

**ASSESSING THE ROLE OF WASTE PICKERS AT WASTE MANAGEMENT  
FACILITIES IN EHLANZENI DISTRICT MUNICIPALITY,  
MPUMALANGA PROVINCE, SOUTH AFRICA**

by

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## DECLARATION

I, **Rirhandzu Marah Ntusi**, student number: **50703536**, hereby declare that the dissertation which I submit for the degree of MSc in Environmental Management at the University of South Africa is my own work and has not been previously submitted by myself at this Institution or any other. I declare that where words from previous written sources have been used, such information has been referenced completely. I declare that during my study, I adhered to the rules and recommendations of the Research Ethics Committee of the Institution. Ethical approval was granted by the Institution prior to commencement of the research project (2019/CAES\_HREC/162). I declare that the final content of the research was submitted to originality checking software to check for any instances of plagiarism.



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Signature

07 August 2022

Date

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## **ABSTRACT**

Waste management appears to be a global challenge across all nations. As a result, there is a dire need to ensure that waste is handled in a manner that does not negatively impact human health, or the environment in general, as stipulated in section 24 of the Constitution of South Africa 1996. The high rate of unemployment prompts individuals to venture into waste picking as a source of income. This study sought to assess the role of waste pickers at waste management facilities, specifically focusing on landfill sites, transfer stations and buy-back centres, and the constraints hindering effective waste collection by waste pickers in the Ehlanzeni District Municipality in South Africa, in particular. This descriptive, cross-sectional study was conducted using quantitative methods. A convenience sampling technique, with a sample size of 46 waste pickers and four supervisors, was applied in face-to-face structured interviews with field workers and self-administered closed-ended questionnaires. The quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) version 26.0 and Microsoft (MS) Excel 2021. The framework (in SPSS) within which to capture the collected data was prepared. After all the questionnaires had been entered into this software, the analysis of the frequencies of the data was run. The data output was exported to MS Excel version 2021, so that tables and statistics could easily be extracted. The qualitative data were analysed using Tesch analysis.

The results revealed that waste pickers played a significant role in waste management facilities by minimising waste through recycling. Ehlanzeni District Municipality has not sped up the process of aligning its policies with the national priorities in terms of formalising waste picking, resulting in a lack of support available to the waste pickers from the local municipalities. Most waste pickers do not have valid documentation for them to be included in the local municipalities database, and this also makes it difficult for the municipalities to provide the necessary support. Most respondents indicated that they performed the waste-picking activity to earn an income for their household responsibilities and dependants. Most waste pickers were interested in collecting plastic (50%) and polyethylene terephthalate (16%) waste. Lack of support from the municipalities, infrastructure and access to waste landfill sites was a concern for waste pickers.

**Keywords:** Human health, solid waste management, municipalities, landfill sites, transfer stations

## SIBUTSETELO

Kuphatfwa kwenkhukhuma (imfucuta) kubonakala kuyinsayeya yemhlaba kuto tonkhe tive. Ngesizatfu saloku, kunesidzingo lesikhulu sekucinisekisa kutsi inkhukhuma iphatfwa ngendlela lengatsintsi kabi imphilo yemuntfu, noma-ke imvelo/simondzawo ngebubanti baso, njengoba kushiwo eSigabeni se-24 seMtsetfosisekelo waseNingizimu Afrika. Lizinga leliphakeme lekweswelakala kwemisebenti likhutsata bantfu kutsi bacale umsebenti wekugcogca inkhukhuma njengendlela yekutingenisela imali. Lolucwaningo beluhlose kuhlola indzima ledlalwa bagcogi benkhukhuma etindzaweni lekulahlwa kuto inkhukhuma, ikakhulukanti etindzaweni tekulahla inkhukhuma, titeshi tekwendlulisa kanye nasetindzaweni tekutsenga kabusha, kanye netinkinga letikhinyabeta kugcogcwa kwenkhukhuma ngemphumelelo kwalabo labagcogca inkhukhuma kuSigodzi sase-Ehlanzeni eNingizimu Afrika, ikakhulukati.

Lolucwaningo loluchazako, lolwentiwe kubantfu labanyenti labahlukene kusetjentiswa tindlela tebunyenti. Indlela lelula yekwenta isampuli, isampuli yebagcogi benkhukhuma labange-46 nabosuphavayiza la-4, yafakwa kuluhlolokhono loluhlelekile lwekubonana buso nebuso nebagcogi bemininingwane kanye neluhlumibuto yekutibuta levalekile. Imininingwane yebunyenti yahlatiwa kusetjentiswa lphakheji Yetibalobalo yeSayensi Yetenhlalakahle (i-SPSS) yeluhlobo lwe-26.0 kanye ne-Microsoft Excel 2021.

Kwahlelwa luhlakamsebenti (ku-SPSS) lwekubamba lemininingwane legcogiwe. Ngemuva kwekungeniswa kwato tonkhe tinhlumibuto kusofthiwe, kwabese kwentiwa luhlathiyo lwemahlandla eminingwane. Imiphumela yemininingwane yendluliselwa ku-Microsoft Excel 2021, kute kutsi kuhlungwe kalula emathebuli netibalobalo. Imininingwane yalokungukona lucobo yahlatiwa ngesikhatsi seLuhlathiyo lwe-Tesch.

Imiphumela yakhombisa kutsi bagcogi benkhukhuma badlala indzima lebalulekile ekuphatfweni kwetindzawo tenkhukhuma ngekutsi banciphisa inkhukhuma ngekuyenta umkhicito lomusha. Masipala weSigodzi sase-Ehlanzeni akalusheshisi luhlelo lwekwenta tinchubomgomo tabo netintfo lekufanele kucalwe ngato kwentiwa tavelonkhe kutsi tihambisane nemibandzela ekugcogcwa kwenkhukhuma kutsi kube ngulokuhlelekile, lokubangele kweswelakala kwekwesekelwa kwebagcogi

benkhukhuma bomasipala bendzawo. Linyenti lebagcogi benkhukhuma bete emadokhumententi lafanele ekutsi bafakwe kudathabhesi yamasipala wenzawo, futsi loku-ke kwenta kutsi kube matima kutsi bomasipala banikete kwesekelwa lokudzingekako. Bahlanganyeli labanyenti bakhombise kutsi benta lomsebenti wekugcogca inkhukhuma kute kutsi batfole imali yekutiphilisa yetibopho temakhaya abo kanye nabomondliwa babo. Linyenti lalabagcogca inkhukhuma bebanshisekelo yekubutsa emaplastiki (50%) kanye nenkhukhuma ye-polyethylene terephthalate (16%). Kweswelakala kwekwesekelwa bomasipala, kanye nekufinyelela tindzawo lekulahlwa kuto inkhukhuma kwaba yintfo lebakhatsata kakhulu bagcogi benkhukhuma.

**Emagama labalulekile:** Imphilo yebantfu, kuphatfwa kwenkhukhuma lecinile, bomasipala, tindzawo tekulahla inkhukhuma, titeshi tekwendlulisa

## **KOMISO LOWU NGA NA VUXOKOXOKO BYA NDZAVISISO WA DYONDZO**

Vulawuri bya mathyaka byi vonaka byi ri ntlhontlho eka misava hinkwayo na le ka tinxaka hinkwato. Hikokwalaho ka sweswo, ku na xilaveko xikulukumba xa ku tiyisa leswo mathyaka ya khomiwa hi ndlela leyi nga ri ku na switandzhaku swo biha eka rihanyu ra vanhu, kumbe eka mbangu hi ku nava, tanihilaha swi nga vekiwa eka Xiyenge 24 xa Vumbiwa ra Afrika Dzonga. Ku kala ka mitirho swi endla leswo vanhu va ngenela eka ku rholela mathyaka tanihi ndlela yo kuma mali. Ndzavisiso lowu wu kambela ndzima ya varholeli va mathyaka eka tifasiliti ta vulawuri bya mathyaka, ngopfu ngopfu hi ku landzelela tisayiti ta tindhawu to lahla mathyaka ku nga ti landfill, switici swa ku hundzisa mathyaka, na tisenhara to xava nakambe, na leswi vahlengeleti va mathyaka va hlanganaku na swona eka Masipala wa le Ehlanzeni District eAfrika Dzonga ngopfu ngopfu. Ndzavisiso wu tirhise timethodi ta descriptive, cross-sectional na quantitative. Ku tekiwile sampuli ya thekniki ya convenience sampling, hi sampuli ya varholeli va mathyaka va 46 xikan'we na vasuphavhayisara va 4, hi ku endla ti-structured interview ta ku hlangana xikandza-na-xikandza na vatirhi va le tindhawini to tirhela xikan'we na nongonoko wa swivutiso leswi tsariweke swa close-ended questionnaire leswi vanhu a va tihlamulela swona. Ku xopaxopiwile quantitative data hi ku tirhisa Statistical Package for the Social Sciences (SPSS) version 26.0 and Microsoft Excel 2021. Rimba (hi SPSS) leri ku nga hlengeletwa hi rona vutivi ri lulamisiwile. Endzhaku ka loko nongonoko wa swivutiso hinkwawo wu ngenisiwile eka software, vuxopaxopi bya frikhwensi ya vutivi byi endliwile. Leswi nga kumeka hi vutivi swi ngenisiwile eka Microsoft Excel version 2021, leswo tithebuli na statistiki swi ta humesiwa. Ku xopaxopiwile vutivi bya qualitative hi ku tirhisa Tesch Analysis.

Vuyelo byi kombise leswo varholeri va mathyaka va tlanga ndzima ya nkoka eka tifasiliti ta vulawuri bya mathyaka hi ku hunguta mathyaka no endla leswo swilo swi tlhela swi tirhisiwa nakambe (recycling). Masipala wa le Ehlanzeni District kambe yena a nga si hlanganisa tipholisi ta yena na swilo leswi faneleke swi vekiwa emahlweni hi ku landza ku rholeriwa ka mathyaka, leswi nga na vuyelo bya ku kala ku seketeriwa ka varholeri va mathyaka eka vamasipala. Vunyingi bya varholeri va mathyaka a va na tidokumende leti faneleke leswo va ta katsiwa eka database ya masipala wa ndhawu, na swona leswi swi endla leswo swi nonon'hwa eka vamasipala ku nyiketa



hi nseketelo lowu lavekaka. Vaanguri vanyingi eka ndzavisiso va kombise leswo va endla nghingiriko wa ku rholela mathyaka ku kuma mali yo hlayisa mindzeni ya vona na vanhu lava va va wundlaku. Vunyingi bya varholeri va mathyaka va tsakela ku rholela tiplastiki (50%, na mathyaka ya polyethylene terephthalate (16%). Nkala nseketelo wa vamasipala, infrastrakchara na ku fikelela ti-landfill site i swilo leswi swi karhataku varholeri va mathyaka.

**Marito ya nkoka:** Rihanyu ra vanhu, vulawuri bya mathyaka yo khomeka, vamasipala, landfill sites, switici swo hundzisa

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## **ABBREVIATIONS**

EDM	Ehlanzeni District Municipality
EPA	Environment Protection Agency
IPEA	Institute of Applied Economic Research
IWMP	Integrated Waste Management Plan
IUCMA	Inkomati Usutu Catchment Agency
NEMA	National Environmental Management Act 107 of 1998
MDG	Millennium Development Goal
MSW	municipal solid waste
NWA	National Environmental Management Waste Act 59 of 2008
NWMS	National Waste Management Strategy
PET	polyethylene terephthalate
SAWIC	South African Waste Information Centre
SAWIS	South African Waste Information Centre

## GLOSSARY

**Municipal solid waste:** Unwanted solid fractions, generated from domestic units, trade centres, commercial establishments, industries and agriculture, institutions, public services and mining activities (Van Niekerk and Wegmann, 2019). In the study, *municipal solid waste* is defined as unwanted materials that are discarded in different waste management facilities, of which some have the potential to be recycled.

**Recovery:** Reappropriating waste which further serves a useful purpose by replacing other materials that would otherwise have been used to fulfil a given function (Gharfalkar *et al.*, 2015).

**Recycling:** Involves waste reuse, waste recovery and waste composting (Waite, 2013).

**Reuse:** An action or a practice of using a waste item, whether for its original purpose or to fulfil a different function (Pires *et al.*, 2019).

**Treatment and disposal:** Include the physical and chemical destruction of waste production. Disposal involves landfill, and is regarded as a last resort for waste management under the hierarchy (Bovea *et al.*, 2010).

**Waste avoidance and source reduction:** Include waste prevention and minimisation (Zorpas *et al.*, 2014).

**Waste management:** This controls the many disciplines and processes in the disposal of waste, with the aim that it be done in an appropriate manner, adopting best practices beneficial to the public in relation to health and wellbeing, economics, conservation and aesthetics, as well as factoring in environmental considerations, all of which is responsive to the attitude of civil society (Sukholthaman *et al.*, 2015). In this study *waste management* refers to the proper handling of waste until the final disposal, which will not pose a threat to health and the environment.



**Waste picker:** A woman, man or child who supports herself, himself or itself by trading or using valuables from materials that other domestic users and businesses have abandoned (Awopetu *et al.*, 2014). In this study *waste pickers* refer to individuals who collect different types of waste for recycling purposes

**Waste recovery:** This is an amount of waste that is collected and recycled or treated (Cucchiella *et al.*, 2015).

## CHAPTER 1: INTRODUCTION

### 1.1 Background of the study

The twenty-first century has resulted in many parts of the world experiencing rapid rates of urbanisation, with most cities and surrounding areas seeing exponential growth in their populations (Cobbinah *et al.*, 2015; Venter, 2019). The critical achievement of urbanisation in most countries, particularly those that were previous agriculturally dominated economies, ends in the formation of new urbanised cities and countries (Barrett *et al.*, 2019). However, with urbanisation comes a need for many services that can improve the environment and the lives of people, which include proper waste management as a result of the rapid generation of waste due to continually growing populations.

Around the world, waste generation rates are rising. According to Hakuzimana (2021), the world's cities generated 2.01 billion tons of solid waste in 2016, amounting to a footprint of 0.74 kilogram per person per day (Barrett *et al.*, 2019). With rapid population growth and urbanisation, annual waste generation is expected to increase by 70% from 2016 levels to 3.40 billion tonnes in 2050 (Kaza *et al.*, 2018).

In countries such as Australia, waste management accounts for approximately 20% of municipal budgets while waste management in the municipal budget in countries such as Pakistan accounts for about 10%, as this service falls under the jurisdiction of local government (Kaza *et al.*, 2018). In many countries, local government is dependent on national government for finances for waste management services but national government often does not prioritise these services. Even though waste management services have been decentralised, fiscal decentralisation has generally not been followed. Most municipalities in South Africa are failing to meet the demand for effective and efficient waste management services (Guerrero *et al.*, 2013).

Solid waste management remains one of the most challenging concerns in rural areas and urban cities, as the enormous amounts of solid waste produced pose a severe contamination problem (David *et al.*, 2019). The various challenges faced by many developing and urbanising countries such as South Africa are that it has areas that lack

waste collection and management services. This phenomenon is also exacerbated by lack of waste management knowledge and practices among the public who are primarily the initial waste generators. This has presented a great deal of issues such as illegal dumping. From this challenge comes opportunities of turning waste into an economic activity: thousands of men and women have taken to waste picking as a way to survive harsh socioeconomic conditions in their cities (Godfrey and Oelofse, 2017).

Waste pickers have become important players in improving the waste management in municipalities, thereby reducing the waste collection inefficiency gap (Zon *et al.*, 2020). The term *waste picker* has numerous definitions. According to Marelllo and Helwege (2018), 'waste pickers are individuals who generate an income through selling recyclable material found in waste disposal sites.' The Gutberlet and Uddin, 2017 (DEA, 2017) refers to waste pickers as people engaged in gathering recyclable materials, which they collect from waste that has been disposed of at landfill sites and elsewhere. Those recyclables are then used or traded by the waste pickers to earn a living. Waste pickers move from one place to another, collecting material from areas that include landfill sites, canals, dump sites and watercourses (Schenck *et al.*, 2019).

Previous studies conducted in South Africa have shown evidence that waste picker activities contribute highly to the country's economy and environmental protection. However, they have been undervalued and marginalised (Da Silva *et al.*, 2020). In cities and developing countries, many people depend on recycling materials from waste for their livelihoods, as unemployment remains high (Mvuyane, 2018). While the earnings are low, some families have been able to provide for themselves and their dependents through this type of informal employment. Waste picking has found a role for itself as a response to poverty, unemployment and the shortage of social security services (Marelllo and Helwege, 2018).

Waste recycling has increasingly gained recognition for its influence on sustainable development. Fergutz *et al.* (2011) indicated that recycling activities in Latin America were undertaken by some of the lowest-income community residents who relied on selling recyclables to sustain themselves. It has been reported that in Asian and Latin American cities, up to 2% of the population survived through waste picking (Hettiarachchi *et al.*, 2018). Hence, waste pickers have made a great contribution in developing

countries, as their municipal solid waste processing relies primarily on the informal reclamation of recyclables from waste pickers (Dias, 2016). Subsequently, waste pickers are becoming important players in waste management as they make waste available to recyclers who then convert it into useful resources (Sasaki and Araki, 2013).

Maema (2017) states that waste pickers contribute to waste minimisation and management, and that most municipalities have been slow in aligning waste pickers with integrated formal waste collection systems. Ehlanzeni District Municipality in Mpumalanga Province, South Africa, which is the area study of this research, has not done much in terms of incorporating waste pickers into formal waste management plans.

## **1.2 Research problem**

Solid waste management remains a challenge in most municipalities in South Africa as they face increasing pressure due to the growing waste generation. It is estimated that a total of 12.7 million tonnes of domestic waste is generated in the country per annum (Simatele *et al.*, 2017). Every year approximately 3.67 million tonnes of this waste is not collected and treated through formal waste collection systems (UNEP, 2020), resulting in large amounts of waste being dumped illegally. Ehlanzeni District Municipality is not an exception (Verster and Bouwman, 2020). Some of the challenges faced by this municipality with regard to solid waste management include, but are not limited to, illegal dumping, lack of resources (e.g., tipper trucks, fork lifts and excavators), littering, and poor access roads in informal settlements and rural areas (Verster and Bouwman, 2020).

Waste management practices in regions of the Ehlanzeni District Municipality pose a threat to the environment by polluting natural resources through high levels of littering and illegal dumping. Illegal dumping has a negative impact on natural water sources, for example, waste products find their way into river systems thereby affecting the water quality (Shama and Sharma, 2022). Furthermore, inefficient waste management by municipalities in the Ehlanzeni District Municipality has resulted in increased health risks, increasing outbreaks of communicable diseases such as cholera and typhoid (Addo *et al.*, 2015). In addition, the effects of inappropriate waste management practices are experienced more severely by underprivileged communities (Wilson, 2006).

The activities of waste pickers are clearly visible within the Ehlanzeni District Municipality. However, it seems not much is being done by municipal authorities to recognise their efforts in the waste management system. Only the City of Mbombela, Bushbuckridge and Nkomazi Local Municipalities are keeping records of the tonnage of waste disposed of at the landfills, as well as logging other statistics (Stats SA, 2016). While research has been and continues to be conducted, there are gaps when it comes to the South Africa context (Rosa and Cerelli, 2018). In Ehlanzeni District Municipality no study has been done on the challenges and limitations faced by waste pickers, hence the need for the current study.

