AN EVALUATION OF THE ROLE OF WASTE PICKERS IN MUNICIPAL SOLID WASTE MANAGEMENT AT GREATER LETABA MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

by

SHOROMA LERATO MAITE

Submitted in accordance with the requirements for the degree of

MASTER OF SCIENCE

in the subject

ENVIRONMENTAL MANAGEMENT

at the

UNIVERSITY OF SOUTH AFRICA

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCES

SUPERVISOR: MS TP TSHIMBANA

CO-SUPERVISOR: MR ND BALOYI

November 2023

DECLARATION

I, Shoroma Lerato Maite (student no: 44673779) declare that “An evaluation of the role of waste pickers in municipal solid waste management at Greater Letaba Municipality, Limpopo Province, South Africa” is my own work and that all the sources used or quoted have been indicated and acknowledged by means of complete references. Furthermore, the ethical approval letter was applied for and granted by University of South Africa (UNISA) CAES, Health Ethics Committee reference number 2019/CAES-HREC/127.

……..… ……..

SIGNATURE DATE

ACKNOWLEDGEMENT

I would like to thank my supervisors, Ms Tshimbana T.P and Mr Baloyi N.D, as well as my late parents, Mr. Masia Charles Shoroma and Mrs. Motsatsi Cathrine Shoroma. Furthermore, thank you to his Worship Mayor of Greater Letaba Municipality, Cllr. Mamanyoha T.D.

I would like to take this opportunity to thank the Ward Councillors and Ward Committees of the Municipality. Thanks again to the Portfolio Committee of Environmental Management within GLM.

Special thanks are hereby given to the Municipal Traditional Authorities and stakeholders involved, who were the Chiefs, Tribal Council, and Indunas of Pheeha, Phooko, Raphahlelo, Mamaila Kolobetoba, Vuyani, Mahuntsi, Mamaila Mphotoane, Rakwadu, Sekgopo, and Modjadji Traditional Authority.

My appreciation to the Greater Tzaneen Municipality. as well as community service (environmental staff). Furthermore, thanks to Mankgabe F.M (Former municipal manager).

Lastly, I would like to thank the former Mayor CLLR Matlou P Without your continued support, I would not be able to get so much information on municipal solid waste.

ABSTRACT

Waste pickers are underappreciated despite playing a significant part in reducing the amount of solid waste dumped in landfills and generating value from the rubbish produced by others. Many people from underprivileged and low-income communities work as rubbish collectors and sorters, selling recovered items to the recycling sector. The purpose of this study was to assess waste pickers' contribution to the management of municipal solid waste in South Africa's Limpopo Province's Greater Letaba Municipality (GLM). Waste generated from GLM is disposed at Tzaneen Landfill Site at cost, due to a lack of an operational landfill site in the area. GLM Landfill Site at Maphalle was still under development at the time of the study. Observation was used in the qualitative approach, and records from weighbridges and recycling facilities and a questionnaire with closed questions were used in the quantitative approach. Fifty waste pickers participated in the study. The data was analysed using SPSS.

The results were obtained from the data records at Tzaneen Landfill Site. The records of waste bought and sold by a buyback centre at Tzaneen Landfill Site indicate that 4 455 tonnes of recyclables were reclaimed between July 2019 and June 2020, and 3 656 tonnes from July 2020 to June 2021. This is a total of 8 121 tonnes of recyclable materials that were reclaimed over the 24-month period. Due to access restrictions to the Tzaneen Landfill Site in 2020 because of COVID-19 regulations, it is anticipated that kerb-side reclamation and reclamation of waste from other areas may have had a larger contribution to the quantities of waste reclaimed during 2020. The waste at the buyback centre in Tzaneen Landfill Site comes from different areas. The results from the survey/questionnaire for the waste pickers included demographic information. The results show that more males were inspired to practise recycling than females. Due to unemployment and the need for an income for their families, they were looking for a source of income to support their families. The types of waste collected and sorted by waste pickers, according to the volumes, are as follows: Cans at 36%, bottles at 22%, boxes at 20% and plastics at 18%. The survey indicates that waste collected annually ranged from 1–10 tonnes in 2023, which is the lowest, to 501–900 tonnes in 2023 and more.

This shows that waste pickers are reclaiming solid waste collected from different areas, such as central business districts, households, industries and other areas. A significant contribution was made in terms of diverting recyclable waste from the landfill site.

KEYWORDS: Waste pickers, reclamation, recycling, storage, recovery, disposal.

KAKARETŠO

Ke ka sewelo fao batopi ba ditlakala ba fiwago tlhompho ka lebaka la karolo ye bohlokwa yeo ba e bapalago mo go direng gore go dirwe tše di botse ka ditlakala tšeo di tšweleditšwego ke ba bangwe le go ba le seabe phokotšong ya ditlakala tše di tiilego mafelong a bolahladitlakala. Palo ye kgolo ya batho go tšwa ditšhabeng tšeo di hwetšago megolo ya fase le tšeo di hlokago e iphediša ka go kgoboketša le go hlopha ditlakala gomme ka morago tša rekišetšwa intaseteri ya go risaekela ditlakala tšeo di kgobokeditšwego. Nyakišišo ye e sekaseka karolo yeo e kgathwago ke batopi ba ditlakala ka go taolo ya mmasepala ya ditlakala tše di tiilego ka Mmasepaleng wa Greater Letaba (GLM) ka Profenseng ya Limpopo, Afrika Borwa. Ditlakala tšeo di tšwago go GLM di lahlelwa Bolahladitlakala bja Tzaneen ka ditshenyagalelo, ka lebaka la go hloka bolahladitlakala bjoo bo šomago ka lefelong leo. Bolahladitlakala bja GLM kua motseng wa Maphalle bo be bo sa ntše bo mpshafatšwa nakong ya nyakišišo. Mokgwa wa go lebelela o šomišitšwe go mokgwa wa khwalithethifi, gomme direkhoto tša go tšwa maporogong a keloboima le mafelong a borisaekelelo le lenaneopotšišo leo le nago le dipotšišo tše di tswaletšwego di šomišitšwe go mokgwa wa khwalithethifi. Batopi ba ditlakala ba masomehlano ba kgathile tema mo nyakišišong ye. Datha e sekasekilwe ka go šomiša SPSS.

Dipoelo di hweditšwe go tšwa direkhotong tša datha ka Bolahladitlakaleng bja Tzaneen. Direkhoto tša ditlakala tšeo di rekilwego le go rekišwa ke lefelo la go reka gape Bolahladitlakaleng bja Tzaneen di laetša gore ditone tše 4 455 tša dilo tšeo di kago risaekelega di kgobokeditšwe gare ga Julae 2019 le June 2020, le ditone tše 3 656 go tloga ka Julae 2020 go fihla ka June 2021. Ye ke palomoka ya ditone tše 8 121 ya ditlakala tšeo di ka risaekelegago tšeo di kgobokeditšwego mo lebakeng la dikgwedi tše 24. Ka lebaka la COVID-19, go bonala eka kgoboketšo ya ditlakala ka thoko ga tsela le kgoboketšo ya ditlakala go tšwa mafelong a mangwe e bile le seabe se segolo go bontši bja ditlakala tšeo di kgobokeditšwego ka 2020. Ditlakala tša lefelong la go reka gape ka Bolahladitlakaleng bja Tzaneen di tšwa mafelong a go fapana. Dipoelo tša sabeyi/lenaneopotšišo la batopi ba ditlakala di akareditše tshedimošo ya palo ya batho. Dipoelo di laetša gore ke banna ba bantši bao ba hlohleleditšwego go risaekela go feta

basadi. Ka lebaka la tlhokego ya mešomo le tlhokego ya letseno la malapa a bona, ba be ba nyaka mothopo wa letseno go fepa malapa a bona. Mehuta ya ditlakala tšeo di kgoboketšwago le go hlopša ke batopi ba ditlakala, go ya ka dibolumo, ke ye e latelago: Dithini ka 36%, mabotlelo ka 22%, mapokisi ka 20% le dipolasitiki ka 18%. Disabeyi di laetša gore ditlakala tšeo di kgoboketšwago ngwaga ka ngwaga di tlogile go ditone tše 1–10 ka 2023, yeo e lego fase kudu, go ya go ditone tše 501–900 ka 2023 le go feta. Se se laetša gore batopi ba ditlakala ba kgoboketša ditlakala tše di tiilego tšeo di kgobokeditšwego go tšwa mafelong a go fapana, go swana le dileteng tša kgwebo tša bogare, malapeng, diintastering le mafelong a mangwe. Go bile le seabe se segolo mabapi le go fapoša ditlakala tšeo di ka risaekelegago go tšwa bolahladitlakala.

MANTŠU A BOHLOKWA: Batopi ba ditlakala, kgoboketšo, go risaekela, go boloka, pušetšomaemong, go lahla.

NKOMISO

Varhwalelathyaka a va tekeriwi enhlokweni naswitsanana eka xiave xa nkoka lexi a va xi tlangaka eka ku tumbuluxa nkoka kusuka eka thyaka leri endliwaka hi van'wana na le ka ku hoxa xandla eka ku hunguta thyaka ro tiya etindhawini ta matala. Tinhlayo letikulu ta vanhu kusuka eka miganga ya malinghena ya le hansi na leyi pfumatiweke ti hanya hi ku rhwalela na ku ava thyaka kutani endzhakukaswona ti xavisa timatheriyali leti kumekeke hi vuntshwa eka indhasitiri yo vuyelerisa. Ndzavisiso lowu a wu lava ku kambela xiave xa varhwalelathyaka eka malawulelo ya thyaka ro tiya ya masipala eka Masipala wa Greater Letaba (GLM) lowu kumekaka eka xifundzakulu xa Limpopo, Afrika-Dzonga. Thyaka leri endliweke kusuka eka GLM ri cukumetiwa eka Ndhawu ya Tala ya Tzaneen hi ku hakela mali, hikwalaho ka mpfumaleko wa ndhawu ya tala endhawini leyi. Ndhawu ya Tala ya GLM eka Maphalle a ya ha ri eku tumbuluxiweni hi nkarhi wa ndzavisiso lowu. Nxiyaxiyo wu tirhisiwile eka endlelo ra risima, naswona tirhekodo kusuka eka mabiloho yo pima na miako yo vuyelerisa na khwexinere leswi nga na swivutiso swo pfaleka swi tirhisiwile eka endlelo ra mpimo. Makumentlhanu wa varhwalelathyaka va teke xiave eka ndzavisiso lowu. Switiviwa swi xopaxopiwile hi ku tirhisa SPSS.

Mivuyelo yi kumekile kusuka eka tirhekodo ta switiviwa eka Ndhawu ya Tala ya Tzaneen. Tirhekodo ta thyaka leri ri xaviweke na leri xavisiweke hi senthara yo xava hi vuntshwa eka Ndhawu ya Tala ya Tzaneen ti komba leswaku 4 455 wa tithani ta swivuyelerisiwa ti kumiwile hi vuntshwa exikarhi ka Mawuwana 2019 na Khotavuxika 2020, na 3 656 wa tithani kusuka hi Mawuwana 2020 kufika hi Khotavuxika 2021. Lowu i ntsengo wa 8 121 wa tithani ta timatheriyali leti vuyelerisiwaka leti ti kumiweke hi vuntshwa eka nkarhi wa 24 wa tin'hweti. Hikwalaho ka swipimelo swa mfikelelo eka Ndhawu ya Tala ya Tzaneen hi 2020 hikwalaho ka swinawana swa COVID-19, swi languteriwile leswaku ku kumeka hi vuntshwa eka tlhelo leri nga na rihika na ku kumeka hi vuntshwa ka thyaka kusuka eka ndhawu tin'wana swi nga ha va swi hoxile xandla swinene eka mitsengo ya thyaka leri kumekeke hi vuntshwa hi nkarhi wa 2020. Thyaka eka senthara yo xava hi vuntshwa eka Ndhawu ya Tala ya Tzaneen ri huma etindhawini to hambanahambana. Mivuyelo kusuka eka mbalango/khwexinere ya varhwalelathyaka yi katse vuxokoxoko bya xidemogirafiki. Mivuyelo yi komba leswaku vaxinuna vo tala va hlohlotelekile ku endla mbuyeleriso

kutlula vaxisati. Hikwalaho ka mpfumaleko wa mitirho na xidingo xa malinghena emindyangwini ya vona, a va lava xihlovo xa malinghena ku tundzela mindyangu ya vona. Mixaka ya thyaka leri rhwaleriweke na ku aviwa hi varhwalelathyaka, hi ku ya hi tivholomu, yi hi ndlela leyi landzelaka: Swikotela eka 36%, mabodhlela eka 22%, mabokisi eka 20% na tipulasitiki eka 18%. Mbalango lowu wu komba leswaku thyaka leri hlengeletiweke lembe na lembe ri nava kusuka eka 1–10 ra tithani hi 2023, leti ti nga tona leti nga ehansihansi, kufika eka 501–900 wa tithani hi 2023 na kutlula. Leswi swi komba leswaku varhwalelathyaka va kuma thyaka ro tiya leri rhwaleriweke kusuka eka tindhawu to hambanahambana, to tanihi tindhawu ta le xivindzini xa doroba, miti, tiindhasitiri, na tindhawu tin'wana. Vuhoxaxandla byo tivikana byi endliwile hi ku ya hi ku hambukisa thyaka leri vuyelerisiwaka kusuka eka ndhawu ya tala.

MARITOKULU: Varhwalelathyaka, ku kumeka hi vuntshwa, mbuyeleriso, vuhlayiselo, nhlakarhelo, ncukumeto.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF TABLES

LIST OF ABBREVIATIONS

DFFE	Department of Fish, Forestry and Environment
EPA	Environmental Protection Agency
GLM	Greater Letaba Municipality
GTM	Greater Tzaneen Municipality
ILO	International Labour Organization
IWMP	Integrated Waste Management Plan
OECD	Organisation for Economic Co-operation and Development
WBO	World Bank Organisation

CHAPTER 1: INTRODUCTION

1.1 Background of the study

Waste pickers are the harbingers of a system that plays a part in alleviating poverty, hunger, pollution and creating jobs (Bell, 2018). Additionally, they are vital to the functioning of waste management systems (Shrestha, 2021). In some countries, like France and Columbia, waste pickers provide the only form of solid waste collection system, providing widespread public benefits and achieving high recycling rates. Furthermore, waste pickers contribute to the local economies, environmental sustainability, safety and public health and are widely recognised for their growing economic contribution in some places (Fergutz, 2011). Waste pickers collect different types of waste depending on the value and availability of that waste. They are the principal actors in the reclamation of waste for the recycling industry across the world. Furthermore, they are also widely recognized as being an essential component of the formal economy, diverting waste from the resource economy. (Chen & Vasquez, 2016; Chitaka *et al.,* 2022).

Waste pickers are recognised for the important role they play in landfill sites in respect of creating value from the waste generated by some people and in contributing to minimising greenhouse gases (Mlotswa *et al*., 2022). Additionally, by diverting garbage to landfills through their reuse and recycling efforts, waste pickers help to mitigate the detrimental consequences of climate change by lowering greenhouse gas emissions from landfill sites. (Dayaram *et al*., 2022).

According to Gutberlet and Carenzo (2020), Brazil was the first country to incorporate waste pickers into municipal solid waste management systems through their cooperatives. In large Brazilian cities, more than 500,000 people make a living by gathering and selling recyclables. Furthermore, waste pickers perform an invisible task and many of them work in dumps, where they are exposed to health risks and all kinds of exploitation (Fergutz *et al.,* 2011). It is referred to as an invisible task since the majority of the services they provide—which involve lowering the quantity of garbage that ends up in landfills—are paid for, and their efforts are rarely acknowledged as having a positive

impact on the circular economy. (Gutberlet & Carenzo, 2020). In Europe, waste pickers are referred to as people with extraordinary expertise who have helped the government from paying R748 million in landfill airspace fees (Oxford, 2020). Governments at the local and national levels, including those in Brazil, have developed job classifications to keep tabs on the number of waste pickers and the economic effects they have (Buch, 2021). Furthermore, waste pickers help to reduce poverty and promote urban development by gathering recyclable rubbish for a living (Uddin *et al.,* 2020). Waste picking is a common activity among Bangladesh's impoverished urban population because it doesn't require any special knowledge or expertise (Paul & Bhattacharjee, 2022). It is estimated that the number of recyclable materials sent to the buyback centres in Chicago, United States, is 254 million metric tonnes (Mansour & Shafy, 2018).

Waste pickers face many challenges while working in the informal waste economy, such as being vulnerable to volatile price changes on the recycling market, waste collectors collectively recovered 1.2 – 2.4 million metric tonnes of solid waste materials each year in India (Singh, 2021). In regions like Sub-Saharan Africa, South Asia, the Middle East, and North Africa, few people out of many of them are involved in informal waste recycling, and 11 billion metric tonnes of solid waste are recycled each year (Kaza, 2020). Furthermore, in Colombia they faced challenges such as harassment violence, whereby government-imposed regulations to prevent them from accessing waste (Waste Integration Guideline DFFE, 2020). In Lagos, Nigeria, most landfill sites have BuyBack Centres (BBC), where the waste pickers sell recyclables worth about $4.3 million annually, such as glass, plastics, and paper (Kaza, 2020). The quantity of solid waste from the municipal landfill site in Dilla Town, Southern Ethiopia, discovered that residential homes generated garbage at an average rate of 0.475 kg/capita/day (Fereja & Chemeda, 2021).

Waste picking is a common occurrence at landfills, and it has even evolved into a means of subsistence for some people and families. Waste pickers are part of the informal subsistence work sector. In the developing countries such as South Africa, Pretoria waste pickers are a common sight in the urban informal economy to survive, create jobs, and work for themselves. Moreover, in South Africa, waste picking provides between 60 000

and 90 000 informal self-employment opportunities (Blaauw *et al.,* 2016; Blaauw *et al*., 2021). Therefore, waste picker integration is the global best practice, and waste picker integration advance the achievement of several government priorities (Torgovnik, 2018).

Over 60 000 waste pickers work in South Africa's waste management sector, gathering 80 – 90% of used recyclables from landfills each year (Maleka & DeWet, 2021). Furthermore, this includes communities that struggles to make ends meet by rummaging through waste. They must often work multiple jobs as a community to make ends meet (Sewa, 2016; Kakar *et al*., 2022). In a few informal engagements with waste pickers working in landfills, streets, and dump sites, waste pickers are looking for a voice that represents their interests and well-being (Mbata, 2021). They do, however, seldom receive credit for the significant contribution they make to reducing the amount of solid waste dumped in landfills and generating value out of the trash produced by others. Additionally, by preventing garbage from entering landfills, they contribute significantly to the management of an integrated waste management system (Chen & Vasquez, 2016; Chironda, 2022). Moreover, they are accomplishing waste minimisation as they performed the crucial first step in extracting, recyclables and reusable materials from the waste stream and initiating their revalorisation (National Waste Management Strategy DFFE, 2020).

Waste pickers play a significant role in the management of waste at the landfill sites (Edokpayi *et al*., 2021). Moreover, informal waste pickers have made a significant contribution to the diversion and packaging of recyclables from landfills to recycling in South Africa (Godfrey, 2021; Vernier, 2021). They have an impact on the population, quality of life, and lifespan of landfill sites through adequate management of solid waste (Cruvinel *et al*., 2019). Formalising their operations, waste pickers have been integrated into waste management cooperatives as a means of enhancing the effectiveness and quality of waste management (Kasinja & Tilley, 2018). Solid waste management is referred to as the activity and action required to manage waste by collecting and treating waste from its inception to its final disposal (El-Zeiny & Mohammed, 2021).

The landfill site is the site that is used for the disposal of waste materials for burial and is the oldest form of waste treatment. Additionally, landfills are the main source of microplastics, which include the microscopic plastic scents made from the breakdown of microplastics and the tiny plastic granules used in cosmetics (Baryla *et al.,* 2022). In South Africa, waste pickers are estimated to have saved municipalities between 30 and 700 million metric tonnes of solid waste in landfill space (CSIR, 2018). The advantages of sorting allowed them to obtain entry to the waste stream, employment opportunities, demand legalisation and storage space, raise the volume of waste collected, and strengthen their position in negotiation with the intermediary by assembling recycling materials. By collecting trash from public areas, they help keep cities clean, enhance their aesthetic appeal, and remove a sizable amount of materials from the waste stream (Marello & Helwege, 2017; Wiego, 2023). Many South African municipalities have attempted to integrate waste pickers before; however, they were doing so in relative isolation and policy development. Moreover, most of these municipalities have started to integrate waste pickers into their waste management systems (Samson, 2020).

The ultimate goal of the city's waste minimization initiatives, for instance in the City of Johannesburg, is to increase the yield of recyclable items diverted from Pikitup dump sites, and waste pickers are one of the important partners in this process (De Jager, 2018). They did a far more effective job of collecting waste for recycling in Johannesburg metro than in other urban areas in South Africa (Samson, 2021). The Department of Fish, Forestry, and the Environment in South Africa states that approximately 10% of waste is recycled every day (Blaauw & Schenk, 2018). They are at the forefront of driving the recycling rate in the City of Cape Town, South Africa, to 7.5% of the recyclables that were recovered from the municipal landfill site to the buyback centres (Viljoen, 2022).

Waste pickers in landfills face a number of challenges including chemical exposure, hazardous material exposure, and contaminants exposure (Wiego, 2023). They are not provided with personal protective equipment (PPE) to reduce the risks they are facing at landfill sites (Singh, 2021). To determine the characteristics and pattern of municipal solid waste in the City of Johannesburg, South African plastics solid waste constitutes the

highest waste contents in both the daily and round collected, which is 80% tonnes per day (Ayeleru *et al*., 2018).

In Greater Letaba Municipality (GLM), Limpopo Province, the quantity of solid waste generated monthly at the Tzaneen Landfill Site Weighbridge depends on the quantity of tonnes disposed of (GLM IWMP, 2022). The problems that are observed and may be experienced in the Tzaneen Landfill Site within GLM in Limpopo Province are papers, bottles, cans, and boxes that were disposed of without sorting, which lead to the cells in the landfill site becoming full and the life span of the landfill site not lasting much longer.

