections of the questionnaire included demographics, operations, dismantling, processing and training. The questionnaire consisted of questions often asked when profiling waste pickers and questions regarding their willingness to undergo training. Both open-ended and closed-ended questions were asked. The researcher and fieldworkers conducted interviews in the field and applied participant observation method for field observation. The observed field work involved processing and dismantling practices.

A total number of 229 respondents were interviewed at 23 different recycling centers. A problem experienced with data collection occurred when South Africa went into lockdown Levels 3 and 4. The fieldworkers were not granted access to the recycling centres and therefore could not conduct interviews. Only when the country moved to adjusted Level 2 on 13 September could the data collection take place again. Therefore, not all recycling centres in the CoJ could be included in data collection.

3.7 Data analysis methods

Thematic analysis was applied using the Nvivo software to transcribe interview conversations into coded themes. Thematic analysis is an identifying, analyzing, organizing, describing and reporting method on themes found within a set of data (Nowell et al., 2017). In line with this, another study

by Castleberry & Nolen (2018) defines thematic analysis as a translator for both qualitative and quantitative data allowing researchers to use different methods to communicate.

For quantitative data, descriptive statistical analysis was performed in Excel. This method was used because it summarizes complex numerical findings into a representable tables, graphs or chats. According to Carlberg (2014), statistical analysis refers to methods of planning, designing, collecting, analyzing and concluding on a meaningful interpretation of research findings. It basically gives meaning to numbers to uncover patterns and trends (Rayat, 2018).

CHAPTER 4: ANALYSIS AND INTERPRETATIONS

4.1 Introduction

This section is going to focus on the analysis of data. The questionnaire consisted of 63 questions, but due to the limited scope of this study not all questions of the questionnaire were analyzed. The analysis only focused on demographics, operations, dismantling, processing. This section will end of with training needs.

4.2 Demographics

According to Raymer et al. (2019), demography is the statistical study of human populations to illustrate the changing structure of human populations over space and time. In line with this, this section presents the respondents' gender, race and country of origin.

4.2.1 Gender

Waste picking in this survey was dominated by men (83.4%) and only 16.6% were women. This is in line with the Schoeman (2018) study that found that 80.4% male and 19.6% female waste pickers operated as trolley pushers in Johannesburg. Waste picking is a strenuous job and it is expected to be dominated by men as they have greater physical strength than women (DEFF & DST, 2020).

4.2.2 Race and country of origin

The majority of the respondents were African/Black (87.3%) followed by Coloureds (11.4%). Only two respondents (0.9%) were White and one respondent (0.4%) identified as Indian/Asian (Figure 4.1 (a)). A total of 81.6% of the respondents were South African followed by 11.4% from Zimbabwe and 3.1% from Malawi (Figure 4.1 (b)). This is in contrast to the Schoeman (2018) study that had 78% foreign nationals and Sentime (2011) that only recorded 56.6% South Africans. The result is in line with the DEA (2016) report that noted that only 9.3% of waste pickers originated outside South Africa. Possible explanations on the difference in the country of origin with previous studies are the impact of the Covid pandemic that reduced the number of foreign nationals waste picking in Johannesburg, or that undocumented foreign nationals do not participate in surveys as they fear that they would be reported.

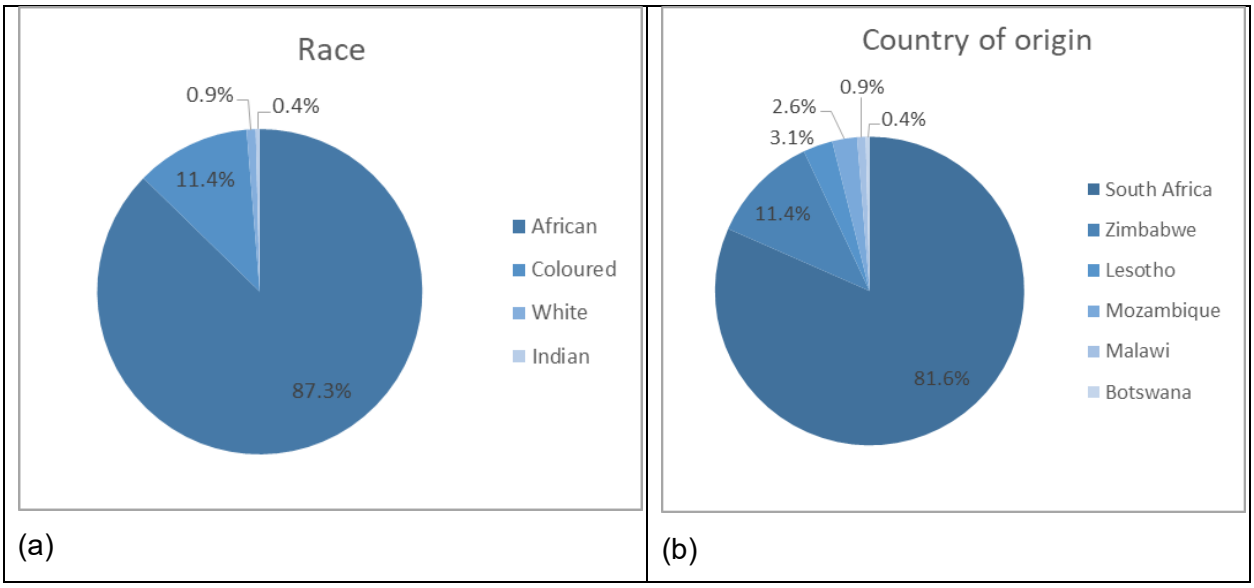

Figure 4.1: (a) Race and (b) Country of origin

4.2.3 Level of education

The bigger number of informal waste pickers completed some high school level (65.2%), while 25.9% attended or completed only primary school. The most surprising result was that there are well educated waste pickers, three (1.4%) waste pickers obtained tertiary qualifications, namely a BCom Accounting, a BA Honours Design and Technology and Nursing degree (Table 4.1). In contrast with the Sentime (2011) study that found that waste pickers in Johannesburg have very limited education, this study found that Gauteng waste pickers have a higher level of education. This national study (DEA, 2016) reported that 13.1% waste pickers in Gauteng completed matric, which is similar to the results of this study.