### **1.3 Motivation for the study**

Perez (2021) highlighted the fact that incorporating waste pickers into formal waste management systems is socially, economically and environmentally beneficial to both municipal authorities and the waste pickers. Hence, the need to develop a waste management system with an integrated approach that is mutually inclusive. It is also noted that waste pickers play a significant role in waste management, but are marginalised by most authorities (Asim *et al.*, 2012; Aparcana, 2017; Gall *et al.*, 2020). Waste picking is an entrepreneurial activity that creates employment, thus providing a living for the poor, while simultaneously assisting authorities in waste management by creating a clean environment (Ahmed and Ali, 2004). Although some communities associate waste pickers with dirtiness and mentally disturbed individuals (Gitau, 2019; Wittemer, 2021), and sometimes criminals, their contributions to overall waste management cannot be overlooked (Porrás *et al.*, 2021).

Historically, South African waste pickers in general have played a crucial role in the waste-recycling sector, for example, in the minimisation of general waste through recycling initiatives and separation of waste at source (Da Silva *et al.*, 2019). However, although it is challenging to measure the contribution made by the waste pickers in Ehlanzeni District Municipality, their significant contribution to waste management within the district indicates that there is a need to include waste pickers in future plans.

The municipalities have not taken a keen interest in supporting the work of waste pickers, despite the latter's considerable contribution to the efficacy of the waste management

system (Davis and Garb, 2015). This research addresses some of the gaps, which include, but are not limited to, quantifying the contribution made by the waste pickers. This research has come up with practical solutions and recommendations that can be implemented by municipalities and other relevant institutions. This can be done by ensuring that waste pickers are prioritised, their work is supported, and that their activities are integrated into the municipal service delivery budget and implementation plans.

#### **1.4 Research questions**

- ❖ What are waste-picking processes in Ehlanzeni District Municipality?
- ❖ What type of waste disposed and reclaimed form the management facilities?
- ❖ What is the safety of waste pickers at the landfill sites?
- ❖ What are constraints hindering effective waste collection by waste pickers at the landfill sites, transfer stations and buy-back centres?
- ❖ What is the waste management legislation on waste pickers in the Ehlanzeni District Municipality?

#### **1.5 Aim of the study**

The aim of the study was to assess the role of waste pickers at waste management facilities within Ehlanzeni District Municipality, Mpumalanga Province, South Africa.

#### **1.6 Research objectives**

- ❖ To evaluate the waste-picking processes such as collection, transportation, recycling and storage within Ehlanzeni District Municipality.
- ❖ To identify the types of waste disposed of, and reclaimed from, waste management facilities.
- ❖ To assess the safety of waste pickers at landfills around the district.
- ❖ To evaluate the constraints hindering effective waste collection by waste pickers at landfill sites, transfer stations and buy-back centres.
- ❖ To assess and analyse the existing legislation on waste pickers.

## 1.7 Chapter breakdown

**Chapter 1:** This chapter introduces the background of solid waste management and waste pickers worldwide. It also provides the motivation for the study, research problem, research questions, and the aim and objectives of the study.

**Chapter 2:** This chapter introduces the literature on the topic for a better understanding of the background. Waste management, waste pickers, waste hierarchy, integrated waste management, challenges experienced by waste pickers, health and safety of waste pickers, and the existing legislation and policies on waste management are discussed in this chapter.

**Chapter 3:** This chapter identifies and explore the research methods used during the study, sampling methods, data collection, data analysis and the limitation of the study.

**Chapter 4:** This chapter provides the results of the study and a discussion thereof.

**Chapter 5:** This chapter contains the conclusions drawn from the study results and discussions. Furthermore, recommendations are made based on the findings of the study.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Waste management

The need for waste management comes about as a result of civilisation and the development of societies (Rhyner *et al.*, 2017). Societal development triggered waste challenges, as people began dumping waste products into river systems and on vacant lands (Ramesh *et al.*, 2017). Consequently, modern societies have developed modern waste management practices, which include incineration, composting and landfilling (Pujara, *et al.*, 2019). In South Africa, the incineration of waste in households has been banned as a waste management method due to its negative impact on the environment, such as air pollution, which affects the health of communities and their surroundings; and global warming, which leads to negative impacts on climate change (Thakur *et al.*, 2021). However, there are controlled facilities that still use incineration as one of their methods to control waste (Thakur *et al.*, 2021).

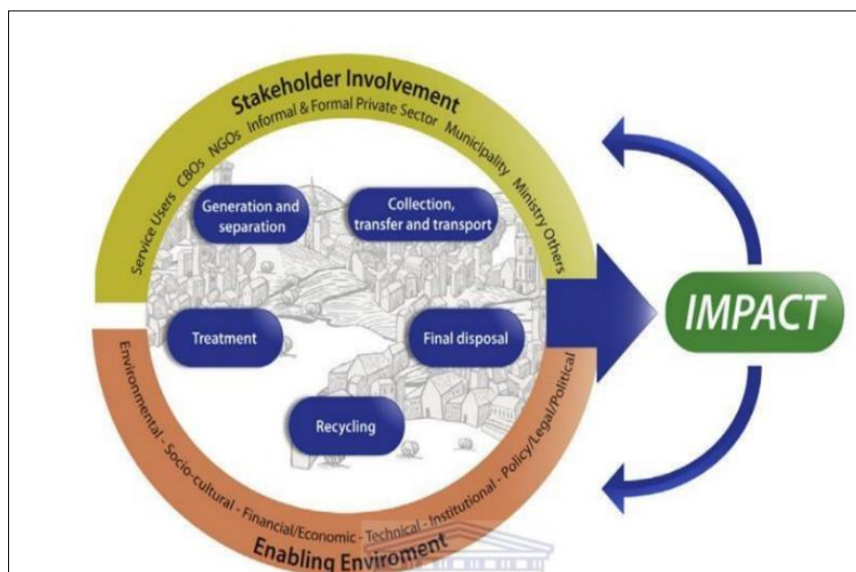
South Africa has made progress in meeting environmental sustainability as a Millennium Development Goal (MDG). There are eight (8) MDGs for South Africa and Goal seven (7) is to ensure environmental sustainability. However, there are still some challenges in ensuring environmentally sustainable development paths (Ololade and Rametse, 2018). For example, in 2015 it was reported that 80% of landfill sites in South Africa were licensed for operation in compliance with the National Waste Management Licence Strategy (Mokoena, 2019).

In Ehlanzeni District Municipality, environmental sustainability is being partially met due to limited resources; for example, insufficient personnel to perform environmental management services. Waste management is one of the key functions at the district municipality. However, policies and programmes are compiled by the Department of Forestry, Fisheries and the Environment. As a result, the district municipality has to acquire sufficient resources such as approved plans or strategies to fully implement the MDG (Department of Forestry, Fisheries and the Environment and Department of Science and Innovation, 2020).



### 2.1.1 Integrated waste management

Integrated waste management (IWM) (Figure 2.1) involves the integrated system of waste collection, transportation and final disposal in a manner that does not create a health nuisance and does not affect the environment negatively (Okot-Okumu, 2012; Ziraba *et al.*, 2016). It can be described as a means of waste management that focuses on integrating environmental, socio-cultural, legal, institutional and economic activities, and presents a system that enables efficient waste management practices. A recent study by Ayorinde *et al.* (2021) recommended possible IWM strategies in order to achieve the sustainable management of waste.



Source: WASTE, 2004; adapted from ISSOWAMA Consortium, 2009

Figure 2.1: The integrated sustainable waste management model

South Africa has aimed to balance the broader economic and social challenges of its developed and unequal society while trying to protect environmental resources (Ziervogel, 2019). What is critical in terms of waste management is the balance between product design, resource efficiency and waste prevention, with minimisation where avoidance cannot be implemented (Yano and Sakai, 2016). There is also a need to investigate the extent to which waste pickers are accommodated by local authorities in the latter's IWM plans and strategies, to improve waste management efficiency (Pholoto, 2016).

Most developed countries, such as those in the United Kingdom, are aware of these IWM systems, however, implementation is a challenge (Wilson *et al.*, 2012, 2013). In South Africa, effort is being made to implement IWM practices, though it has been noted that much of the work has concentrated on developing good waste management legislation without proper implementation plans (Mmereki, 2018). Moreover, other factors, such as investigating the need to introduce waste pickers into waste management strategies have not been considered (Mohee and Simelane, 2015).

### 2.1.2 Waste Management Hierarchy

The Waste Management Hierarchy (Figure 2.2) is a concept in waste management that ranks waste management methods from the least preferred to the most preferred (Perrot and Subiantoro, 2018). It aims to encourage a shift within waste management practices that ensures environmental and economic sustainability. The first step is waste avoidance, which deals with the separation of waste at the source by encouraging a reduction in waste generation. The second step is recycling, which encourages consumers and communities to retain waste for reuse. The third step is the treatment of waste that cannot be recycled or reused before implementing the final step, which is disposal at landfill. Implementing the waste management hierarchy goes a long way towards a greener, less wasteful future (Traven, 2019). The Waste Management Hierarchy was adopted in South Africa when the National Environmental Management Waste Act 59 of 2008 (NWA) was promulgated. It is the responsibility of local government to implement waste minimisation efforts.

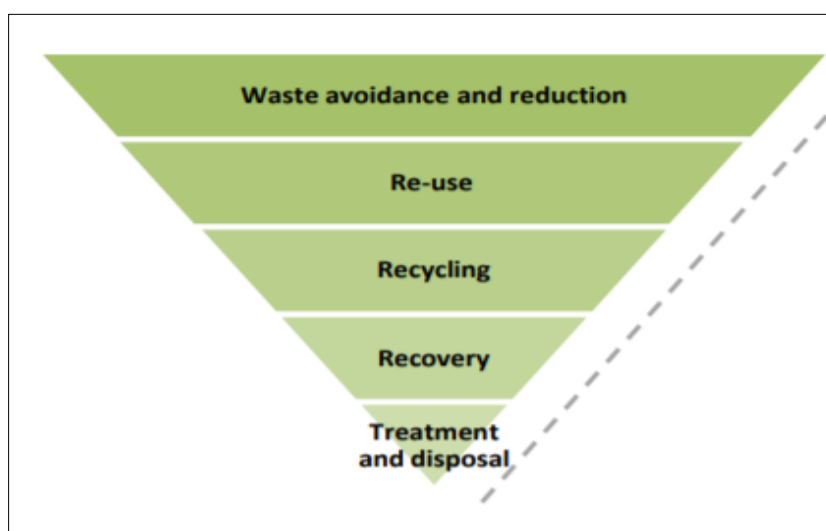


Figure 2.2: Waste Management hierarchy (Traven, 2019)

### 2.1.3 Waste generation, types and quantities of waste

The characterisation and quantification of municipal solid waste is considered a basis for proper planning and implementation of waste collection and transportation methods (Ugwu *et al.*, 2020). Waste is mainly generated from the following sources: agricultural activities, household or domestic activities, commercial activities and natural waste, which includes garden refuse and animal carcasses (Abdel-Shafy and Mansour, 2018). The amount of waste generated worldwide annually amounts to 2.1 billion tons with at least 33% of that waste not managed in an environmentally safe manner (Awopetu *et al.*, 2014).

In India, municipal solid waste largely comprises decomposable waste. This includes foodstuff waste, kitchen waste and green waste such as vegetables, fruit, flowers, leaves and paper (Ong *et al.*, 2018). Rogoff and Screve (2013) explained that approximately 40–60% of municipal solid waste in India was compostable, while inert waste comprised between 30 and 50%, of which between 10 and 30% was recyclable. It was also found that the city of Bangalore in India generated 2 000 tons of waste every day, most of which was made up of vegetable matter (78%), with the remainder comprising paper (4%), plastic (2%), glass (1%) and (15%) miscellaneous items (Anantharaman, 2014).

Of the about 40 000 tons of waste produced in Latin America, calculations revealed that two thirds of the produced waste originated from households (Friedrich and Trois, 2016). The United States of America generated an estimated 292,4 million tons of waste, while about 96 million tons of that waste was recycled and another 25 million tons was compacted (Shiner, 2018).

Two decades ago, in Nigeria, waste generation was estimated at a 20 kilogram rate per capita per year (Elagroudy *et al.*, 2016). However, a decade-and-half later, according to Awopetu *et al.* (2014), approximately 2.8 million tons of solid waste per year was generated in Nigeria. Moreover, of the waste that was produced in Nigeria, 55% was organic and 37% inorganic waste (i.e., glass, paper, plastic, metal and textiles).

Research conducted by Gumbi and Mnkandla (2015) stated that South Africa produced up to 42 million cubic square metres of solid waste annually. The amount of municipal

solid waste in South Africa was 42 230 000 cubic metres in 1997, and this increased to 54, 2 million tons in 2019 (Dhal *et al.*, 2013). Waste pickers in South Africa recover several solid waste materials, including scrap metals such as copper, steel, aluminium, lead and iron. Other material collected includes newspapers, magazines, cardboard, plastic, glass and garden waste (Gumbi and Mnkandla, 2015). Scrap steel was further found to be the most recovered material, followed by plastic (Gumbi and Mnkandla, 2015). The same study noted the significant role waste pickers played in the minimisation of waste.

#### **2.1.4 Types and quantities of recyclables reclaimed from landfill sites**

A study carried out in Brazil suggested that in 2006 the worldwide rate of city waste recycling was 11% (Kim *et al.*, 2006). The arid part of the cities in Brazil (producing 77 000 tons per day) has a recycling rate of roughly 18%, and organic materials in Brazilian urban waste form 55%. Specialists provide extremely positive approximations concerning the recycling market in Brazil, which creates a revenue of US\$1.2 billion annually (Fergutz *et al.*, 2011).

Gowan (2009) indicated that 'in the city of San Francisco, the informal waste pickers (gathering plastics, bottles, cardboard and aluminium cans) make an amount ranging from US\$5 to US\$20 daily. Many waste pickers work up to twelve hours each day, taking in two or three loads of 50–100 kilograms of waste per day.' According to Aparcana (2017) waste pickers in the informal sector appear to have the solution to the solid waste management disaster, as they recycle up to 70% in Santiago, the capital of Chile, recycling 10.1% of all waste created as well as saving US\$12 million yearly.

In Nigeria, a survey carried out at the Awotan solid waste landfill site suggested that the waste production rate per capita annually was projected at 20 tons (Idowu *et al.*, 2019). It was further predicted that around 2.8 million tonnes of solid waste were generated in Nigeria annually (Yahya *et al.*, 2018).

According to research conducted in Pretoria and Bloemfontein, South Africa, the recyclable material product with the highest minimum, maximum and average price in Pretoria (apart from scrap metal) was white paper (Viljoen *et al.*, 2019a). The highest

price per kilogram in Bloemfontein was for polyethylene terephthalate (PET). Most buy-back centres collecting PET export their excess to countries such as China, and therefore their prices are at times influenced by the exchange rate (Viljoen *et al.*, 2019b). The study also revealed that the level of business activities at buy-back centres differed from day to day, and most were said to be particularly busy in December and January (Mutungwa, 2016). Viljoen and Schenck (2019) indicated that 'all eleven buy-back centres bought the recyclable waste products, which included white papers and cardboards as well as other types of recyclables.

A different view has been noted in Bloemfontein, as only 71% of the buy-back centres bought cardboard, where over 50% bought newspaper and magazines. The buy-back centres in Bloemfontein only buy 43% of coloured paper and mixed paper, indicating that the demand for these products is very low. Additionally, the buy-back centres in Pretoria only purchased 70% of paper, where 50% of PET is purchased in Bloemfontein. Rarely do urban buy-back centres purchase other plastic products such as polyvinyl chloride (PVC), polystyrene (PS) and polypropylene (PP), and only about 50% of the buy-back centres in Pretoria also buy glass and cans. While Bloemfontein's buy-back centres buy cans and glass, most of them prefer cans. Finally, 43% of the buy-back centres also purchase ferrous and non-ferrous metals on a huge scale (Mwanza *et al.*, 2018).

## **2.2 Waste-picking activity in waste management**

Dias (2015) revealed that Brazil was the only nation that systematically captured and reported official statistical data on waste pickers. Data collected by Brazil's official statistical system found over 229 000 people in this occupation in year 2008 who were responsible for high rates of the recycling in the country, which accounted for nearly 92% of aluminium and 80% of cardboard recyclables (WIEGO, 2021). It was further revealed that formal and informal employed waste pickers represented 1% of the urban workforce, about 0.1% in India, 0.1–0.4% in seven West African cities and 0.7% in South Africa (WIEGO, 2021).

Schenck *et al.* (2016) noted that waste pickers made a substantial impact on environmental management in different cities, as well as rendering services to the local economy. It was reported that in 2008, 15 million people living in the urban areas of

developing countries made a living through picking waste (Ziraba *et al.*, 2016). Waste picking involves collecting and searching for used products and recoverable materials from streets, landfill sites and illegal dumping hotspots (Thangavelu, 2013). Waste-picking activities are predominantly carried out by vulnerable and marginalised people referred to as *waste pickers*. Research by Chen *et al.* (2018), which focused on developing an approach to adopt waste pickers into a formal framework, concluded that waste pickers can play an integral role in waste management. Waste pickers can be categorised as follows:

- ❖ *Itinerant waste pickers*: According to Ezeah *et al.* (2013), they collect recyclables from door to door
- ❖ *Street waste pickers*: Who collect secondary raw materials from households, waste from streets, illegal dumping hotspots, transfer stations and buy-back centres (Sembiring and Nitvattanon, 2010).
- ❖ *Municipal waste pickers*: Who collect recyclables as they transport solid waste to disposal sites and sell to buy-back centres (Sembiring and Nitvattanon, 2010).

The role that waste pickers play in municipalities' waste management, include ongoing waste collection, sorting and recycling, which has a positive impact that improves public health and sanitation, moreover results in the reduction of expenses from municipal waste management services budget (WIEGO, 2014). A United Nations World Cities publication on Solid Waste Management found that waste pickers performed about 50–100% of ongoing waste collection in most developing countries.

### **2.2.1 Challenges of waste pickers**

A study carried out under Khabokedi Waste Management Company in 2016 at Johannesburg listed the following as difficulties faced by waste pickers: health and safety; lack of personal protective equipment; lack of security; exposure to injuries; exposure to dangers in terms of equipment and potentially harmful items; exploitation by recyclers, collectors and transporters; no secure income; lack of infrastructure applicable to their business; poor working relationship with local government; lack of implementation of the legislative frameworks, recycling by-laws and recycling programmes; lack of support, as they are not formally recognised (Blaauw *et al.*, 2019).

Reyneke (2016) also explained that some of the difficulties and limitations faced by waste pickers included: lack of unity between waste pickers, as they compete for recyclable materials; the buyers of recyclable materials were unfair and inconsistent with their pay; municipal officials overlooked waste pickers' problems and commonly treated them unfairly; and weighing of the waste on measuring scales was not always consistent.

High levels of unemployment forced people living in South Africa to seek work in the informal sector of the country's economy. Various activities of waste pickers became a contributing factor due to the challenge of the high employment rate in the country. Landfill waste pickers recover recyclables on mountains of waste and sell to different buy-back centres in their respective areas. Despite the hardships, working under unbearable working conditions and earning a poor income, landfill waste pickers have managed to sustain their livelihoods (Mudavanhu, 2020).