1.2 Research problem

Considering the GLM, most of the villages have been observed or identified as having waste lying along the roadsides, illegal dumping sites, burning of waste causing atmospheric gaseous emissions that possibly contribute to global warming, and disposing of waste in streams, rivers, and dams causing water pollution and contamination, which could pose a serious health hazard to humans, ecosystems, and aquatic life (GLM EMP, 2023). Building rubble was lying everywhere, and these areas needed serious attention when it came to cleanliness. Many concerns have been raised by community members about the potential harm to the environment and the public health from the burning of waste. In Komani, South Africa illegal solid waste dumping was prevalent with adverse social and environmental impacts, particularly in poor communities (Ngalo & Thondhlana, 2023). Furthermore, in Kenyan City Kimusi surging amount of waste are reported globally, with negative impacts for health and the environment (Davies *et al*., 2021). Furthermore, solid waste deposited in a landfill site has adverse effects on the surrounding environment and humans living closer to landfill sites (Jerie, 2016). Municipal solid waste is a significant problem, particularly in developing countries that lack infrastructure, such as large cities in developing countries like Thailand (Yukalang *et al.,* 2018).

According to a research study conducted in South Africa, sustainable and livable towns require efficient waste management as well as the promotion and administration of recycling initiatives (Schenk *et al*., 2018). Moreover, waste pickers' unauthorised collecting system has not been integrated into official municipal separation at source

programs in South Africa, which assign people the responsibility of separating recyclables from their rubbish for separate collection (Samson *et al*., 2021).

The problems that were observed and may be experienced in the Tzaneen Landfill Site in Limpopo Province are papers, bottles, cans, and boxes that were disposed of without sorting, which led to the cells in the landfill site becoming full and the life span of the landfill site not lasting much longer. Waste management issues in Greater Letaba Municipality (GLM) such as illegal dumping sites, burning of waste inside skip bins, were the problems that needed attention of waste pickers. They should have sorting recyclables materials there, as recycling initiatives. Due to lack of operational landfill sites at GLM, waste is collected by compactor trucks, tipper trucks being loaded by TLB, skip trucks, and disposed at Tzaneen Landfill Site. Some of unemployed residents from GLM, Mokgoba, Modikong villages were sorting recyclables items at Tzaneen Landfill Site.

This was the gap created, by lacking operational landfill site that could have benefited most of the unemployed community members in GLM. It was very important to understand this gap, because GLM was paying high amount of cost by making use of Tzaneen Landfill Site, sorting recyclables items by waste pickers from the illegal dumping sites and out of the skip bins. This could have assisted GLM skip bins from being burned and collecting low volume of waste to Tzaneen Landfill Site.

This led to the improper management of waste in the villages and the contamination of water caused by illegal dumping sites due to a lack of knowledge of proper disposal. Household waste is one of the core urban problems and challenges, with high quantities of waste being generated (Gutberlet & Uddin, 2018). Moreover, household waste management in rural areas poses a major challenge, such as the burning of solid waste, to local governments in developing countries (Blaauw *et al*., 2021). GLM is disposing of waste at Tzaneen Landfill Site at cost, and all the waste from GLM taken to Tzaneen Landfill Site was weighed and records were safely kept.

These villages, such as Mokgoba, Jamela, Mmamphakgathi, Ditshosing, Madibeng, Koope, and Rasewana, are mostly affected by poor solid waste management services. People are dumping waste everywhere, which is harmful to human beings (GLM IDP

2018–2019). These villages are sitting with a serious problem, which is poor waste management, which has caused serious health effects (IDP, 2020–2021). Solid waste dumps are seriously affecting the environment, and this waste dump incidence aggravates the environmental conditions in developing countries. The negative environmental impacts of improper solid waste dumping, such as illegal dumping sites and burning of solid waste, are easily observed in developing countries (Eneogwe & Umunnake, 2021). In England, illegal waste dumping has been regarded as of the biggest challenge for environmental damage (Kong *et al*., 2017).

1.3 Research Purpose and Importance

In the informal economy, earnings from waste picking are the main source of household income (Wiego, 2021). The importance of this is that waste pickers create jobs to reduce poverty by attempting to render collection and processing services in exchange for a small income to support their families. Reclamation of waste also refers to the process of recycling waste products to create economically useful material and is normally handled by marginalised, uneducated, vulnerable, disabled, and poor people to generate income. There are risks attached to the reclamation of waste in landfill sites, and there are several chemicals that have detrimental effects on human health (Edokpayi *et al*., 2021).

Waste pickers put a lot of effort into recovering and reselling recyclable and reused items in order to make a living. There are families with multiple generations of reclaimers, and some have been collecting recyclables for almost 30 years (Samson, 2021). Scavengers play a crucial part in a dynamic recovery model by demonstrating that economies dependent on solid waste can achieve efficiency; Columbia and the Gaza Strip, Palestine, are two such examples (Al-Khatib *et al*., 2020). The role of waste pickers in Greater Letaba Local Municipality has benefited waste pickers and other local municipalities. The gaps identified by the researcher in South Africa on which the study seeks to evaluate the role of waste pickers were the non-practice of sorting in landfill sites, which was making the lifespan not last much longer. A study on the evaluation of the role of waste pickers in GLM was never done. This is the first study conducted in the area. Many studies were conducted on waste management and waste pickers in metropolitan municipalities such

as Ekurhuleni Metropolitan, eThekwini Municipality, the City of Tshwane, the City of Cape Town, and the City of Joburg, as they produced a huge volume of municipal solid waste (Fourie & Koen, 2022). Studies were done in Africa and worldwide on the role of waste pickers in solid waste management, the gaps in illegal dumping sites, the disposal of waste inside streams, and the burning of waste (Ferronato & Torreta, 2021).

1.4 Aim and Objectives

1.4.1 Aim

The aim of this study was to evaluate the role of waste pickers in municipal solid waste management in Greater Letaba Municipality within Limpopo Province, South Africa.

1.4.2 Objectives of the study

- To evaluate the role of waste pickers in solid waste management at Greater Letaba Municipality.
- To identify the challenges waste pickers, encounter at the landfill site.
- To estimate the tonnes of waste reclaimed from landfill site by waste pickers.
- To identify and quantify tonnes of solid waste from the municipal landfill sites.
- To identify and quantify tonnes of recyclables reclaimed by waste pickers from the municipal landfill sites to the buy-back centres.

1.4.3 Research questions

- What is the role of waste pickers in solid waste management at Greater Letaba Municipality?
- What challenges do the waste pickers encounter at the landfill site?
- How many tonnes of waste were reclaimed from the landfill site by waste pickers?
- How many tonnes of waste were identified and quantified from the municipal landfill sites?
- How many tonnes of recyclables reclaimed by waste pickers were identified and quantified from the municipal landfill sites to the buy-back centre?

1.5 Delineation of the Study

The study took place in villages such as Mokgoba, Jamela, Mmamphakgathi, Ditshosing, Madibeng, Koope, and Rasewana within GLM. The data was collected at the Greater Tzaneen Municipality (GTM) weighbridge, as Letaba Municipality is currently making use of Tzaneen at a cost. Closed-ended questionnaires were collected from waste pickers to get their perceptions. Furthermore, the data was collected from field observation based on what was happening in the field. Sampling method such as multimethod (qualitative and quantitative), inclusion and exclusion criteria, data collection from weighbridge, and the buyback centre (BBC). Observations at the landfill site, where questionnaires were distributed to waste pickers, were limited due to the time provided for the visit, even though the researcher visited several times but with time limits.

The time frame for the scope of work was two to three years. The inclusion criteria were waste pickers who were over 18 years old at waste management facilities. Waste pickers under the age of 18 were not included because of their inability to make informed decisions, according to South African law.

1.6 Outline of the Dissertation

Chapter 1: Introduction

This chapter gives the background for the waste pickers on their roles, challenges, and the quantity of solid waste and recyclable materials from the landfill site to thebuyback centre. Furthermore, this gives the research problem, importance of the study, aim, objectives, and research questions of the waste pickers. Moreover, it provides a delineation of the study.

Chapter 2: Literature Review

This chapter discusses the literature review of waste pickers worldwide, including terms and definitions, roles, environmental contribution and benefits to solid waste, partnerships with the government, and waste pickers. Furthermore, it explains waste pickers worldwide, on their consideration, combination, lessons of waste pickers integration,

quantity of solid waste and recyclable materials, the impacts they made on solid waste, the legislation, and policies international, national, and local, as well as the challenges they explored.

Chapter 3: Research Methodology

An outline of the study is discussed in this chapter. It shows where the study areas are located including longitudes and latitudes, population which consists of how many people or residents are within the study area, sampling method such as multimethod (qualitative and quantitative), inclusion and exclusion criteria, data collection from weighbridge, and the buyback centres. Furthermore, this chapter explains the data analysis on how to analyse data by using which software, ethics consideration on the approval by ethical committee and limitation of the study.

Chapter 4: Research results and Discussion

This chapter discusses the research findings of the study. It also provides the data gathered using different set of tools and methods. Furthermore, this chapter analyses and discuss the findings regarding the role of waste pickers within the study area.

Chapter 5: Conclusion and Recommendations

This chapter reviews the research objectives as formulated in Chapter 1. Furthermore, it makes recommendations to the readers and relevant stakeholders of the research on the findings and finally makes conclusions and recommendations from the research undertaken as well.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter discusses the literature review of waste pickers at an international, continental, national and in the study area, on terms and definitions, roles, environmental contribution and benefits on solid waste, partnership with the government and waste pickers. Furthermore, it explains waste pickers on worldwide, on their consideration, combination, lessons of waste pickers integration, quantity of solid waste and recyclables materials, the impacts they made on solid waste, the legislation, and policies international, national, and local, as well as challenges they are explored.

2.2 Brief overview of waste picking

Despite associated health and social difficulties, waste pickers—those who gather domestic, commercial, or industrial waste—make up hundreds of thousands of individuals in India and rely on waste for their income (Kumar *et al*., 2017). Additionally, by encouraging resource circulation and lowering the quantity of landfill waste, they are considered to as those who are significantly improving public health, sanitation, and the environment (International Labour Organization [ILO], 2023). They collect waste from private waste bins along the streets, and then they sell recyclables to middlemen or businesses (Wiego, 2021). Waste pickers in cities across Global South such as Brazil and Peru, are diverting a significant amount of tonnage from landfills, and contributes towards a sustainable environment, and better public practices (Dayaram *et al.,* 2022).

Waste pickers contribute to the circular economy by supplying raw materials to industry, buying back centres, and creating many jobs for middlemen who are able to purchase, segregate, process, and resell the materials collected (Gall & Hansen, 2020). Nuswon (2020) in Nigeria states that by gathering garbage from public spaces, they contribute to cleanliness, help beautify the city, reduce air, and water pollution. Rutkowski (2015) states that waste pickers bring social, environmental, and economic benefits such as the reduction of the quantity of waste generated and the environmental impacts of landfilling.

Waste pickers collect up to 90% recyclables of post-consumer packaging, including papers, thereby saving municipalities millions, and reducing the amount of waste that has been dumped from the landfill sites (Matshili, 2019). Although waste pickers create value from the waste generated by society, as they are treated with respect for the services, they are provided with important waste collection services that fill the gap between municipalities and other waste management services (Fisk, 2021). Schenck (2019) states that in the South African context, street and landfill waste pickers divert 90% of recyclables from landfill sites and 10% of reusable materials from the solid waste stream.

Stats SA (2022) state that 90% of estimated 59 million tonnes of waste produced in South Africa in 2011 ended up in the landfill site, while 10% of waste was recycled, and this was due to lack of shortage of land for disposing solid waste. Waste pickers are exposed to a different types of environmental health risks, and their self-rated health may have an impact on their ability to access healthcare, increase clinic visits, and detect infections (Made *et al*., 2020). They are essential for offering service to remove recyclables for free, recycle items from landfill sites, municipalities save money in terms of indirect costs of recycling and waste management (Ntuli, 2017). Moreover, waste pickers positively into our environment and they play a vital role in reducing the waste from waste bins, waste minimisation strategy (Edenvale News, 2023). Furthermore, waste pickers play a significant role in South Africa, in the management of waste by reducing the amount of waste that goes to the landfill (Edokpayi *et al*., 2021). In Tzaneen Landfill Site, they are assisting the municipality from paying a lot of money, in constructing more cells as they are taking out re-usable items to the buyback centre (GTM/ IDP, 2022-2024).

2.3 Terms and definitions

2.3.1 Waste pickers

Waste pickers refer to people who recover recyclable or reusable items that others have thrown away for sale or their own use. According to Paulo (2020) and Ahmad and Barford (2021), waste pickers are low-income people who dedicate themselves to activities of recyclable material collection, sorting, processing, transformation, and commercialisation. Moreover, waste pickers are typically referred to as people who receive little social

protection, work in dangerous conditions, and earn a low wage. Waste pickers refer to a group of communities that struggle to make ends meet by rummaging through waste, which is generated in different cities (Rashtriya, 2016). Furthermore, these waste pickers are making a living by rummaging through refuse in the waste dumps.

2.3.2 Waste Management

Waste management refers to the collecting and disposal of garbage with the intention of minimizing, reusing, and recycling waste (DFFE, 2022). In addition, it comprises cleaning the city, which includes sweeping the streets and gathering recyclables along the streets and refers to the various waste management and disposal schemes, as well as transporting various waste forms to landfill sites and recycling or composting centres (DFFE, 2022).

2.3.3 Recycling

Recycling is the process of recovering waste for further use. It entails removing waste from a waste stream, processing that material to become a product or raw material, and then reusing it (DFFE, 2022).

Recycling refers to collecting a waste product and reprocessing it so that it can be consumed once again, or reprocessing waste materials for use in new products (Strydom, 2018).

2.3.4 Landfill and waste disposal site

According to Thompson & Sons (2023), a landfill site is a piece of land where waste has been disposed of, either directly on the ground or by filling in an unintentional hole in the ground. In order to lessen contamination of the nearby area, solid waste like as paper, glass, and metal are buried there between layers of dirt and other materials (DFFE, 2022).

2.3.5 Solid waste management

The process of managing waste from the point of origin to the point of disposal is known as solid waste management (Abhishek *et al*., 2020). It is a word used to describe the

procedure of gathering and handling solid waste. It also provides options for recycling things that don't belong in the garbage.

2.4 The role of waste pickers

Waste pickers are people who saw a gap, created jobs, supported the industry, and protected the environment (Suss, 2023). Waste pickers drastically lowering the quantity of waste that ends up in landfills or is left unattended in streets and watercourses, waste pickers are able to manage municipal solid waste by recovering valuable resources (Colombijn & Morbidini, 2017). In Argentina, they informed and educated the public and raise the awareness of socio environmental issues related to waste management in promoting recycling at the landfill sites (Compos *et al*., 2021).

Millions of people worldwide are making a living by collecting, sorting, recycling, and selling recyclable materials that was disposed (Wiego, 2021). In India, the Government recognised the contribution of waste pickers and the role they are playing in waste management, their incorporation into waste collection systems as the responsibility of local authorities and their as they are bringing themselves a financial stability and upward mobility (Meghani, 2023).

Additionally, in the Indian capital, they acknowledged the part informal waste pickers play in managing the waste generated in the city and how existing systems may better use their advanced understanding of this field to address a developing problem (Arora, 2016; Majithia, 2018). In Brazil, some municipalities have established agreements with waste picker cooperatives in charge of collecting specific recyclables, which occasionally gives them the chance to enhance formal selective waste collection while also participating in environmental education initiatives (Gutberlet *et al.,* 2021).

Moreover, waste pickers play a key role in informal waste separation in most developing countries, unlike in Europe, where separation at source was legislated (Arnoldi, 2019). Waste pickers are fundamental actors at the Brazilian recycling scheme and principal actors in reclaiming waste for the recycling industry, as they are playing an important role in the waste economy (Chen & Vasquez, 2016). They reduce the amount of waste getting

dumped at the landfill site (Pachauri & Singh, 2022). They collected approximately 60 per cent of all solid waste gathered for recycling for example, in Northern Bangladesh they provide solid waste collection only (Ali, 2020). In Asia Vietnam, most of 60% recycling materials are collected by waste pickers, made it to avoid use of waste trucks where all recyclables are mixed, contaminated, rendering them for recycling and good for a landfill site (Sanders, 2022).

Waste pickers supplied crucial solid waste management services and are referred to as reclaimers, recicladores in Spanish, and catadores in Portuguese (Arrendondo, 2023). They are a principal actor in making a living by recovering and selling reusable items from landfill sites (Paulo, 2016; Ali *et al.,* 2023). In Bengaluru, waste pickers play a crucial role in waste management and are informal waste collectors in the city. Furthermore, they are the backbones of the decentralised inclusive waste management system with their contribution to waste collection and management helping the Bengaluru municipal body save annually by recycling 1 050 tonnes of waste (Chatterji, 2023). The author agreed with the current study, as waste pickers are reclaiming recyclable materials to save the lifespan of the landfill site.

Waste pickers in Nigeria City of Lagos forms an integral part of the economy, as they were essential service providers who plays a pivotal role in keeping the cities clean and sustainable. Furthermore, they were responsible for collecting and disposing of waste playing a critical role in waste management (Ecobater, 2023). In most of Tanzanian Cities, they played in role on contributing by saving part of lifespan of the landfill sites, even though there are factors that saves the lifespan (Onesmo, 2023).

One of the metropolitan municipalities in South Africa that uses informal rubbish pickers is City of Johannesburg. Waste pickers are now active in municipal waste collection, sorting, and recycling of recyclable items that are commercially viable as part of waste management (Simatele *et al*., 2017). As the ultimate goal of the city's waste minimisation efforts, waste pickers are one of the major contributors in boosting the yield of recyclable materials diverted from Pikitup landfill sites (Nene, 2018). Waste pickers has partnered with Pikitup and given the official recycling work to unemployed people and as well as to

provide municipal waste management services. This was the fact that Pikitup designs charity style projects for them (Samson, 2021). They play an important environmental role by directing recyclable materials to the recycling chain, while lowering the quantity of waste disposed of in the landfill sites (Dias, 2018).

The City of Johannesburg recognised that waste pickers form an integral part of waste minimisation as they reduce waste going to landfill sites by separating it at its source and diverting it from being landfilled (Baker *et al.*, 2016). They were very important as they played a role in the waste management activity, which benefited society as production costs in some sectors and landfills' lifetimes were lengthened (Wiego, 2019). They were integrated into the formal waste management sector, and collected household, commercial, and industrial waste (Nowicki, 2019; Wiego, 2019). They have been described as the backbone of the recycling industry in South Africa, collecting about 90% of post-consumption packing and paper that gets recycled. Furthermore, they are playing a crucial role in slowing down the ever-shrinking landfill site (eNCA, 2019). Most used sticks or other instruments with which to sort through the waste, such as plastic, cardboard, and other recyclables. Chen *et al*. (2018) stated that waste pickers play a crucial role by helping to control municipal solid waste. According to a 2016 assessment, there was a sizable waste picker community in South Africa, who worked on municipal landfill sites as well as in city and town streets (Blaauw *et al*., 2016).

This result in waste separation by asking people to separate their waste at home, reducing waste reuse, aiding recycling, and reducing pressure on the environment (Kaza, 2020). Their function is important in guaranteeing the community's constitutional entitlement to a healthy and safe environment. An estimated 60 000 informal waste pickers in Gauteng Province, a remarkable case study in entrepreneurial agility, were instrumental in saving recyclable waste from ending up in the city's overflowing landfills (Ross, 2018). Waste pickers are indispensable for cleanliness, health, and resilience in rapidly urbanised countries. In many cities across South Africa, waste pickers provide form of collecting recyclables (Suss, 2023).

Waste pickers play an imperative role in environmental justice by reducing reliance on raw materials and greenhouse gas emissions from landfill sites (Friend of Earth, 2020). This article is relevant and supportive to the study; as waste pickers evaluate their roles in municipal solid waste. As a tactic to raise the quality and effectiveness of waste management in these areas, informal waste pickers were formalised and integrated into waste management cooperatives (Kasinja & Tilley, 2018). According to Torgovnik (2018), waste picker integration is a worldwide best practice, waste pickers are currently the main actors removing recyclables from the waste stream, and waste picker integration helps the government fulfill its main objectives.

Waste pickers are the silent environmental heroes who built the foundation of South Africa's recycling sector. Along their predetermined routes, they separate recyclables from non-recyclable waste in residential bins and landfills (Monte, 2020). Packaging SA's executive director have said that they form a vitally part of our waste management infrastructure and recycling industries (3S Media, 2020).

Waste pickers in South Africa are essential to recycling economy and environmentally conscious future, but they are ignored, mistreated, and marginalised. According to Oxford (2020), waste pickers who have developed a community from abandoned waste and landfill sites have been marginalised by these approaches. They work as waste collectors, collectors of recyclable materials in the streets, or as waste pickers on the transfer of waste recyclables from the landfill site (Bizjak *et al*., 2020). The authors agreed upon with the study, as waste pikers are reclaiming waste materials from the municipal landfill site, for example, the Tzaneen Landfill Site. They are leading the charge to raise South Africa's recycling rate to 7.5%. They retrieve objects from landfills and load them into improvised carts and bags (Viljoen, 2022).

2.4.1 Environmental contribution and economic benefits of waste pickers in solid waste

South Africa now has a recycling rate comparable to several European nations, thanks in large part to waste pickers (DFFE, 2019). Waste pickers have shown to be making significant contributions to society; they have been found to be bringing more value to the

earnings of waste producers and to the savings of local government expenses in Columbia than they were to their own income., i.e., recycling recyclable waste materials from garbage produced in cities. The type of recyclables materials that are reclaimed by waste pickers were glass, cardboard, paper, plastic, metals, and other materials (Para, 2022). In Philippines, waste pickers collected solid waste for from the households, sort re-usable items for selling and the remaining were collected by municipal truck to the landfill sites (Calupitan & McDermott, 2023).

In Lagos, Nigeria, landfill sites supported thousands of people who searched through what is discarded for materials for resale. The survey of two landfill sites discovered a total of about 2 800 waste pickers, both men and women (Kaza, 2020). The irony was that waste pickers benefited municipalities the most, as they were the only reason that recycling happened at the municipal level (Chamane, 2021).

Analyses of informal recycling in Lagos showed that the activity provided jobs and a means of livelihood to a significant number of people. Furthermore, their work contributes to protecting the environment and improving the life span of waste disposal sites (Morais *et al.,* 2022). In lieu of formal recycling operations, waste pickers collected litter and sold it to middlemen, who aggregated plastic waste and sold it to recyclers abroad (Mayerhoff, 2020). In Zambia, Waste pickers accrue economic benefits, and the municipality has less waste within their area (Nkhata, 2022).