Table 4.1: Level of education

Level of education	Number of respondents	Percentage
Completed some primary school	29	12.9%
Completed primary school	15	6.7%
Complete some high school	146	65.2%
Completed Matric	31	13.8%
Post-matric qualification	3	1.4%

4.3 OPERATIONS

Operations in this study refers to the way in which waste pickers function on their daily basis. This section presents the types of waste they collect, their number of years working, place of e-waste collection, other recyclables they collect, the buyers they sell to, place of storage, income they made and their willingness to sell to e-waste recyclers.

4.3.1 Types of e-waste collected by waste pickers

Waste pickers collect different types of e-waste and cables (45.9%) were the most collected type of e-waste, followed by screens (43.1%) and radios (30.2%) (Table 4.2 and Figure 4.2). The least collected types of e-waste were monitors (7.0%) and washing machines (2.9%). Washing machines and monitors are bulky and heavy equipment and would therefore not be easy to transport to a collection or recycling centre.

Table 4.2: Types of e-waste collected

Commonly collected waste	% of collectors
Cables	45.9%
Screens	43.1%
Radios	30.2%
Microwave	23.8%
Monitors	7.0%
Washing machines	2.9%
Kettle	21.4%
Iron	18.2%
All types of electronic goods	23.6%

Figure 4.2: Examples of e-waste collected (Author)

4.3.2 Number of years working

A fifth of waste pickers (20.1%) had five to six years' experience, while 16.6% had more than ten years' experience (Figure 4.3). The highest number recorded was a waste picker that reported 22 years working as a waste collector, while only 0.4% was not sure of how many years they worked. There can be several reasons why more than a third (36.7%) of waste pickers in the City of Johannesburg have less than five years' working experience. One such reason is that often it is young people that dropped out from or recently completed school that works as waste pickers. With very high youth unemployment rates they could not find jobs in the formal sector. In the Alexandra Township, most of the young waste pickers indicated that they are just into waste picking/recycling because they are "tired of staying at home and doing nothing". This is in line with the Made et al. (2020) study that found that there is a growing number of 18 years old waste pickers in the CoJ, who just left high school and could not get jobs.

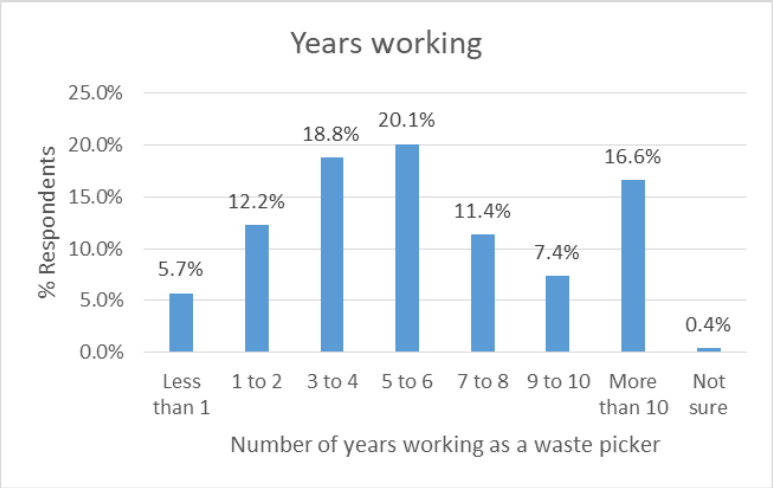

Figure 4.3: Number of years working as a waste picker

4.3.3 Place of e-waste collection

Waste pickers in the CoJ collect e-waste from multiple locations (Figure 4.4). Dustbins outside houses (74.2%) are where the most e-waste is collected, followed by shops/business (60.9%) and 56% is directly collected from residents. The lowest number of waste pickers (7.3%) indicated that they collect their waste from other, with other being streets/roads and local illegal dumping areas. This is similar to the DEFF & DST (2020) guidelines that described waste pickers as people who collect both re-usable and recyclable material from residential and commercial bins, landfill and open spaces.

Figure 4.4: Place of collection of e-waste

4.3.4 Other recyclables collected

Waste pickers collected multiple other recyclables with metals (79%) as the most collected, followed by plastic (77.1%) and paper (76.2%) (Figure 4.5). It is only 16.4% of waste pickers collected globes and 19.2% tetra pak. The findings of this study are similar to those of Yang et al. (2018) and Kasinja & Tilley (2018) that found that metal, plastic and paper are the most collected type of recyclable by waste pickers. They can get relatively higher prices as these recyclables have the highest recycling potential.