#### **2.2.1.1 Informality in the work administration of waste pickers**

Informal waste personnel do not register their activities or recyclables material, which leaves the quantities of recyclables picked out of the municipal solid waste stream unknown. This points out the size and importance of the existing informal recycling system, with an emphasis on the gathering of recyclables (Dlamini *et al.*, 2017). A study carried out in Brazil revealed that there were no legal frameworks to attribute responsibility for waste, and no common tax incentives to inspire accountability. Commonly, waste pickers have no citizenship rights and there are limited controls regarding their capacity to form part of adding value through conducting recycling activities. There are limited studies available to guide the future development of the market for recycling products, making it difficult to predict what may be required (Fergutz *et al.*, 2011).

#### **2.2.1.2 Lack of policy and government support**

Societal perceptions are one of the difficulties waste pickers face. In Bogota, Columbia, and Durban, South Africa, about 97% of waste pickers said social perceptions and exclusions were a problem in their line of work (WIEGO, 2020). Waste pickers lack government support and are mostly excluded in public policy formation processes. They

are treated as nuisances by authorities. The non-improvement percentage in areas receiving waste management services may be a consequence of developing country governments still needing to address issues of urbanisation, human settlement, sanitation and poverty (Ferronato and Torretta, 2019).

#### **2.2.1.3 Lack of infrastructure for waste-picking activities**

The occupation of waste pickers is mostly impacted by their access to waste which has been a problem worldwide. This is supported by a study conducted by Women in the Informal Economy: Globalizing and Organizing (WIEGO) (2014) that revealed that 85% of waste pickers in Durban and 74% in Nakuru lacked access to waste. Upon accessing waste, waste pickers resorted to sorting and storing. However, this has been picked up as one of the challenges as there is lack of infrastructure for such activities. Moreover, it was found that Thaba Chweu landfill sites in Ehlanzeni District Municipality had no weighbridges, making it difficult to quantify the waste that is collected and resold for recycling. Furthermore, the workers at some landfills lack the appropriate training to deal with waste pickers (Van Heerden *et al.*, 2015).

#### **2.2.1.4 Waste picker workplace health and safety**

Waste from industries could comprise contaminated materials such as heavy metals and edible material in the waste may lead to food poisoning, while sharp objects can cause cuts (Cercelaru *et al.*, 2016). There are also risks of explosions, especially at landfills where fire is present (Rim-Rukeh, 2014). The waste pickers in most areas face a wide array of dangers, ranging from being cut or pricked with sharp objects, to coming into contact with toxic material (Owusu-Sekyere, 2014). This situation becomes desperate for the majority of waste pickers who do not have access to protective clothing, and as such have no means to reliably protect themselves from harm (Schenck *et al.*, 2019). Most of the waste pickers in a study carried out in Nigeria confirmed that they experience serious headaches and backaches. The headaches can result from working under direct sunlight as they scavenge for items to sell. They also become susceptible to respiratory disease due to toxic emissions (e.g., methane) present at the dumpsites (Osho, 2016). The same study attributed back problems to the long distances waste pickers have to travel while carrying heavy loads.



A study conducted by WIEGO (2021) found that waste pickers were mostly concerned about occupational risks such as ergonomic problems, exposure to extreme temperatures in the sun, chemical hazards and gender violence for women waste pickers. Hunter (1997) described the health risks that come with waste picking in India, explaining that more than five million people in the south of India were estimated to die annually as a result of diseases related to the poor disposal of waste. Occupational risks for waste pickers include coming into contact with faecal matter, and this can easily transmit bacteria from hands to the mouth, resulting in infections. Waste pickers are also exposed to biohazardous waste from hospitals such as syringes, razor blades, body parts and dressings (Hunt, 1996).

In Bangalore, India, another study revealed that children waste pickers were at a higher risk of contracting health problems such as worm infestation, scabies, xerophthalmia, upper respiratory tract infection, dental caries, abdominal pain, fever, pallor and lymph node enlargement, when compared with children of a similar demographic who are not waste pickers (Ibrahim, 2017). Some of the reasons for these infections and infestations were associated with children handling materials contaminated with human waste, and thereafter touching food or putting their fingers into their mouths. It was further suggested that some become infested with parasites through feeding on food found at disposal sites (Linder and Meissner, 2015).

### **2.3 A discussion on legislation, policies, regulations and guidelines that govern waste in South Africa**

Globally, as well as in South Africa, waste and the management thereof are governed by legislation to ensure the protection of those involved. According to section 24 of the Constitution of South Africa, 1996 (which is the supreme law of the country), everybody has the right to an environment that is not harmful to their health and wellbeing. Moreover, a number of principles have been set by the National Environmental Management Act 107 of 1998 (NEMA) with the potential to affect the environment.

The National Waste Management Strategy (NWMS) was established to deal with the classification of waste, and the following legislation was also passed: National Water Act 36 of 1998, NEMA, and the National Environmental Management: Air Quality Act 39 of

2004, National Environmental Management: Waste Act 59 of 2008 as amended, National Environmental Management: Waste Amendment Act 26 of 2014 and the National Environmental Management Laws Amendment Act 25 of 2014.

According to the Department of Forestry, Fisheries and the Environment and the Department of Science and Innovation (2020), waste pickers as South Africa residents, are 'entitled to rights stipulated in the Bill of Rights in the Constitution (1996)'. These rights are explained in the Waste Picker Integration Guideline for South Africa (2020) as follows:

Respect and dignity are the right of all humans; therefore, waste pickers also have this right, both inside and outside of their work, to be treated equally without judgment irrespectively of their gender, race, class and nationality.

Life is the right of all human beings; therefore, waste pickers have the right not to be killed or threatened with their lives.

Freedom of thought, conscience, religion, belief and opinion is a right that should be enjoyed by all citizens, including waste pickers.

Each person in South Africa has a right to choose their occupation, profession or trade; therefore, waste pickers have a right to trade their labour and recycling materials to the businesses they select in order to sustain their livelihood.

Everybody has the right to a living and working environment not detrimental to their health or wellbeing; as such, waste pickers have a right to working conditions that do not threaten their safety and health, as well as having the right to conditions effective in the earning of a living.

Freedom of association is a right for all; consequently, waste pickers have the right to choose who they connect with or join, be it an individual or a group.

The waste information regulation gives effect to section 60 of the National Environmental Management Waste Act, regulating the procedure and criteria for the submission and processing of applications to register on the national waste information system National

Environmental Management: Waste Act (Act 59 of 2008). Registration and reporting of listed activities on the waste information system is a requirement under the National Environmental Management Waste Act (Act 59 of 2008). The activities consist of general waste disposal facilities that receive more than 150 tonnages of waste daily, recycling and treatment facilities, the trading of hazardous waste (import or export) and energy recovery facilities (Williams, 2005).

The national waste information system for the recording, collection, management and investigation of data and information must take into account data on the quantity and type or grouping of waste that is produced, put in storage, reduced, reused, recycled transported, transformed, treated or recovered (National Environmental Management Waste Act, 2008). The Department of Forestry, Fisheries and the Environment's waste information regulations (in terms of section 69 of the National Waste Act) include waste categorisation. This is necessary to regulate the collection and reporting of waste data and information in the South African waste information system (Liu *et al.*, 2020).

The system is user-friendly and informative, detailing the forms and magnitudes of waste produced, together with data collected by municipalities. Municipalities can either enter this data directly into the South African Waste Information System (**SAWIS**) at the Department of Forestry, Fisheries and the Environment website, or the data can be manually provided to a Provincial Waste Information Officer who will then populate the information on the South African Waste Information System (SAWIS) (SAWIS, 2021).

Waste management is a concurrent function among the three spheres of government: the Department of Forestry, Fisheries and the Environment (DFFE), as the custodian of environmental management, is mandated to ensure a safe and healthy environment that is not harmful to the health and wellbeing of the people of the nation (Chiti, 2014). In respect of its constitutional obligation, the DFFE promulgated the National Environmental Management: Waste Act 59 Of 2008 (Waste Act), and two years later in the year 2010 established the NWMS. In South Africa, waste management has been a major topic for deliberations in most environmental policies and strategies-related discussions. In the Polokwane Declaration in 2002, the following resolutions were taken: waste generation to be reduced by 50% in 2012, waste disposal to be reduced by 20% in 2012 and zero waste produced by 2022 (Department of Forestry, fisheries and environment, 2014).

In South Africa rapidly increasing urbanization, together with inadequate governance structures, and financial and technical resources, has resulted in waste collection services that are rarely provided in a rightful and regular way (Ahmed *et al.*, 2019). In cities with households that do not receive waste collection or that receive irregular waste collection, it is informal workers that remain the only means for the collection of waste, reclaiming waste for income, while providing an important community service (Corvellec *et al.*, 2013). In cities that lack municipal recycling initiatives, waste pickers provide augmentation by recovering recyclables and ensuring the formal recycling chain is provided with the input of raw materials (Dias, 2016).

Rogan *et al.* (2017) state that Ghana, akin to a number of other countries, lacks precise legislation on informal waste pickers. This elucidates the trend in government organisations to disregard informal waste picking in their policies and strategies (Agamuthu *et al.*, 2009). Chen *et al.* (2018) also clarify that as a result of policy not including or giving attention to informal waste pickers, waste pickers are thereby not covered by labour laws. As such, they receive no official support or welfare.

Consequently, the neglect of policy results in their disempowerment, further exacerbating several difficulties present in the form of labour they undertake.

The result therefore is that, with the lack of proper government and society communication, these waste pickers are marginalised and left without legal protection or even societal acknowledgement. Dinler (2018) states that waste pickers are not recognised under Indian law and as such face discrimination. Municipalities prohibit the collection, sorting and selling of waste from landfill sites across the country by waste pickers, and municipalities consider this to be theft under Indian law. Gügüş (2019) elucidates that several waste pickers that were questioned had been arrested at least once and had been charged for petty cases.

O'Hare's (2019) revealed that lack of recognition was the cause for migrant waste pickers not qualifying for government schemes. This is coupled with their challenges in receiving electricity, ration cards and water facilities. This has had a major negative impact on their livelihoods, and on their psychological and physical wellbeing (O'Hare, 2019).

There are no legislation and policies on waste pickers in South Africa. The only 'official' document is the Waste Picker Integration Guideline for South Africa. This guideline explains: (1) Why waste picker integration is important; (2) Who waste pickers are, how they work, and the importance of recognising their contributions; (3) What waste picker integration is; and (4) How to develop, institutionalise and implement waste picker integration plans (DFFE, 2020).

Common ground between the informal and formal sectors must be created before new waste management legislation can be drafted with the view to effectively incorporating the current informal recycling system into the formal systems (Makwara and Snodia, 2013).

#### **2.4. Summary**

This literature review has confirmed that waste picking brings abundant social and economic benefits to society, including employment, social status, clean environment, raw material savings, income generation, poverty alleviation, promotion of conservation of natural resources and reduction of landfill space. Despite substantial research done on recycling and waste management, informal waste pickers have long been unrecognised stakeholders on the fringes of the urban waste landscape. The current study investigates the role played by informal waste pickers in waste management, and adds value to the work done by other researchers in the field of recycling and waste management. Furthermore, studies of informal waste collectors elsewhere point to the fact that these people are generally marginalised as they are uneducated and extremely poor.

## CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

### 3.1 Study area and population

Municipalities are at the coalface of service delivery and stand as the closest sphere of government to communities, mandated to provide support as per the requirements of the Constitution and the Local Government Systems Act 32 of 2000 (Ehlanzeni IDP, 2021). Ehlanzeni District Municipality (Figure 3.1) is a Category C municipality and one of the three district municipalities in Mpumalanga Province. Ehlanzeni District Municipality is found in the north-eastern section of Mpumalanga and includes the entire southern part of the Kruger National Park. It is bordered by both Mozambique to the east and Eswatini to the south (Ehlanzeni District Municipality, 2019). Mpumalanga Province is estimated to have a land size of 76 495 square kilometres; and Ehlanzeni District Municipality covers 27 895.47 square kilometres, which is approximately 36.47 % of the land area (Ehlanzeni District Municipality, 2019).

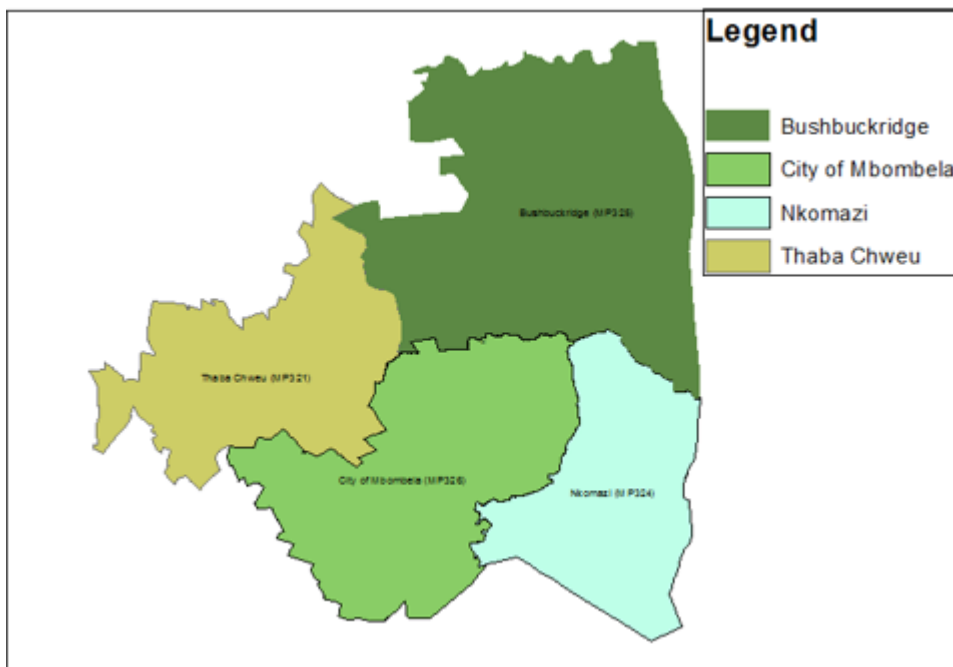


Figure 3.1: Ehlanzeni District Municipality map (GIS, 2019)

Ehlanzeni District Municipality's adjacent district municipalities are Sekhukhune in the north, Gert Sibande in the south and Nkangala in the west. Furthermore, Ehlanzeni District Municipality comprises four local municipalities, namely (1) Thaba Chweu Local

Municipality, (2) Bushbuckridge Local Municipality, (3) the City of Mbombela and (4) Nkomazi Local Municipality. The district promotes investments, economic growth and job creation (Ehlanzeni IDP, 2021). Situated in the provincial capital of Mpumalanga, Ehlanzeni District Municipality remains one of South Africa's popular tourist destinations due to its beautiful landscapes, as portrayed by the splendid meandering slopes showcasing the natural, inspiring areas of the district such as the Mac Mac Falls, God's Window, Bourke's Luck Potholes and many others. Inspiration is drawn from the province's pay-off line, 'The Place of the Rising Sun', which communicates a life experience of hope and abundant opportunities (Ehlanzeni IDP, 2021).

The population covered all components and met programme criteria for addition in the study (Quick and Hall, 2015). The target population included waste pickers who collect waste from waste facilities, which included landfill sites, buy-back centres and transfer stations in Ehlanzeni District Municipality, Mpumalanga Province. The target population also included managers and/or supervisors for these waste management facilities.

### **3.2 Study design**

The researcher used a descriptive cross-sectional study design to achieve the research objectives. A descriptive cross-sectional study is a study in which the conditions and potentially related factors are measured at a specific point in time for a defined population, reflecting the reality of the targeted population as it is (Mann, 2003). Descriptive research follows quantitative and qualitative measures to collect information and describe the demographics with the assistance of statistical analysis.

A quantitative study is the analytical progression of data in the form of graphs from different fields, while qualitative study involves evaluation of data such as different interviews, videos, pictures and artefacts (Lakshman *et al.*, 2000).

The disjointing of quantitative and qualitative is a very common difference; the tendency has been due to the desire to link quantitative methods with natural science (positivist) and qualitative methods with social science (interpretivist) (UK Essays, 2021). Mixed methods are especially useful in understanding contradictions between quantitative

results and qualitative findings. Mixed methods give a voice to study participants and ensure that study findings are grounded in participants' experiences.

### **3.3 Sampling technique and sample size**

Sampling is a method of choosing participants that represent a population under study (Quick and Hall, 2015). The purposive sampling procedure was used in this study to select waste managers and supervisors to conduct interviews using structured questions. Total population sampling is a type of purposive sampling where the whole population of interest is used for a study (Etikan *et al.*,2016).

For this study, the sampling equated to four supervisors ( $N=4$ ; 100%) as each of the municipalities had one supervisor. This sampling method assisted the researcher in ensuring that no member of the population was omitted from the study. The purposive sampling is a non-probability sampling method used in phenomenological inquiry, where the researcher purposely chooses participants based on individual discretion (Polit and Beck 2017). A non-random criterion was used for the selection of waste managers and supervisors that participated in this study.

Convenience sampling was used to select waste pickers for participation in the study. Convenience sampling is a non-probability sampling technique, which entails carefully selecting subjects who are easily accessible (Yousefi *et al*, 2016). Waste pickers found at the waste management sites during visits were considered for completing questionnaires and therefore the findings of the study are not a total reflection of the broader population. However, it was revealed in the current literature that waste pickers are a difficult cohort to sample for research due to their mobile and fluctuation waste-picking seasons (WIEGO, 2014). The advantages of this convenience sampling include cost-effectiveness and ease of availability of the sample. In total, the sample size equated to 50 participants, inclusive of four supervisors representing four (4) local municipalities in Ehlanzeni District Municipality and a total of forty-six (46) waste pickers.



### **3.3.1 Inclusion criteria**

The inclusion criteria required waste pickers and supervisors of over 18 years of age. In addition, they had to be workers at waste management facilities in Ehlanzeni District Municipality waste management facilities. The waste management facilities must have had transfer stations or buy-back centres.

### **3.3.2 Exclusion criteria**

Waste pickers and supervisors below the age of 18 were left out because of their inability to make informed decisions according to South African law. Those who did not work at waste management facilities were also excluded.

## **3.4 Data collection methods**

A mixed (qualitative and quantitative) research approach was used to acquire data from waste facilities, managers or supervisors and from the waste pickers at the Ehlanzeni District Municipality waste management facilities (i.e., landfill sites, transfer stations and buy-back centres). The mixed method approach involved collecting and analysing both quantitative and qualitative data (Tashakkori & Teddlie, 1998). It is practical in the sense that the researcher is free to use all methods possible to address a research problem (Creswell, 2003).

### **3.4.1 Data collection using semi-structured interviews**

A semi-structured face-to-face interview is one of the tools used in qualitative studies. It was selected as the tool used in the data collection for this study for the four supervisors and managers in order to unpack themes. Hennink *et al.* (2011) state that semi-structured interviews are not a platform or a two-way dialogue; rather they offer an in-depth, special kind of knowledge, as a meaning-making conversation between the respondent and the interviewer. Additionally, the use of semi-structured interviews enabled the researcher to understand the broad themes in waste picking. A greater insight into how to integrate waste pickers and their activities was discussed in the data collection process.

Waste managers from each waste management facility were interviewed during their work lunch hour. A greater insight into how to integrate waste pickers and their activities was gained using prepared close-ended questions in the form of an interview (Appendix 1). Multilingual local interviewers or facilitators were recruited and guided on using the data collection instrument. Interviews were conducted using the English language and upon request by participants the questions were verbally translated into the Siswati and Xitsonga languages to avoid misunderstanding or language barriers. The data collection tool for facility managers and supervisors collected information on demographic factors such as age, education, usage of current waste legislation, types of waste collected, recycling activities, access to services and facilities such as security, water, medical surveillance, and waste management training.