Many cities in South Africa, such as Johannesburg, Pretoria, and Polokwane employed waste pickers to extend household collection and promote recycling by reclaiming recyclables from household waste (Gutbert & Uddin, 2018). The purpose of the waste picker programme was to encourage household recycling as well (Khunou & Makwarela, 2018). It was estimated that about 67 000 people make a living through waste picking in South Africa by operating in landfill sites, while other studies estimated 85 000 people, and international studies revealed that around 15 million people in developing countries are waste pickers (Viljoen, 2022). Since they gathered 80% of the post-consumer packaging and paper material, South Africa's recycling rate was on par with several Western European nations, which made them vital to the local economy (Bax, 2019).

Harrisberg (2019) states that waste pickers, known as reclaimers, are workers engaged in collecting and recycling 80 to 90% of plastic and packaging materials gathered from refuse, landfill sites, and elsewhere, which they sell for a living. This author is agreed with the study, as waste pickers are reclaiming recyclable waste materials from the landfill site to the recycling facility in tonnes. Additionally, waste pickers remove a sizable amount of materials from the waste streams (Wiego, 2021). By encouraging resource rotation and lowering the quantity of waste in disposal sites, they significantly improved sanitation, public health, and the environment (ILO, 2023). It was predicted that they save towns hundreds of millions of metric tonnes of landfill space because they gather between 80 and 90% of the nation's discarded packaging and paper (Postman, 2019).

2.4.2 Partnership between government and waste pickers

Given that Brazil has the best recycling rates in the nation, the collaboration between waste pickers and local officials has won recognition on a national level (Fergutz *et al*., 2011). Curitiba in Brazil, the country’s third largest city, planned to partner with a private company to make its streets cleanest and divert garbage from its ever-filler landfill, while obliging that company to provide recyclable material to the waste picker businesses (Hammer, 2017). Moreover, Curitiba was one of the towns included in the pilot project, and the city intended to decrease the amount of waste that was going to be dumped in landfills (Devendran *et al*., 2023). In addition to providing training and support for waste pickers in the waste industry, Chintan also assisted with the education of the children living in waste picker settlements. Additionally, they managed a cooperative effort to gather, classify, and recycle waste at the New Delhi railway station in partnership with the New Delhi railroads (Devendran *et al*., 2023).

In Buenos Aires, Argentina, waste pickers have been supported by the municipality, catered with their needs, provided with the infrastructure for sorting and included them as partners in the source segregation scheme (Dias, 2017). Waste pickers contributed to kerbside and household collection and have partnered with most of the Italian municipalities for assisting them by transporting recyclables items to buy back centres (Gastaldi *et al*., 2021).

In order to solve the growing waste problem and create long-term sustainable solutions for waste processing, some organizations in Jordan sought to formalise the work of waste pickers and undermine their function as recyclers (Gutberlet *et al*., 2016). Furthermore, a collective of well-organised waste pickers contributed to the city's sustainability and provided better living conditions for the waste pickers, i.e., mounting rubbish crisis (Aquino *et al.,* 2023). Companies and their employees were encouraged to contribute funds to help provide resources for waste pickers impacting their immediate safety and health, including PPE (Made *et al*., 2020). It revealed that collaborating with the unorganised recycling industry presents a genuine chance to enhance resource efficiency and trash management in low- and middle-income nations like Nigeria, all the while assisting in the reduction of waste and poverty (EPA, 2021). In Namibia and Swaziland, there was a relationship between waste pickers and buyback centres recycling purposes, by local government including all stakeholders such as landfill operators, municipal officials in charge with the landfill sites (ILO, 2020).

Organised waste pickers group requires waste pickers to work collaboratively and environmental justice in their organised structures, for example South Africa, Soshanguve landfill site (Paul, 2023). They recycled 80 to 90% of post-consumer and packaging in South Africa and saved the authorities up to R750 million in municipal landfill airspace and costs (DFFE, 2019; Harrisberg, 2019). This is agreed and relevant, as they are reducing the quantity of solid waste from the landfill site to save the lifespan. According to Ross (2018), in order to aid waste pickers mechanise their hauling solution, the Gauteng government planned to provide them with motorised, three-wheeled trolley.

This shows the role that they were playing in reducing municipal solid waste from landfill sites. Mpofana local municipality in Kwa-Zulu Natal Province supported the reclaiming livelihoods initiative and has granted permission for recyclable waste to be collected in landfills. This enabled the waste pickers to collect recyclables directly from the landfill (Seed award, 2021). Together with the packaging sector, the Department of Forestry, Fisheries, and Environment (DFFE) has negotiated a plan to support waste pickers who have lost their jobs across the nation (SAnews, 2020). DFFE has teamed up with the

packaging industry to provide food vouchers to waste picker reclaimers to cushion them from the hardship (MJO, 2020).

The government's inclination to collaborate with cooperatives encouraged the formation of independent waste collectors and provided a conduit for the state when bringing vehicles to other municipalities. The relationship with the local government played a direct role in improving waste pickers' working conditions (Abizaid, 2016). There was a strong emphasis on cooperation and models between waste pickers and local government (Dias & Fernandez, 2020). The prospect of improved waste management and the social inclusion of these marginalised persons was made possible by collaboration between waste pickers and municipalities (Marello & Helwege, 2017). The government has developed recommendations for local governments to acknowledge the vital role that informal waste pickers play in the recycling business and to incorporate them into the economy (Postman, 2019).

Waste pickers might become agents in the development process, increase their negotiating power with the government and business community, and end poverty through grassroots development if they organised (Medina, 2015). They should work towards establishing a good working relationship with landfill site municipal staff (Bonner & Mbata, 2020). Chamane (2022) states that these were usually indicative of a healthy partnership between waste pickers and the municipality where they worked. Furthermore, Blaauw *et al*. (2019) argues that landfill site waste pickers in South Africa were responsible for collecting substantial volumes of recyclable materials, saving municipalities millions, and besides contributing to a generally healthy and clean environment.

It indicated that they had successfully negotiated with the municipality for equipment, transportation, and operating space at the landfill (Marello & Helwege, 2017). There was increasing support for including waste pickers in the model of cooperation between waste picker cooperatives and municipal solid waste systems, frequently as part of integrated solid waste management (Buch, 2021). Local authorities intermittently threatened to bar waste pickers from the landfill site; worsening poverty in the city meant that more people

were scavenging at the landfill (Paulo, 2020). Buch (2021) adds that the government's inclusive green growth in cities initiative works with waste picker organisations and the municipality to formalise informal waste collecting operations in order to improve working conditions.

2.4.3 Environmental legislations/ Acts associated with solid waste management

The United Nations adopted a resolution that focused on waste, including end pollution, towards an internationally legally binding instrument adopted at the United Nations Environment (UNEP, 2022). According to Pikitup (2020), the Polokwane declaration of zero waste to disposal sites was endorsed by the City of Johannesburg's 2040 growth and development strategy. The National Environmental Management: Waste Act of 2008, the integrated pollution and waste management strategy of South Africa that govern the collection of glass, paper, and the like by waste pickers. The waste pickers and groundwork waste campaign, which focuses largely on supporting the emerging waste pickers, have been working together to ensure that the South African government recognises waste pickers as part of the economy of the country under the Waste Act (National Environmental Management Act 2008).

Municipalities from all over South Africa have started to engage waste pickers as part of the integration; for example, the City of Tshwane and the City of Johannesburg have started to implement formal projects with the aim of working with waste pickers as part of the economy (Mbatha & Bonner, 2022). Waste pickers were recognised in the National Environmental Management Act: Waste Act 2008 as an important part of the waste management system. These environmental legislation, strategies, and policies govern the roles of waste pickers in municipal solid waste. The Waste Pickers Integration Guideline of Department of Forestry, Fisheries and Environment (DFFE) 2020, was guiding the municipalities, industry, and waste pickers as they develop and implement waste picker integration initiatives. As well as the development of a waste picker integration support programme, as waste pickers would play a role in the implementation of the programme. The National Waste Management Strategy (DFFE, 2020) outlines the

government's concerns regarding waste pickers, including minimising health risks to women, youth, and individuals with disabilities.

2.4.4 Consideration of the Waste Pickers

In Argentina and Brazil, waste picker organisations were performing selective waste collection services, engaging with municipalities and industries, and practising the circular economy (Gutberlet & Carenzo, 2020). It is crucial to completely restructure the inclusive recycling systems, particularly in light of the fact that waste pickers play a crucial role in the Brazilian recycling industry by supplying and maintaining it (Abussafy *et al.,* 2020). Despite their efforts, waste pickers faced discrimination from some urban residents and were viewed as nuisances by the government (Dias, 2018). Sorting waste at collection locations, the informal waste pickers performed crucial waste collecting services that bridged the gap left by municipal and other waste management agencies that did not cover all areas of operation. In order to recover end-of-life plastic items, recycle, and stop plastic from leaking into the ocean, informal garbage workers are essential (IUCN, 2021).

Recognition of the contribution that waste pickers made was growing in some countries (Clausager *et al*., 2020). Wiego (2021) argue that in Ecuador, an agreement that aimed to include 20,000 waste pickers and their families through programmes and funding was even signed by government agencies. At their second national congress, waste picker associations from seven cities in Bolivia marched in support of a bill that would recognise them as workers and grant them access to social security benefits. Thus, by encouraging and funding waste pickers' involvement in municipal waste management systems, governments in Bolivia and throughout Latin America had the chance to capitalise on their experience (Abussafy *et al*., 2020). They were experiencing a new global dynamic of self-awareness and recognition as they participated in international gatherings, exchanged experiences, and dreamed of their future (Kumar *et al*., 2017). In Germany, waste separation has started with waste pickers, whereby solid waste from household is sorted and put it in a separate bins and containers to be transported to buyback centre. A large part of the waste generated is recycled and Germany was even set to become the world

champion, by considering waste pickers for waste separation (Handbook Germany, 2024).

The inclusion of waste pickers has helped increase waste collection coverage from 75% to 90% in the capital of Accra. The shift towards the waste collectors in Ghana has effectively improved waste collection services in major cities (Global Alliance, 2021).

The South African Wood Preservers Association (SAWPA) has been successful in lobbying both national and municipal governments to acknowledge waste pickers as stakeholders and key actors in waste management in South Africa since its founding (Mbata, 2021). This is relevant and encouraging since it illustrates the functions of waste pickers in recovering recyclable elements from waste. The study showed how local governments might cooperate to create jobs locally and improve recycling and composting services by acknowledging the crucial role informal recyclers already perform and forming partnerships with them (Marnce, 2021). The Food Fortification Resource Centre (FFRC) collaborated with waste pickers to gather flip flops, and they were instrumental in creating demand for the waste material and finding a use for it by connecting with communities and offering a market (Holt & Steinfeld, 2019).

With the commitment to advocate for better laws and public policies that involve waste picker organisations in the formulation process, they should take on an active role in decision-making, looking for ways to improve common conditions, their role in the circular economy, capacity-building initiatives, and information that will help them be recognized for and become professionals in their field.

Furthermore, this was to allow waste pickers as part of the decision-making, improve their current working conditions, develop their capacity, and achieve recognition for their work (Gutberlet *et al*., 2017). Chintan Environmental Research and Action Group has anchored its work in grassroots partnerships with organisations of the urban marginalised, like waste pickers and municipalities. Organisations are centred on environmental justice and work in partnership with various individuals or groups in society, such as waste pickers (Our Endangered World, 2023).

2.4.5 Lessons from waste pickers integration

Waste picker incorporation into local and regional waste management systems and recycling economies is now a universal practise such as Latin America and European countries (Scheinberg, 2018). The Jordanian Government in Amman has committed to integrate waste pickers, by recruiting them into formal jobs in the public sectors (Abu *et al*., 2022). The environmental cooperatives Europe Serbia engaged waste pickers in an organised recycling system and their idea was recognised as one of the best innovative solutions, to accelerate solid waste recycling (UNDP, 2024).

Waste pickers in Egypt Cairo, were in garbage zone that occupy some of accessible recesses of the city's extensive outer fringes and some neighbours are integrated into the city, frequently threatened with raising of solid waste that cause littering (Badir & Florin, 2017).

As South Africa moved forward with the implementation of waste picker integration, it was important to draw lessons from existing experiences. This briefing note presented findings on initiatives to integrate reclaimers (waste pickers) in Johannesburg and Metsimaholo Local Municipality in Sasolburg (Samson, 2020). Waste picker integration advanced several key policy priorities in South Africa. The lesson from the initiatives was the development of evidence-based guidelines to integrate waste pickers into the South African municipal waste management systems research project (Pholoto, 2021).

The designed for the project outputs was, to support waste picker integration by ensuring that the role of waste pickers was formally recognised, valued and that they were integrated into the design, implementation of separation at source and other recycling initiatives (Maleka & De Wet, 2021). Waste picker integration has played an important role in South Africa achieving a recycling rate (DFFE, 2019). This shows how it relates to the roles of waste pickers in reclaiming waste recyclable materials. As waste pickers provided a non-motorised form of collection, waste picker integration helped to contain greenhouse gas emissions related to recycling. Furthermore, an emission calculator was used by greenhouse gas organisations to estimate the emissions that waste picker organisations were helping to prevent with their work (Abizaid, 2016; Wiego, 2021).

Reclaimers in South Africa had been organising and negotiating with governments to be officially integrated into solid waste management systems (Samson, 2020).

In Tzaneen Landfill Site waste pickers played integration helped to save the life span of the landfill by reducing the quantity of solid waste disposed, by sorting re-usable items (GTM/ IDP 2022-2023).

2.5 Quantity of solid waste in the landfill site

In Brazil, official data showed that over 250 000 people engaged in waste picking in that country (Wiego, 2023). Waste pickers, also known as waste reclaimers play an important role in solid waste management systems, building on existing waste management practices and acting in a parallel way to formal waste collection (Gutberlet *et al.,* 2016). This has shown that waste reclamation is an important element in the waste management system, with a positive impact on the economy and environment (Mapa *et al*., 2019). In the United States of America, the total generation of municipal solid waste in 2018 was 292.4 million tonnes and 25 million tonnes were composted (EPA, 2022). This article is supportive, related and agreed with the study, as this statement is identifying and quantifying the tonnes of solid waste from the landfill site. Globally, most waste is dumped or disposed of. About 37% of waste was disposed of in some form at a landfill site, and 8% of it was disposed of at a sanitary landfill site (Likar, 2022). An estimated 12.59 million of the 17.49 million tonnes of solid waste produced annually in Aotearoa, New Zealand, are disposed of in landfills (Te Taiao, 2021). This article supported the fact of the study, as the tonnes of solid waste are quantified from the landfill site.

Landfill dumping and littering were the grievous problems to the environment, which Botswana is facing, whereby 10 000 tonnes of solid waste is generated per day and the government bodies considered recycling services (Nagabooshnam, 2018).

Ninety percent of the 59 million tonnes of trash produced in South Africa in 2011, according to Jordaan (2022), ended up in landfills. There were additional demands associated with working at the landfill; waste pickers occasionally had to carry their bags from the dumping site to the sorting area. In addition, waste vehicles that had a

compensation arrangement with waste pickers were employed at the disposal site solely to assist in transporting the bags to the sorting regions (Mothiba, 2017). The only method of collecting solid waste was given to waste pickers, who greatly benefited the public and achieved excellent recycling rates.

Waste pickers salvaged recyclables from landfills, which decreased the cost of managing municipal solid waste, created jobs later on, and improved the environment and public health (Godfrey, 2017). They were important in managing waste at landfills, and most low-income individuals turned to waste picking as a source of income (Edokpayi *et al*., 2021). In order to lessen the amount of waste that was sent to landfills and incinerators and instead ended up in recycling industries, a sizable amount of materials was diverted from disposal. This helped to preserve natural resources by lowering the amount of pollution that was released into the air and water and reduced the need for virgin materials (EPA, 2020).

By decreasing the quantity of waste that ended up in landfills and supplying materials for recycling operations, waste pickers made a significant contribution to environmental sustainability. According to Samson (2020) and Jordaan (2022), waste separation at the source decreased the quantity of recyclables that were dumped in landfills, hence lowering the opportunity for waste pickers to make money there. The annual amount of recyclables that were informally diverted from municipal solid waste was estimated using the number of waste pickers engaged in collection activities, including waste segregation and identification for recyclable materials, the amounts collected by waste pickers each day, and the number of working days (Naveen, 2021). There had been proper management of waste picker activities on the landfill site, as well as cooperation, proper collection, and support from buyback centres (Viljoen & Swart, 2016). Effective management of waste and the promotion and management of recycling activities were necessary for sustainability. In South Africa, waste pickers have access to landfills and buyback centres to sort and package recyclable waste materials (Blaauw *et al*., 2018). The Pikitup was intended to roll out separation in the remaining informal and formal areas, and the four-year target was to recycle 160 000 tonnes of waste that was generated in Johannesburg every year (Pikitup, 2020).

Gowda *et al.* (2022) argues that projects that included material recycling facilities and equipment, such as bailing machines, ensured that waste pickers remained off the landfill site, as the waste was brought to them first to be sorted and separated. Bailer machines were among the best tools to manage waste recycling. The total amount of waste that ends up in landfills is over 40% less than it was in the 1960s, when the EPA started keeping records. This reduction was due to the widespread adoption of recycling by reclaimer programmes across municipalities (EPA, 2020).

2.5.1 Reduction of waste at the landfill site by waste pickers

Approximately 470 tonnes of municipal solid waste per day from Yogyakarta entered the Piyungan Landfill Site; of this, 77% consisted of organic components and 23% of inorganic fractions (Dias, 2016). Additionally, according to Panchayat (2018), more than 3,000 female employees offered door-to-door waste collecting services through a contract with the Pune Municipal Corporation, recycling more than 50,000 metric tons of waste annually. Soni *et al.* (2016) Pune Corporation has taken steps to collect, separate, and treat solid waste, and mechanisms were in place to handle about 1,600 tonnes of solid garbage per day. In addition to waste collecting, waste picker operations in Brazil have improved recycling efforts and contributed to a 20% decrease in the amount of waste dumped to landfills. This has contributed to the nation's landfills' increased useful life (Sudibyo *et al.,* 2017). In England UK, waste reduction was essential for achieving sustainable waste management practices, by reducing waste that can be minimise the need for disposal in landfill sites (DBG Group, 2021).

In Kenya, waste pickers played a crucial role in solid waste management, by diverting recyclables items from the landfill sites (Strong, 2021). Waste pickers' activities that reduce landfill site waste directly or indirectly help agencies responsible for waste management but reduce their costs (Omosimua *et al.,* 2020). Waste pickers collected, sorted, transported, and sold materials, saving the state and private industry millions, and extending the life of landfills (African reclaimers, 2018).

Waste pickers play an important environmental role by directing recyclable materials to the recycling chain, thereby reducing the quantity of waste disposed of and saving South

African municipalities up to R750 million in landfill airspace each year (eNCA, 2020). Reduction of municipal solid waste incurs an economic cost, and that is why it is forced to be integrated into the waste management site (Maziotis & Senate, 2021). Coban and Cavdaroglu (2018) argue that, in a problematic environment, municipal authorities need to develop the most effective disposal solution to manage the ever-growing municipal solid waste challenges. These authors agreed with the study, as it shows the role of waste pickers in municipal solid waste by reducing waste through reclaiming recyclable waste materials.

Waste pickers contributed to municipal solid waste management by significantly reducing the amount of waste that ends up in landfill sites (Colombijn & Morbidini, 2017). Moreover, waste pickers were contributing by reducing waste volumes in landfill sites through sorting reusable items (Morais *et al.,* 2022). The volume of waste collection may have been reduced if recycling of recyclables such as card boxes, plastics, paper, and other recyclables could be promoted at the landfill site. Projects in this area, such as waste picking, helped to cut down on the amount of waste that ends up in landfills, extending their useful lives (DFFE, 2020). By collecting and selling waste to buyback centres, which then sold it to recycling companies and helped reduce waste, recycling played a significant part in giving people the chance to make a living.

Moreover, waste pickers needed substantial and sustainable volumes of recyclables, and increased volumes of recyclables can translate into more jobs and income-earning opportunities at recycling (Blaauw *et al*., 2019). They reduced the amount of waste generated and decreased the environmental impact by keeping the waste out of landfill sites (Sudibyo *et al*., 2017).

2.5.2 Management of municipal solid waste at the landfill site by waste pickers

Cans, bricks, plastics, steel, card boxes, and other recyclable materials are all gathered by waste reclaimers. About 2.8 times as much material was diverted from landfills and incinerators in 2017 as there was in 1990 when 35.2% of the municipal solid waste produced in the US was recovered for recycling or composting (EPA, 2017). About 90% of municipal solid waste was disposed of at landfill sites and sorted by reclaimers (Madyira

& Rasmeni, 2019). Most of the municipal solid waste, both in the US and globally, was placed in landfill sites and reclaimed (Rischar, 2023). Some 37% of waste is disposed of in some form of landfill, and 19% is recovered through recycling (WBO, 2023).

Waste pickers were recognised as an important in the management of solid waste value chain in circular economy, in Kenya landfill sites (Destiny Africa, 2021). South Africa aims to move towards a more sustainable path of diverting waste from landfills, and the waste management hierarchy approach is at the core of waste management (DFFE, 2019). Waste management was shifted away from the collection and disposal of waste and focused instead on waste minimisation (Godfrey, 2017). Harrisberg (2019) states that in 2001/2, 17% of waste was recycled by waste pickers and 83% was landfilled. The study is relevant and linked with Oxford (2020), who states that waste pickers are estimating the tonnes of solid waste that are reclaimed from the landfill site. Waste pickers were people with unexpected expertise who had saved the government up to R748 million in landfill airspace and put South Africa's recycling economy on hold.

In Tzaneen Land Site solid waste are weighed at the weighbridge, tonnes of disposal are recorded and disposed in a safe manner. They are recycled by waste pickers by sorting re-usable items out of the land fill site (GTM/ IDP, 2022-2023).

2.5.3 Challenges waste pickers encounter during waste reclamation

Managing solid waste was the main challenge facing cities in developing countries such as Syria, both the national and local authorities (Cruvinel *et al*., 2019). Britto and Galato (2019) found that the risks and types these waste pickers faced varied depending on where they worked (landfill sites, recycling centres, warehouses, streets, or organised groups), what kind of waste they handled, how long they handled it, and other factors. However, because they were exposed to the dangers for a significant amount of their employment, waste pickers handling solid waste were more vulnerable (Cruvinel *et al*., 2019).