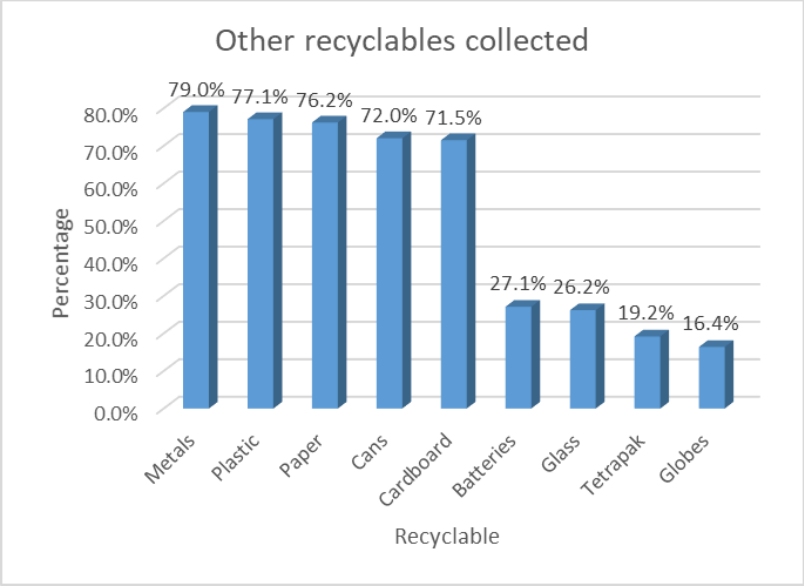

Figure 4.5: Other recyclables collected

4.3.5 E-waste buyers

The majority of waste pickers (76.4%) sold the e-waste they collected to scrap metal dealers, while 49.3% of them sold it to the general buy-back centre or an e-waste buy-back centre (Table 4.3). Only 10 respondents (4.1%) were selling to factories, other waste pickers or local individuals and some e-waste are repaired and then sold (represented as category 'other'). Most waste pickers from all sites prefer scrap metal dealers as they are of the opinion that scrap metal dealers pay higher prices than other potential buyers and have less strict requirements. The results, however, also showed that waste pickers sell e-waste to more than one buyer.

Table 4.3: E-waste buyers

Sold to	Number	Percentage
Scrap metal dealer	172	76.4%
General buy-back centre/depot	112	49.8%
E-waste buy-back centre/depot	111	49.3%
Buyer with a bakkie	111	49.3%
E-waste recycler	102	45.3%
I do not know who it is	23	10.2%
Other	10	4.1%

4.3.6 Willingness of waste pickers to sell to e-waste recyclers

There was a number of waste pickers (45.3%) that indicated that they do sell to e-waste recyclers (Table 4.3). For trolley pushers (54.7%) that did not sell to e-waste recyclers, a question was administered to find out whether they are willing to sell to e-waste recyclers or not. For those that indicated they would sell to e-waste recyclers, a common theme was depicted from their responses, namely: better income. In support, two chosen responses from willing waste pickers were:

> *"Yes, maybe they will pay better than other dealers."*
>
> *"Yes, I think they would pay better than scrap yards. I think scrap metals pay less".*

In contrast, responses from waste pickers unwilling to sell to e-waste recyclers, three notable themes were identified, namely: location, familiarity, and reduced income. Regarding location, one respondent said:

> "*No, I don't know their locations*".

Common problems identified by waste pickers is the fluctuation in prices for recyclables (Kasinja & Tilley, 2018) and not been paid a fair price for recyclables (Schoeman, 2018). Therefore, it is

not unexpected that waste pickers will not sell to e-waste recyclers if they get lower prices for goods. This is reflected in the following view of a waste picker:

"*No, they will give me a small amount of money compared to what I get at scrap dealers*".

Been familiar with a buyer and having a good working relationship is also important to waste pickers. This came to the fore in the following reason provided by a respondent:

"*No, I have a good relationship with my current buyers*".

4.3.7 Storing of e-waste

Just more than half (54.9%) of waste pickers store their e-waste somewhere (Figure 4.6). The top five places of storage for those that store e-waste were: on the streets, under bridges, at home, in bins and in bulk bags. The most surprising response was finding that some waste pickers store their e-waste at the scrapyards they sell to. It is quite surprising to have so much trust that they even store their e-waste to the same person who is supposed to buy from them. However, for those that do not store e-waste anywhere, the study found that they sell their e-waste on a daily basis.

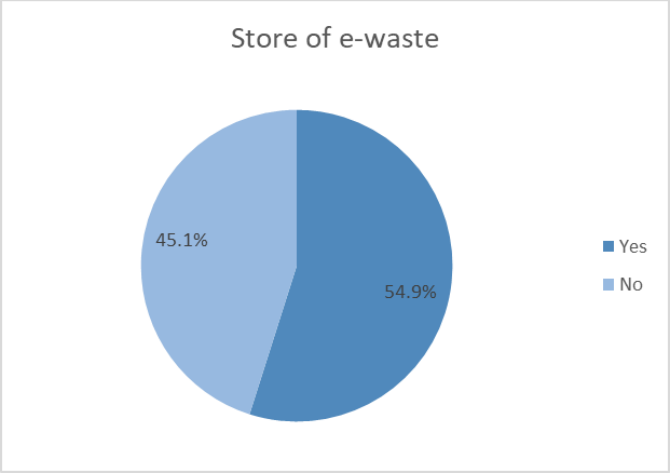

Figure 4.6: Store of e-waste

4.3.8 Income earned per week

Almost three-quarters (72%) of waste pickers earned less than and up to R600 per week for e-waste collected and sold (Figure 4.7). The lowest figure given for earnings per week was R100 and the highest R7 000. Only 3% earned more than R1 501 per week. The average income calculated was R580 and the median income per week R400.