### **3.4.2 Data collection using interviewer-administered questionnaires**

The interviewer-administered questionnaire with closed-ended questions was used to collect data from the 46 waste pickers in order to promote quick replies (Annexure 2). The challenge of working with waste pickers is that their lower educational level (WIEGO, 2020) may hinder their understanding of the questionnaire if they were to administer it by themselves. Hence, the questionnaire was completed in the presence and assistance of an interviewer during the waste pickers' visit at waste-sorting stations. The advantage of this data collection method is that it assists with improving the respondents' understanding, the researcher also clarified the questions where requested. The disadvantage of an interviewer-administered questionnaire is the chance of bias occurring if respondents find it hard to answer truthfully in front of the mediator. Voice recording was added as a data collection tool during the interview with the waste pickers to ensure validity and reliability.

### **3.4.3 Field observations**

The researcher employed field observation to add to the primary data collection methods. *Field observation* can be defined as a method in which the researcher observes the ongoing behaviour of a phenomenon in study and then records the results for analysis (Appasamy and Nellyyat, 2007). The present researcher visited all four local municipalities under Ehlanzeni District Municipality, namely Thaba Chweu Local

Municipality, Bushbuckridge Local Municipality, the City of Mbombela and Nkomazi Local Municipality to observe how waste pickers conducted their everyday duties, as well the challenges they faced within their scope of work. The information gathered from observation assisted the researcher in gaining knowledge and understanding of the processes of waste management, the safety of waste pickers in the landfill sites and the constraints hindering effective waste collection by waste pickers at landfill sites, transfer stations and buy-back centres.

#### **3.4.4 Data records and management**

Monthly data records from 01 July to 31 December 2019 were systematically sampled from the transfer station and buy-back centres by checking data recorded on the last week of each month.

Data records from transfer stations or buy-back centres were used to estimate the quantity of waste collected by waste pickers. The researcher reviewed monthly records with the assistance of data capturers. The data assisted in identifying how waste pickers contributed to waste management. The data records and completed questionnaires were scanned and securely stored electronically on the Google Cloud platform. The stored data were secured with a password available only to the researcher and the individuals primarily involved in the study.

### **3.5 Data analysis**

#### **3.5.1 Interviews with waste pickers**

Interviewer-administered questionnaires with closed-ended questions were used to collect data from the 46 waste pickers in order to promote quick replies (Annexure 2). The close-ended questionnaires were analysed in the form of descriptive statistics, compiled from the frequency tables using the Statistical Packages for Social Sciences (SPSS). SPSS also known as IBM SPSS Statistics version 26, which is a software package used for the analysis of statistical data. The total number of questionnaires completed coded and captured in SPSS was forty-six (46) in order to obtain meaningful results. The results were presented as frequencies and percentages. The results from

the SPSS were exported to Microsoft Excel version 2021 for easy presentation in form of tables, histograms and pie charts.

### **3.5.2 Interviews with supervisors and managers**

A semi-structured face-to-face interview was also used to collect data from four supervisors and managers. The researcher used the Tesch method of qualitative data analysis. The method was used as an analysis tool that analysed the data from the transcription of the audiotape from four participants, organisation of the material, listening to the recordings and reading through field notes in order to thoroughly understand the raw data and to code the transcribed data (Polit and Beck, 2017). The Tesch method identified the steps that this research followed. These steps involved the following: the researcher went through all the information contained in the transcripts; selected and reread transcripts of particular interest or relevance; short notes, ideas, thoughts and emerging information were written in the margin with coloured pencils; information answering the research questions was clustered into themes, sub-themes and categories; all transcripts were coded; the data were grouped; and the most emerging descriptive wording for the themes, sub-themes and categories was noted. To finalise the process of analysis, re-coding was applied.

### **3.5.3 Field observation**

Data collected through observation of waste picker duties, procedures, challenges and safety, and the constraints hindering effective waste collection by waste pickers at landfill sites, transfer stations and buy-back centres were compiled and presented in a form of a summary.

## **3.6 Validity and reliability**

Validity is understood as the degree to which the results from measuring characterise the variable they are anticipated for (Grove *et al.*, 2015). In this study, the inter-rater validity was enhanced by engaging a professional statistician to assist in the analyses of the research results. Content validity was enhanced by comparing the findings from interviews with literature reviews. Correctional validity was enhanced by comparing the

findings from semi-structured interviews and questionnaires. Semantic validity was enhanced by virtue of the categories being mutually exclusive and exhaustive, as judged by the researcher and the statistician consulted. In order to enhance the validity of this study, the following steps were taken: the literature was examined to identify variables to be delineated and the questions used for data collection were in line with the conceptual framework of the research and contained statements that were easy to understand.

Reliability of the research study denotes the dependability of a particular measure. The researcher resorted to three styles of consistency, namely (1) across items, also known as *internal consistency*; (2) across different researchers, also known as *inter-rater reliability*; and (3) consistency over time, also known as *test-retest reliability* (Powell, 2013).

### **3.7 Ethical consideration**

Hsieh *et al.* (2021) state that 'ethical consideration is the synchronisation of moral values which influence behaviour concerning human relations and is concerned with the degree to which research procedures adhere to professional, legal and social responsibilities to study participants. It is only after authorisation by the Research and Ethics Committee at the University of South Africa (UNISA) that the present research was conducted. The Acting Municipal Manager granted permission. UNISA's Research and Ethics Committee provided the researcher with the Ethical clearance with the reference number **2019/CAES-HREC/162**. The researcher maintained confidentiality by ensuring that names were not written on the questionnaires and that no unsanctioned individual had access to the study information without consent. A password to access electronic data protected any unauthorised access to the computer on which data were stored. A confidentiality-binding form was signed and attached as an annexure.

The participants voluntarily decided whether they wanted to take part in the study with no penalty implications. Participants had the right to ask questions, refuse to give information or to withdraw from the study. They had the liberty to make informed choices on participating in the study that called for full disclosure. The researcher ensured that no identification in the form of biographical information was used in the study.

### **3.7.1 Permission to conduct the study**

Permission to conduct the study was received from the Research and Ethics Committee at UNISA (**2019/CAES-HREC/162**) (Appendix 6). Further permission was granted was by the Acting Municipal Manager of Ehlanzeni District Municipality (Appendix 5).

### **3.7.2 Informed consent**

Research participants were informed that they were at liberty to withdraw from participation at any given time without incurring any penalty (Appendix 3). Informed consent forms for the research were handed out to the participants who were deemed to be psychologically and legally fit, and who voluntarily gave their consent. Consent was obtained from participants through the signing of the consent form (Appendix 4). The participants voluntarily chose whether they wanted to take part in the study, with no penalty implications should they refuse or withdraw. Participants had the right to ask questions, to refuse to give information or to withdraw from the study. They had the liberty to make informed choices regarding their participation in the study, which called for full disclosure.

### **3.7.3 Privacy and confidentiality**

The researcher maintained confidentiality by ensuring that names were not written on the questionnaires and that no unsanctioned individual had access to the study information. A password for all electronic data protected any access to the computer on which data was stored and also on the Google Cloud platform which was accessible to only those involved in the study. Confidentiality-binding forms were signed and attached as an annexure. The researcher ensured that nothing identifiable in the form of biographical information was used in the study.

### **3.8 Limitations to the study**

The study was limited to waste management facilities in the three local municipalities instead of four, due to the unavailability of data on the fourth one. The researcher also experienced more difficulty in acquiring data on waste quantities.

## **CHAPTER 4: RESULTS AND DISCUSSION**

### **4.1 Introduction**

In this chapter the data analysis and research findings concerning waste pickers at Ehlanzeni waste management facilities are discussed. Data collected from forty-six (46) waste pickers and four (4) supervisors from the waste management sites were analysed using both qualitative and quantitative methods. The chapter is structured to detail the demographic and social profile of the waste pickers at waste management facilities (i.e., landfill sites, transfer stations and buy-back centres). This chapter provides the results of the study and a discussion thereof.

### **4.2 Demographic and social profile of the waste pickers and supervisors**

#### **4.2.1 Gender distribution**

Gender distribution of the waste pickers at all the waste management facilities in Ehlanzeni District Municipality revealed a clear female dominance, characterised by ( $n=37$ ; 80 %) and ( $n=9$ ; 20%) female and male waste pickers respectively, as shown in Table 4.1 The gender distribution for the supervisors also concurred with that of waste pickers with ( $n=3$ ; 75%) females as compared to ( $n=1$ ; 25%) males. The dominance of females in the study may be due to the fact that waste picking is viewed as simple work and women are often not particular about what type of job they will do as long as it does not demand more physical strength. This phenomenon is typical, according to a study done by Ullah *et al.*, (2008) in Dhaka City, the capital of Bangladesh, where the majority of waste pickers were females and only 24% were males. However, in contrast, a study conducted by Blaauw (2019) revealed that day labourers in the informal labour-market activity were mostly dominated by males (96.4%) when compared to females (3.6%). However, the International Labour Organisation (2018) has recorded males as the having high employment in the informal sector as compared to females.

**Table 4.1: Gender distribution of waste supervisors and pickers**

Participants	Waste facility managers/supervisors		Waste pickers		Total participants
	<i>N</i>	(% )	<i>N</i>	(%)	<i>N (%)</i>
Male	1	25	9	20	10 (20)
Female	3	75	37	80	40 (80)
<b>Total</b>	<b>4</b>	<b>100</b>	<b>46</b>	<b>100</b>	<b>50 (100)</b>

#### **4.2.2 Race**

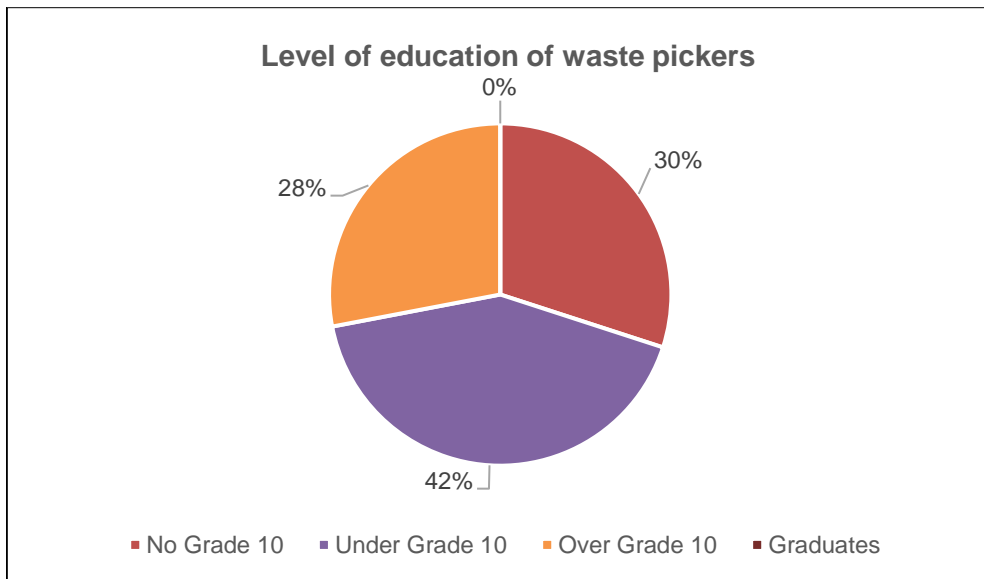
The findings of this research indicate that waste picking is done by black Africans with 100% representation from both genders, as is also the case for supervisors. South Africa has a mixed-race population, ranging from black South Africans, white South African, Indians and coloureds, with black South Africans being the majority race. In South Africa waste picking is primarily an occupation for Africans with a very low representation from other population groups (Schenck and Blaauw, 2011).

The black population in South Africa is historically economically disadvantaged and, because of the apartheid era, blacks were not given an equal opportunity to obtain education. This might be the reason why they are found to dominate in the waste-picking category as it is regarded as a job for the poor (Sinha, 2014). However, because South Africa is now 26 years into democracy and there are now equal opportunities, this trend might change. Ehlanzeni District Municipality is also dominated by black migrants from Eswatini and Mozambique who also work as waste pickers as a means of survival.

#### **4.2.3 Level of education**

Figure 4.1 illustrates that a total number of 46 waste pickers went through formal education at some stage of their lives. However, 42% had formal education up to Grade 10, 30% had not studied up to Grade 10, 28% went beyond Grade 10 and 0% graduates. The results of this study show that there were no graduates in this category of work. Of the four supervisors interviewed, the results illustrated that 50% had completed their Matric.



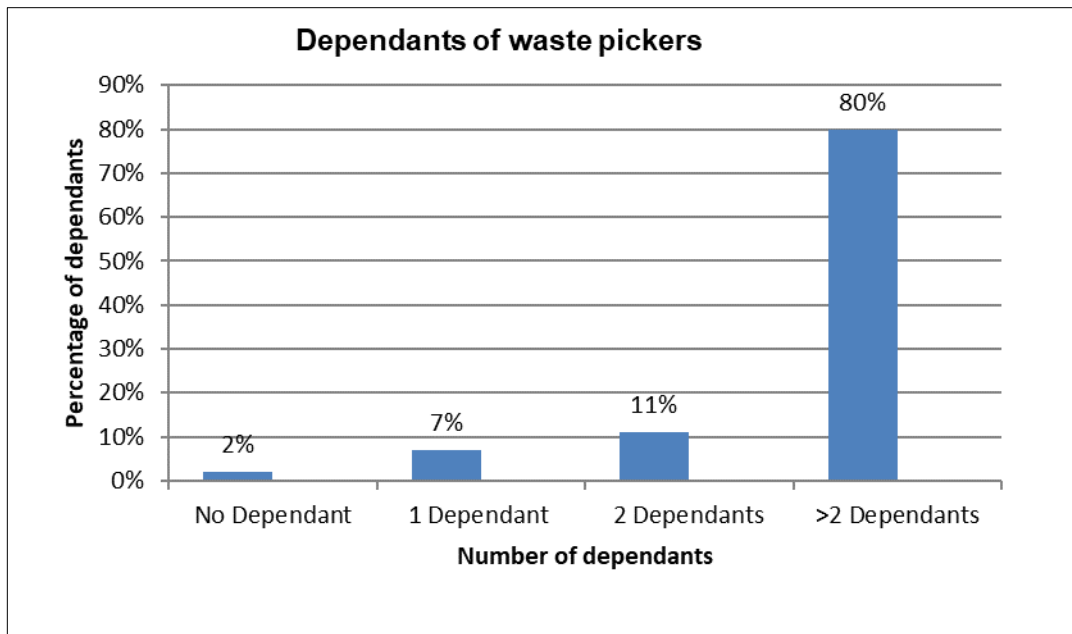


**Figure 4.1: Level of education of waste pickers at Ehlanzeni District Municipality landfill sites**

The overwhelming majority of waste pickers who did not complete their secondary school education corresponds with the findings of a similar study in South Africa, such as that of Schenck and Blaauw (2011) who concluded that the education level of waste pickers was very low. These results are supported by A Women in Informal Employment: Globalizing and Organizing (WIEGO) study which found that many waste pickers had generally low levels of formal education. In many places the work was done by primarily disadvantaged groups (WIEGO, 2014). The low level of education of the waste pickers inhibits their competitiveness in entering the formal job market but allows them to enter waste picking as it does not require any qualification.

#### **4.2.4 Household and income status**

Sixty-five per cent of waste pickers in a study conducted by WIEGO (2014) revealed that their work was the main household income, and 15% of waste pickers' households relied on earnings from the informal work of others (WIEGO, 2014). For the present study, the majority of respondents from the landfill sites indicated that they performed the activity to earn an income. Through analysis, it was also noted that 80% of respondents had more than two dependents and only 2% had no household dependants, as indicated in Figure 4.2.

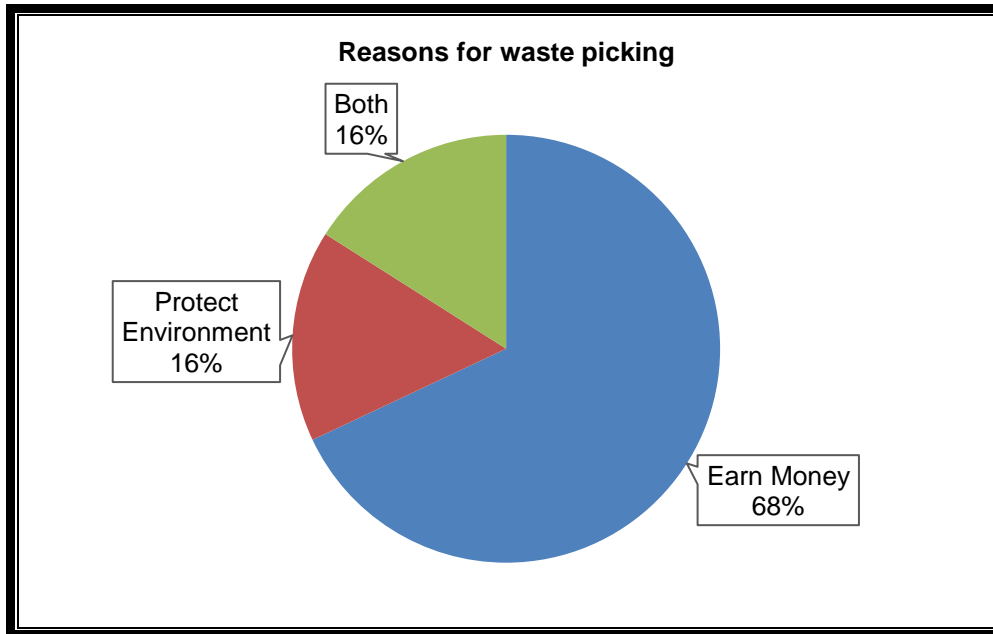


**Figure 4.2: Number of dependants of waste pickers**

Reno (2009) stated that waste picking was portrayed as something done out of necessity, and the people doing it were suffering from abject poverty. There is a linkage between the need for income and the number of dependants the waste pickers needed to support, given that they have to scratch out a living simply to sustain their lives and those of their dependants.

According to Benson and Vanqa-Mgijima (2010), South Africa has a long history of people collecting waste to survive. Job losses have shifted people onto the streets to earn their income.

Medina (2007) indicates that waste collecting and selling is an activity that saves many people from starvation. It was revealed that the highest number (68%) of respondents are in the waste-picking occupation for economic reasons, which was followed by 16% of the respondents indicating both economic and the environmental protection as their reason (Figure 4.3). It was noted that Ehlanzeni District Municipality, in support of all its local municipalities, has been performing environmental awareness campaigns for the past few years; this might be in reaction to these campaigns from the general populace.



**Figure 4.3: Reasons for waste picking at Ehlanzeni Landfill Site**

### **4.3 Type of material collected and its value**

#### **4.3.1 Material collected**

Interviews with municipal officials and supervisors from buy-back centres, landfill sites and transfer stations revealed that although the motive behind collecting waste was purely economically driven, a significant amount of recyclable materials are usually collected and recycled. Waste pickers collect any recyclable waste material in whatever form or shape merchants accept in exchange for cash. The most collected materials include cardboard boxes, plastic, aluminium cans, PET, white paper, newspapers, magazines, steel, iron, glass and rubble waste. According to Singhal *et al.* (2014), recyclable material includes paper, bottles, glasses, cans, metals and certain plastics, among other materials, where inert waste includes dirt and fragments as shown in Figures 4.4 and 4.5.