Waste pickers provided services that were beneficial to the environment yet faced traumatic occupational hazards and were exposed to pollutants since they work without

the protective gear (Bhaduri, 2022). In some cities such as Brazil, Indonesia, and India, most waste pickers were migrants, likely coming from marginalised groups or rejected from the global economic process (Sapuay, 2020). Arakal (2021) argue that Bengaluru residents were against the informal waste pickers in the city because of the high level of stigma.

According to one study conducted in Arica, South Sudan, waste pickers who worked with recyclable materials were at risk of developing lung diseases from coming into contact with solid waste and sharp objects, as well as cuts, maiming, fatal accidents, heavy metal contamination, and other hazardous wastes (Hande, 2019).

Suddenly, reengineering and decommissioning of the Kumasi landfills in the Ghanaian metropolitan area was underway. The waste pickers were shocked to learn that up to 500 people in Ghana's Kpone region alone depended on access to waste at landfills in order to survive and provide for their families (Wiego, 2023). Waste pickers in Tema and Kpone, Ghana, have organized and created a few plans to enhance recycling and their living conditions, but they are still excluded from formal waste management, endangering their livelihood as a result of the impending closure of landfills (EJAtlas, 2020). Among other valuable commodities, plastic is collected by informal waste pickers, but the nation lacks the infrastructure and waste management policies necessary to handle it (Provencal, 2020).

Mafata (2021) states that waste picker livelihoods were at risk in Johannesburg, as the informal reclaimers say the expansion of Pikitup into recycling had left them without an income. Waste pickers were subject to discrimination and unsafe working conditions (Carenbauer, 2021). Although the informal waste pickers recovered a greater proportion of recyclables than the formal sector in most developing countries, they worked under poor conditions and did not get a fair value for recyclables (Hande, 2019). Waste pickers at landfill sites were vulnerable, as 37% of them had common mental disorders like anxiety, depression, or stress (Mehlwana, 2020). They encountered many challenges in their line of work; for example, there was the issue of social stigma, whereby waste pickers were reviewed as lowly individuals in society (Marnce, 2021). Baker *et al*. (2016)

state that the biggest challenge facing the city of Johannesburg was the growing volumes of waste generation and the demising landfill sites of the city. Furthermore, Ngcuka (2022) argue that rapid urbanisation has contributed a vast amount to the city's growing waste problem.

Growing amounts of waste pose one of the major challenges to the environment of the City of Johannesburg as it struggles to keep up with the city's fast urbanisation and development. According to Simatele *et al.* (2017), the two biggest issues that waste pickers in Johannesburg experience are the lack of physical infrastructure, which is represented at 29% and harassment at various social stages, respectively. Additionally, waste pickers encountered regular harassment when gathering waste (Yukalang *et al*., 2018). Heavy machinery utilisation in landfill operations puts waste pickers at risk and may increase the risk of salvaging on landfill sites (Mothiba, 2017).

Furthermore, as they worked as waste pickers on landfill sites, they were working on the periphery of the economy and were subject to a variety of dangers, especially health concerns, which directly affect the sustainability of their livelihoods (Blaauw et al., 2019). Waste pickers encountered many difficulties every day whether they were working on a landfill or collecting waste on the streets. These difficulties included unfair and inconsistent prices from buyers of the waste they collected, no assurance that they would make a living from waste picking, and limited information availability (Yukalang *et al.,* 2019).

Waste pickers were faced with a deadly choice: keep salvaging or risk contracting the viruses (Krige & Panchia, 2020). Their article is related with the study, with the fact that waste pickers at Tzaneen Landfill Site have accounting problems, such as salvaging rotten food and eating it, which end up causing viruses and diseases. According to Nowicki (2019), one of the challenges that the organisers were facing was guaranteeing services to the growing population due to a lack of space, given the increased demand for waste collection. Moreover, Gebre and Gebremedhin (2019) argue that because of the rapid rate of urbanisation and urban poverty, limited space was among the problems that the urban areas were facing, leading to increased demand for waste collection.

In the informal waste industry, waste pickers faced numerous difficulties, including stigma from the public and government, access to landfills being restricted in some areas, and hazardous working conditions (Nowicki, 2019). Waste pickers working with solid waste were more vulnerable, as they spent a large proportion of their time exposed to the risks (Cruvinel *et al.,* 2019). For instance, at Tzaneen Landfill Site, waste pickers used to pick up rotten food that was disposed of, which could threaten their health status if consumed. This shows, as waste pickers are encountering challenges from the landfill sites. Schenk (2016) state that one of the biggest challenges experienced by the waste pickers were the perceptions and attitudes of the government officials, business partners and public towards them. Moreover, waste pickers were environmental stewards, according to Gutberlet and Oloko (2022), who also list some of the difficulties they faced on the job. Waste pickers endure robbery, intimidation, violence, and occasionally inequitable compensation for their diligent labour in making a living each day (Reginize, 2023). Their capacity to maintain the viability of their businesses was being hampered by the increasingly challenging economic climate in which they were working (Viljoen, 2022). However, due to their employment, these unpaid waste collectors were frequently stigmatized, go unrecognized, and lack social protection (Dayaram *et al.,* 2022).

Some waste pickers jump onto arriving compactor trucks while they are still moving to get to the refuse first, and its dangerous work, and several pickers have died on site (Khoza, 2019). Waste pickers are the backbone of the recycling industry, operating in the informal sector and being self-employed with no one providing PPE (Mbata, 2020). Waste pickers and informal workers needed PPE, food, water, and money for medications and supplies in the short term and recognition in the long term (Khoza, 2019).

They were exposed to hazardous pathogens and viruses from recyclables; they used to pick out general waste with their bare hands (Mndebele, 2021). Although waste pickers had been working towards sustainability before it was trending, they remain some of the most widely excluded people on the planet (Goncalves, 2020). They had no legal standing. Furthermore, they were not vaccinated against diseases or used any personal protective equipment (PPE) (Matar and Thoni, 2019). The waste pickers said that they

raid the landfill on Fridays, as the guards said that it is impossible for them to patrol the vast facility (Samson, 2020).

2.6 Waste recyclables materials that are reclaimed by waste pickers

According to Bax (2019), residents and reclaimers were given clear plastic bags to store their recyclables, which included cardboard, steel, polystyrene, paper, cans, juice and milk cartons, and juice. Reclaimers earned an additional payment of 50 cents per kilogramme for the recyclable items they brought to one of the city's repurchase centres, after the bag of recyclables had been weighed. The author agrees with Godfrey and Oelofse (2017), who states that waste pickers reclaim recyclable waste materials from the landfill site to the buyback centres. Waste separation at the source had reduced the number of recyclables that went to the landfill and therefore the income potential of pickers at the landfill (Godfrey & Oelofse, 2017). Furthermore, waste pickers made significant contributions to the environment by promoting resource circulation and reducing the number re-usable items from the landfill sites (ILO, 2023). Waste pickers were the principal actors in reclaiming waste for the recycling industry.

In USA Chicago, recyclables materials that are reclaimed by waste pickers were cardboard, box, plastics and only 9.6% waste were recycled (Perez, 2023). Waste pickers in England and Wales, were informal workers who collect, sorted, and sell material for recycling or reuse, through collecting materials such as plastics, glass, paper from households, streets, and dumpsites (Tearfund, 2023). Municipal waste collection in Mozambique focuses on mixed solid waste, picked up by garbage trucks and valuable recyclables materials such as cans, boxes, glass is sorted and the remain solid waste was sent to the city landfill site (AfricaRise, 2022).

Furthermore, South Africa Johannesburg they sorted recyclable materials from non-recyclables waste in residential bins and landfills sites. Private recycling companies only collect the recyclables that were put out in separated recycling bags (Monte, 2020). Many people from underprivileged and low-income countries earn a job by gathering and sorting waste, which they subsequently sell to the recycling sector through middlemen (Chinronda, 2022). They filled a gap by reclaiming recyclables and providing raw material

inputs into the formal recycling chain (Dias, 2016). Additionally, waste pickers made a global contribution by recovering a variety of products from domestic waste, including cardboard, paper, plastics, and glass (Gutberlet & Carenzo, 2020). Between 60,000 and 90,000 reclaimers work in South Africa, gathering an astounding 80–90% of recycled paper and packaging waste, which is used as vital raw material for manufacturing (Samson, 2020).

This shows how waste pickers estimate the tonnes of waste reclaimed from landfill sites. Waste pickers stopped South Africa from drowning in its own garbage, rescuing tonnes of recycling from landfill sites full to bursting (Mndebele, 2021). Furthermore, it was estimated that this informal sector saves municipalities up to almost R750 million annually in potential landfill costs by diverting recyclable materials out of waste streams (Krige & Panchia, 2020).

According to estimates, the waste pickers' actions resulted in at least 725.4 tonnes of recycled soft plastic pellets and 280,8 tonnes of recycled hard plastic flakes produced at the dump (Sasaki *et al.,* 2020). A considerable amount of materials was diverted from the waste stream by waste pickers (Krige & Panchia, 2020). The activity of 260 waste pickers cooperatives was examined using data from the 2017–2018 yearly recycling report. It was discovered that in 2018, each waste picker produced an average monthly income and collected 1.6 tonnes of recyclable material on a monthly average, keeping that material out of landfills and garbage dumps (Ferraz, 2020).

2.6.1 Waste separation at source by waste pickers

The practise of waste reduction through recycling at the landfill site was the highest priority in efficient solid waste management, for example, in the United States (DFFE, 2019). The segregation of waste has positively impacted the lives of residents as well as the everyday jobs of waste pickers, who otherwise separate the waste by hand while reclaiming it from the dumping site (Utopia, 2021). The author agrees with the current study findings, as waste pickers are reclaiming waste recyclable materials from the landfill site to save their lifespan. In areas such as where kerbside collection of recyclables and yard solid waste is not available waste pickers took those source – separated waste to

drop – off centres or sell recyclables to buyback centres, for example in Australia (EPA, 2020). In China, Waste separation at source would reduce the amount of recyclables going to landfill sites, and therefore the income potential of waste pickers at the landfill sites. Ethiopia has predominately utilised the Koshe dump site as the landfill site in Addis Ababa, whereby waste pickers were utilising it as a site for separation at source, before taking the recyclables items to the buyback centre (African Union Development Agency, 2022).

Waste pickers create jobs, and their involvement in the value chain creates opportunities (DFFE, 2019). Waste pickers separated garbage at the source by putting post-consumer waste products aside at the site of generation to keep them out of the waste steam that was meant to be dumped in a landfill (Wcape Govt., 2019). Waste pickers reduced the volume of waste through separation, which was the best way to reduce the amount of solid waste in the landfill (Barba, 2018). Waste pickers were minimising the recovery of recyclables and recovering value from waste by diverting this valuable resource from landfilling (PlasticEurope, 2021).

The recycling that results from the sorting operation may be processed on the same landfill site where the sorting took place (HSE, 2020). The separation at source by reclaimers was a programme that was part of the national strategy to respond to the environmental issue of overfilled landfills (CSIR, 2018).

According to Engineering News (2016), material recovery plants in South Africa usually use waste pickers and labour-intensive sorting lines to aid in recovery and separation. Furthermore, Ahmad and Barford (2021) state that the labour-exhaustive task of waste collection for recycling is contemporary to corporate circularity. The fundamental approach to waste management was to minimise the volume of waste by maximising recycling levels, effectively reducing the amount of waste at the landfill site (Ecowize, 2017). Separation at source took place at Tzaneen BuyBack Centre and they are selling to middlemen to get a source of living (GTM/ IDP, 2022/2023).

2.6.2 Waste reclamation at the Landfill site

There are estimated 1.5 million to 4 million waste pickers in India who pick up, clean, sort, and segregate recyclable waste from landfill sites and sell it further up the value chain to make a living (Aggarwal, 2021). The reclaimers collected around 90% of all post-consumer packaging and papers left behind (Walsh, 2020). Majority of solid waste in Europe Coatia, from kerbside, households which were reclaimed by pickers was 20% and 67% was sent to the landfill site (Freschi *et al.,* 2019).

The informal waste pickers in Connaught Place and landfill sites were segregating the waste they were collecting, extracting recyclables from the waste, and selling it, which helped them sustain their livelihood (Singh, 2021). Kpone waste pickers in Ghana were removing about 800 tonnes of recyclable material from the landfill annually, which was a substantial environmental contribution (Boampong *et al.,* 2020).

Most waste pickers in South Africa operated on the many landfill sites, including the Chloorkop Landfill Site, and the advantages included a reduction in the amount of waste that must be landfilled as well as the monitoring role they played in spotting illegal behaviour (Sportlightnsp, 2020). An informal group of waste reclaimers in Johannesburg called the African Reclaimers Organization gathers recyclables from landfills in the city and sells them at recycling yards for a little fee (Amphan, 2021).

Petterson (2016) states that waste pickers help divert recyclables away from landfills and formalising them would help to ensure the safety and protection of these currently vulnerable workers. Furthermore, Postman (2018) states that waste pickers help divert waste away from landfill sites by collecting recyclable materials from households as well as from the city's landfill sites. In this study, reclamation of waste at Tzaneen Landfill Site took place, by sorting re-usable items such as cans, plastics, boxes, tins, and bottles. They are taken to buyback centre for packaging and selling purpose.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents an overview of the study area, including geographical coordinates, population size, sampling methods inclusion and exclusion criteria, secondary data n from weighbridge, and buyback centres. Furthermore, this chapter explains the data analysis, Ethical clearance approved by the ethical committee, and limitations of the study were also included in this chapter.

3.2 Study Area

According to IDP (2018/2019), GLM is located in the Mopani District Municipality in the northeastern region of the province of Limpopo. Greater Giyani borders GLM from the east, Modimolle from the west, Makhado from the north, and Greater Tzaneen from the south. GLM covers an area of land that is roughly 1891 km^2. The declared towns of Modjadjiskloof and Ga-Kgapane, which are located in the farthest south of the municipal territory, and Senwamokgope, which is located in the northwest of the area of jurisdiction, are included in the GLM as indicated in figure 3.1 (IDP, 2018/2019). This area has 200 rural villages within the municipal area. The municipality consists of 30 wards. The GLM consists of economic sectors such as water and sanitation, electricity, roads, agriculture, community services, and finance (IDP, 2018/ 2019).

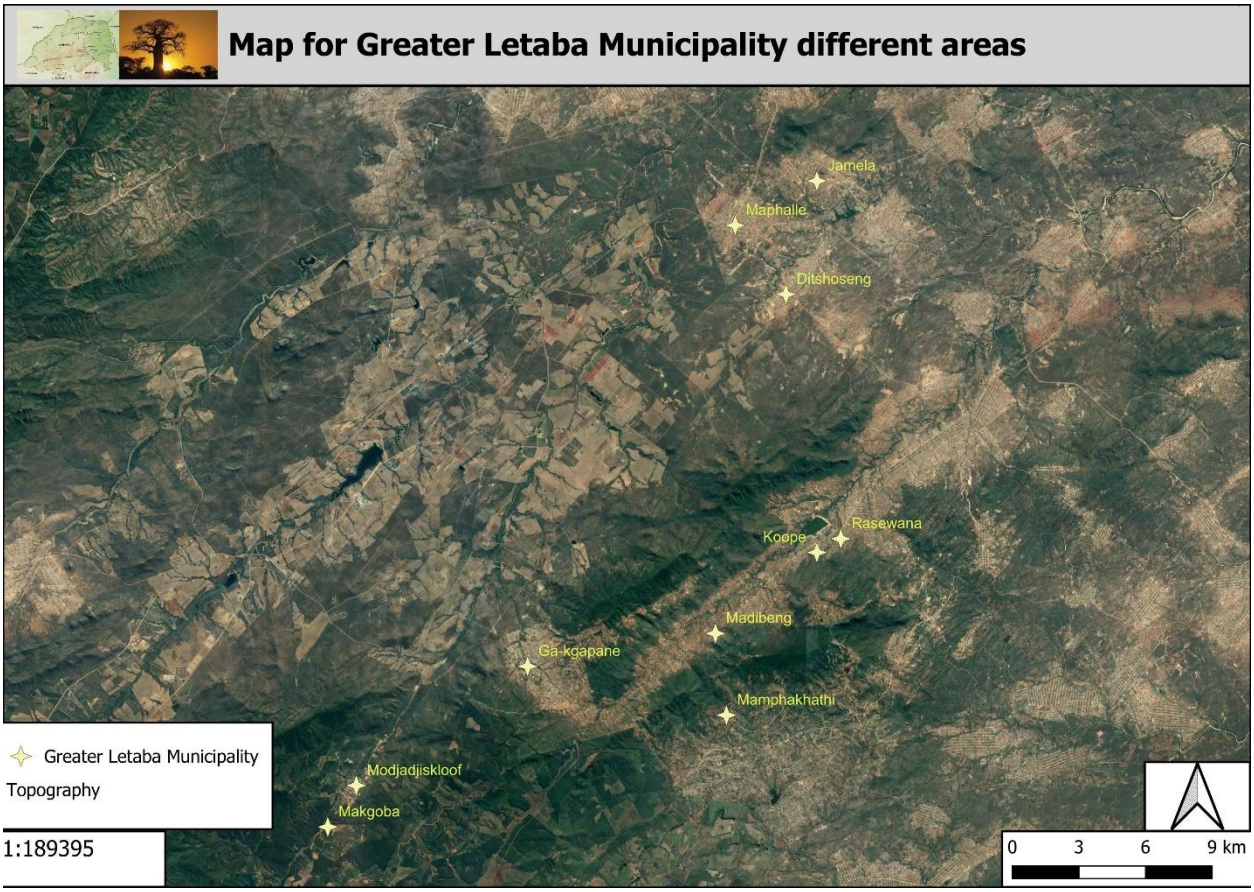


Figure 3.1: Map of Greater Letaba Municipality with different locations of study areas (source: IDP 2018/ 2019).

According to IDP (2018/2019:38) Mokgoba, Jamela, Mmamphakgathi, Ditshosing, Madibeng, Koope, and Rasewana Villages are situated in GLM (ward 29), within the Mopani District Municipality in the Limpopo Province of South Africa. These villages formed part of the 200 villages that were the squatter camps in GLM, located in the extreme north of the municipal areas. The land area of Mokgoba extends over approximately 1.85 km^2. The latitude is 30° 08'24. 24" E and the longitude is 23° 42' 38.28" S. Jamela village extends over approximately 3.83 km^2. The latitude is 13° 23' 37" E and the longitude is 52° 32' 15" N. These villages are situated in a mountainous ecosystem in terms of topography, but the area is not rocky. These areas are mid-hot and mid-cold in terms of temperature.

3.3 Research design

To fulfil the goals of this investigative study, a multi-method research design was employed. Data collection techniques have included both qualitative and quantitative approaches. Both quantitative and qualitative data are gathered and analysed as part of this method (Streefkerk, 2020). The quantitative approach uses information from a weighbridge, records from a recycling facility, and closed-ended questionnaires filled out by the total number of 50 waste pickers at the Tzaneen Landfill Site to get the required data.

This research design shows the quantity of waste that was disposed of at the weighbridge. Further data on the quantity of recyclable waste materials that were reclaimed by the waste pickers while they were observing and questioning them during their operation at the Tzaneen Landfill Site was collected. They made a significant contribution in terms of diverting recyclables waste from the landfill site. It was useful since the researcher could employ any approach to solve a research topic (De *et al*., 2016; Creswell, 2018). As a result, data collection and observation were done using a qualitative approach at the Tzaneen landfill.

3.4 Methods and Materials

This study took place at GLM in Mopani District Municipality within Limpopo Province, South Africa. Currently, GLM does not have an operational landfill site. Maphalle Landfill Site which is the official site was still under construction and has a permit/ licence. GLM was disposing waste at Tzaneen Landfill Site at a cost, and all the waste from GLM to Tzaneen Landfill Site was weighed and records were safely kept.

3.4.1 Population

The target population included the total of 50 waste pickers at Tzaneen Landfill Site. When conducting the research, the population entailed all components that met certain criteria in solid waste management (Grove, 2017; Barnsbee *et al.,* 2018).

3.4.2 Sampling

At the Tzaneen Landfill Site, waste pickers were chosen for questionnaires using a deliberate sample technique. This study employed a non-probability sampling technique, a phenomenological investigation in which the researcher selected particular participants at the discretion of the individual (2023). In this study, the total of 50 waste pickers that were there, have been selected for questionnaires. This was due to the total number of waste pickers who were there and were interested on to be questioned. All participants have completed questionnaires after completing consent forms.

The inclusion criteria were waste pickers who were over 18 years old at waste management facilities. Waste management facilities with buyback centres were also considered. According to South African law, waste pickers or participants under the age of 18 are excluded because they are unable to make informed decisions.

3.5 Data collection

Data was collected through weighbridge data records, data records from buyback centres or facilities, field observation, and close-ended questionnaires completed by waste pickers.

3.5.1 Weighbridge data records

Data records from weighbridges have been used to quantify solid waste. Records indicated the quantity in tonnes of waste disposed at the landfill site. The data assisted in identifying the volume of solid waste the municipality was collecting and transporting to the landfill site for disposal. This data method is linked and relevant with, the tonnes of waste that were identified and quantified from the municipal landfill sites. Photograph 3.1 presents information about the Tzaneen Landfill Site weighbridge, where the quantity of tonnes of solid waste is calculated.

Photograph 3.1: Tzaneen Landfill Site weighbridge where quantity of tonnes for solid waste are calculated.

3.5.2 Data records from buyback centres

Data records provided from the recycling facility, indicating the monthly statistics of recyclables from 2019-2021 were used to estimate the quantity of solid waste, that was collected by reclaimers at the landfill site for the buyback centre/ material recovery facility that is specialised plant that receives, separated, and prepares recyclables materials for marketing to end users. The data assisted in identifying the role of subsistence reclaimers in solid waste management.

Data collection tools, as explained above, assisted in ensuring that relevant data was collected from recycling facilities. This data method is linked and relevant with the tonnes of recyclables reclaimed by waste pickers that were identified and quantified from the municipal landfill sites to the buyback centre. Photograph 3.2 presents information about the quantity of solid waste reclaimed by waste pickers.

Photograph 3.2: Quantity of solid waste reclaimed by waste pickers.