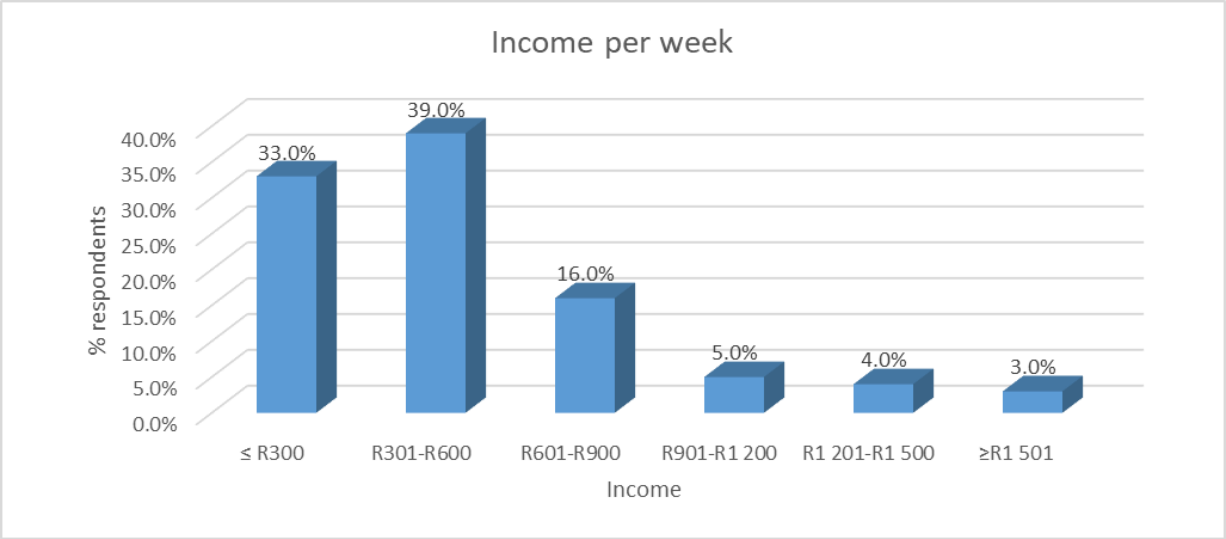

Figure 4.7: Average income per week

The income earnings for e-waste are very similar to the DEA (2016) report that gave R1 430 as the mean monthly income, which translates to R357 per week. Waste pickers that sell their e-waste are provided with a receipt (Figure 4.8). Unfortunately, none of the respondents kept detailed records of their earnings from e-waste. This is mainly because waste pickers collect more than one type of waste.


CU MIXED
1 @ 85.00 R85.00

TOTAL : R85.00
Cash : R85.00
Change : R0.00
VAT NUMBER : R0.00

Cashier : susan ndlovu
Date : Mon 06 09 2021 16:51
Transaction : 444457022598393
Till : Server

Total Qty : 1

Figure 4.8: An example of a receipt (Author)

In order to earn higher income for e-waste, often dismantling and processing of e-waste take place. By dismantling e-waste, only the valuable fractions are sold and the rest discarded. Processing involves extracting the valuable components and often includes the burning of cables to extract copper. The next sections briefly explain dismantling and processing of e-waste by respondents.

4.4 Dismantling of e-waste

E-waste dismantling involves the breaking down of discarded EEE using tools such as hammers to separate the discarded waste (Heacock et al., 2016). The majority of the respondents (68.0%) dismantled e-waste (Table 4.4). Out of those that conduct dismantling, only 3.3% received training and a number of them were trained by close relatives and friends and education. To attest on this, some responses:

> "*I have learnt by watching other people do it*."
>
> "*From experienced co-workers*."
>
> "*Training from friends*."
>
> "*From my father who was an electrician*."
>
> "*I did an electrical engineering course at Sedibeng College*".

Table 4.4: Dismantling, training and working together

Response	Dismantle e-waste	Training in dismantling	Work with other waste pickers to dismantle
Yes	68.0%	3.3%	30.4%
No	32.0%	96.7%	69.6%

However, the study found out that whether with or without training the CoJ waste pickers dismantle goods such as printed circuit boards to extract mostly valuable metals such as copper, lead, aluminum and gold (Figure 4.9). The least dismantled goods were washing machines and geysers. Moreover, the study also found out that 30.4% of waste pickers dismantle their e-waste with other waste pickers, whereas 69.6% prefer to work alone. Those that work with other had different reasons on how they work together, one being 'sharing responsibilities' that when the other one breaks down the goods, the other one carries the load to the buyer.

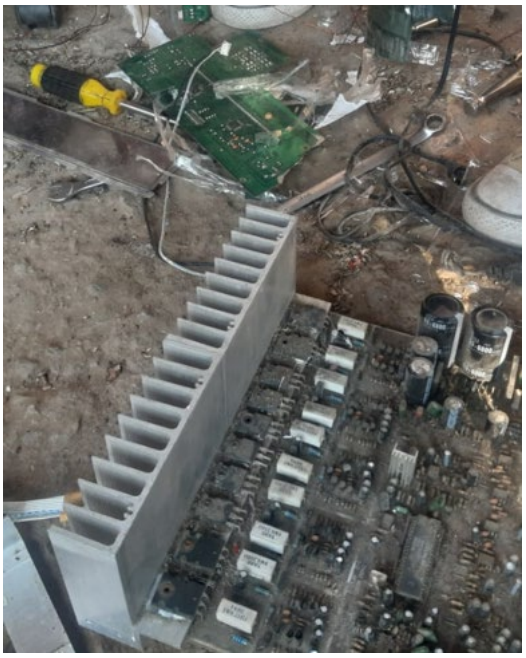

Figure 4.9: Dismantling of e-waste (Author)

4.5 Processing of e-waste

Processing e-waste refers to the extraction of valuable metal from discarded cables using chemical and mechanical methods (Masud et al., 2019). More than a half (60.2%) of waste pickers conduct e-waste processing (Table 4.5). Out of all waste pickers that conduct processing, only 1.6% received training. Similar to the findings of the previous section, waste pickers were trained by friends and family and the majority (66.4%) prefer to work alone.