**Figure 4.4. Recyclables collected at Arconhoek Buy-Back Centre**



**Figure 4.5: Glass collected at Arconhoek Buy Buy-Back Centre**

This study results revealed the material that was mostly collected was mixed plastics (50%), PET (16%), with similar collection of paper and cardboard (17%), and the least-collected material was polyethylene (16%) (Figure 4.4). These materials have a higher monetary exchange value compared to other types of recyclables and are easy to collect. According to most waste pickers, aluminium is a favourable item to collect as it is 100% recyclable and can be recycled over and over again. Aluminium cans can be recycled into new cans, and this takes 95% less energy than making new ones. In fact, recycled aluminium can be back in use again in 60 days after having been recycled.

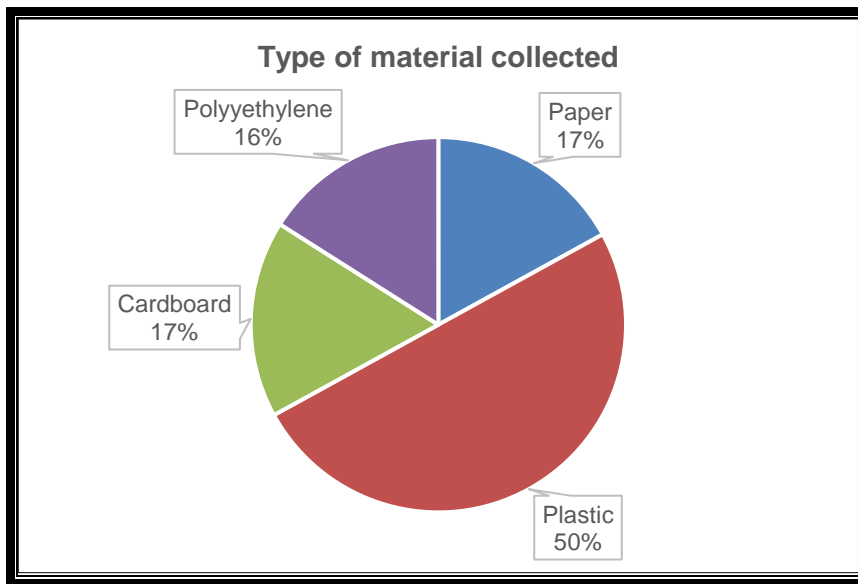


Figure 4.6: Type of material collected on Ehlanzeni waste management facilities

### 4.3.2 Material value

Waste pickers select their best buyer in terms of the prices offered to them, and also in terms of the buy-back centres and transfer station proximity. The buy-back centres and transfer stations are the middlemen in the recycling of recovered waste, especially because industries do not buy recyclable materials directly from individual waste pickers. Instead, they buy in bulk at the buy-back centres and transfer station. The engagement between buy-back centres and waste pickers seems to be increasingly a major form of employment and source of income.

A study conducted in the Free State Province, South Africa, indicated that half of the landfill waste pickers did not sell their waste daily, instead selling their waste at different time intervals ranging from two weeks to three months (Viljoen *et al.*, 2016). All the waste pickers in Ehlanzeni District Municipality sell their waste on a weekly basis in order to allow the buy-back centre to bail enough waste to sell on a monthly basis.

The buying price of recyclable material from waste pickers, according to Wilson *et al.* (2006) and Medina (2001), depends on the price of virgin materials existing at local markets, the supply and demand for secondary materials, as well as the level of accessibility and convenience of transporting the materials. Waste pickers do not always earn the same income, and their income fluctuates from day to day and from season to season (Ezeah *et al.*, 2013).

It is important to know that the dealers play a significant role in the income-earning potential of the waste pickers since they are directing the volumes and prices, as well as the frequency and type of waste collected as shown in Figure 4.4. Private companies buy certain types of waste from the waste pickers, as indicated in Table 4.2, which summarises the different kinds of recyclable waste products that private companies buy, as well as the average prices the waste pickers receive for the different waste products. This also has an impact on the waste pickers' income potential.

**Table 4.2: Types of recyclable waste and price list (Shodula waste price list; 2020)**

<b>Type of waste</b>	<b>Price per kilogram (R/ZAR)</b>
<b>Aluminium cans</b>	R4.00
<b>PET plastics</b>	R0.50
<b>Cardboard</b>	R0.40
<b>White paper (HL)</b>	R0.50
<b>Cans</b>	0.30
<b>Mixed paper</b>	0.30
<b>Cans</b>	0.30
<b>Glass</b>	0.20
<b>Distell small</b>	0.50
<b>Distell large</b>	0.50
<b>High Density</b>	0.30
<b>Black pipe</b>	0.50
<b>Blue pipe</b>	0.50
<b>SUB grade</b>	0.30
<b>Mixed bottle caps</b>	0.50
<b>Mixed plastic</b>	0.50
<b>Plastic bags</b>	0.50
<b>Bottle caps (sorted)</b>	0.50
<b>Steel</b>	0.50

#### **4.4 Role of waste pickers in waste management**

Table 4.3 presents the findings of this study according to units, categories and themes, highlighting the major factors that were found to be the important contributions of waste pickers in waste management in the Ehlanzeni District Municipality. The identified themes are described below as follows: clean environment and cost reduction, waste minimisation and management, source of employment and livelihood in the Ehlanzeni District Municipality.

**Table 4.3: Units; categories and themes in Ehlanzeni District Municipality**

<b>Units</b>	<b>Categories</b>	<b>Themes</b>
<b>Environmental management</b>	Protection of the environment	Clean environment and cost reduction
<b>Reduces municipal expenses</b>	Clean local municipalities	Clean environment and cost reduction
<b>Poverty alleviation</b>	Employment creation	Employment and livelihoods

#### **4.4.1 Clean environment and cost reduction**

Solid waste is one of the main environmental pollutants in municipalities, and Ehlanzeni District Municipality is not an exception in this regard. The activities of waste pickers have been identified as contributing significantly towards reducing solid waste in the district, since removing usable and recyclable waste cleans up the environment. Waste pickers are found on landfill sites collecting materials such as metal, glass, plastic, cardboard and paper, which are packaged and sold to buy-back centres for recycling purposes. As such, these activities contribute to reducing environmental waste pollution. A supervisor from Nkomazi Local Municipality stated that:

*waste pickers play a significant role in environmental waste management, as they are sometimes found collecting waste in the streets and illegal dumping hotpots.*

Figure 4.7 shows waste pickers from Nkomazi Local Municipality at Siyabuddy Recycling Facility processing waste using a bailing machine and transporting it to the buy-back centre which could have been ferried by a municipal vehicle for disposal.



**Figure 4.7: Pictorial representation of waste pickers sorting recyclables**

The researcher also noted that waste pickers played a significant role in reducing municipal expenses, because informal waste-picking reduces the burden on the municipality in terms of financing fleet management and resources. The job of waste pickers also adds value to recycling in the district by saving space at landfill sites while simultaneously reducing waste treatment and disposal costs for municipalities.

#### **4.4.2 Waste minimisation and management**

The recovery of recyclable waste in the Ehlanzeni District Municipality is mostly run by the informal sector. Eighty per cent of the waste pickers indicated that much of the waste they handled was found to be household general waste on which they spent a lot of time separating, as it arrived mixed up. Residents do not practice the separation at source principle, this creates a burden for waste. There is a need for municipal authorities to strengthen awareness for separation at source by communities.

Waste pickers in Bushbuckridge Local Municipality and the City of Mbombela contribute to waste management as they collect recyclables from the shopping complexes, landfill sites, and illegal hotspots, and sell the waste to buy-back centres and transfer stations in exchange for money (Prasad *et al.*, 2019). However, the researcher observed that waste pickers from the Ehlanzeni District Municipality waste facilities faced a challenge



when receiving mixed waste not separated at the source. This led to waste pickers spending more time trying to separate waste before selling to buy-back centres.

#### 4.4.3 Source of employment and livelihood

The unemployment rate in South Africa stood at 30.1% in the first quarter of the year 2020 (Stats SA, 2020) and this basically means that most South Africans are living in poverty as indicated in Table 4.4. In the Ehlanzeni District Municipality, the populace is not spared from the devastating effects of poverty, which has become a major driver for people becoming involved in waste picking activities.

**Table 4.4: Unemployment and poverty rate in Ehlanzeni District Municipality (Sere Report, 2017)**

<b>Unemployment rate</b>			
City of Mbombela	Thaba Chweu Local Municipality	Bushbuckridge Local Municipality	Nkomazi Local Municipality
27,50%	20,50%	52,10%	32 %
<b>Poverty rate</b>			
City of Mbombela	Thaba Chweu Local Municipality	Bushbuckridge Local Municipality	Nkomazi Local Municipality
40,35%	21,50 %	48,10%	48,10%

According to Williams (2019), waste pickers can be described as entrepreneurs. Waste pickers make use of small pieces of collected waste to build up to a kilogram for them to raise few rand. The fact that they are capable of finding value and opportunities to make a living by being their own bosses means that they have entrepreneurship capability.

Authorities in Ehlanzeni District Municipality do not recognise the entrepreneurship gift in waste pickers; hence they are not giving them the necessary support to assist in growing their 'businesses'. Waste pickers need to be accepted and they also need to be integrated into the solid waste management system in municipalities and be respected as primary entrepreneurs. Waste pickers have been driven into self-employment by the poverty and unemployment experienced in Ehlanzeni District Municipality and South Africa at large (Muller, 2015).

According to (Serrat, 2017),

A livelihood comprises the capabilities and assets which include both social and material resources for activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stress and shocks and maintain or enhance its capabilities and assets both now and in the near future, while not understanding the natural resource base.

The waste pickers in Ehlanzeni District Municipality developed a livelihood and collected, separated and sold the materials to buy-back centres. One of the supervisors in Bushbuckridge Local Municipality indicated that

Waste picking is a livelihood more especially for poor people and is accessible to individuals marginalised in society due to lower barriers to practise in terms of skills and educational level.

Ninety-five per cent of the waste pickers who participated in the research study indicated that their main reason for waste picking was to raise finances to support themselves and their families.

The seriousness of this was evident when one waste picker who mentioned that:

I have more than eight dependents that I am supporting, using income received from waste picking.

Therefore, the income generated through waste picking cannot continue to be overlooked.

#### **4.5 Quantities and types of recyclables in Ehlanzeni District Municipality**

Table 4.5 shows the different types of recycled solid waste, including the estimated average amounts collected by the local municipality.

**Table 4.5: Quantities and types of recyclables in Ehlanzeni District Municipality**

<b>Name of the Municipality</b>	<b>Average waste collected per month (ton)</b>	<b>Type of waste collected</b>
Nkomazi Local Municipality	118 000	Cardboard, polythelne terethylate, aluminium cans, mixed plastics, glass.
Bushbuckridge Local Municipality	100 000	Cardboard, polythelne terethylate, aluminium cans, mixed plastics, glass.
City of Mbombela	800 000	Cardboard, polythelne terethylate, aluminium cans, mixed plastics, glass.

Table 4.5 shows an estimated 1 018 000 tonnages of recyclable waste collected within the District Municipality. Again, an interviewee from the Siyabuddy Recycling Facility in Nkomazi Local Municipality indicated that:

Waste pickers collect different types of waste, which are: cardboards, polyethylene terephthalate, all kinds of plastics, aluminium cans and scrap metal.

Waste collection activities by waste pickers contribute to waste management within the municipality and can also assist in cases where formal waste collection service is not rendered.

#### **4.6 Challenges faced by waste pickers in the Ehlanzeni District Municipality**

During data collection, some waste pickers highlighted a few of their challenges in terms of occupational health and operational concerns when waste picking. These challenges have been categorised in the following themes and sub-themes in Table 4.6.

**Table 4.6: Themes and sub-themes of challenges faced by Ehlanzeni District Municipality**

<b>Themes</b>	<b>Sub-themes</b>
Occupational challenges	Social challenges Health challenges Security challenges Poverty Distance, theft and long working hours Logistics Absenteeism

## **4.6.1 Categories of challenges experienced or faced by waste pickers**

### **4.6.1.1 Social challenges**

Previous studies have shown that waste pickers have social concerns, more specifically when interacting with community members (Wittmer, 2021). They are often associated with people who have mental health challenges and, due to their dirty appearance, no one usually wants to socialise with them even after working hours. Again, waste pickers often face harassment from the community, especially from household owners who regard them as criminals. According to a study conducted by Simatele (2017) in Johannesburg, harassment at different scales of society and lack of physical infrastructure were found to be major challenges.

Municipal law enforcement officers usually seek to arrest waste pickers because they associate them with criminal activities. Taxi drivers and motorists also find waste pickers a nuisance as they sometimes block vehicles while crossing roads pushing their waste picking trolleys. Similarly, Schoeman (2018) reported the same findings in the City of Johannesburg.

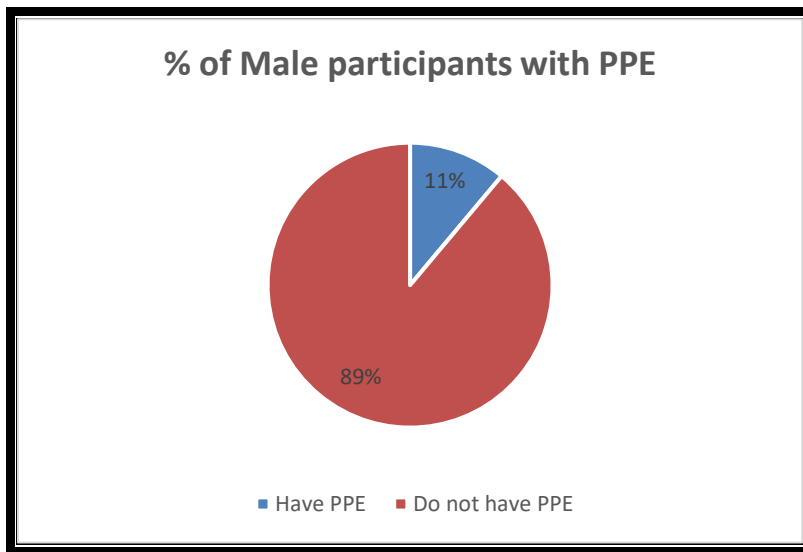
The negative attitude by community members towards waste pickers is usually as a result of lack of knowledge regarding their role in waste management.

### **4.6.1.2 Health challenges**

From the literature overview it appears that waste pickers in South Africa are responsible for collecting significant volumes of recyclable materials, which assists most municipalities in saving millions of rands, and contributes to a generally healthier and cleaner environment. However, waste pickers continue to operate on the fringes of the economy and are exposed to many risks, particularly health risks such as respiratory diseases, muscular skeletal diseases and hearing loss, which have a direct impact on the sustainability of their livelihoods (Schenck *et al.*, 2019).

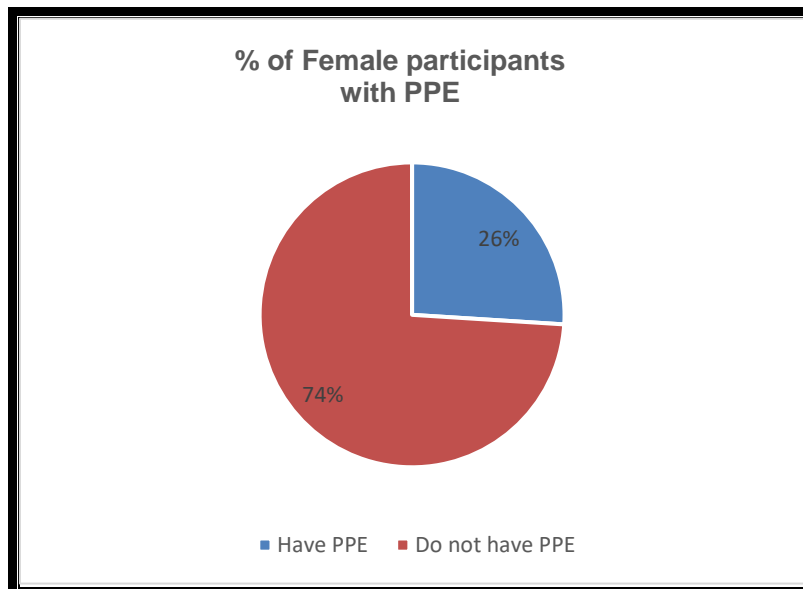
Officials do not provide waste pickers with personal protective equipment, which poses a threat to the waste pickers as they may experience pricks and injuries while at work.

Waste pickers from Ehlanzeni District Municipality face a number of health-related challenges as a result of not having full personal protective clothing as indicated in Figures 4.8 and 4.9.



PPE: personal protective equipment

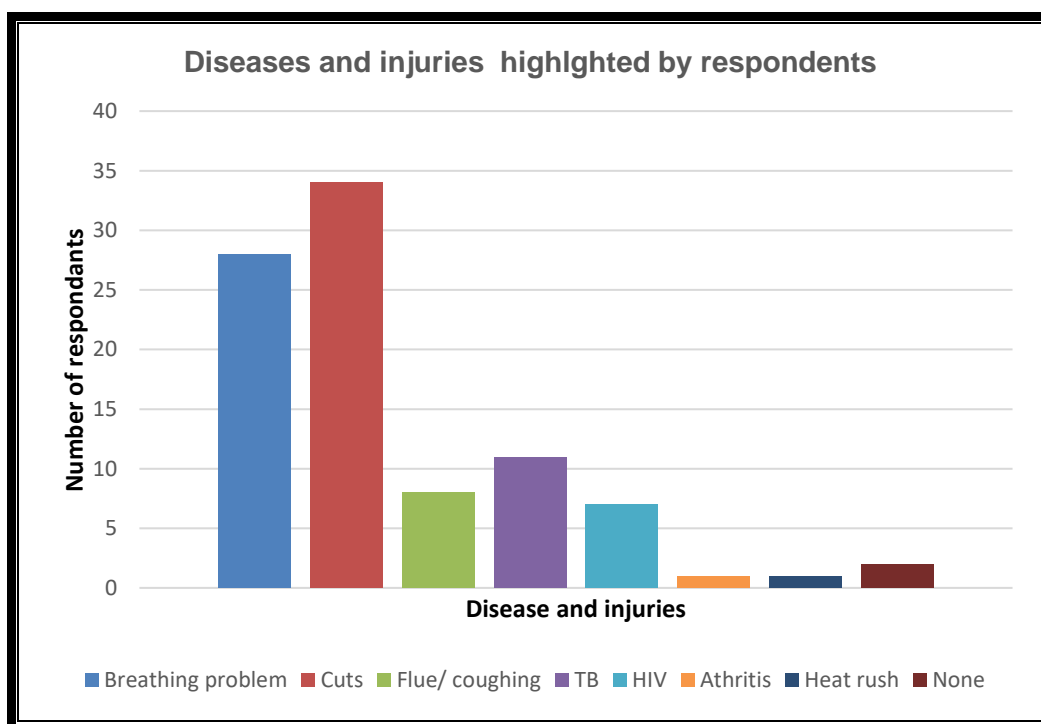
**Figure 4.8: Percentage of male waste pickers with personal protective equipment**



PPE: personal protective equipment

**Figure 4.9: Percentage of female waste pickers with personal protective equipment**

The daily routine of a waste picker is practiced under harmful conditions as they work in a dirty environment where they are likely to be exposed to bacterial contamination, and the inhalation of dust and other harmful odours or nuisances. At the same time, they work with glass and sharp objects that can cause injuries. Apart from these challenges, the researcher observed a malfunctioning bathing infrastructure at Siyabuddy Recycling Facility. Figure 4.10 indicates different types of diseases, conditions and injuries that waste pickers are subjected to if proper precautionary measures are not followed on site when on duty. Respondents rated breathing problems and injuries from cuts the highest risks.