3.5.3 Close-ended questionnaires

Participants in closed-ended questionnaires are given a list of possible answers to select from when answering the questions. These kinds of inquiries were frequently multiple-choice questions (Toker & Yilmaz, 2022). The questionnaires have been prepared in English. Fifty questionnaires have been administered. Fifty waste pickers were requested to complete a questionnaire, and the researcher assisted them by demonstrating how the questionnaire was to be completed. Data collected through questionnaires has been analysed in the form of descriptive statistics, compiled from the frequency tables and charts followed by their discussion. Microsoft Excel was used to create charts and graphs during data analysis.

3.5.4 Field observation

The researcher further collected data through field observation. Observation was a process where a researcher visited the Tzaneen Landfill Site several times with the aim of observing without interfering too much (Creswell, 2018). Information collected through

observation was used to describe and analyse the process of solid waste reclamation, such as collection, handling, sorting, and transportation through waste pickers. This data method is linked and relevant with the evaluation on the role of waste pickers in solid waste management, at Greater Letaba Municipality. Photograph 3.3 presents information about the observation of waste pickers at Tzaneen Landfill Site sorting solid waste.

Photograph 3.4: Observation of waste pickers at Tzaneen Landfill Site sorting solid waste.

3.6 Motivation of the research study

The importance of this is that waste pickers create jobs to reduce poverty by attempting to render collection and processing services in exchange for a small income to support their families. Their role of waste pickers in municipal solid waste, by sorting recyclables

items such as cans, boxes, papers, glass at Tzaneen Landfill Site, has assisted the municipality by reducing some of solid waste, that could have been landfilled. Through that, it was part of saving the lifespan (significant contribution by diverting recyclables from the landfill site)

of the landfill site cell. Some residents of Greater Letaba Municipality from Modikong and Mokgoba villages, were sorting waste at Tzaneen Landfill Site. This was due to lack of operational landfill site, as GLM was making use of Tzaneen Landfill Site at cost.

3.7 Ethical consideration

Whether conducting research in the social sciences, humanities, or hard sciences, ethical issues are a researcher's constant companion. In their work, researchers encounter a range of options and decision-making points about risks, rewards, and drawbacks (Markham & Buchanan, 2015; Bhandari, 2022).Throughout their work, researchers must make decisions about risks, advantages, and drawbacks (Markham & Buchanan, 2015; Bhandari, 2022). Thus, through the University of South Africa's ethical clearance system, the researcher applied and was granted ethical approval and clearance with reference number 2019/CAES-HREC/127 (Appendix 4).

Permission was requested and obtained from GLM to conduct the study. The researcher was granted permission for conducting the research study, within the jurisdiction area of the municipality (Appendix 4). The permission letter to conduct research from GLM, has included the purpose of the study and the measures to ensure confidentiality and anonymity.

A consent form requesting consent for participation in the study was given to each questionnaire (Appendix 1). Waste pickers were interviewed at the Tzaneen Landfill Site when they were reclaiming usable waste materials. The participants were not requested to provide any personal details on the questionnaires. They only answered the questions based on how they were saving the lifespan of the Tzaneen Landfill Site by taking recyclable waste materials to the recycling facility. This has assisted the municipality in saving expenses on the construction of more cells.

The waste pickers were also made aware that participation in the research was entirely voluntary and that their completion and signature on questionnaires would be seen as their agreement to participate. Throughout the process of gathering data, analysing it, and summarising the results, anonymity and confidentiality were preserved. Primary data, such as questionnaires and observations, and secondary data, such as quantitative data, were used. All information obtained was used only for this study.

Informed consent was the major ethical issue in conducting research. Those fifty respondents, who were waste pickers, should have been informed of the purpose of the research study. We were also seeking to prevent assaults on the integrity of the participants and protect personal liberty and veracity among research participants (Polit & Beck, 2017; Xu *et al.,* 2020).

3.8 Data analysis

Data records from weighbridges were used to quantify solid waste. Records gave the quantity of tonnes disposed of at the landfill site. The data was used to identify the volume of solid waste that was collected from GLM and transported to the Tzaneen Landfill Site for disposal.

Data records from the recycling facility were used to estimate the quantity of solid waste that was collected by reclaimers at the Tzaneen Landfill Site and sent to the recycling facility. The data assisted in identifying the role of subsistence reclaimers, who were packaging and selling recyclable waste materials to gain profit. Data collection tools explained above (questionnaires, observations, and data records) assisted in ensuring that relevant data was collected, including the fifty respondents who were waste pickers.

After collecting data through the different methods, the collected data was analysed by coding out responses to different questions asked.

Data collected through closed-ended questionnaires was analysed in the form of descriptive statistics, compiled from the frequency tables. Questionnaires were administered to fifty respondents at Tzaneen Landfill Site. Statistical Packages for Social Sciences (SPSS) were used to make meaningful predictions. The total number of

questionnaires fully completed has been coded, and data has been captured in SPSS and Microsoft Excel.

Data was collected through observation in the field, where researchers gathered data about the places where the activity is taking place (Creswell, 2018). The Tzaneen Landfill Site was visited to observe the process of solid waste reclamation, such as handling and sorting by the waste pickers. The process of taking usable waste materials to the recycling facility was observed at the landfill site.

The safety of the waste pickers at the landfill site during the process of handling and sorting was also observed. Site visits were made to observe the process of solid waste collection and transportation from GLM to the Tzaneen Landfill Site. During observation, a checklist was used to ensure that the required data was collected at the landfill site.

3.9 Limitations of the study

The researcher showed how the data was collected as well as the challenges encountered. The data was collected at the Tzaneen Landfill Site by the researcher. Waste pickers were not all present on the same say, during the completion of the questionnaires at the landfill site, which means only 50 waste pickers completed the questionnaires on five days. Some of the waste pickers refused to provide information, as they did not understand what the purpose was, but the researcher explained properly and ended up providing them with a questionnaire form. The time frame for the scope of work (research study) was two to three years. Observations at the landfill site, where questionnaires were distributed to waste pickers, were limited due to the time provided for the visit, even though the researcher visited several times but with time limits.

The waste at the buyback centre in Tzaneen Landfill Site comes from different areas such as Nkowankowa, Tzaneen Lenyenye, Haenesburg and other rural areas (public). The records from buyback included recyclables materials by waste pickers from the landfill site and others from public. The GLM municipal trucks is disposing waste at Tzaneen Landfill Site, and waste pickers are sorting those recyclables items and take them to buy-back centre. There are records kept that indicate quantity of solid waste from Greater

Letaba Municipality that, are disposed at Tzaneen Landfill Site at the weighbridge. Mokgoba and Modikong waste pickers are from Greater Letaba Municipality, sorting recyclables items at Tzaneen Landfill Site to buyback centre.

Currently Greater Letaba Municipality does not have operational buyback centre (BBC). The Maphalle buyback centreis there and completed but waiting for the operational landfill site at Maphalle as well. Waste that ends up at the Tzaneen BuyBack Centre may the combination of waste collected through kerbside collection in tows (s) and waste from landfill sites.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter discusses the research findings of the study. It also provides the data gathered using different set of tools and methods. Furthermore, this chapter analyses and discuss the findings regarding the role of waste pickers within the study area.

4.2 Demographic questionnaires of waste pickers at Tzaneen Landfill Site

Demographic questionnaires are a statistical study of human populations (Whitemay, 2021). Figures 4.1 to 4.9 present the results and discussions for the questionnaires from the waste pickers, including sex/gender, age, race, monthly income, employment, education level, majority of collection, types of waste collected, and tonnes collected yearly (Steelman *et al*., 2014). This demographic questionnaire is indicated on the charts and graphs below.

4.2.1 Gender

A total of 50 waste pickers were used to determine the gender at Tzaneen Landfill Site. The study showed that 80% (n = 40) were males and 20% (n = 10) were females. The result shows that more males were inspired to practise recycling than females. Due to unemployment and the need for an income for their families, they are looking to get a source of income for their children. Furthermore, Strydom (2018) suggested that South African women are not interested in recycling because of the health risks. Figure 4.1 illustrates the gender profile of respondents (waste pickers) at Tzaneen Landfill Site.

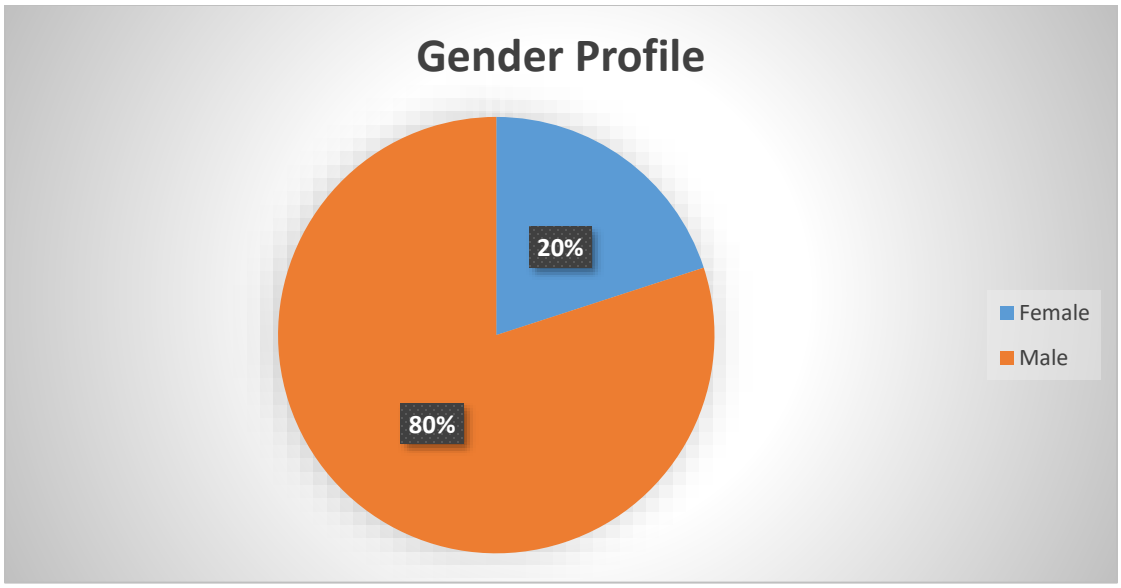


Figure 4.1: Gender profile of respondents (waste pickers) in Tzaneen Landfill Site.

These findings are agreed and supportive in this study, as males are the main role players of waste pickers rather than females. In Pretoria, the study revealed that waste pickers were 66% males and 34% females and carried heavy loads of waste for recycling purposes (Loans *et al*., 2017). Furthermore, in the City of Tshwane it was revealed that 21% males and 2% females were working as landfill sites for recycling purposes (Lawhon & Markina, 2022). Most waste collectors, who are facing inequalities and disproportionate economic and health impacts in comparison to their female counterparts, are generally make up by men (Arruda et al., 2020). At the land fill sites, most of gender both women and men are playing a role as waste pickers who go through the incoming mixed waste to pick out re-usable items (Ocean Conservancies, 2023). Furthermore, the findings are related to the role of waste pickers in solid waste management at Greater Letaba Municipality.

4.2.2 Age

The present study was conducted among people aged 18 to 55 years old. The findings of this study are similar, and according to Statista Research (2023), which indicated that most of the age group that works with waste varies from 18 to 55 years old. Figure 4.2 illustrates the age profile of waste pickers at the Tzaneen Municipality Landfill Site.

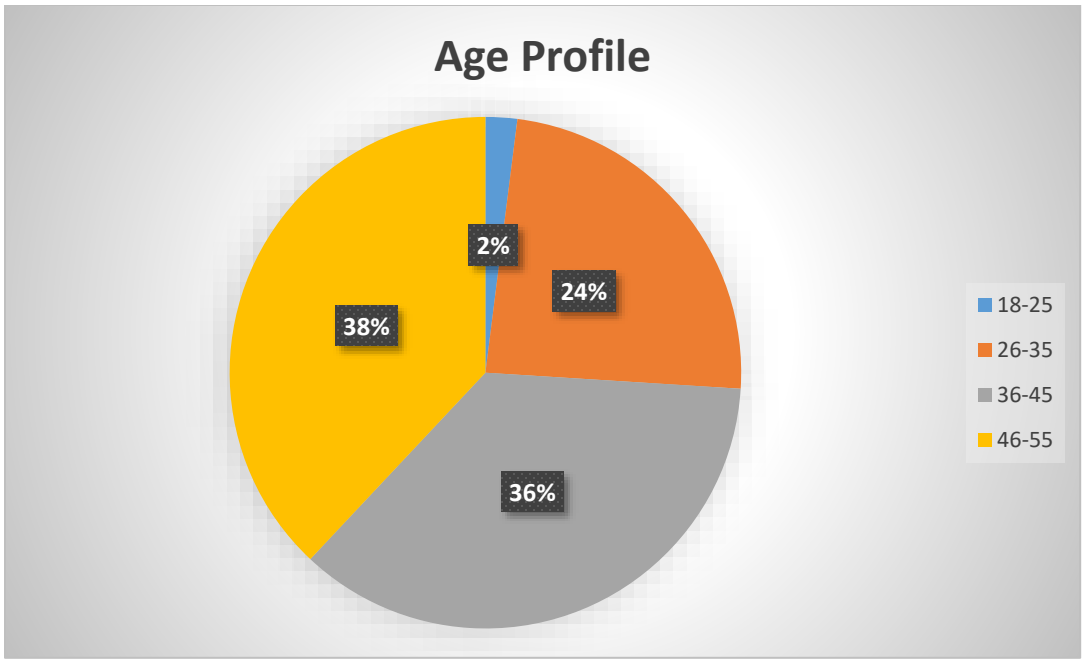


Figure 4.2: Age profile of waste pickers at Tzaneen Municipality Landfill Site

Waste pickers of this age from 18 to 55 years are responsible for families, and youth is responsible for their own job creation. The study is agreed with these findings, as most of the waste pickers are mature people, who are the main role players among waste pickers, including youth. For instance, the age distribution of waste pickers in Pretoria, according to the finding, was from 18 to 55 years. Furthermore, the findings are related to the role of waste pickers in solid waste management at Greater Letaba Municipality. They are people who know poverty, work for themselves, and are capable of adapting to the environment of landfill sites and recycling facilities, even though the places contain toxic materials and are a risk to human health (Blaauw *et al*., 2016). The amount of waste getting dumped at the landfill site are reduced by waste pickers (Pachauri & Singh, 2022). In Polokwane Landfill Site, the study revealed that many waste pickers were within the age group of 25–40 years, as they are mature people who are responsible for feeding their families (Edokpayi *et al*., 2021).

4.2.3 Race

Out of the 50 respondents, 49 were black people, and 1 was a coloured person at the landfill site. Figure 4.3 illustrates the data about the race profile of waste pickers at the Tzaneen Municipality Landfill Site.

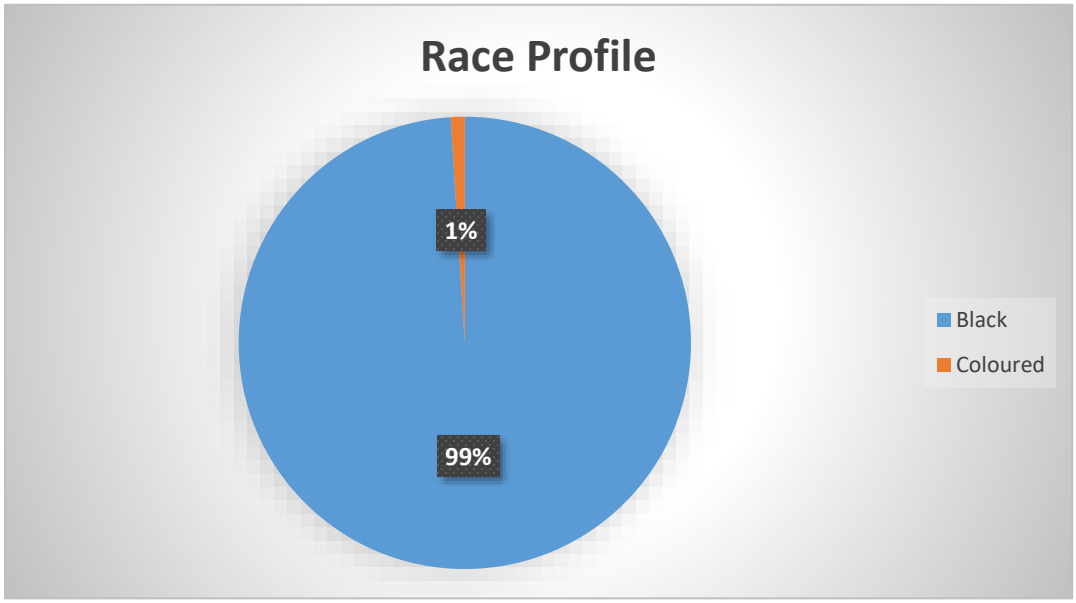


Figure 4.3: Race profile of waste pickers at Tzaneen Municipality Landfill Site

The findings shows that most black people are working and taking the work of waste sorting into consideration rather than coloured people; this could also be informed by the race profile of the study area, which is 41,5% of black, 25,0% of coloureds and 5,7% of whites (Stats SA, 2022). The findings are like those of Blaauw *et al*. (2019), who found that the racial composition was predominantly blacks, followed by whites and coloureds at most of the landfill sites, where the majority were men, and the minority were women. In Chicago, United States of America, Seamster and Purifoy (2021) revealed that 75% of waste pickers were black people.

4.2.4 Monthly income

Figure 4.4 illustrates the data about the monthly income of waste pickers at the Tzaneen Municipality Landfill Site.

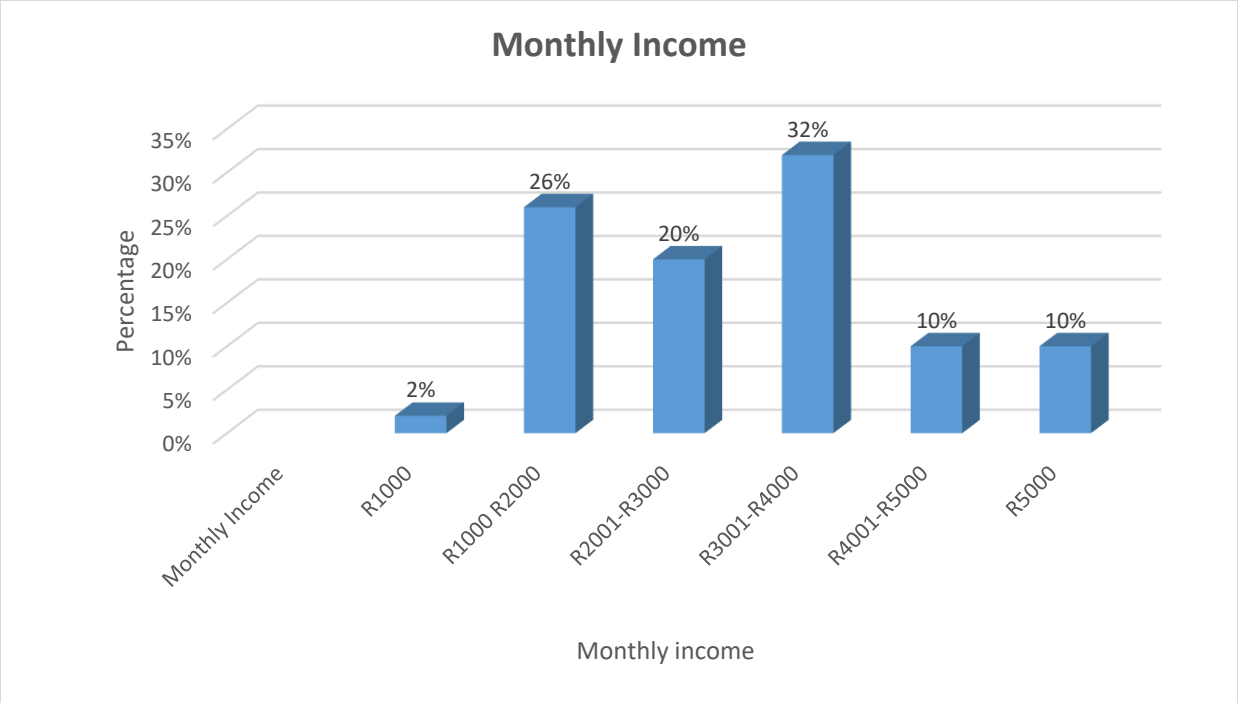


Figure 4.4: Monthly income of waste pickers at Tzaneen Municipality Landfill Site

As shown in figure 4.4, the findings from this study revealed that the waste pickers are earning in the range of R1,000 to R5,000 per month. The findings of the study are similar to Yu (2020), who indicated that the waste pickers' salaries ranged from R2,900 to R5,000 per month, with 70% of them below the average. Most waste pickers who are earning these amounts are responsible for their families and youth's job creation. The findings are agreed in this study as most waste pickers are mature people, who are the main role players of waste pickers, including youth. Furthermore, the findings are related to the role of waste pickers in solid waste management at Greater Letaba Municipality. According to the data from a survey conducted in Pretoria, South Africa, waste pickers have earnings ranging from R1,000 to R5,000 as well (Viljoen, 2022). They are people who know poverty, can adapt to the environment, especially waste disposal sites like landfills, and work for their own recycling facilities, even though the places contain toxic materials and are harmful to the health of human beings (Godfrey, 2021).

In the City of Johannesburg landfill sites, Velis *et al.* (2022) revealed that waste pickers were earning R2,400 to R3,640 per month as a source of income.

4.2.5 Employment

Figure 4.5 illustrates the data about the employment profile of waste pickers at the Tzaneen Municipality Landfill Site.