Table 4.5: Processing, training and work together

Response	Process e-waste	Training in processing	Work with other waste pickers to process
Yes	60.2%	1.6%	33.6%
No	39.8%	98.4%	66.4%

The processing that was done was mostly to extract copper and aluminium from cables (Figure 4.10). Section 2.6 outlined some of the health and environmental impacts associated with the processing practices used by the informal sector. There is thus a clear need to train and provide waste pickers with the necessary skills and tools to process e-waste in a safe manner.

Figure 4.10: Processing of e-waste (Author)

Another way to increase the value of e-waste is to repair and refurbish it and sell it as used goods. The next section outlines repair and refurbishment of e-waste.

4.6 Repair and refurbishment of e-waste

The majority of waste pickers (75%) repair and/or refurbishment e-waste collected. There were multiple purposes for repairing and refurbishing goods – some of the goods are sold but some is kept for personal use. In this study, a high number of waste pickers (87.4%) indicated that they resell repaired/ refurbished goods for income and 42.1% indicated that they keep the repaired/refurbished goods for personal use. Items that are kept for personal use include cellphones, kettles, irons, fans, heaters and even large household appliances such as stoves.

4.7 Training

The study found that 52% of waste pickers in the CoJ were very willing to be trained, 5.8% of them was neutral while only 12.6% were very unwilling to be trained (Figure 4.11). The DEA (2016) report and the DEFF & DST (2020) guidelines both emphasized the importance to up-skill waste pickers and that municipalities should provide training for waste pickers. As discussed in Section 2.7, e-waste can contribute to the circular economy and create sustainable green jobs. The majority of the respondents (80.6%) expressed a willingness to be trained in the repair and refurbishment of e-waste.

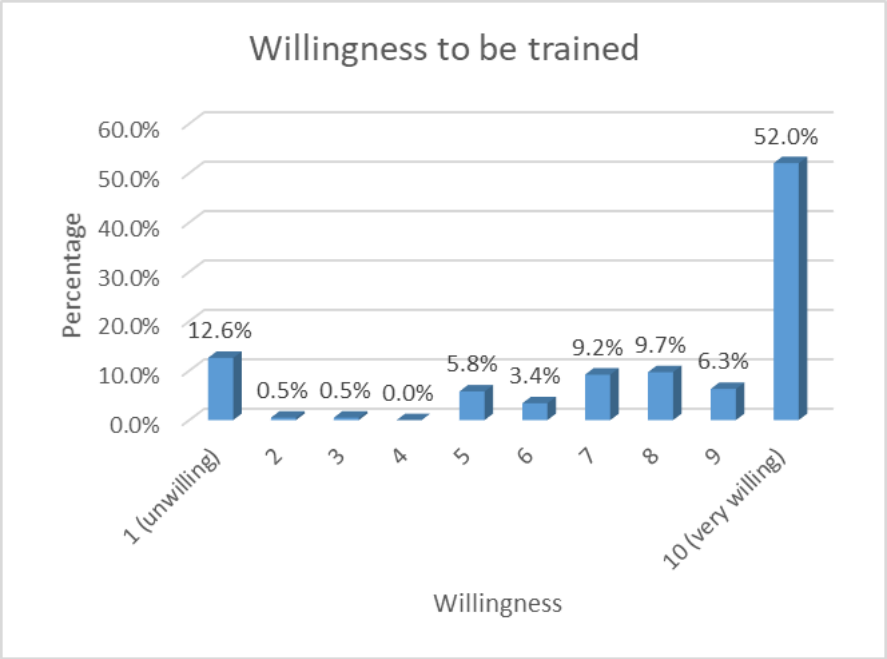

Figure 4.11: Willingness to be trained

Further questions in the survey were on what type of training respondents would like to undergo (Table 4.6 (a)) and 193 respondents completed this question. The top training need identified by waste pickers was training in safety (47.7%) by almost half of the respondents. This was followed by repair of household appliances (24.9%), and kettles and irons both at 12.4%. Respondents also would like to receive training on electricity and 9.8% indicated that they required this type of training. The need for safety training is expressed in the following responses of two waste pickers:

> "*I would like to learn how to properly break-down the appliances without hurting myself.*"
>
> "*Learning how to dismantle goods and how to be safe while doing so would be great.*"

On when the training should take place, a big variance in answers was recorded for the 196 waste pickers that answered this question. Some were very specific like twice a month on a Monday morning, while other responses only indicated the time of day and not the frequency. Therefore, the answers were grouped rather using time of day or month and not frequency (Table 4.6 (b)). Just more than half of waste pickers (50.3%) indicated that they would prefer training to take place in the afternoon. A common reason for this choice was that they need to collect the recyclables in the mornings. A quarter (25.4%) would prefer training to take place in the mornings and 15.2% prefer weekends. The variation in answers is illustrated in the following responses:

"*Only in the afternoon so that I can collect waste in the morning*."