**Figure 4.10: Diseases and injury highlighted by respondents**

#### 4.6.1.3 Security challenges

Fifty-two per cent of waste pickers indicated that they did not feel secure when working on site as indicated in Figure 4.11. The reason for this is that security infrastructure has been vandalised at most of the facilities, and also because there are chances of them being robbed by unauthorised individuals while on duty. As a waste picker from the City of Mbombela Local Municipality described:

Due to vandalism of the fence, in most instances my life is at risk since unauthorised people gain access to the facility and try to rob us of our belongings.

There are also instances in which waste pickers fight among themselves for recyclable materials.



Figure 4.11: Perception of waste pickers on site

#### 4.6.1.4 Distance, theft and long working hours

It was also noted that waste pickers travel long hours around 10 hours daily in average in order to sell their waste, which then prolongs their working hours. Extreme weather, more especially in the rainy season, was found to be another challenge faced by waste pickers since they do not have secure means to store their waste. A supervisor did mention that:

Waste needs to be dry before it can be packed and loaded for selling, and the process of drying can take up to five to seven days. The impact this has is to delay the process. Hence the need to transport their waste to Gauteng.

#### 4.6.1.5 Operational challenges encountered by waste pickers

Despite the occupational problems experienced by waste pickers, they are also confronted with operational challenges in terms of the lack of formal working structure regarding operational protocols. Most waste pickers work individually and, as such, do not have designated managers or supervisors who will oversee them on a daily basis. Another challenge was insufficient resources for the separation and processing of recyclables, since waste collected from communities was not separated at the source.

#### 4.6.1.6 Transport challenges

Most waste pickers do not earn enough to be able to pay for public transport or to own private transport, hence they rely on walking to and from work as well as transporting their waste to buy-back centres. However, some waste pickers do have common transport to ferry their recyclables to their buy-back centres. Table 4.8 indicates that 32 waste pickers out of 46 walk to waste sites on a daily basis to perform their work.

**Table 4.7: Mode of transport for waste pickers**

<b>Mode of Transport</b>	<b>Walking</b>	<b>Public transport</b>	<b>Private transport</b>
Number of respondents	32	11	3

#### 4.6.1.7 Working hours

One hundred per cent of waste pickers who participated in the study are working five days a week in Ehlanzeni District Municipality, and their working hours range from 07:00 to 16:00 and 08:00 to 17:00. This gives an average of 45 hours per week for waste pickers assigned to work at landfill sites and transfer stations. Waste pickers at buy-back centres begin work as early as 05:00 in the morning and knock off at 19:00.

#### 4.6.1.8 Resources

Waste pickers from the City of Mbombela expressed great concern about the resources used to process recyclables. The bailing machine is aged, and it takes time for the municipality to maintain due to its limited budget. The infrastructure available is not in



good condition, making their work difficult. Waste pickers from Nkomazi Local Municipality and Acornhoek Buy-Back Centre indicated that their bailing machines were in good working order, and that their infrastructure was not in bad condition. However, renovation did need to be done.

#### **4.7 Response by supervisors on constraints hindering formalisation of waste pickers in the Ehlanzeni District Municipality**

##### **4.7.1 Lack of commitment from authorities dealing with waste management**

Waste management authorities seem reluctant to adopt the formalisation of waste pickers, as they are concentrating more on using formal waste management institutions to collect and dispose of waste. IN 2020 South Africa showed concern for waste pickers through the Waste Picker Integration Guideline when introducing policies concerning waste picking. Since then, the Ehlanzeni District Municipality has not sped up the process of aligning its policies with national priorities where informal waste pickers are concerned; for example, there was no formal database for waste pickers in the City of Mbombela as of June 2020.

##### **4.7.2 Lack of policies, framework and plans**

Supervisors within the Ehlanzeni District Municipality's waste management facilities who were selected to participate in the research study were not familiar with waste legislation such as the Integrated Waste Management Plan (IWMP). Out of the four supervisors who participated, only one from Nkomazi Local Municipality indicated that she was familiar with the National Waste Act. The participants showed more knowledge of the health, safety and business legislation than environmental management legislation, and particularly waste legislation and related policies.

Local municipalities within the district do have a legislative framework that deals with waste management, and this includes: the INWMS, IDPs, NEMA and the National Waste Act. However, these policies do not specify guidelines on integrating informal waste pickers into the municipal waste management system. Municipal authorities do not have systems in place on how to formalise and make the best use of informal waste pickers.

The waste pickers, in turn, do not have policies that they can use to push for adoption into the formal waste management system.

The challenges regarding policy, plan and programme implementation at Ehlanzeni District Municipality as revealed by this study is the insufficient and lack of inclusion of waste management programmes. In the municipalities where IDPs and bylaws were included, there is lack of prioritisation and allocation of funds to implement such plans, policies and programmes.

#### **4.7.3 Waste pickers lacking valid documentation**

An interview with a supervisor from Nkomazi Local Municipality revealed that most of the waste pickers working at the recycling facility did not have valid identity documents. An attempt to come up with a database of waste pickers was considered to be a challenge because most of the waste pickers did not have citizenship documents, and also most of them were from Mozambique. She pointed out that:

It is a challenge to formalise waste pickers who are working at this facility because the government requires the municipality to compile a database of all waste pickers who have valid documentation, most of whom do not have the required documentation.

#### **4.7.4 Inconsistency in attendance**

One of the supervisors highlighted the inconsistency in attendance as one of the challenges they encountered. Since waste pickers do not have financial security, they therefore seek alternative jobs in order to sustain themselves and their families. This results in a shortage of waste brought to the buy-back centres, creating a backlog in transporting the waste to various recycling companies.

#### **4.7.5 Lack of representation**

Municipal officials pointed out that there was a lack of a formal representative which could otherwise assist in raising concerns of waste pickers and integrate waste pickers into their existing systems.

The municipal official indicated that

the waste pickers do not have formal representatives, who can represent their concerns, challenges at the local municipalities. They work individually, they do not have union to represent and advocate for them.

#### **4.7.6 Authorization issued by the licensing authority**

All waste management facilities have a licence to operate issued by the competent authority. However, most landfill sites reach the end of their lifespan and are issued with a licence for closure. This will become a challenge in formalising waste pickers at landfill sites once these facilities have reached their end. The Nkomazi Local Municipality has a recycling facility within the landfill site, and all recyclables are packaged by waste pickers within the facility. This has positively contributed to the lengthening of its lifespan. In Bushbuckridge Local Municipality most of the landfill sites have reached the end of their lifespan, which poses an environmental threat. Recycling to those facilities becomes a challenge since waste picking on site cannot be formalised.

## CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Introduction

This chapter contains the conclusions drawn from the study results and discussions. Furthermore, recommendations are made based on the findings of the study.

### 5.2 Conclusions

Municipal solid waste management is a great challenge. The incorrect management of solid waste by municipalities results in significant environmental impacts on areas such as climate change, biodiversity loss and soil-erosion, as well as on human health (Leballo, 2017). According to Arcapana (2017), solid waste management has negative social, economic and environmental impacts. The challenge is mostly experienced by low- and middle-income countries. These countries share numerous connections concerning their socio-economic situations resulting from the lower standards of their waste management operations (Arpacana, 2017).

Considering these challenges, decision and policy developers have recognised the necessity to recognise the impact made by the informal sector, and are trying to ensure that working conditions and the overall socio-economic situation are improved. Subsequently, a diversity of formalisation approaches has been planned and implemented over the period from 2000 to the present (Debrah, 2007). The purpose of the current study was to enlighten policy and decision makers, as well as waste managers in the Ehlanzeni District Municipality, on the specifics to be considered when designing formalisation strategies, by considering the full scope of obstacles likely to occur before and after formalisation, and in aiding the measures formulated to address them (Bortoleto, 2014).

**Objective one:** To evaluate the waste-picking processes such as collection, transportation, recycling and storage with Ehlanzeni District Municipality.

The Ehlanzeni District Municipality comprises four local municipalities. Of the four local municipalities, Bushbuckridge and Nkomazi Local Municipalities have buy-back centres.

The City of Mbombela has a transfer station, while Thaba Chweu Local Municipality has neither a buy-back centre nor a transfer station. In Bushbuckridge Local Municipality, at Aconhoek Buy-back Centre, waste is collected by the facility trucks from sources which include shopping complexes. Waste pickers sort the waste within the facility before they transfer it for bailing. After the bailing process, the waste is transported to Gauteng for recycling purposes. Similarly, waste pickers at the Siyabuddy Buy-back Centre collect, sort and transfer waste for bailing within the facility before the waste is transported to Gauteng for recycling. The City of Mbombela has a transfer station where municipal trucks and the communities around the area drop off their waste to be sorted by waste pickers before it can be transported to the Tekwane Landfill Site for disposal. The waste pickers collect, sort and transfer the waste for bailing at the transfer station. Non-recyclable waste is directed to the landfill site for disposal.

**Objective two:** To identify the types of waste disposed and reclaimed from waste management facilities.

This study revealed that material mostly collected was plastic, followed by PET and cardboard, and the least-collected material was polyethylene. These materials have a higher monetary exchange value compared with other types of recyclables and are easy to collect. Aluminium is also a favourable item to collect as it is 100% recyclable and can be recycled over and over again. Aluminium cans can be recycled into new cans, and this takes 95% less energy than making new ones.

**Objective three:** To assess the safety of waste pickers at landfills around the district.

The waste pickers from Ehlanzeni District Municipality face a number of safety-related challenges, such as pricks and lacerations from sharp objects when sorting the recyclables, which occur as a result of not having suitable personal protective equipment. At the same time, they work with glass and sharp objects that can cause injuries. Waste pickers indicated that they did not feel secure when working on site, the reason being the vandalism of security infrastructure at most of the facilities.

**Objective four:** To evaluate the constraints hindering effective collection of waste by waste pickers at landfill sites, transfer stations and buy-back centres.

Ehlanzeni District Municipality has not sped up the process of aligning its policies with the national priorities in terms of formalising waste picking, resulting in a lack of support available to the waste pickers from the local municipalities. Most waste pickers do not have valid documentation in order for them to be included in the local municipality database, and this also makes it difficult for municipalities to provide the necessary support.

**Objective five:** To assess and analyse the existing legislation on waste pickers.

Local municipalities within the district do have a legislative framework that deals with waste management, and that includes a waste management strategy, integrated development plans, the NEMA, and the National Waste Act. However, these policies do not specify guidelines on integrating informal waste pickers into the municipal waste management system. Municipal authorities do not have systems in place on how to formalise and make the best use of informal waste pickers. In turn, waste pickers do not have policies that they can use to push for adoption into the formal waste management system.

This study has contributed positively to all local municipalities within the Ehlanzeni District Municipality in terms of prioritising the formalisation of waste pickers and incorporating waste management programmes aimed at reducing waste through recycling initiatives, separation at source programmes and avoidance of waste to be disposed at landfill sites. The study was limited to only waste management facilities in the three local municipalities instead of four due to the unavailability of data where the researcher experienced challenges in acquiring quantities of waste.

## **5.3 Recommendations**

### **5.3.1 Integration of the informal sector in local government waste management policies and plans**

The integration of informal sector (waste pickers) in local government waste management plans is needed, especially for waste collection and recycling programs (WIEGO, 2014; UNEP, 2020). Local municipalities need to incorporate issues of waste pickers into their plans such as the IWMP. The DFFE has developed guidance for waste pickers. Hence, municipalities are therefore encouraged to utilise those guidelines and integrate them into their plans.

A formal database for waste pickers needs to be compiled at each local municipality in order for waste pickers to be prioritised by different spheres of government. Local municipalities need to allocate budgets specifically to support waste pickers in terms of providing them with the necessary equipment (personal protective equipment and tools of the trade) in order for waste pickers to be able to execute their work safely and efficiently.

The waste pickers and their associations should be included in the policy-making processes that have an impact on waste management or waste-picking activity and, most importantly, their value chains should be strengthened (WIEGO, 2014).

### **5.3.2 The need for an asset-based community development model**

The challenges faced by local municipalities regarding improper waste management requires the involvement of the community members, stakeholders and the private sector (Sepadi, 2021). A bottom-up approach has been found to lead to sustainable development as it places the community members as drivers of waste management where they take charge.

### **5.3.3 Training and capacity development**

Frequent capacity building for waste pickers is necessary in order for them to broaden their knowledge and skills, thereby equipping them to be better able to understand current developments in terms of guidelines and requirements. The lack of knowledge within the waste-picking activities should be remedied by empowering waste pickers with the current legislation, waste management practices, risk factors and control measures. Providing training to waste picker organisations to help them meet requirements for accountability and service delivery may be a necessary component of formal integration. Likewise, municipal officials may require training to interact with waste pickers as legitimate partners (WIEGO, 2014).

### **5.3.4 Workplace infrastructure to support safe and healthy workplaces**

The municipalities should support the provision of infrastructure location for waste pickers, such as access to waste that has been collected from residential and commercial surroundings, and equipment used during waste-picking activities.



## REFERENCES

Abdel-Shafy, H.I. and Mansour, M.S. (2018). Solid waste issue: Sources, composition, disposal, recycling, and valorisation. *Egyptian Journal of Petroleum*. 27(4): 1275–1290.

Addo, I.B., Adei, D. and Acheampong, E.O. (2015). Solid waste management and its health implications on the dwellers of Kumasi metropolis, Ghana. *Current Research Journal of Social Sciences*. 7(3): 81–93.

Agamuthu, P., Khidzir, K.M. and Hamid, F.S. (2009). Drivers of sustainable waste management in Asia. *Waste Management & Research*. 27(7): 625–633.

Ahmed, S.A. and Ali, M. (2004). Partnerships for solid waste management in developing countries: Linking theories to realities. *Habitat international*. 28(3): 467–479.

Ahmed, S., Dávila, J.D., Allen, A., Haklay, M., Tacoli, C. and Fèvre, E.M. (2019). Does urbanization make emergence of zoonosis more likely? Evidence, myths and gaps. *Environment and Urbanization*, 31(2): 443–460.

Anantharaman, M. (2014). Networked ecological citizenship, the new middle classes and the provisioning of sustainable waste management in Bangalore, India. *Journal of Cleaner Production*. 63: 173–183.

Asim, M., Batool, S.A. and Chaudhry, M.N. (2012). Scavengers and their role in the recycling of waste in Southwestern Lahore. *Resources, Conservation and Recycling*, 58, pp.152–162 (accessed 20 February 2022).

Aparcana, S. (2017). Approaches to formalization of the informal waste sector into municipal solid waste management systems in low- and middle-income countries: Review of barriers and success factors. *Waste Management*. 3(61): 593–607.

Appasamy, P. and Nelliya, P. (2007). *Compensating the loss of ecosystem services due to pollution in Noyyal River Basin*. Chennai: Tamil Nadu Madras School of Economics.

Awopetu, M.S., Awopetu, R.G., Sample, E.D., Olufiropo, A.O.C., Awokola, S., Fullen, M.A., Booth, C.A. and Hammond, F.N. (2014). Municipal solid waste management and the role of waste-pickers in Nigeria. *International Journal of Education and Research*. 2(3): 1–12.

Ayorinde, A.O., Philip, M., Nicholas, D.O., Okibe, O.J. and Adesola, A.T. (2021). The importance of water as an essential natural resource and emerging environmental concerns for mangroves and wetland ecosystems in Nigeria (accessed on 14 January 2021).

Barrett, C., Reardon, T., Swinnen, J. and Zilberman, D. (2019). *Structural transformation and economic development: Insights from the agri-food value chain revolution*. Ithaca, New York: Cornell University Press.

Benson, K. and Vanqa-Mgijima, N., 2010. Organizing on the streets: A study of reclaimers in the streets of Cape Town. *Women in Informal Employment: Globalizing and Organizing*.

Blaauw, D., Pretorius, A. and Schenck, R. (2019). The economics of urban waste picking in Pretoria. *African Review of Economics and Finance*. 11(2): 129–164.

Bortoleto, A.P. (2014). *Waste prevention policy and behaviour: New approaches to reducing waste generation and its environmental impacts*. Oxford: Routledge. Available at: <https://www.routledge.com/Waste-Prevention-Policy-and-Behaviour-New-Approaches-to-Reducing-Waste/Bortoleto/p/book/9781138225992> (accessed 26 October 2021)

Bovea, M.D., Ibáñez-Forés, V., Gallardo, A. and Colomer-Mendoza, F.J. (2010). Environmental assessment of alternative municipal solid waste management strategies. A Spanish case study. *Waste Management*. 30(11): 2383–2395.

Cercelaru, C., Ionel, I. and Balogh, R.M. (2016). Odour causing discomfort and their impact on human health. *Journal of Environmental Protection and Ecology*. 17(2): 427–434.

Chen, F., Luo, Z., Yang, Y., Liu, G.J. and Ma, J. (2018). Enhancing municipal solid waste recycling through reorganizing waste pickers: A case study in Nanjing, China. *Waste Management & Research*. 36(9): 767–778.

Chiti, L. (2014). A critical analysis of the legal provisions for responding to environmental emergency incidents in South Africa, with particular emphasis on the National Environmental Management Act (NEMA) Emergency Provisions. Master's thesis, University of Cape Town.

Cobbinah, P.B., Erdiaw-Kwasie, M.O. and Amoateng, P. (2015). Africa's urbanisation: Implications for sustainable development. *Cities*. 47: 62–72.

Corvellec, H., Campos, M.J.Z. and Zapata, P., 2013. Infrastructures, lock-in, and sustainable urban development: The case of waste incineration in the Göteborg Metropolitan Area. *Journal of Cleaner Production*. 50: 32–39.

Creswell, J.W. (2003). *Research design: qualitative and quantitative and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Cucchiella, F., D'Adamo, I., Koh, S.L. and Rosa, P. (2015). Recycling of WEEEs: An economic assessment of present and future e-waste streams. *Renewable and Sustainable Energy Reviews*. 51: 263–272.

Da Silva, C.L., Weins, N. and Potinkara, M. (2019). Formalizing the informal? A perspective on informal waste management in the BRICS through the lens of institutional economics. *Waste Management*. 99: 79–89.

David, V.E., Wenchao, J., Johna, Y. and Mmereki, D. (2019). Solid waste management in Monrovia, Liberia: Implications for sustainable development. *The Journal of Solid Waste Technology and Management*. 45(1): 102–110.

Davis, J.M. and Garb, Y. (2015). A model for partnering with the informal e-waste industry: Rationale, principles and a case study. *Resources, Conservation and Recycling*. 105: 73–83.