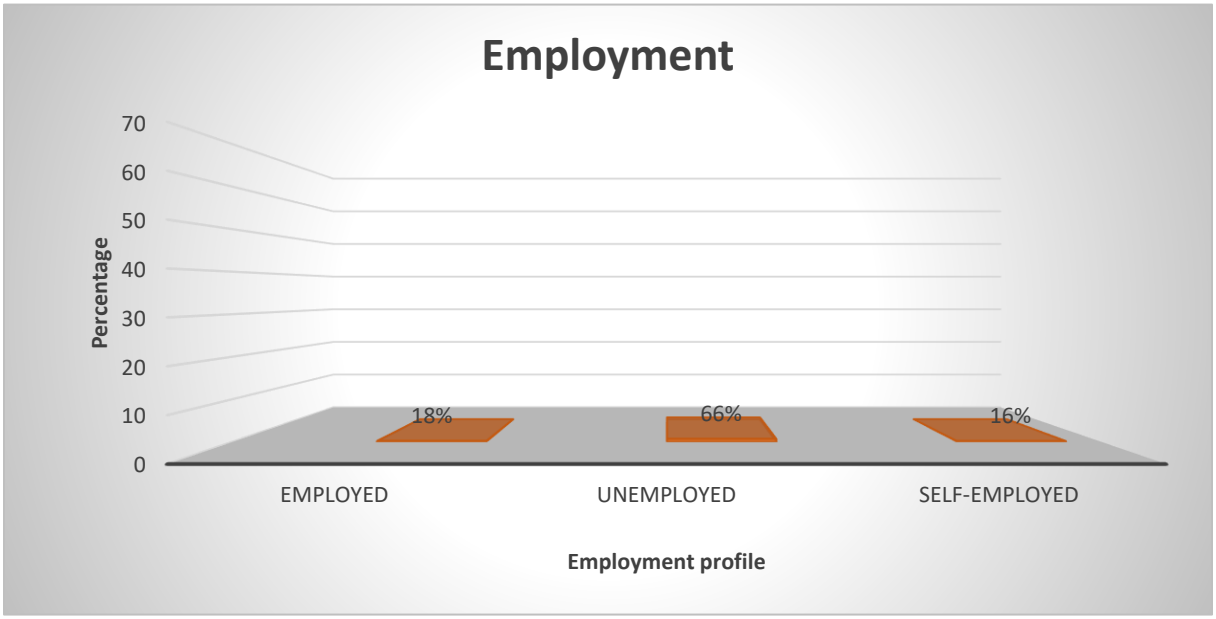


Figure 4.5: Employment profile of waste pickers at Tzaneen Municipality Landfill Site

As shown in figure 4.5, out of the 50 waste pickers, 18% were employed, 66% unemployed, and 16% self-employed. This study uncovered that the job of waste picking is not only for the unemployed community to get a source of living. Even those community members who are working and self-employed, such as small business owners, are also interested in waste reduction and making a source of revenue.

The study's findings are encouraging because waste pickers helped reduce waste by generating jobs and giving individuals a way to make money by collecting waste on the side and selling it to buy-back centres, which then sold it to recycling businesses. Furthermore, these findings are related to the role of waste pickers in solid waste management at GLM. Moreover, waste pickers played an essential role in collecting waste to sell to buyback centres to be recycled (Dube, 2020). According to Modise (2019), waste pickers contribute more to the earnings of waste producers than they do to their own income. They also help the municipal government save money on waste disposal

costs by recycling, which helps to create jobs and opportunities for people to make a living. In developing countries such as Angola and Nigeria the other study was done according to Ali *et al*. (2023) shown that for those with little to no marketable talents and no other means of support, waste pickers offer significant opportunity.

4.2.6 Educational level

Figure 4.6 illustrates the data about the education level of waste pickers at the Tzaneen Municipality Landfill Site.

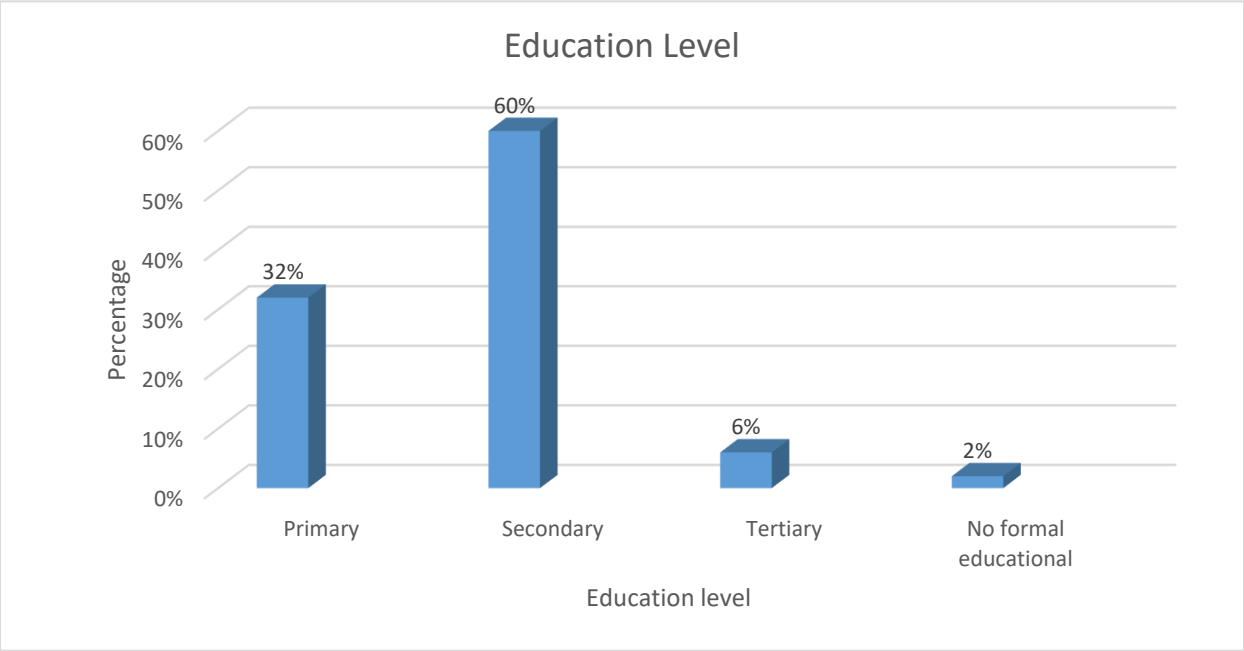


Figure 4.6: Education Level of waste pickers at Tzaneen Municipality Landfill Site

As shown in figure 4.6, most of the waste pickers in the study area are not at the same educational level. This can be seen in figure 4.6, 6% have tertiary qualifications. About 60% have secondary level. This shows that 32% of those surveyed waste pickers have the lowest education, which is primary level, and 2% have no formal education, have an interest in recycling.

The findings are agreed with Torgovnik (2018), who indicated that, in South Africa, most waste pickers have a low level of education and are practising recycling as a source of revenue. A high level of unemployed and unskilled people was a feature of the waste

pickers at the landfill sites in urban areas, who were playing a role in waste picking by sorting because of poverty and hardship caused by unemployment (Ramelelle, 2022). Furthermore, these findings are linked and related to the role of waste pickers in municipal solid waste management at GLM. Furthermore, the important survival option for the poor, unemployed, and unskilled waste pickers, is waste picking which occurs in developing countries because waste picking activity from landfills, may be significantly reduced (Blaauw *et al*., 2016; Taiwo & Venter, 2019).

Wiego (2023) found that the majority of waste pickers in Pune, India, typically have little formal education. In many locations, underprivileged populations perform the majority of the labour.

4.2.7 Majority of collection

Figure 4.7 illustrates the data about the collection areas for waste dumped at the Tzaneen Municipality Landfill Site.

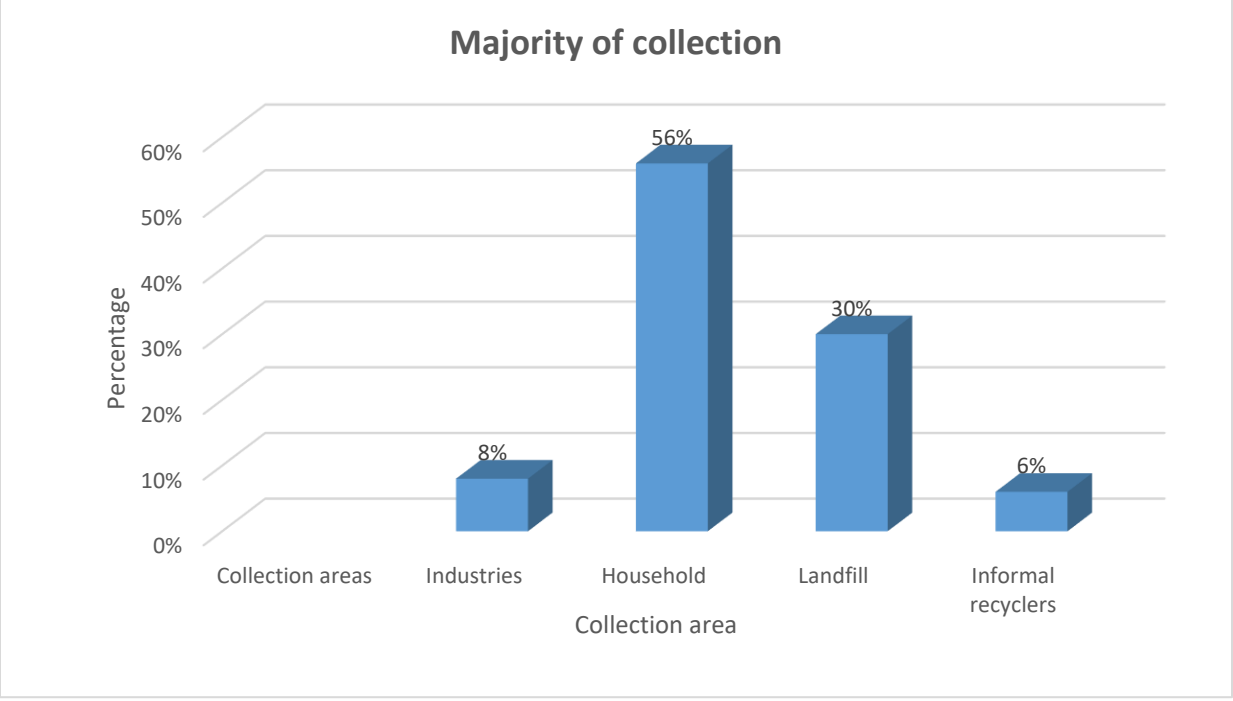


Figure 4.7: Collection areas for waste dumped at Tzaneen Municipality Landfill Site

As per figure 4.7, most of areas where waste was collected at the landfill site are as follows: Household collection points are at 56%, which is higher; landfill sites are at 30%; industries are at 8%; and informal recyclers are at 6%, which is lower. These are areas where waste is sorted by the waste pickers at the landfill site, from which waste is generated. The findings are agreed with Colombijn and Morbidini (2017) and ILO (2023), who indicated that this makes an important contribution to environmental sustainability by significantly reducing the amount of waste that goes to landfill sites by providing material for the recycling process. Moreover, Waste pickers collected household, commercial, and industrial waste (Torgovnik, 2018).

Furthermore, in other developed countries such as Australia, Canada, and the United States, Aslam *et al*. (2022) revealed that solid waste is collected from houses, workplaces, small companies, and commercial enterprises.

4.2.8 Types of waste collected

Figure 4.8 shows the data on the types of waste collected at the Tzaneen Landfill Site.

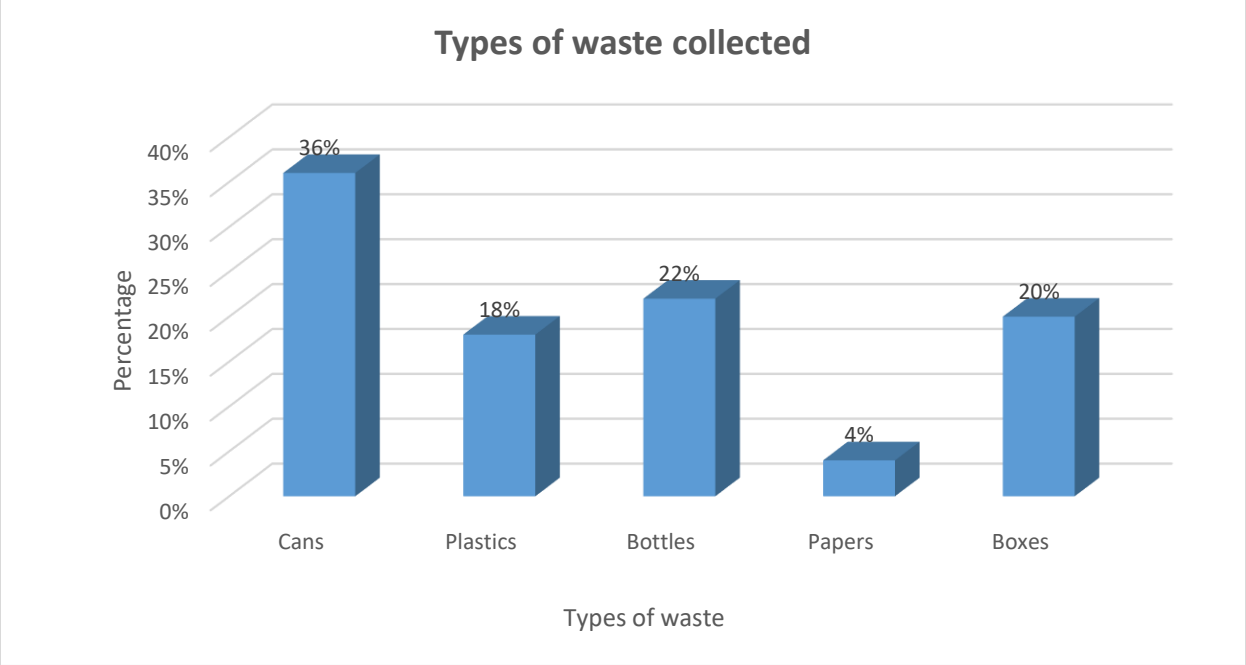


Figure 4.8: Types of waste collected by waste pickers at Tzaneen Municipality Landfill Site

As per figure 4.8, the types of waste collected and sorted by waste pickers, according to the volumes, are as follows: Cans are 36%, which is the majority; bottles are 22%; boxes are 20%; and plastics are 18%, which has a lower volume. These findings are related to this study, as waste pickers collected all the waste that was usable or recyclable, ranging from bottles, plastics, steel, card boxes, and cans (Harrisberg, 2019).

The volume of waste collection may have been reduced if recycling of recyclables such as card boxes, plastics, paper, and other recyclables could be promoted at the source in the landfill site (DFFE, 2022). Furthermore, the findings are linked to how many tonnes of waste were identified and quantified from the municipal landfill sites. Morais *et al.* (2022) in other study revealed that waste pickers in low- and middle-income countries such as Kenya, Ghana, and Zimbabwe are collecting re-usable materials thrown at landfill sites, such as plastics, card boxes, bottles, and cans. In South Africa, most waste pickers made a significant contribution to the diversion of re-usable materials such as plastics, card boxes, bottles, and cans and packaging recyclables from the landfill site to buyback centre (Godfrey, 2021). The current study agrees with Walsh (2020), who stated that the waste pickers collected around 80 to 90% of all recyclables left behind, as identifying, and quantifying solid waste from the municipal landfill sites.

4.2.9 Tonnes collected annually

Figure 4.9 illustrates the data about the tonnes of waste collected annually by waste pickers at the Tzaneen Municipality Landfill Site.

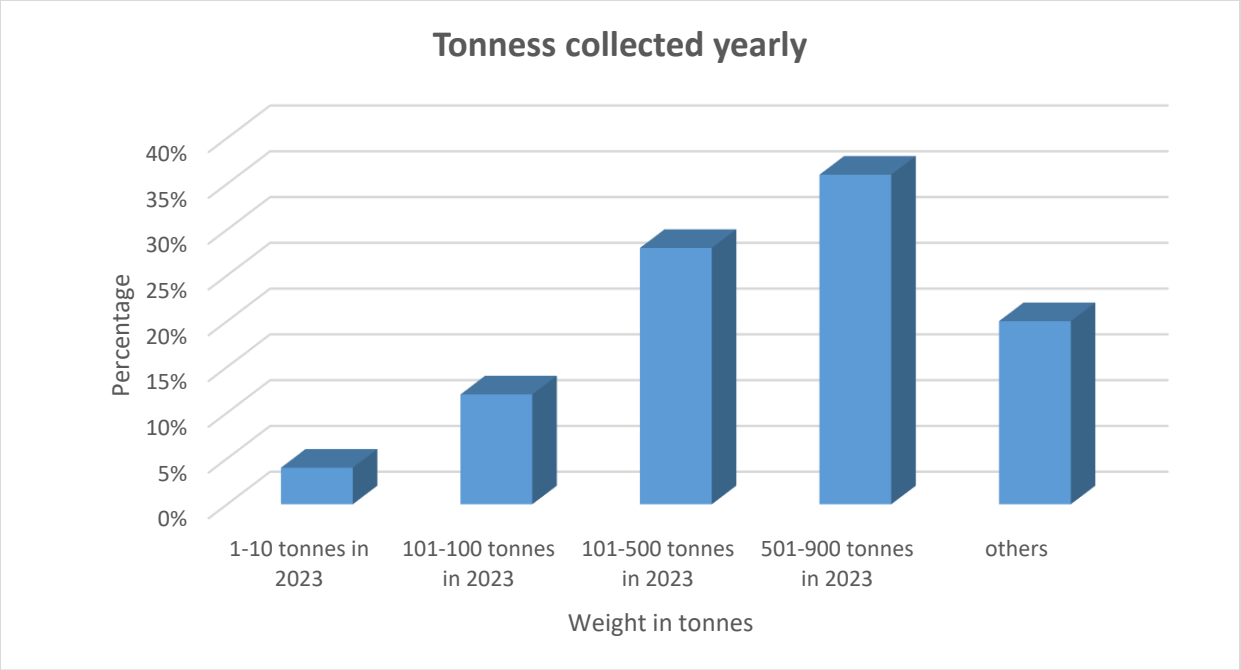


Figure 4.9: Tonnes of solid waste collected by same waste pickers yearly at Tzaneen Municipality Landfill Site

The survey conducted indicates the tonnes of waste collected annually, as per figure 4.9. ranged from 1–10 tonnes in 2023, which is the lowest, to 501–900 tonnes in 2023 and more. This shows the quantity of tonnes of waste, which are packaged by waste pickers yearly at the buyback centre, from the landfill site.

The findings are related and supportive on this study, as waste pickers are estimating tonnes of recyclable waste materials at the buyback centre from the landfill site. Furthermore, South African waste pickers were in charge of gathering substantial amounts of recyclable items, sparing municipalities millions of dollars, and enhancing the overall cleanliness and well-being of the environment (Blaauw *et al*., 2019; Chamane, 2022). In the United States of America, the total generation of municipal solid waste in 2018 was 292.4 million tonnes generated, and 25 million tonnes were composted (EPA, 2022). This is related and agreed upon with the findings, as quantifying the tonnes of solid waste from the landfill site.

Waste pickers in Ghana were removing about 800 tonnes of recyclable material from landfills annually, which was a substantial environmental contribution (Boampong *et al*., 2020).

4.3 Data records from weighbridge and buy-back centre at Tzaneen Landfill Site

Table 4.1 and 4.2 present the data records indicating the quantity of waste disposed of at the weighbridge and recyclable materials reclaimed by waste pickers at the landfill site from 2019 to 2021.

As per table 4.1, this indicates the data that was collected from July 2019 to June 2020, which is the quantity of waste disposed of at the Tzaneen Landfill Site and recyclable materials by waste pickers. This has shown the quantity collected from GLM to Tzaneen Landfill Site and recyclable items that were sorted by waste pickers from the landfill site. According to the findings the fact is that this has saved the municipality from paying a high amount to construct a new cell. When waste pickers are busy recycling usable items, it saves the life span of the landfill site.

Table 4.1: Data records indicating quantity with tonnes of waste at the weighbridge disposed and recyclable materials reclaimed by waste pickers in the landfill site, from 2019 to 2020.

No	Descript	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Marc	Apr	May	Ju	Total
1.	Recycling (out)	481.00	596.00	551.00	608.00	537.00	529.00	0.00	537.00	455.00	0.00	116.00	45.00	4455.00
2.	QTY of solid waste (Modjadjiskloof)	875.00	418.00	447.00	335.00	396.00	421.00	773.00	396.00	392.00	120.00	307.25	352.00	5232.25

As per table 4.2, this is indicating the data that was collected from July 2020 to June 2021, which is the quantity of waste disposed in the Tzaneen Landfill Site and recyclables materials by waste pickers. This has shown the quantity of solid waste, collected from GLM to Tzaneen Landfill Site, and recyclables items that was sorted by waste pickers from the landfill site. According to the findings, this has saved the municipality from paying high amount, to construct a new cell. When waste pickers were busy recycling usable items, it saves the life span of the landfill site. The quantity of waste disposed and recyclables materials, was different with the one of July 2019 to June 2020. Waste pickers were operating during July 2019 to middle March 2020. This was when lockdown by covid 19 started from middle March 2020 to June 2021, whereby landfill sites were not operating properly, as South Africa was operating with levels. This led the quantity of waste disposed at weighbridge and recyclables materials by waste pickers, from July 2019 to June 2020 to be higher than, from July 2020 to June 2021.

Table 4.2: Data records indicating quantity with tonnes of waste at the weighbridge disposed and recyclable materials reclaimed by waste pickers in the landfill site, from 2020 to 2021.

No	Descript	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Marc	Apr	May	Ju	Total
1.	Recycling (out)	0.00	386.00	0.00	0.00	0.00	454.00	445.00	502.00	554.00	480.00	411.00	424.00	3656.00
2.	QTY of solid waste (Modjadjiskloof)	591.00	392.00	502.00	865.00	649.00	781.00	879.00	972.00	817.00	574.00	226.00	236.00	7484.00

4.3.1 Data records from the weighbridge

Data records from weighbridge have been used to quantify solid waste. Records gave the quantity of solid waste (tonnes) disposed of at the landfill site that was collected in GLM from July 2019 to June 2021. Figure 4.10 illustrates the data about the records of solid waste from the weighbridge, indicating the quantity of waste collected in GLM in 2019 and 2020. Furthermore, figure 4.11 illustrates the data about the records of solid waste from the weighbridge, indicating the quantity of waste collected in GLM in 2020 and 2021.