"It should take place once a week on Monday mornings when my brain is still fresh."

"Definitely morning, as I have to go sell my waste later on during the week."

"Anytime of the day, just the opportunity to do the training would be great."

Table 4.6: (a) Type of training and (b) when training should take place

What to see in the training	%
Safety training	47.7
Repair of household appliances	24.9
Repair of kettles	12.4
Repair irons	12.4
Training on electricity	9.8

(a)

When training should be	%
Afternoons	50.3
Mornings	25.4
Weekends	15.2
Fulltime	6.6
Anytime	2.5

(b)

Waste picking is a physical strenuous job and a concern, doing training in the afternoon can be the lack of concentration in participants. A number of waste pickers also commented that they can only attend a full day or fulltime training if they are paid to do so as they cannot afford to lose any income. These are all factors that should be taken into consideration in the planning of training of waste pickers.

The work of waste pickers would be made much easier if residents would separate their recyclables, including e-waste, from their domestic solid waste. Further advantages of doing this are expanding the life of landfills, creating jobs, using less resources and contributing to the circular economy. Respondents were asked for recommendations to increase participation in e-waste recycling and this is discussed in the next section.

4.8 Recommendations to increase e-waste recycling

An open-ended question asked of waste pickers what municipalities can do to encourage recycling of e-waste. A total of 190 answered this question but a surprising finding was that 57 responses (30%) can be considered as negative. The negative views expressed are mainly on the corruption and the 'uselessness' of municipalities. The following responses are examples of such negative views towards municipalities:

"The Municipality must just focus on corruption, we will recycle e-waste for people."

"The Municipality is as corrupt as its leader, people like us are the ones who are supposed to inform people about e-waste recycling."

"The Municipality can't do anything because they are useless."

Some responses indicated that there is nothing the municipality can do. One respondent also commented on the independence of waste pickers that was also a finding of the DEA (2016) report and of broken promises. The quotes below illustrate these opinions:

> *"Nothing. We are now used to being independent. Many companies or firms have been coming and promising jobs or wanted us to work under them but fail to keep their promise."*
>
> *"Nothing, they have already failed us a lot."*
>
> *"Nothing. They are not doing anything anyway."*

However, a total of 134 respondents made recommendations and municipalities should take note of these (Table 4.7). Too often waste pickers views and opinions are not taken into consideration when developing recycling programmes to integrate waste pickers. The top recommendation (43.3%) is to provide residents with the necessary information, education and awareness on how to recycle e-waste. This was followed by the provision of personal protective equipment (PPE) to waste pickers (11.2%), provision of jobs in e-waste recycling (8.2%), provision of bins for e-waste and more recycling facilities dedicated for e-waste with both at 7.5%. A need was also expressed by 6.7% of respondents for equipment such as trolleys and dismantling tools. Some respondents (3.7%) even suggested that residents that do not recycle should be fined.

Table 4.7: Recommendations from waste pickers

Recommendations	% responses
Information, education and awareness	43.3
Provide PPE	11.2
Provide jobs	8.2
More bins	7.5
More e-waste recycling facilities	7.5
Equipment	6.7
Fine non-recyclers	3.7

The next chapter will conclude this study and make recommendations for future work and research in this field.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The study was conducted in the City of Johannesburg. All profiled informal waste pickers were found around selected recycling centers in the CoJ. A typical waste picker that also collects e-waste was male (83.4%), from the Black population group (87.3%) and a South African (81.6%). The most collected type of e-waste was cables (45.9%), and e-waste was collected from multiple locations, but mostly from dustbins outside houses (74.2%). The majority of waste pickers (76.3%) sold e-waste to scrap metal dealers and earned an average income of R580 per week from selling e-waste.

Amongst waste pickers that collected e-waste for recycling, 68% conducted dismantling and 60.2% processing. These practices are all profit driven and income from processed cables was higher than those who only conduct dismantling. However, informal waste pickers in the CoJ were found to have mostly no safety equipment for the practices they perform. It was observed that they used tools such as hammers and stones to break down the electrical goods for metal extraction. Those who conducted processing used fire to burn cables in open land. Thus, these risky activities threaten their health and the environment they live in.

As part of the journey to achieve sustainable development, the CoJ has started formalizing waste pickers. In 2010 a program for waste picker empowerment was initiated to register and integrate the informal waste pickers into the formal sector. It seems that once again waste picker integration failed and no support is given to waste pickers. Even though waste pickers are considered to be the main recyclers in South Africa and it is estimated that they have saved municipalities up to R748 million per annum (Godfrey et al., 2016), local government keeps on ignoring their contributions and experience.

The latest regulatory requirement is the EPR regulations that came into effect on 5 November 2021 and the success of these regulations are uncertain. Instead of making use of the informal sector to increase the recycling, repair and refurbishment of WEEE, the government keeps on formulating legislation and regulations. As stated by Godfrey & Oelofse (2017), waste management is overregulated in South Africa and makes it extremely difficult for recyclers to comply with.