Debrah, Y.A. (2007). Promoting the informal sector as a source of gainful employment in developing countries: Insights from Ghana. *The International Journal of Human Resource Management*. 18(6): 1063–1084

Department of Forestry, Fisheries and the Environment (2014). National Environmental Management Waste Act 59 of 2014 (No. 278 10 March 2009). Available at: [https://www.environment.gov.za/sites/default/files/legislations/nema\\_amendment\\_act59.pdf](https://www.environment.gov.za/sites/default/files/legislations/nema_amendment_act59.pdf) (accessed 21 October 2021).

Department of Forestry, Fisheries and Environment and Department of Science and Innovation (DSI). (2020). Waste picker integration guideline for South Africa: *Building the recycling economy and improving livelihoods through integration of the informal sector*. DEFF and DSI: Pretoria.

DFFE see Department of Forestry, Fisheries and the Environment

Dhal, B., H. N. Thatoi, N. N. Das, and B. D. Pandey. (2013). Chemical and microbial remediation of hexavalent chromium from contaminated soil and mining/metallurgical solid waste: a review. *Journal of Hazardous Materials*. 250: 272–291.

Dias, S.M. (2016). Waste pickers and cities. *Environment and Urbanization*. 28(2): 375–390.

Dinler, D.Ş. (2018). New forms of wage labour and struggle in the informal sector: the case of waste pickers in Turkey. *Class Dynamics of Development*. 37(10): 1834–1854.

Dlamini, B.R., Rampedi, I.T. and Ifegbesan, A.P. (2017). Community resident's opinions and perceptions on the effectiveness of waste management and recycling potential in the Umkhanyakude and Zululand District Municipalities in the KwaZulu-Natal Province of South Africa. *Sustainability*. 9(10): 1835.

Ehlanzeni District Municipality. (2021). Integrated Development Plan in Mbombela, Mpumalanga. South Africa. Mbombela: Ehlanzeni District Municipality.

Ehlanzeni District Municipality. (2019). Mbombela. Mpumalanga Province. South Africa. Geographical Information Map. Mbombela: Ehlanzeni District Municipality

Elagroudy, S., Warith, M.A. and El Zayat, M. (2016). Municipal solid waste management and green economy. Global Young Academy. Available at: [https://globalyoungacademy.net/wp-content/uploads/2016/09/Municipal-Solid-Waste-Management-and-Green-Economy-Report\\_20160901.pdf](https://globalyoungacademy.net/wp-content/uploads/2016/09/Municipal-Solid-Waste-Management-and-Green-Economy-Report_20160901.pdf) (accessed 1 December 2021)

Etikan, I., Musa, S.A. and Alkassim, R.S., (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*. 5(1): 1–4.

Ezeah, C., Fazakerley, J.A. and Roberts, C.L. (2013). Emerging trends in informal sector recycling in developing and transition countries. *Waste Management*. 33(11): 2509–2519.

Fergutz, O., Dias, S. and Mitlin, D. (2011). Developing urban waste management in Brazil with waste picker organizations. *Environment and Urbanization*. 23(2): 597–608.

Ferronato, N. and Torretta, V., 2019. Waste mismanagement in developing countries: A review of global issues. *International journal of environmental research and public health*, 16(6), p.1060.

Friedrich, E. and Trois, C. (2016). Current and future greenhouse gas (GHG) emissions from the management of municipal solid waste in the eThekweni Municipality, South Africa. *Journal of Cleaner Production*. 112(5): 4071–4083.

Gall, M., Wiener, M., de Oliveira, C.C., Lang, R.W. and Hansen, E.G. (2020). Building a circular plastics economy with informal waste pickers: Recyclate quality, business model, and societal impacts. *Resources, Conservation and Recycling*. 156: 1–11.

Gharfalkara, M. Courta, R. Campbella, C. Alib, Z. and Hillierac, G. (2015). Analysis of waste hierarchy in the European waste directive 2008/98/EC. *Waste Management*.

Gitau, M.W. (2019). *Analysis of the role of waste pickers on informal solid waste management: A case of Roysambu constituency, Nairobi County*. PhD dissertation, University of Nairobi.

Godfrey, L. and Oelofse, S. (2017). Historical review of waste management and recycling in South Africa. *Resources*. 6(4): 1–11.

Gowan, T. (2009). *New hobos or Neo-Romantic fantasy? Urban ethnography beyond the neoliberal disconnect*. Minnesota: Department of Sociology, University of Minnesota.

Grove, A., Clarke, A. and Currie, G., 2015. The barriers and facilitators to the implementation of clinical guidance in elective orthopaedic surgery: a qualitative study protocol. *Implementation Science*, 10(1), pp.1-8.

Guerrero, L.A., Maas, G. and Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management*, 33(1): 220–232.

Gügüş, E.A. (2019). *The waste pickers of İstanbul: A case study*. Doctoral dissertation.

Gumbi, L.N. and Mnkandla, E. (2015). Investigating South African vendors' cloud computing value proposition to small, medium and micro enterprises: A case of the City of Tshwane Metropolitan Municipality. *The African Journal of Information Systems*. 7(4): 1–17.

Gutberlet, J. and Uddin, S.M.N., 2017. Household waste and health risks affecting waste pickers and the environment in low-and middle-income countries. *International journal of occupational and environmental health*, 23(4), pp.299-310.

Hakuzimana, J. (2021). Break free from plastics: Environmental perspectives and evidence from Rwanda. *Environment & Ecosystem Science (EES)*. 5(1): 27–36.

Hennink, M.M. Hutter, I. and Bailey, A. (2011). *Qualitative research methods*. Thousand Oaks, CA: SAGE.

Hettiarachchi, H., Ryu, S., Caucci, S. and Silva, R. (2018). Municipal solid waste management in Latin America and the Caribbean: Issues and potential solutions from the governance perspective. *Recycling*. 3(2): 1–15.

Hsieh, S.L., Li, F.Y., Lin, P.Y., Beck, D.E., Kirankumar, R., Wang, G.J. and Hsieh, S. (2021). CaO recovered from eggshell waste as a potential adsorbent for greenhouse gas CO<sub>2</sub>. *Journal of Environmental Management*. 297: 113–430.

Hunt, C. (1996). Child waste pickers in India: The occupation and its health risks. *Environment and Urbanization*. 8(2): 111–118.

Hunter, P. (1997). *Waterborne disease: Epidemiology and ecology*. Hoboken, NJ: John Wiley & Sons.

Ibrahim, A.E. (2017). Effects of solid waste management in Kitengela Ward: A case study of Kajiado County. Doctoral dissertation, University of Nairobi. Nairobi, Kenya

Idowu, I.A., Atherton, W., Hashim, K., Kot, P., Alkhaddar, R., Alo, B.I. and Shaw, A. (2019). An analysis of the status of landfill classification systems in developing countries: Sub Saharan Africa landfill experiences. *Waste Management*. 87: 761–771.

International Labour Organisation. (2018). Women and men in the informal economy: A statistical picture. Available at: [https://www.ilo.org/wcmsp5/groups/public/---dgreports/--dcomm/documents/publication/wcms\\_626831.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/--dcomm/documents/publication/wcms_626831.pdf) (accessed on 12 November 2021).

Kaza, S., Yao, L., Bhada-Tata, P. and Van Woerden, F. (2018). What a waste 2.0: A global snapshot of solid waste management to 2050. *World Bank Publications*.

Available at:

<https://openknowledge.worldbank.org/bitstream/handle/10986/30317/211329ov.p>

(Accessed 1 December 2021)

Kim, H., Borges, M.C. and Chon, J. (2006). Impacts of environmental values on tourism motivation: The case of FICA, Brazil. *Tourism Management*. 27(5): 957–967.

Lakshman, M., Sinha, L., Biswas, M., Charles, M. and Arora, N.K. (2000). Quantitative vs qualitative research methods. *The Indian Journal of Pediatrics*. 67(5): 369–377.

Leballo, B.S., (2017). Integrated Waste Management Plan: Ehlanzeni District Municipality. Mpumalanga. Available at: <https://cogta.mpg.gov.za/IDP/2016-17%20IDPs/Ehlanzeni/Ehlanzeni2016-17.pdf> (accessed on 1 December 2021)

Lindner, C. and Meissner, M. eds. (2015). *Global garbage: Urban imaginaries of waste, excess, and abandonment*. Oxford: Routledge.

Liu, J., Yu, S. and Shang, Y. (2020). Toward separation at source: Evolution of municipal solid waste management in China. *Frontiers of Environmental Science & Engineering*. 14(2): 1–3.

Maema, K. (2017). Determining practices and power relation between street reclaimers with a view to how they control their spaces. University of Witwatersrand. South Africa.

Makwara, E.C. and Snodia, S. (2013). Confronting the reckless gambling with people's health and lives: Urban solid waste management in Zimbabwe. *European Journal of Sustainable Development*. 2(1): 67–67.

Mamphitha, D. (2012). *The role played by subsistence waste pickers in recycling*. Doctoral dissertation. University of Pretoria, South Africa.

Mann, C.J. (2003). Observational research methods: Research design II; Cohort, cross sectional, and case-control studies. *Emergency Medicine Journal*, 20(1): 54–60.

Marello, M. and Helwege, A. (2018). Solid waste management and social inclusion of waste pickers: opportunities and challenges. *Latin American Perspectives*. 45(1): 108–129.

Medina, M. (2007). *The world's scavengers: Salvaging for sustainable consumption and production*. Walnut Creek, CA: AltaMira Press.



Mmereki, D. (2018). Current status of waste management in Botswana: A mini-review. *Waste Management & Research*. 36(7): 555–576.

Mohee, R. and Simelane, T. (2015). Future directions of municipal solid waste management in Africa. *Africa Institute of South Africa*. Available online: <http://www.ai.org.za/wp-content/uploads/downloads/2012/10/No.-81.-Future-Directions-of-Municipal-Solid-waste-Management-in-Africa.pdf> (accessed 1 December 2021)

Mokoena, T. (2019). *Waste management in Ekurhuleni: Evaluation against the instruments of the National Waste Management Strategy*. Master's dissertation. North-West University. South Africa.

Mudavanhu, N. (2020). *An analysis of livelihood of landfill waste pickers in South Africa*. PhD thesis. University of the Western Cape. South Africa

Muller, M. (2015). Assemblages and actor-networks: Rethinking socio-material Power, politics and space. Available online: <https://doi.org/10.1111/gec3.12192> (accessed 1 December 2021)

Mutungwa, M.F. (2016). Assessment of public–private partnership for solid waste management in Wote Town, Makueni county Kenya. Doctoral dissertation.

Mvuyane, A.T.T. (2018). *War on waste: Perspectives on supporting and formalising informal solid waste pickers in Johannesburg, South Africa*. Doctoral dissertation. Witwatersrand University. South Africa.

Mwanza, B.G., Mbohwa, C. and Telukdarie, A. (2018). The influence of waste collection systems on resource recovery: A review. *Procedia Manufacturing*. 21: 846–853.

O'Hare, P. (2019). The landfill has always borne fruit': precarity, formalisation and dispossession among Uruguay's waste pickers. *Dialectical Anthropology*. 43(1): 31–44.

Okot-Okumu, J. (2012). Solid waste management in African cities: East Africa. *Waste Management: An Integrated Vision*.

Ololade, O.O. and Rametse, P.P. (2018). Determining factors that enable managers to implement an environmental management system for sustainable construction: A case study in Johannesburg. *Business Strategy and the Environment*. 27(8): 720–1732.

Ong, K.L., Kaur, G., Pensupa, N., Uisan, K. and Lin, C.S.K. (2018). Trends in food waste valorization for the production of chemicals, materials and fuels: Case study South and Southeast Asia. *Bioresource Technology*. 248: 100–112.

Osho, S.T., 2016. *An assessment of waste management facilities in Nigeria: The impact of waste disposal facilities on public health in Lagos State, Nigeria*. Houston, TX: Texas Southern University.

Owusu-Sekyere, E. (2014). Scavenging for wealth or death? Exploring the health risk associated with waste scavenging in Kumasi, Ghana. *Ghana Journal of Geography*. 6: 63–80.

Perez, T.S. (2021). The discursive power of recycling: Valuing plastic waste in Cape Town. *Worldwide Waste: Journal of Interdisciplinary Studies*. 4(1): 1–10.

Perrot, J.F. and Subiantoro, A. (2018). Municipal waste management strategy review and waste-to-energy potentials in New Zealand. *Sustainability*. 10(9): 1–12.

Pholoto, L. (2016). Impacts of Pikitup's integration and spatial work formalisation on informal reclaimers: The case of Johannesburg inner city. Johannesburg: University of the Witwatersrand.

Pires, A., Martinho, G., Rodrigues, S. And Gomes, M.I. (2019). Prevention and reuse: Waste hierarchy steps before waste collection. *In Sustainable Solid Waste Collection and Management* (pp. 13–23). Edinburgh: Springer, Cham.

Polit, D.F. and Beck, C.T. (2017). Generalization in quantitative and qualitative research: Myths and strategies. *International Journal of Nursing Studies*. 47(11): 1451–1458

Porras Bulla, J., Rendon, M. and Espluga Trenc, J. (2021). Policing the stigma in our waste: What we know about informal waste pickers in the global north. *Local Environment*. 26(10): 1299–1312.

Powell, G.E. (2013). The selection and development of measures. *Behavioural and Mental Health Research: A Handbook of Skills and Methods*, p. 29.

Prasad, M.N.V., Vithanage, M. and Kapley, A. (2019). *Pharmaceuticals and personal care products: Waste management and treatment technology: emerging contaminants and micro pollutants*. Durban: Butterworth–Heinemann.

Pujara, Y., Pathak, P., Sharma, A. and Govani, J. (2019). Review on Indian municipal solid waste management practices for reduction of environmental impacts to achieve sustainable development goals. *Journal of Environmental Management*. 248: 1–14.

Quick J, Hall S. (2015). Part Two: Qualitative research. *Journal of Perioperative Practice*. 25(7–8): 129–133.

Ramesh, M.V., Nibi, K.V., Kurup, A., Mohan, R., Aiswarya, A., Arsha, A. and Sarang, P.R. (2017). Water quality monitoring and waste management using IoT. 2017 IEEE *Global Humanitarian Technology Conference (GHTC)* 1–7.

Reno, J. (2009). Your trash is someone's treasure. *Journal of Material Culture*. 14(1): 29–46

Reyneke, P. (2016). *Dumpsite bricolage: The responses of the urban waste precariat to the formalisation and privatisation of waste management in the City of Tshwane*. PhD dissertation. University of Pretoria, South Africa.

Rhyner, C.R., Schwartz, L.J., Wenger, R.B. and Kohrell, M.G. (2017). *Waste management and resource recovery*. CRC Press.

Rim-Rukeh, A. (2014). An assessment of the contribution of municipal solid waste dump sites fire to atmospheric pollution. *Open Journal of Air Pollution*. 3(3): 53–60.

Rogan, M., Roever, S., Chen, M.A. and Carré, F. (2017). Informal employment in the global south: Globalization, production relations, and 'precarity'. In *Precarious work*. Emerald Publishing Limited.

Rogoff, M.J. (2013). Solid waste recycling and processing: Planning of solid waste recycling facilities and programs. Elsevier (accessed 20 February 2022).

Rogoff, M.J. and Screve, F. (2019). Waste-to-energy: technologies and project implementation. Available at: <https://www.elsevier.com/books/waste-to-energy/rogoff/978-0-12-816079-4> (Accessed 21 October 2021).

Rosa, E. and Cirelli, C. (2018). Scavenging: Between precariousness, marginality and access to the city; The case of Roma people in Turin and Marseille. *Environment and Planning A: Economy and Space*. 50(7): 1407–1424.

Sasaki, S. and Araki, T. (2013). Employer–employee and buyer–seller relationships among waste pickers at final disposal site in informal recycling: The case of Bantar Gebang in Indonesia. *Habitat International*. 40: 51–57.

#### SAWISsee South African Waste Information System System

Schenck, R. and Blaauw, P.F. (2011). December. The work and lives of street waste pickers in Pretoria: A case study of recycling in South Africa's urban informal economy. *Urban Forum*. 22(4): 411–430.

Schenck, C.J., Blaauw, P.F. and Viljoen, J.M. (2016). The socio-economic differences between landfill and street waste pickers in the Free State Province of South Africa. *Development Southern Africa*. 33(4): 532–547.

Schenck, C.J., Blaauw, P.F., Viljoen, J.M. and Swart, E.C. (2019). Exploring the potential health risks faced by waste pickers on landfills in South Africa: A socio-ecological perspective. *International Journal of Environmental Research and Public Health*. 16(11): 1–21.

Schoeman, T., (2018). Trolley pushers in the City of Johannesburg. *South African Geographers*. 1: 360.

Sembiring, E. and Nitivattananon, V. (2010). Sustainable solid waste management toward an inclusive society: Integration of the informal sector. *Resources, Conservation and Recycling*. 54(11): 802–809.

Sepadi, M.M. (2021). Unsafe management of soiled nappies in informal settlements and villages of south Africa. *Cities and Health*. Available at: <https://www.tandfonline.com/doi/abs/10.1080/23748834.2021.1892440> (accessed 21 October 2021).

Serrat, O., (2017). The sustainable livelihoods approach. In *Knowledge Solutions* (pp. 21–26). Singapore: Springer.

Shama, R. and Sharma, S.R. (2022). Microbial aspect in wastewater management: biofilm. In *Advanced industrial wastewater treatment and reclamation of water* (pp. 71–86). Springer,

Shiner, Z.P. (2018). An investigation of wood and wood packaging waste in the United States. PhD dissertation, Virginia Tech.

Simatele, D.M., Dlamini, S. and Kubanza, N.S. (2017). From informality to formality: Perspectives on the challenges of integrating solid waste management into the urban development and planning policy in Johannesburg, South Africa. *Habitat International*. 63: 122–130.

Singhal, S., Agarwal, S., Bahukhandi, K. and Singhal, N. (2014). Bio-adsorbent: A cost-effective method for effluent treatment. *International Journal of Environmental Sciences and Research*. 3(1): 151–156

Sinha, J.B. (2014). *Psycho-social analysis of the Indian mindset*. New Delhi: Springer India.

Stats, SA see Statistics South Africa

Statistics South Africa (Stats SA). (2016). Community survey 2016, statistical release P0301. Pretoria: Statistics South Africa.

Statistics South Africa (Stats SA). (2020). Community survey 2016, statistical release P0301. Statistics South Africa

Statistical Package for the Social Sciences (SPSS). IBM SPSS Statistics. (2020). Available at: <https://www.ibm.com/products/spss-statistics> (accessed on 12 January 2022)

Sukholthaman, P. and Shirahada, K. (2015). Technological challenges for effective development towards sustainable waste management in developing countries: Case study of Bangkok. *Technology in Society*. 3: 231–239.

South African Waste Information System System (SAWIS). (2021). Waste information system guideline on technical implementation.

Tashakkori, A. and Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches*. Sage Publications, Inc.

Thakur, B. Dubey, P. Benitez, J. Torres, J.P. Reddy, S. Shokar, N. Aung, K. Mukherjee, D. and Dwivedi, A.K. (2021). A systematic review and meta-analysis of geographic differences in comorbidities and associated severity and mortality among individuals with COVID-19. *Nature Portfolio*. 11: 8562. Available online: <https://www.nature.com/articles/s41598-021-88130-w> (accessed 21 January 2021).

Thangavelu, J.A. (2013). Considerations for informed pursuit of zero waste: Lessons from two case studies. Doctoral dissertation. Virginia Tech.

Traven, L. (2019). Circular economy and the waste management hierarchy: Friends or foes of sustainable economic growth? A critical appraisal illustrated by the case of the Republic of Croatia. *Waste Management & Research*. 37(1): 1–2.