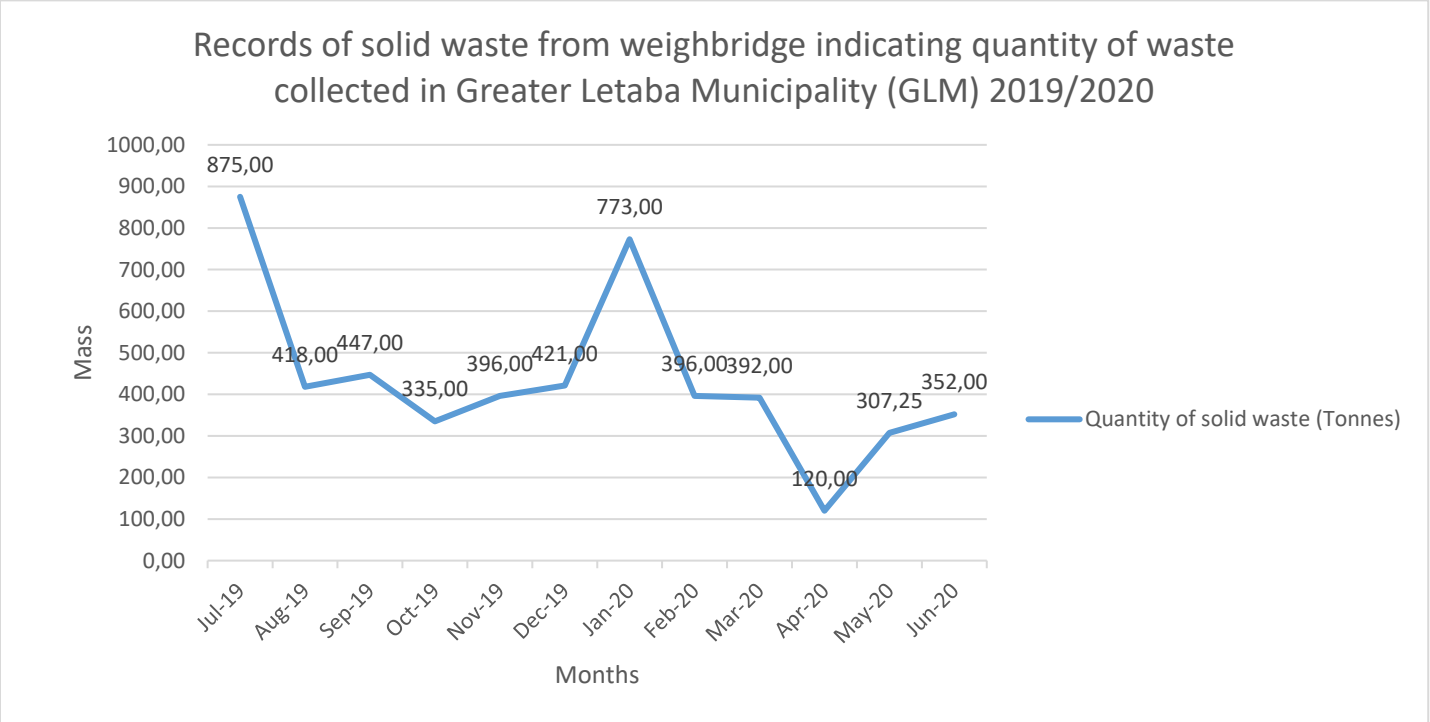


Figure 4.10: Records of solid waste from weighbridge indicating quantity of waste collected in Greater Letaba Municipality (GLM) 2019/2020

As per the graph figure 4.10, the results show that the quantity of solid waste collected from July 2019 to June 2020 was 5 232 metric tonnes. The quantity of solid waste collected in January 2020 was 773 metric tonnes, and the fact was that this was due to the increase in waste pickers who come to landfill sites to make money after festive seasons. The fact is that the quantity of solid waste collected in April 2020 was 120 tonnes, because it was the beginning of COVID-19 Level 1 lockdown. The volume of

waste generated from July 2019 to June 2020 is less than the quantity of waste generated from July 2020 to June 2021. This was since, from July 2019 to June 2020, GLM had two (2) compactor trucks, one (1) tipper truck, and one (1) skip truck. A similar trend has been observed in Johannesburg City Townships, South Africa whereby the overall collection was less than 50%, due to insufficient fleet that was on operation (Abubakar *et al*., 2022).

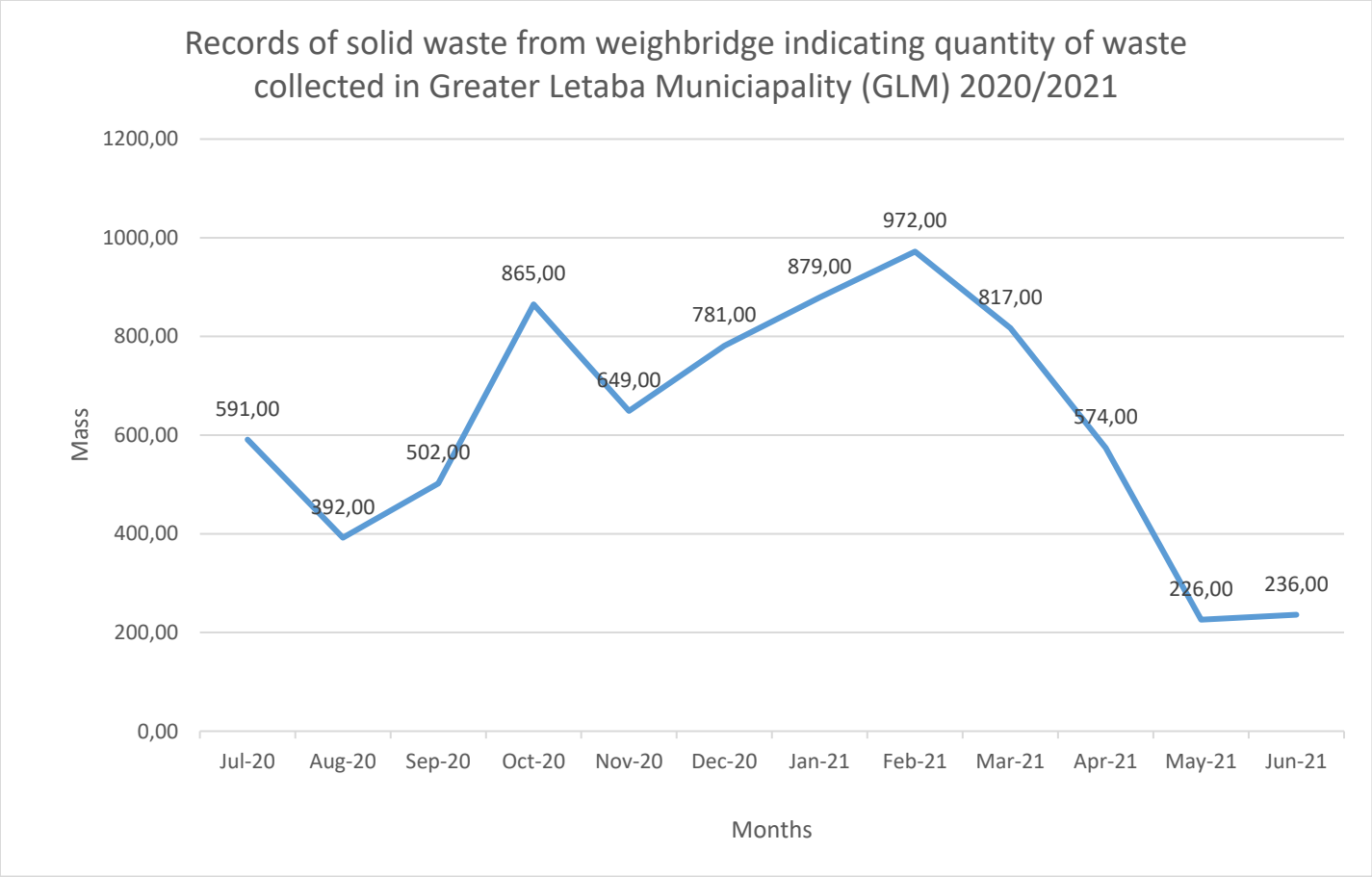


Figure 4.11: Records of solid waste from weighbridge indicating quantity of waste collected in Greater Letaba Municipality (GLM, 2020/2021).

As per the graph figure 4.11, the results show that the quantity of solid waste collected from July 2020 to June 2021 is 7 484 tonnes. Solid waste that was collected and disposed of was generated from households within the municipality. The volume of waste generated from July 2020 to June 2021 is higher than the quantity of waste generated from July 2020 to June 2021. This was due to the fact that, from July 2020 to June 2022, the municipality procured an extra two (2) refuse trucks, which are compactors and skip

trucks, for a total of six (6) refuse trucks. A similar trend was observed in India, where the amount of solid waste has been increasing due to the increase in municipal refuse fleets that were procured to extend services to some of the areas because of the increase in human population and urbanisation.

4.3.2 Data records from buy- back centres

Data records from the buyback centre were used to estimate the quantity of solid waste that was collected by reclaimers in the landfill site at the buyback centre in GLM from July 2019 to June 2021.

Figure 4.12 illustrates the data about the records of recyclable materials collected by waste pickers from the buyback centre at the Tzaneen Landfill Site in 2019/2020. Furthermore, figure 4.13 illustrates the data about the records of recyclable materials collected by waste pickers from recycling facilities at the Tzaneen Landfill Site in 2020/2021. The waste at the buyback centre in Tzaneen Landfill Site comes from different areas such as Nkowankowa, Tzaneen Lenyenye, Haenertsburg and other rural areas (public). The record from buyback includes recyclables materials by waste pickers from the landfill site and others from public. The GLM municipal trucks is disposing waste at Tzaneen Landfill Site, and waste pickers are sorting those recyclables items and take them to buy-back centre.

Figure 4.12: Records of recyclable materials by waste pickers from buyback centre in the Tzaneen Landfill site 2019/2020

As per the graph in figures 4.12 the results show that the quantity of recyclables reclaimed from the recycling facility from July 2019 to June 2020 is 4 455 tonnes. Recycling refers to collecting a waste product and reprocessing it so that it can be consumed once again, or reprocessing waste materials for use in new products (Strydom, 2018). The types of recyclable materials, including quantities, were plastics (230 tonnes), cans (90 tonnes), bottles (160 tonnes), papers (150 tonnes), boxes (150 tonnes), and glass (66 tonnes). This depends on the volume of waste reclaimed monthly, and due to that, the quantity of recyclables from July 2019 to June 2020 is greater than the quantity of recyclables that were reclaimed from July to June 2021. Recycling was not practised by waste pickers in the landfill site for a long period of eight (8) months starting in March 2020, as South Africa was on lockdown due to the COVID-19 pandemic, based on the above recycling statistics.

During the first half of 2020, waste pickers in developing nations like Ghana and South Africa saw a sharp fall in their average daily earnings as their operational expenses rose (Boampong *et al.,* 2021).

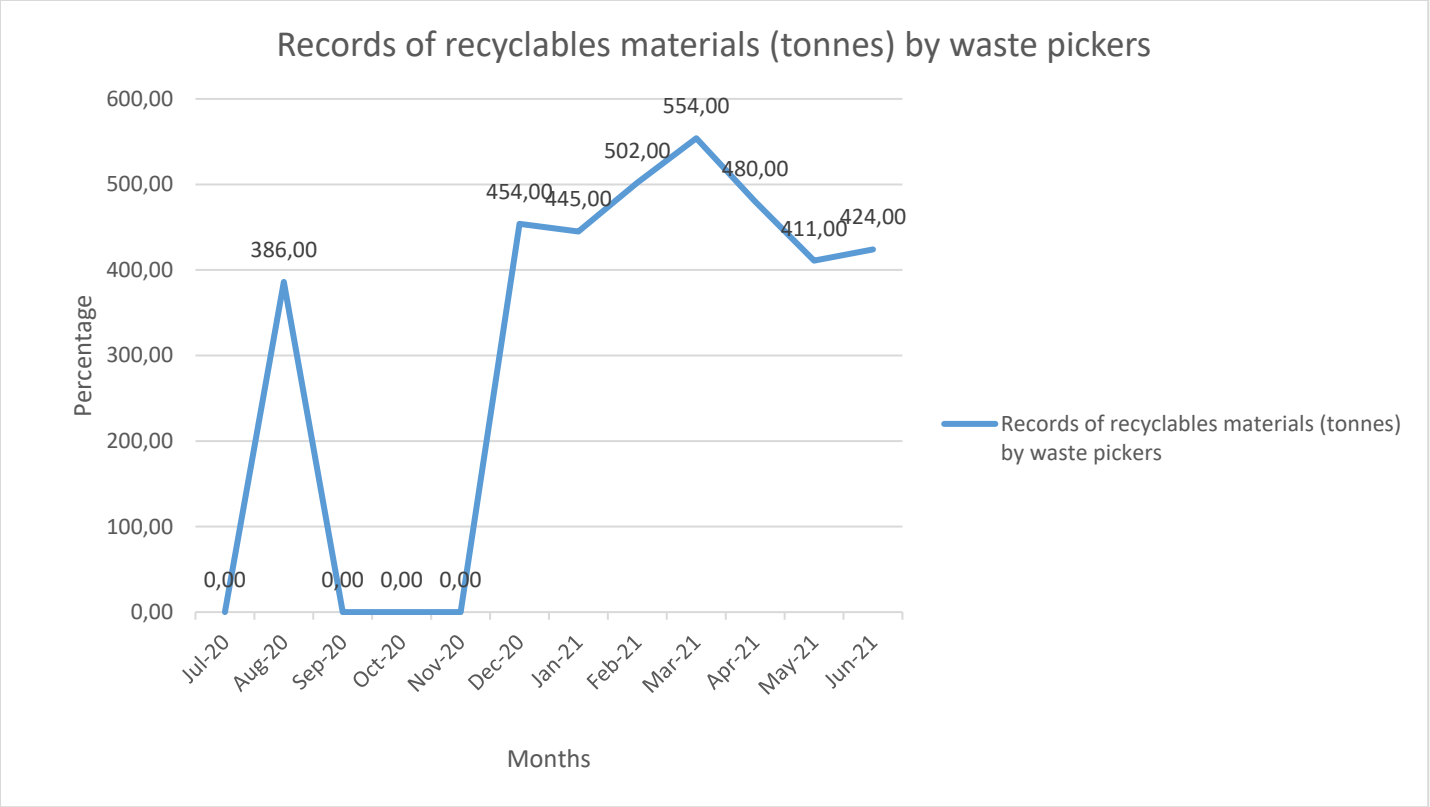


Figure 4.13: Records of recyclable materials by waste pickers from buyback centre in the Tzaneen Landfill site 2020/2021

As per the graph in figures 4.13, the results show that the quantity of recyclables reclaimed from the recycling facility from July 2020 to June 2021 is 3 656 tonnes. Recycling reduces the cost of waste disposal and the demand for raw materials by extending the lifespan of the landfill site (EPA, 2023). The types of recyclable materials, including quantities, were plastics (130 tonnes), cans (70 tonnes), bottles (120 tonnes), papers (100 tonnes), boxes (110 tonnes), and glass (50 tonnes). Collectors know the value of reclaiming and diverting tonnes of recyclable materials (Petco, 2022). This depends on the volume of waste reclaimed monthly, and due to that, the quantity of recyclables from July 2020 to June 2021 is less than the quantity of recyclables that were reclaimed from July 2019 to June 2020. Recycling was not practised by waste pickers in the landfill site for a long period of eight (8) months starting in March 2020, as South Africa was on lockdown due to the COVID-19 pandemic, based on the above recycling statistics.

In Portugal, waste pickers were facing specific challenges, including losing essential daily earnings, when governments ordered work to be stopped and employees to stay home (Arredondo, 2023).

4.3.3 Data records from weighbridge and buyback centre 2019/2020

Figure 4.14 below illustrates the data about the results of data records from the weighbridge and buyback centre for 2019 and 2020. Furthermore, figure 4.12.1 illustrates the data about the results of data records from the weighbridge and buyback centre for 2020–2021.

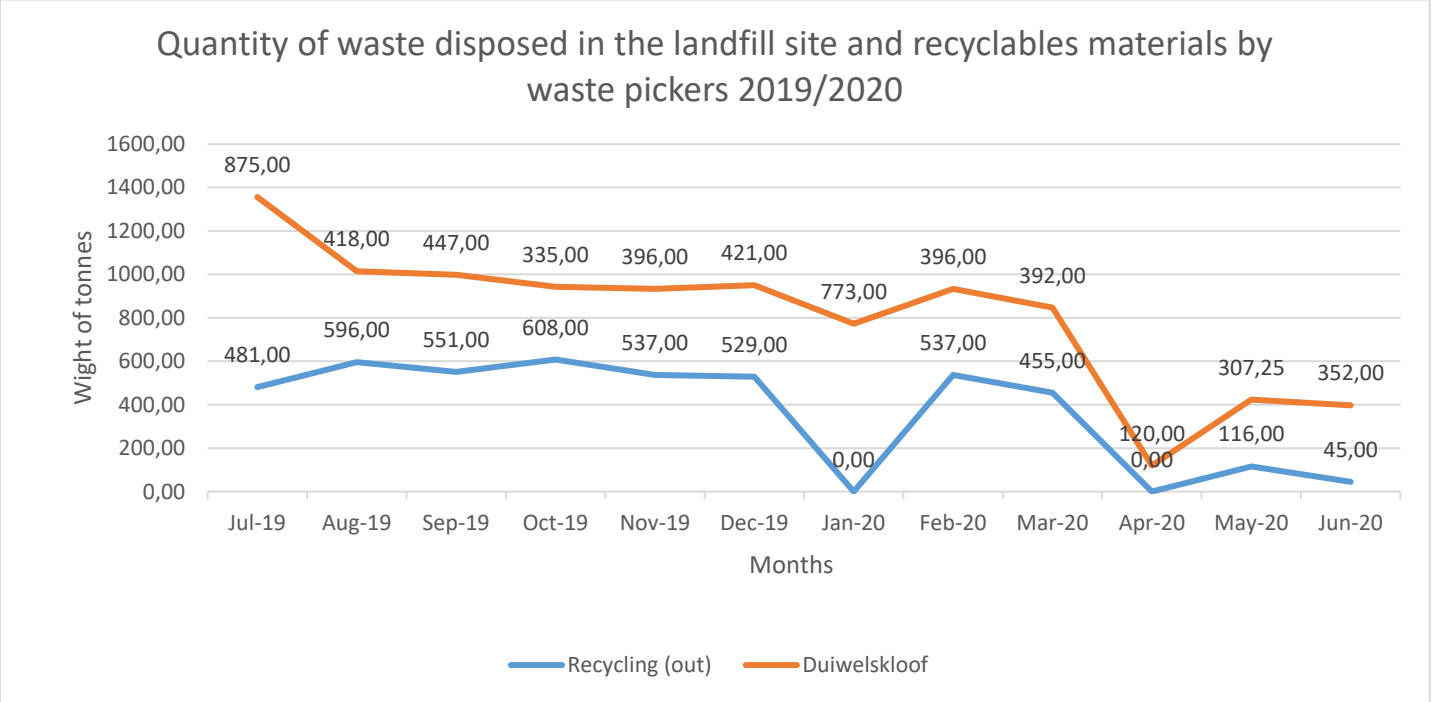


Figure 4.14: Results of data records from weighbridge and buyback centre 2019/2020

As per the graph, it can be seen from figure 4.14 the results show that, of the 100% of the waste in the landfill site, 80% was recycled by waste pickers, and the balance of 20% was disposed of there from July 2019 to June 2020. The graph is indicating the results of data records for the quantity of recyclables reclaimed from the buyback centre from July 2019 to June 2020, which is 445 tonnes. Furthermore, the data records show the quantity of solid waste collected from July 2019 to June 2020, which is 5 232 metric tonnes.

The fluctuation in the quantity of recyclable materials was due to the non-operation of the waste pickers at the landfill site from March 2020 to November 2021, which was caused by COVID-19 regulations. Furthermore, the fluctuations in the quantity of tonnes of solid waste in Greater Letaba that was disposed of were due to the less fleet that were on operation. Waste pickers filled a gap by reclaiming recyclables and providing raw material inputs into the formal recycling chain (Dias, 2016). The findings are agreed, as during lockdown due to COVID 19, waste picker services in the landfill sites were suspended for a short period of time. Furthermore, less fleet that were on operation has decreased the quantity of tonnes for solid waste disposal.

Waste pickers play a role in generating an economy as a source of income by reclaiming and selling recyclable solid waste materials (Wiego, 2023). The study has shown the importance of waste pickers at the landfill site by reducing the quantity of re-usable items (recyclables materials) to the but back centre. The problem was that waste pickers who dealt with solid waste were more susceptible since they were in danger for a significant amount of the time (Cruvinel *et al*., 2019).

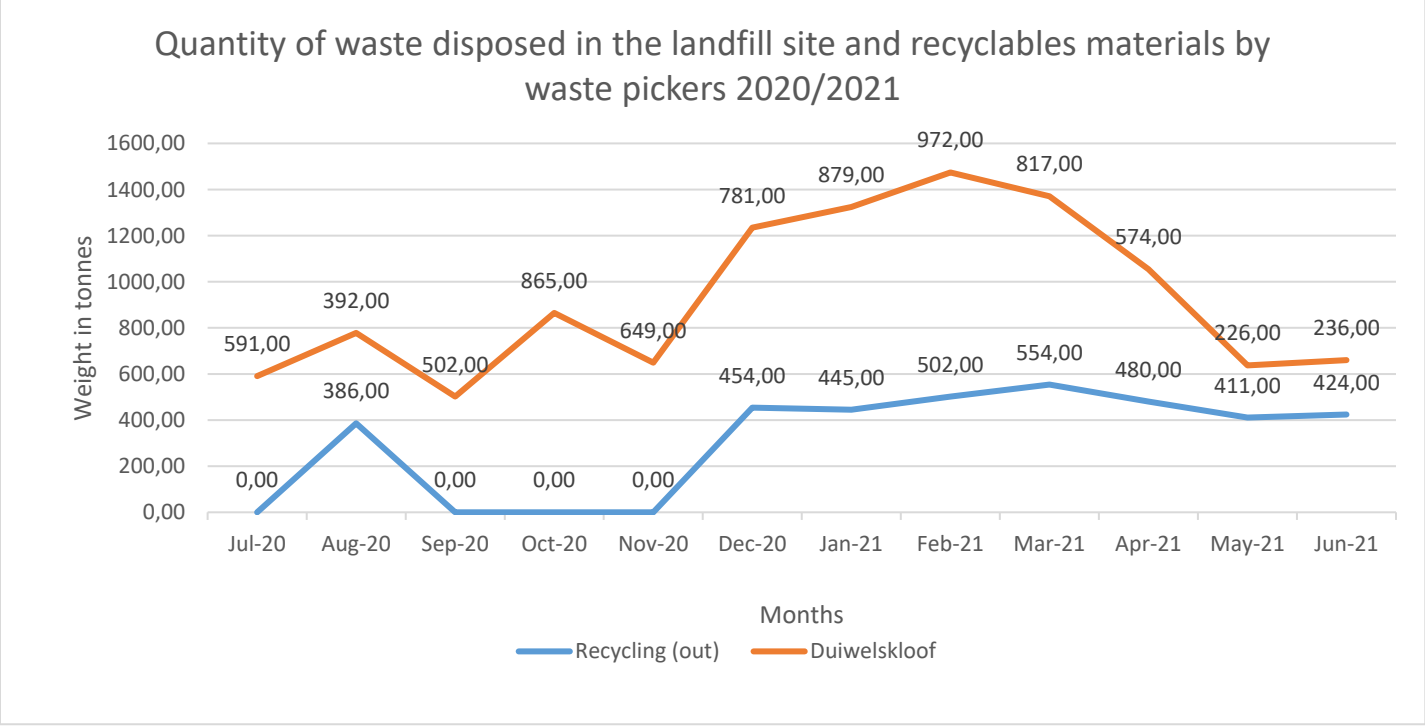


Figure 4.15: Results of data records from weighbridge and buyback centres 2020/2021

It can be seen from the figure 4.15 that, of the 100% of the waste in the landfill site, 60% was recycled by waste pickers, and the balance of 40% was disposed of there from July 2020 to June 2021. The graph is indicating the results of data records for the quantity of recyclables reclaimed from the buyback centre from July 2020 to June 2021, which is 3 656 tonnes. Furthermore, the data records show the quantity of solid waste collected from July 2020 to June 2021, which is 7 484 metric tonnes.