It is a given that e-waste generation will continue to increase on a global scale. The growing amount of e-waste is mainly fueled by an increase in consumerism and shorter life cycles of EEE. Shevchenko et al. (2019) estimated the growth of e-waste generation to 52.2 million tonnes or

6.8 kg per capita per annum by 2021. However, this estimation was done before the Covid pandemic, which demanded more online presence and the resultant increase in use of EEE. The Covid pandemic had a devastating effect on the economy of South Africa and the highest ever unemployment rates were recorded. It is therefore crucial that new sustainable jobs are added to the economy. E-waste recycling and repair have the potential to contribute to the creation of green jobs and the circular economy. Waste pickers in this study also made recommendations on how to increase participation in e-waste recycling – with information, education and awareness recommended by 43.3% of respondents. E-waste recycling and repairing are an entrepreneurial job opportunity and can lead to a reduction of unemployment and poverty and contribute to economic growth.

5.2 Recommendations

The following recommendations are made for local government based on the findings of this study:

- This study recommends that municipalities should manage e-waste in accordance with the existing approach of source separation, waste reduction, reuse and recycling through education and awareness programmes.
- There is a need to amend the integrated waste management plan for the City of Johannesburg municipality to prioritize e-waste reduction, integration of the informal sector and the development of strategies to increase participation of households and businesses in recycling.
- Statistics of e-waste are crucial in managing e-waste and therefore buyers of e-waste should keep records of the amount and type in order to comply with legislation.
- The study recommends that municipalities should develop an online registration portal for informal waste pickers who are willing to be formalized; initiate training of informal pickers; provide PPE and equipment and work gear that would identify them as a recycler.
- The municipality should take note of the findings of the study and incorporate this in future waste management plans.

For future research in this field, the following recommendations are made:

- Research to investigate the capacity and willingness of recycling facilities and buy-back-centres to train waste pickers in certain aspects such as safety.
- Comparative studies in metropolitan and secondary cities in South Africa.

- Research to investigate the volume of e-waste in households and businesses and to determine what measures would increase participation in e-waste recycling.

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ADDENDUM A

E-WASTE PICKERS SURVEY IN SOUTH AFRICA

DSI/NRF/CSIR Chair in Waste and Society – University of the Western Cape

NRF SARChI Chair in Minerals Beneficiation – University of Cape Town

University of Johannesburg

SURVEY DETAILS

Interviewer: *(Complete the following questions after the interview)*.

Date of interview.....

Time of interview.....…….....

Fieldworker name…….....

Geographical details of the site where interview took place:

Name of the Buy-back Centre/Depot/Recycler (if applicable): .....……

Street Address (of site): …….

City/Town and suburb: …….

Questionnaire

Completed	Not Completed

SECTION A

This set of questions relates to the personal background of the respondent you are interviewing.

1. Respondent's gender:

Male	1
Female	2

2. Which racial group do you associate yourself with?

African/Black	1
Coloured	2
White	3
Indian/Asian	4
Other	5
If other, please specify	

3. Language predominantly spoken by respondent. **Mark ONE only**

English	1
Sesotho	2
Sepedi	3
IsiZulu	4
IsiNdebele	5
XiTsonga	6
Afrikaans	7
Setswana	8
IsiXhosa	9
TshiVenda	10
SiSwati	11
Shona	12
Other	13
If other, please specify ……..	

4. Which country do you originate from?

South Africa	1
Zimbabwe	2
Namibia	3
Swaziland	4
Mozambique	5
Botswana	6
Lesotho	7
Malawi	8
Other	9
If other, please specify ……..	

5. If from South Africa, in which province were you born?

Gauteng	1
Mpumalanga	2
KwaZulu-Natal	3
Eastern Cape	4

Limpopo	5
North West	6
Free State	7
Northern Cape	8
Western Cape	9

6. What is the **highest** school or tertiary qualification you have **passed**?

Grade

0	1	2	3	4	5	6	7	8	9	10	11	12
Post School Qualification												13
Please mention the Post School qualification. …….....												

SECTION B

This set of questions relates to the respondent's work as a waste picker collecting waste electrical and electronic waste (i.e. e-waste)

7. What do you like about your work?

.....

.....

8. What about your work don't you like?

.....

.....

9. Why did you decide to collect e-waste? (field worker must probe)

.....

.....

10. What type of e-waste do you collect (e.g. screens, cabling, CPUs)?

.....

.....

11. How long have you been collecting e-waste?

Years …….. Months …….....

12. Where do you find the e-waste? Mark all applicable.

Dustbins outside houses	1
Directly from residents (i.e. door to door)	2
Schools	3
Industrial areas	4

Shops/businesses	5
Landfill	6
Other	7
If other, please specify	

13. What other recyclable waste do you collect? (Mark all applicable)

Paper	1
Cardboard	2
Plastic	3
Cans	4
Glass	5
Tetrapak	6
Metals	7
Batteries	8
Globes	9
Other, please specify.....	10

14. When did you start collecting recyclable waste in general?

Month…….. Year…….

* **Fieldworker: In the next questions try and get a single time not a time range e.g. 5:00 am or 3:00 pm**

15. At what time of the day do you usually start with the e-waste collection?

	am
	pm

16. What time in the day do you stop working?

	am
	pm

17. To whom do you sell the e-waste? Mark all applicable.

I do not know who it is	1
Buyer with a bakkie	2
General buy-back centres/depots	3

E-waste buy-back centre/depots	4
Scrap metal dealer	5
E-waste recycler	6
Other buyers	7
If other buyers, please specify …… ……	

18. If you do not sell to e-waste recyclers, would you be willing to and why?

……

……

……

19. Do you store your e-waste somewhere?

Yes	1
No	2
If yes, please explain where you store the e-waste……..…….. ……..	