Ugwu, C.O., Ozoegwu, C.G. and Ozor, P.A. (2020). Solid waste quantification and characterization in university of Nigeria, Nsukka campus, and recommendations for sustainable management. *Heliyon*. 6(6): 1–9.

UK Essays. (2021). Pros and cons of qualitative, quantitative, and mixed method research. Available: <https://www.ukessays.com/essays/psychology/a-study-on-using-mixed-methods-in-research-psychology-essay.php> (Accessed on 12 November 2021)

Ullah, H., Rashid, A., Liu, G. and Hussain, M. (2018). Perceptions of mountainous people on climate change, livelihood practices and climatic shocks: A case study of Swat District, Pakistan. *Urban Climate*. 26: 244-257.

UNEP see United Nations Environment Programme

United Nations Environment Programme (UNEP) (2020). South African Municipal Waste Management Systems: Challenges and Solutions. Available at: <https://wedocs.unep.org/bitstream/handle/20.500.11822/33287/SAM.pdf?sequence=1&isAllowed=y> (accessed 22 October 2021).

Van Heerden, H., Burger, M., Coetsee, M.P.A., Mahlangu, N.B. and Naude, K., (2015). *The current infrastructure conditions and the problems relating to it: Focusing on Rietkol, Delmas, Mpumalanga, South Africa*. The 3rd Global Virtual Conference. University of Pretoria.

Van Niekerk, S. and Wegmann, V. (2019). Municipal solid waste management services in Africa. *Technologies*. 9(3): 1–17.

Venter, C. (2019). Improved network governance in regional and local economic development partnerships: a management strategy. Doctoral dissertation. Stellenbosch University. South Africa

Verster, C. and Bouwman, H. (2020). Land-based sources and pathways of marine plastics in a South African context. *South African Journal of Science*. 116(5–6):1–9.

Viljoen J, Blaauw D, Schenck C. (2019). The opportunities and value-adding activities of buy-back centres in South Africa's recycling industry: A value chain analysis. *Local Economy*. 34(3): 294–315.

Viljoen, J.M.M., Blaauw, P.F., Schenck, C.J. and Swart, E. (2019). Exploring the potential health risks faced by waste pickers on landfills in South Africa: A socio-ecological perspective. *International Entrepreneurship and Management Journal*. Available at: [https://www.researchgate.net/publication/333700687\\_Exploring\\_the\\_Potential\\_Health\\_Risks\\_Faced\\_by\\_Waste\\_Pickers\\_on\\_Landfills\\_in\\_South\\_Africa\\_A\\_Socio-Ecological\\_Perspective](https://www.researchgate.net/publication/333700687_Exploring_the_Potential_Health_Risks_Faced_by_Waste_Pickers_on_Landfills_in_South_Africa_A_Socio-Ecological_Perspective) (accessed on 12 January 2022).

WIEGO see Women in the Informal Economy: Globalizing and Organizing

Women in the Informal Economy: Globalizing and Organizing (2021). Waste picker perceptions on health and health risks: Perspectives from the ground. [http://parlAmericas.org/uploads/documents/May24\\_WIEGO\\_AnaCarolinaOgando\\_ENG.pdf](http://parlAmericas.org/uploads/documents/May24_WIEGO_AnaCarolinaOgando_ENG.pdf) (accessed on the 21 October 2021).

Women in the Informal Economy: Globalizing and Organizing. (2014). Informal Economy Monitoring Study. 2021. Available at: <https://www.wiego.org/sites/default/files/publications/files/IEMS-waste-picker-report.pdf> (accessed on 21 October 2021).

Williams, J.D. (2019). The dietary intake, food (in) security and nutritional status of waste pickers in South Africa. Masters dissertation. University of the Western Cape. South Africa.

Williams, P.T. (2005). *Waste treatment and disposal*. Hoboken, NJ: John Wiley & Sons.



Wilson, D.C., Rodic, L., Scheinberg, A., Velis, C.A. and Alabaster, G. (2012). Comparative analysis of solid waste management in 20 cities. *Waste Management & Research*. 30(3): 237–254.

Wilson, D.C., Velis, C. and Cheeseman, C. (2006). Role of informal sector recycling in waste management in developing countries. *Habitat International*. 30(4): 797–808.

Wilson, D.C., Velis, C.A. and Rodic, L. (2013). Integrated sustainable waste management in developing countries. In Proceedings of the Institution of Civil Engineers. *Waste and Resource Management*. 166 (2): 52–68.

Wittmer, J. (2021). ‘We live and we do this work’: Women waste pickers’ experiences of wellbeing in Ahmedabad, India. *World Development*. 140 (105253):1–11.

Yahya, M.D., Imam, I.A. and Abdulkareem, S.A. (2018). Column adsorption studies for the removal of chemical oxygen demand from fish pond wastewater using waste alum sludge. *Advances in Remediation Techniques for Polluted Soils and Groundwater 2022*: 21–48.

Yano, J. and Sakai, S.I. (2016). Waste prevention indicators and their implications from a life cycle perspective: A review. *Journal of Material Cycles and Waste Management*. 18(1): 38–56.

Yousefi, H., Soleimanian-Zad, S. and Khandan, M.S.B. (2016). Microencapsulation of probiotics by emulsion method for production of probiotic bread. *Iranian Journal of Nutrition Sciences & Food Technology*. 11(4): 99–106.

Ziervogel, G. (2019). Building transformative capacity for adaptation planning and implementation that works for the urban poor: Insights from South Africa. *Ambio*. 48(5): 494–506.

Ziraba, A.K., Haregu, T.N. and Mberu, B. (2016). A review and framework for understanding the potential impact of poor solid waste management on health in developing countries. *Archives of Public Health*. 74(1): 1–11.

Zon, J.L.N., Leopoldino, C.J., Yamane, L.H. and Siman, R.R. (2020). Waste pickers organizations and municipal selective waste collection: Sustainability indicators. *Waste Management*. 118: 219–231.

Zorpas, Antonis A., Katia Lasaridi, K. Abeliotis, Irene Voukkali, Pantelitsa Loizia, L. Fitiri, Christina Chroni, and N. Bikaki. (2014). Waste prevention campaign regarding the Waste Framework Directive. *Fresenius Environmental Bulletin* 23(11): 2876–2883.

## APPENDICES

### APPENDIX 1: QUESTIONS FOR FACILITY MANAGERS/ SUPERVISORS ONLY

#### TITLE: ASSESSING THE ROLE OF WASTE PICKERS AT WASTE MANAGEMENT FACILITIES AT EHLANZENI DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE, SOUTH AFRICA

##### A. GENERAL INFORMATION

DATE OF INTERVIEW: .....

NAME OF THE MUNICIPALITY .....

REFERENCE: .....

1. What is your gender?  
.....
2. What is your educational qualification did you obtain?  
.....
3. Do you refer to current waste legislation at your facility?  
.....
4. If yes mark the Waste Legislation applicable to your facility?  
.....
5. Do you recycle waste at your facility?  
.....
6. Do you have Weigh Bridge or scale?  
.....
7. Types of waste collected at the facility?  
.....
8. What security measures do you have in place?  
.....
9. Is the facility (landfill) lined to prevent contamination of ground water?  
.....

10. Does the facility have authorization approved by Licensing Authority?  
.....

11. What is the quantity of waste recycled per month?  
.....

12. What type of reclaimed waste that is of more value?  
.....

13. What are the constraints hindering recycling of waste?  
.....

14. Does the facility have security measures in place?  
.....

15. What kind of training are you exposed to?  
.....

16. Do you have access to portable water?  
.....

17. Do you have access to ablution facilities?  
.....

18. Do you have washing/ bathing facility?  
.....

19. Does waste pickers have any union or formal representatives?  
.....

20. Do you undergo medical surveillance?  
.....

21. If yes how often do you go there?

Every three months	Every six months	Once a year	Once after two years
--------------------	------------------	-------------	----------------------

22. Who is providing the medical surveillance services?

Private doctor	Public doctor	The Municipality
----------------	---------------	------------------

**NB: All information provided will be treated as strictly confidential**

**Thank you for your participation!**

**APPENDIX 2: QUESTIONNAIRE FOR WASTE PICKERS**

**TITLE: ASSESSING THE ROLE OF WASTE PICKERS AT WASTE MANAGEMENT FACILITIES AT EHLANZENI DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE, SOUTH AFRICA**

*Questionnaire to be completed by waste pickers only*

**QUESTIONNAIRE REFERENCE NO**

--

**A. GENERAL INFORMATION**

DATE OF INTERVIEW: .....

NAME OF THE MUNICIPALITY .....

1. What is your gender?

Male	Female
------	--------

2. How many dependant(s) do you have?

One	Two	More than two
-----	-----	---------------

3. What educational qualification did you obtain?

Less than grade 10	Grade 10	Grade 12	Tertiary qualification	No education
--------------------	----------	----------	------------------------	--------------

4. Why do you do the waste-picking activity?

To earn money	Protect the environment	Other .....
---------------	-------------------------	-------------

5. Do you have a designated area to recycle the waste?

Open area	Designated sorting area	Other .....
-----------	-------------------------	-------------

6. How often do you reclaim waste?

Twice per week	Three times per week	Four times a week	Other .....
----------------	----------------------	-------------------	-------------

7. Mode of accessing the facility?

Public transport	Private transport	Walking	Other .....
------------------	-------------------	---------	-------------

8. Types of waste collected at the facility?

Paper	Plastic	Cardboard	Polyethylene terephthalate	Other .....
-------	---------	-----------	----------------------------	-------------

9. Do you have personal protective equipment/clothing?

Yes	No
-----	----

10. What sickness you can expect to get from this job?

Breathing challenges	Cuts	Other.....
----------------------	------	------------

11. Accessibility of approved recycling facilities?

Accessibility of the site	Lack of personal protective equipment	Other .....
---------------------------	---------------------------------------	-------------

12. What type of waste is of less value?

Paper	Plastic	Cardboard	Polyethylene terephthalate	Other .....
-------	---------	-----------	----------------------------	-------------

13. Do you feel secured when working on site?

Yes	No	Not sure
-----	----	----------

13. What kind of training are you exposed to?

Waste pickers internal training	Health and safety training	Waste pickers external training	Other .....
---------------------------------	----------------------------	---------------------------------	-------------

15. Do you have access to portable water within the facility at your workplace?

Yes	No
-----	----

16. Do you have access to ablution facilities at your workplace?

Yes	No
-----	----

17. Do you have access to washing/bathing facilities?

Yes	No
-----	----

18. Do you undergo medical surveillance?

Yes	No
-----	----

19. Where do you undergo medical surveillance?

Private doctor	Public Health facility	Other.....
----------------	------------------------	------------

20. Does the municipality send you for you undergo medical surveillance?

Yes	No
-----	----

21. If yes, how often do you go there?

Every three months	Every six months	Once a year	Once after two years
--------------------	------------------	-------------	----------------------

21. Do you have any formal representative or union?

Yes	No
-----	----

**NB: All information provided will be treated as strictly confidential.**

**Thank you for your participation!**

**APPENDIX 3: PARTICIPANT INFORMATION SHEET**

Ethics clearance reference number: 2019/CAES-HREC/162

Research permission reference number:

<23 January 2020 >

**TITLE: ASSESSING THE ROLE OF WASTE PICKERS AT WASTE MANAGEMENT FACILITIES IN EHLANZENI DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE, SOUTH AFRICA>**

Dear Prospective Participant

My name is Rirhandzu Marah Ntusi and I am doing research with Tsakani Tshimbana, a Lecturer in the Department of Agriculture and Environmental Science towards a Master Degree in Environmental Science, at the University of South Africa. We have no funding. We are inviting you to participate in a study entitled Assessing the role of waste pickers at waste management facilities in Ehlanzeni District Municipality, Mpumalanga Province.

**WHAT IS THE PURPOSE OF THE STUDY?**

The main purpose of the study is to assess the role of waste pickers at waste management facilities within Ehlanzeni District Municipality.

**WHY AM I BEING INVITED TO PARTICIPATE?**

Waste pickers involved in the waste picking activities amongst different waste management facilities will be requested to participate in the study as they have experience in the field. Waste Supervisors and managers will be interviewed as they are highly experienced. A total of 50 waste pickers will be selected and informed about the study including waste supervisors and waste managers. The participants will be informed to participate on the study voluntarily. The information will be treated confidentially. Permission will be obtained from the accounting Officer for participants to be selected. The information will be confidential and the information collected will be strictly used for research purposes.

**WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?**

The role of waste pickers will be to complete the questionnaires allocated to them by the researcher. Questions posed will be related to their routine work which is the waste picking and reclamation on a daily basis. Waste supervisors and managers will be interviewed by the research. The interview will be approximately 30 minutes.

## CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

The participants will voluntarily decide whether or not they want to take part in the study with no penalty implications. Participants have rights to ask questions, refuse to give information or withdraw from the study. They have the liberty to make informed choices on participating in the study that call for full disclosure. The researcher will ensure that no identification in the form biographical information will be used in the study. The participant can withdraw anytime from participating without been penalised.

## WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

There are no potential benefits when taking part on the study.

## ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

There are no penalties for participating on the research project. Minor risk can be experienced such as loss of time during completion of questionnaires and interviews. In order to mitigate the risk additional assistance will be requested to assist the researcher by Colleagues in order to collect the data to save time.

## WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

Yes - The researcher will maintain confidentiality by ensuring that names are not written on the questionnaires and that no unsanctioned individual will access the study information (hard copies) without consent. Password for electronic data will be protected and access to the computer on which data is stored will also be restricted. Confidentiality binding form to be signed and will be attached as an annexure

## HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard. Electronic copies will also be stored.

## WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

None



## HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences, UNISA. A copy of the approval letter can be obtained from the researcher if you so wish.

## HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Rirhandzu Marah Ntusi on 0736464159 or email [Rirhandzuntusi@gmail.com](mailto:Rirhandzuntusi@gmail.com)


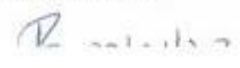
Should you have concerns about the way in which the research has been conducted, you may contact Tsakani Tshimbana, [tshimtp@unisa.ac.za](mailto:tshimtp@unisa.ac.za), 0114712410. Contact the research ethics chairperson of the CAES General Ethics Review Committee, Prof EL Kempen on 011-471-2241 or [kempeel@unisa.ac.za](mailto:kempeel@unisa.ac.za) if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you

Rirhandzu Marah Ntusi

## APPENDIX 4: INFORMED CONSENT FORM

CONSENT TO PARTICIPATE IN THIS STUDY	
I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.	
I have read (or had explained to me) and understood the study as explained in the information sheet.	
I have had sufficient opportunity to ask questions and am prepared to participate in the study.	
I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).	
I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.	
I agree to the recording of the <insert specific data collection method>.	
I have received a signed copy of the informed consent agreement.	
Participant Name & Surname..... (please print)	
Participant Signature.....	Date: 23/01/2020
Researcher's Name & Surname Rirhandzu Marah Ntusi..... (please print)	
	
☐	

## APPENDIX 5: PERMISSION LETTER TO CONDUCT RESEARCH

959 Heron Street  
Stonehenge  
Mbombela  
1201

Ehlanzeni District Municipality  
8 Vaniekerk Street  
Mbombela  
1201

30 September 2019

Dear Sir

**SUBJECT: PERMISSION TO CONDUCT AN ACADEMIC RESEARCH PROJECT**

My name is Rirhandzu Marsh Ntusi a Student (50703536) at University of South Africa. I hereby requesting permission to conduct a research project on assessing the role of waste pickers at waste management facilities in Ehlanzeni District Municipality. The research is part of my wok since waste management is one of the thematic areas in the scope of Environmental Management Directorate.

The research will focus only on waste reclaimers and Waste Managers/Supervisors in the District waste management facilities (Landfill sites, Buyback centers and transfer stations. Only waste reclaimers, municipal staff and recycling companies working directly with the waste reclaimers will be allowed to participate in the study. The data will be collected in the form of interviews, questionnaires and personal observation. I would also like to take photographs of the landfill sites. No waste reclaimers or municipal staff will be taken any photographs to ensure their anonymity for this study.

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**PERMISSION TO CONDUCT AN ACADEMIC RESEARCH PROJECT**

Results and recommendations of the study will be presented to the municipality on the completion of the study.

Your positive response will be much appreciated



Yours sincerely  
Ms Rirhandzu Ntusi  
Student no: 50703536  
Tel: 0137588545 or 0606729623  
Email: [Rirhandzuntusi@gmail.com](mailto:Rirhandzuntusi@gmail.com)

Approved/ Not-Approved



General Manager MHS&EM  
ST Shabangu  
Tel: 013 759 0798743304  
Email: [Sshabangu@ehlanzeni.gov.za](mailto:Sshabangu@ehlanzeni.gov.za)

## APPENDIX 6: ETHICAL CLEARANCE LETTER



### UNISA-CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 12/11/2019

Dear Ms Ntusi

**Decision: Ethics Approval from  
12/11/2019 to completion**

NHREC Registration # : REC-170616-051

REC Reference # : 2019/CAES\_HREC/162

Name : Ms RM Ntusi

Student # : 50703536

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**Researcher(s):** Ms RM Ntusi  
[rntusi@ehlanzeni.gov.za](mailto:rntusi@ehlanzeni.gov.za)

**Supervisor (s):** Ms T Tshimbana  
[tshimtp@unisa.ac.za](mailto:tshimtp@unisa.ac.za); 011-471-2410

**Working title of research:**

Assessing the role of waste pickers at waste management facilities in Ehlanzeni District municipality, Mpumalanga Province

**Qualification:** MSc Environmental Management

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Thank you for the application for research ethics clearance by the Unisa-CAES Health Research Ethics Committee for the above mentioned research. Ethics approval is granted until the

submit the corrected draft consent form to the Committee for record purposes. The forms are provided on the college website: <https://www.unisa.ac.za/sites/corporate/default/Colleges/Agriculture-&-Environmental-Sciences/Research/Research-Ethics>

4. Is there any safety risk to the researcher in going to the landfill sites and interviewing the waste pickers? Are there any security concerns at the site? Will the researcher be on his own, or accompanied by someone?
5. How will the researcher ensure the independence of the responses? Are the waste pickers not likely to influence each other during completion of the questionnaires?
6. The section on data analysis should be expanded and should indicate in more detail what statistical analysis models will be applied for each objective, and how it will be applied.
7. How will the validation of information be done in this project?

*The **low risk application** was reviewed by the UNISA-CAES Health Research Ethics Committee on 07 November 2019 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the

6. The section on data analysis should be expanded and should indicate in more detail what statistical analysis models will be applied for each objective, and how it will be applied.
7. How will the validation of information be done in this project?

*The **low risk application** was **reviewed** by the UNISA-CAES Health Research Ethics Committee on 07 November 2019 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original

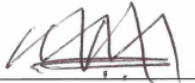
research. Secondary use of identifiable human research data require additional ethics clearance.

7. No field work activities may continue after the expiry date. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

*Note:*

*The reference number **2019/CAES\_HREC/162** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,



**Prof MA Antwi**  
**Chair of UNISA-CAES Health REC**

E-mail: antwima@unisa.ac.za  
Tel: (011) 670-9391



**Prof MJ Linington**  
**Executive Dean : CAES**

E-mail: lininmj@unisa.ac.za  
Tel: (011) 471-3806