SECTION C

This set of questions relates to the dismantling of e-waste

20. Do you conduct any dismantling of electronic/electrical goods?

Yes	1
No	2
If no, please explain why ……..……... …….. ……	

*If yes, please proceed to questions 21 – 29. If no, skip to question 30.

21. What goods do you dismantle and into what fractions?

……

……

……

22. Do you manage to sell all the fractions?

Yes	1
No	2
If no, what happens to the unsold fractions? …….. ……..	

23. Why do you dismantle the goods (e.g. buyer requirements, higher prices for certain fractions)?

.....

.....

24. Where do you dismantle the goods?

.....

.....

25. How do you dismantle the goods and what tools do you use?

.....

.....

26. Have you received any training in dismantling (formal or informal)?

Yes	1
No	2
If yes, please specify what type of training you received and where……... …….	

27. Do you work with other waste pickers to dismantle goods?

Yes	1
No	2
If yes, please describe how you work together……..……... ……. …….	

28. What do you find is the most difficult aspect of dismantling?

.....

.....

.....

29. What are the health and injury risks when dismantling?

.....

.....

.....

.....

SECTION D

This set of questions relates to the processing of e-waste

30. Do you conduct any processing of electronic/electrical goods (e.g. burning of cables, burning printed circuit boards for metal extraction)?

Yes	1
No	2
If no, please explain why ……..……... …….. …….	

*If yes, please proceed to questions 31 – 39. If no, skip to question 40.

31. What items do you process and into what products?

.....

.....

.....

32. Do you manage to sell all the fractions?

Yes	1
No	2
If no, what happens to the unsold fractions? ……... ……..	

33. Why do you process these goods (e.g. buyer requirements, higher prices for certain fractions)?

.....

.....

.....

34. Where do you process the items?

.....

.....

35. Please describe the method you use to process the items including tools and chemicals.

.....

.....

.....

36. Have you received any training in processing (formal or informal)?

Yes	1
No	2
If yes, please specify what type of training you received and where……... ……..	

37. Do you work with other waste pickers to process items?

Yes	1
No	2
If yes, please describe how you work together……..……... …….. ……..	

38. What do you find is the most difficult aspect of processing?

.....

.....

.....

39. What are the health and injury risks when processing?

.....

.....

.....

.....

SECTION E

This set of questions relates to the repair and/or refurbishment of e-waste.

Repair: fixing and maintenance of a defective product

Refurbishment: restore an old product to bring it up to date

Interviewer must take note of whether they refer to repair or refurbishment.

40. Are there goods that you collect for repair/refurbishment?

No	1
Yes	2

*If yes, please proceed to questions 41 – 43. If no, skip to question 44.

41. Do you repair/refurbish the goods yourself?

Yes	1
No	2
If yes, have you received any training and where was it obtained? …… …… ……..	

42. What do you do with the repaired/refurbished goods?

Keep for personal use	1
Resell for income	2

43. Are there goods that you keep for personal use?

No	1
Yes	2
If yes, please give examples	

SECTION F

This set of questions relates to the income patterns of the respondents.

**Ask if respondents are willing to let you see their sale slips and take a photo.*

44. How many days in a week do you collect e-waste?

.....days

45. How often do you sell the waste you have collected?.....

……

46. How much income do you usually earn for a week's e-waste that you collect?

Rand.....

47. What was the best income you have earned for a week's e-waste?

Rand.....

48. What was the lowest income you have earned for a week's e-waste?

Rand.....

49. How much money did you earn the last time you sold e-waste that you have collected?

Rand.....

50. Over how many days have you collected the e-waste to earn the income in question?

.....days.

51. What are the most valuable e-waste streams or components (e.g. metal, printed circuit boards, plastic, CPUs)?

.....

.....

.....

If the respondent has indicated they collect other recyclables in Q13, please proceed to questions 52 – 56. These questions relate to the total income from recyclables including e-waste. If they do not collect other recyclables skip to question 57.

52. How many days in a week do you collect recyclables?

.....days

53. How often do you sell the recyclables you have collected?.....

……..

54. How much income do you usually earn for a week's recyclables that you collect?

Rand.....

55. What was the best income you have earned for a week's recyclables?

Rand.....

56. What was the lowest income you have earned for a week's recyclables?

Rand.....

SECTION G

This set of questions relates to the respondent's relationship with other groups/organisations like the police/metro police, the public, buyers, family members and co-waste pickers.

57. If you have ever dealt with the police, how have they treated you?

.....

.....

58. How does the public treat you (especially if you collect door to door)?

.....

.....

59. How do the buyers at depots and buy-back centres treat you?

.....

.....

SECTION H

This set of questions relates to work satisfaction.

60. On a scale of 1-10 (10 being very happy and 1 very unhappy) how happy are you with life at the moment?

1	2	3	4	5	6	7	8	9	10

61. Would you like to tell us anything else that concerns you or that you think we should know?

Specify.....

.....

.....

SECTION I

Future training.

60. On a scale of 1-10 (10 being very willing and 1 very unwilling) would you be willing to undergo training in repair and dismantling e-waste in a safe manner?

1	2	3	4	5	6	7	8	9	10

61. What would you like to see in the training? (E.g. safety training, soldering, electricity, repair of kettle, iron, etc. – ask them what appliance).

Specify.....

.....

.....

.....

62. How do you think the training should be? (E.g. only in the afternoons so that they can collect waste in the morning, full time for a week, etc.)

.....

.....

.....

63. What do you think can the municipality do to get people to put out their e-waste for recycling?

.....

.....

.....

Interviewer: Thank the respondent for his/her participation.

For more information contact:

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