The fluctuation in the quantity of recyclable materials was due to the non-operation of the waste pickers at the landfill site from March 2020 to November 2021, which was caused by COVID-19 regulations. Furthermore, the fluctuations in the quantity of tonnes of solid waste in GLMthat was disposed of, were due to the increased procurement of an extra two refuse fleets or trucks. Supplying of raw materials was done at industry, buy-back centres, and creating many associated jobs for middlemen who purchase, sort, process, and resell materials collected. Volumes of recyclables were translating into jobs such as the supply of raw materials at buyback centres and income-earning opportunities (Blaauw *et al*., 2019). The findings are agreed, as during lockdown due to COVID 19, waste picker services in the landfill sites were suspended for a short period of time. Furthermore, the procurement of more fleet has increased the quantity of tonnes for solid waste disposal.

Waste pickers play a role in saving the Tzaneen Landfill Site from excessive spending on the construction of new cells, as they are extending the lifespan of the landfill site. The study has shown the importance of waste pickers at the landfill site by reducing the quantity of waste disposed of. Waste pickers know the process of packaging and the quantity of recyclable waste materials from recycling facilities.

4.4 Observation of waste pickers sorting re-usable items at Tzaneen Landfill Site

Observation is where a researcher visited the study area several times with the aim of observing without interfering too much (Creswell, 2018).

4.4.1 Observation of waste pickers

As per photograph 4.1, the results show that the researcher has observed that some waste pickers were wearing personal protective equipment (PPE), while some were not,

when sorting recyclables such as cans, plastics, bags, and papers at the landfill site. Some of the waste pickers, while sorting, did not wear their PPE, even though the municipality has provided the PPE. The study observation showed that waste pickers were reclaiming re-usable items from the landfill site and putting them inside plastic bags to be packaged at the recycling facility or buyback centres. Furthermore, this observation is linked to the tonnes of waste that were reclaimed from the landfill site by waste pickers. The aim was to sell and get a profit for living. From the observation point of view, they played a role by saving Tzaneen Landfill Site from excessive spending on the construction of new cells, as they showed that a significant contribution has been made in terms of diverting recyclables waste from landfill site.

The findings are agreed with this study as, waste separation at the source reduced the number of recyclables that went to the landfill and therefore the income potential of waste pickers at the landfill. Furthermore, waste pickers played a key role in informal waste separation in most developing countries, where separation at source reduced recyclables from the landfill site and was legislated as well (Godfrey & Oelofse, 2017; Arnoldi, 2019). Moreover, the findings on this observation are related to the role of waste pickers in solid waste management. The researcher agrees with Barba (2018), who indicated that waste pickers have reduced the volume of waste through separation and sorting, which was the best way to reduce the amount of solid waste in the landfill site. The challenges that waste pickers used to face was, they used to pick up rotten food at Tzaneen Landfill Site and eat. Furthermore, they used to get injured by sharp objected while sorting recyclables items. According to a study conducted in South Sudan, Africa, waste pickers who worked with recyclable materials were at risk of developing lung diseases from coming into contact with solid waste and sharp objects, as well as cuts, maiming, fatal accidents, heavy metal contamination, and dangerous wastes (Hande, 2019).

Photograph 4.1 illustrates the data about the results of the observation for waste pickers at Tzaneen Landfill Site sorting solid waste.

Photograph 4.1: Results of observation for waste pickers at the Tzaneen Landfill Site sorting solid waste

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter reviews the research objectives as formulated in chapter 1. Furthermore, it makes recommendations to the readers and relevant stakeholders of the research on the findings and finally makes conclusions and recommendations from the research undertaken as well.

5.2 Summary of the findings

Objective one (1): To evaluate the role of waste pickers in solid waste management at Greater Letaba Municipality.

Waste pickers gather, classify, and move waste so that it can be packaged. The waste pickers in South Africa play a crucial role in our recycling economy and environmentally sustainable future, yet they are often neglected and mistreated (Oxford, 2020). Additionally, they played a leading role in raising South Africa's recycling rate to 7.5%. They also salvage materials from landfills by loading them into improvised carts and sacks (Viljoen, 2022). According to the findings on this study, waste pickers play a role in saving Tzaneen Landfill Site from paying a lot of money for the construction of new cells, as a significant contribution that was made in terms of diverting recyclable waste from landfill site. For example, they were collecting 80% of the solid waste for recycling, and the balance of 20% was disposed of. Furthermore, Tzaneen Landfill Site acknowledged the contribution of waste pickers to the role they are playing in waste management services, their integration into sorting reusable items such as cans, plastics, boxes and as they are bringing themselves a financial stability.

Objective two (2): To identify the challenges waste pickers, encounter at the landfill site.

This study revealed that waste pickers used to pick up rotten food that was disposed of, which could threaten their health status if consumed. Waste pickers are provided with PPE when sorting solid waste such as cans, plastics, bags, and papers at the landfill site. Some of the waste pickers were wearing PPE, and some did not wear it, even though

PPE were provided. Waste pickers provided services that were beneficial to the environment of the landfill sites, yet faced hazards that were detrimental to their health.

Objective three (3): To estimate the tonnes of waste reclaimed from landfill site by waste pickers.

The records of waste bought and sold by a buy- back centre (Tzaneen Landfill Site) indicates that 4, 455 tonnes of recyclables were reclaimed between July 2019 and June 2020, while 3, 656 tonnes were reclaimed from July 2020 to June 2021. This is a total of 8,121 tonnes of recyclables materials that were reclaimed over the 24- month period. Due to access restrictions to the Tzaneen Landfill Site in 2020 because of Covid-19 regulations. it is anticipated that kerb side reclamation and reclamation of waste from other areas, may have had a larger contribution to the quantities of waste reclaimed during 2020.

The waste at the buyback centre in Tzaneen Landfill Site comes from different areas such as Nkowankowa, Tzaneen Lenyenye, Haenertsburg and other rural areas. The brought recyclables items for selling and getting profit as well.

Objective four (4): To identify and quantify solid waste from the municipal landfill sites.

The study showed the importance of waste pickers at the Tzaneen Landfill Site by reducing the quantity of waste disposed of. Data records showed the quantity of solid waste collected from July 2019 to June 2020, which was 5232 metric tonnes, and from July 2020 to June 2021, which was 7 484 metric tonnes. Furthermore, that gave a total of 12 716 metric tonnes in 24 months in GLM that were disposed of. The types of solid waste that were collected were cans, plastics, bottles, boxes, and papers. This was due to additional fleet procurement, which increased the quantity of tonnes for solid waste disposal.

Objective five (5): To identify and quantify recyclables reclaimed by waste pickers from the municipal landfill sites to the buyback centres.

This study showed that waste pickers knew how to package and the quantity of recyclable waste materials from recycling facilities. The types of waste that were identified and quantified for recyclable waste materials were cans (36% tonne), which were the majority; bottles (22% tonne); boxes (20% tonne); and plastics (18% tonne), which have a lower volume.

5.3 Conclusions

According to this study, wate pickers have a relatively little role in the circular economy, even if most of the services they provide are paid for, which lowers the quantity of waste that ends up in landfills (Gutberlet & Carenzo, 2020). They need to be recognised by municipalities for the vital role they are playing in keeping the environment clean. Solid waste was disposed of at the landfill site and reclaimed by waste pickers to reduce the volume of waste and recover the lifespan of the landfill site. This is relevant with the tonnes of waste reclaimed from the landfill sites by waste pickers. They were essential for offering a free service to remove and recycle items from landfill sites. Moreover, waste pickers play an important role in reducing the amount of waste as a waste minimising strategy (Ntuli, 2017; Edenvale News, 2023). They helped in identifying the quantity of waste that was generated and collected from GLM to the Tzaneen Landfill Site. This is linked with the identifying and quantifying the tonnes of solid waste from the municipal landfill sites.

Waste pickers played a role in diverting a significant quantity of materials from the waste stream through reuse, reduction, and recycling (Wiego, 2023). They were earning an income by recycling waste found at landfill sites. They were gathering garbage from public spaces; they contribute to cleanliness and help beautify the city (Nuswon, 2020). Waste pickers were protected at the landfill site during sorting, which means it shows their safety in their working conditions by complying with the regulation of the National Environmental Waste Management Act 108 of 2008, as solid waste can cause a serious health hazard to the environment and human beings.

Waste pickers and municipalities need to work together because they are serving the public and the municipality. By recovering recyclable waste from landfill sites, it has

decreased the amount of waste at landfill sites and decreased the longevity of the landfill site (Chamane, 2022). Based on gender, the results show that more men were interested in practising waste picking than women. This indicates that most of the waste pickers, according to their age group, had family responsibilities and needed income to provide bread for their children. Most black people were working and taking the work of waste sorting into consideration rather than white people's. The data indicates the frequency of waste collection and recycling from 2019 to 2021. The purpose of this study was to determine whether waste pickers reduced the amount of solid waste disposed of at Tzaneen Landfill Site by sorting reusable items. Furthermore, they created jobs in cooperation with the municipalities to reduce poverty by attempting to render collection and processing services in exchange for a small income to support their families (Rosaldo, 2022).

5.4 Recommendations

One way to enhance the effectiveness and quality of waste management is to formalise the operations of waste pickers and include them into waste management cooperatives (Kasinja & Tilley, 2018). Because they were job creators, they alleviated poverty and unemployment. This is related to the role of waste pickers in municipal solid waste. Furthermore, they were saving the lifespan of the landfill sites by reducing the amount of solid waste disposed of. This is linked with the tonnes of waste reclaimed from the landfill site by waste pickers. When the municipality is developing an integrated waste management plan (IWMP), waste pickers should be included and budgeted for their resources as well. Furthermore, recognised them as a legitimate part of the waste management system.

They should work towards establishing a good working relationship with landfill site municipal staff (Bonner & Mbata, 2020). Waste pickers should be encouraged and supported to form cooperatives which can secure contracts to sell materials collectively. Because the landfill site staff were the people who knew their needs and working conditions and provided them with help such as medical attention and PPE, as well as supporting them, they were incorporated into the IWMP for funding. Furthermore,

municipal workers pursued motivation based on how they were unemployed community members who were recycling to get revenue to feed their families. Moreover, they were saving the municipality money by constructing new cells on the landfill site when they were reclaiming reusable items.

Most cities should employ waste pickers to extend household collection and promote recycling by reclaiming recyclables from household waste (Wiego, 2019). They were people who helped by keeping the environment clean and practising household recycling as well. Waste pickers' contributions must be properly acknowledged and appreciated, and they ought to be included in the planning and execution of separation at source programs as well as other recycling projects. (Maleka & De Wet, 2021). Because they created jobs for living and reduced the volume of solid waste that was supposed to be landfilled. Furthermore, they knew the types of solid waste for recycling and how to package them in the buyback centre as well. Moreover, they could process those sorted packages at recycling depots. This is linked with the identification and quantifying of tonnes of recyclables reclaimed by waste pickers from the municipal landfill sites to the buyback centres.

GLM should have its own landfill site for disposing of waste to avoid making use of the Tzaneen Landfill Site. This was because GLM is paying Greater Tzaneen Municipality a high amount of money monthly, depending on the quantity of tonnes disposed at the weighbridge. That is, the more tonnes of solid waste generated by GLM that are disposed of at the Tzaneen Landfill Site, the more money GLM pays. This is linked to the quantifying tonnes of solid waste from the municipal landfill sites. The majority of unemployed community members residing within GLM are missing the opportunity to become waste pickers to make a living. GLM should establish municipal buyback centre next to its own landfill site, that purchase recyclables items.

The local municipality are encouraged to support the reclaiming livelihoods initiative and grant permission for recyclable waste on the landfill that enabled the reclaiming livelihoods waste pickers to collect recyclables directly on the landfill site. The municipality should also ensure that waste pickers are protected at the landfill site during sorting for

their safety and their working conditions, as waste is a serious health hazard to the environment and human beings. This is relevant and linked to the challenges waste pickers were encounting at the landfill site. They should be contracted by the municipality to collect the separated waste and take it to sort. Sorting of waste should be practised at the landfill site by waste pickers due to the unemployment opportunity, and this is another way of making a living. Furthermore, the municipality should provide waste pickers with health and safety training. Waste pickers ought to be acknowledged for the significant contribution they make to reducing carbon emissions and generating value from the waste that some people produce. Waste pickers should be compensated by the buyback centre with a fixed rate per kilogram for tons of recyclables that they collect. This is in exchange for their environmental service of removing recyclables from landfills.

Waste pickers associations should demand a law that recognises them as workers and gives them the right to social security benefits. The purpose of the law should be to cover whatever activities they were undertaking at the landfill site. The municipal government should involve waste pickers in developing and implementing policies and systems. In order to fulfil the community's constitutional right to a healthy and safe environment, the municipality should assume a key role.

REFERENCE LIST

Abhishek, A., Utsav, A., Kant, K. & Priya, R., 2020. Prototype Design of Smart Dustbin and Solid Waste Management using IoT. ICICNIS 2020, Available from: SSRN: https://ssrn.com/abstract=3768273 or http://dx.doi.org/10.2139/ssrn.3768273 [Accessed 24 August 2023].

Abizaid, O., 2016. ARB: Fighting for an inclusive Model for Recycling in Bogotá. [online] Available at: http://wiego.org/sites/wiego.org/files/resources/files/Abizaid-Bogota-Wastepicker-Recycling-Case-Study. pdf. [Accessed 2 November 2022].

Abussafy, R. Dias, S.M. Goncalves, J. & Martins, J.P. 2020. Impacts of the COVID 19 pandemic on inclusive recycling, Brazil. Women in Informal Employment: Globalizing and Organizing. Available from: https://www.wiego.org/sites/default/files/publications/file/Impacts% 20of% 20the% 20COVID19% 20Pandemic% 20on% 20Inclusive% 20Recycling% 20in% 20Brazil% 20Portuguese% 20for% 20web_1. pdf [Accessed 23 October 2023]

Aggarwal, N. 2021. Can digitisation of plastic credit model formalise the waste management ecosystem and ensure transparency. Available from: https://timesofindia.indiatimes.com/blogs/voices/can-digitisation-of-plastic-credit-model-formalise-the-waste-management-ecosystem-and-ensure-transparency/ [Accessed on 14 April 2023]

Ahmad, S.R. & Barford, A. 2021. A call for a socially restorative circular economy: Waste pickers in the recycled plastics supply chain. *Circular Economy and Sustainability*, 1, 761-782.

Al-Khatib, I.A., Al-Sari, M.I. & Kontogianni, S., 2020. Scavengers' contribution in solid waste management sector in Gaza Strip, Palestine. *Environmental Monitoring and Assessment*, 192(6), 354.

bonner

Amphan, 2021. Waste reclaimers join hands to save the city, Johannesburg, South Africa. Available from: https://cdkn.org/story/feature-johannesburg-south-africa-waste-reclaimers-join-hands-to-save-the-city [Accessed on 14 January 2023]

Aquino, B.E., Durany, X.G. & Vargas, R.Q. 2023. The role of informal waste management in urban metabolism: *A review of eight Latin American Countries*, 15(3), p1826.

Arakal, R.A. 2021. Lockdown and pandemic, Bengaluru waste pickers claim stigma: The Indian Express. Available from: https://indianexpress.com/article/cities/bangalore/despite-toiling-through-lockdown-and-pandemic-bengaluru-waste-pickers-claim-stigma-7283641/ [Accessed on 14 January 2023]

Arnoldi, M. 2019. Reclaimers progress towards formal inclusion in waste collection system. Available from: https://www.engineeringnews.co.za/article/reclaimers-progress-towards-formal-inclusion-in-waste-collection-system-2019-06-05 [Accessed on 1 February 2023]

Arora, K. 2016. Waste pickers and workers in the informal waste industry: Global alliance of waste pickers in India. Available from: https://globalrec.org/2021/03/24/waste-pickers-and-workers-in-the-informal-waste-industry-the-pillars-of-extended-producers-responsibility/ [Accessed on 171 March 2023]

Arredondo, J. 2023. Waste pickers: Essential service providers at risk. Available from: https://www.wiego.org/waste-pickers-essential-service-providers-risk [Accessed on 14 January 2023]

Arruda, S. Santos, S. Silva, M.M. & Valenca, S. 2020. A contribution to the understanding of the changes in the profile: Waste pickers: informal recycling market, Waste management, developing country Brazil. *Revista Brasileira de Geografia Física*, 13(5), 1958-1969.

Aslam, S., Ali, F., Naseer, A. & Sheikh, Z., 2022. Application of material flow analysis for the assessment of current municipal solid waste management in Karachi, Pakistan. *Waste Management & Research*, 40(2), 185-194.

Ayeleru, O.O., Okonta, F.N. and Ntuli, F., 2018. Municipal solid waste generation and characterization in the City of Johannesburg: A pathway for the implementation of zero waste. *Waste Management*, *79*, 87-97.

Baker, M., Memela, S. & Rampete, N., 2016, October. Empowerment of Waste Pickers in the City of Johannesburg, creating an enabling environment for the informal waste sector to participate in municipal waste service delivery. In Proceedings of the 23rd WasteCon Conference (pp. 17-21).

Barnsbee, L., Barnett, A.G., Halton, K. & Nghiem, S., 2018. Cost-effectiveness. In Mechanical circulatory and respiratory support (pp. 749-772). Academic Press.

Baryla, I.W., Bernat, K. & Zaborowska, M. 2022. Plastic waste degradation in landfill conditions: the problem with microplastics, and their direct and indirect environmental effects. *International Journal of Environmental Research and Public Health*, 19(20), 13223.

Bax, P. 2019. Joburg's waste pickers help SA's recycling rate. Available from: https://infrastructurenews.co.za/2019/05/15/joburgs-waste-pickers-help-sas-recycling-rate-rival-some-in-europe/ [Accessed on 14 March 2023]

Bell, T. 2018. Demands justice for waste pickers- South African Federation of Trade Union. Available from: https://saftu.org.za/2018/06/saftu-demands-justice-for-waste-pickers/ [Accessed on 4 Feb 2023]

Bhaduri, A. 2022. Down in the dumps: Delhi's waste pickers, South African Government Association. Available from: https://www.indiawaterportal.org/articles/down-dumps-delhis-waste-pickers-saga [Accessed on 27 February 2023]

Bhandari, P., 2021. Ethical considerations in research types & examples. *Retrieved*, *1*(18), 2023.

Bizjak, T., Davor, K., Kwarteng, K. & Kontic, B. 2020. Assessing the role of waste pickers in the recycling industry: *Journal of Geoscience and Environmental Protection*, 8(10).

Blaauw, P., Schenck, C.J. & Viljoen, M.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).

Blaauw, P., Schenck, R. & Viljoen, K. 2018. The management of South Africa's Landfills and waste pickers on them. *Impacting lives and livelihoods*, 36(1).

Blaauw, P., Schenck, R., Swart, E. & Viljoen, K. 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*, 6(11).

Blaauw, P., Schenck, R. & Viljoen, K. 2021. The opportunities and value adding activities of buyback centres in South Africa's recycling industry. *A value chain analysis*, 34(3).

Boampong, O., Saagbul, K. and Talbott, T.C., 2020. Ghanaian Government Leaves Waste Pickers to Fend for Themselves amidst COVID-19 Pandemic. Available from: *WIEGO www. wiego. org/ghanaian-government-leaves-waste-pickers-fend-themselves-amidst-covid-19-pandemic*. [Accessed on 4 February 2023]

Bonner, C. & Mbata, S. 2020. A guide waste pickers' guide to organizing: Groundwork, Pietermaritzburg. Available from: https://wasteroadmap.co.za/wp-content/uploads/2021/02/Waste-Picker-Integration-Guidelines.pdf [Accessed on 21 January 2023]

Brito, P. & Galato, D. 2019. WWOSH academic papers: Workshop health without borders. Available from: https://whwb.org/ [Accessed on 21 January 2023]

Buch, R. 2021. An inclusive circular economy solution through development of cooperatives in waste management: *Circular economy, United State of America*, 13(16), 1-13.

Carenbauer, M.G., 2021. Essential or dismissible? Exploring the challenges of waste pickers in relation to COVID-19. *Geoforum*, 120, 79-81.

Chamane, M. 2021. Ten months of lockdown, still no Covid – 19 relief: South Africa Waste pickers.

Chamane, M. 2022. South African Waste Picker Association Biennial: the waste picker revolution, Gaia. Available from: https://www.no-burn.org/sawpa-biennial-2022-the-waste-picker-revolution/ [Accessed 21 May June 2023]

Chatterji, N. 2023. Migrant waste pickers- social exclusion and deprivation of dignity of labor, Bengaluru. Available from: https://www.aicctu.org/workers-resistance/v1/workers-resistance-august-2021/migrant-waste-pickers-bengaluru-%E2%80%93-social-exclusion-and-deprivation-dignity-labor [Accessed 2 June 2023]

Chemeda, D.D., & Fereja, W.M. 2021. Status, characterization, and quantification of municipal solid waste as a measure towards effective solid waste management: The case of Dilla Town, Southern Ethiopia. *Journal of the Air & Waste Management Association*,*72*(2), 187-201.

Chen, F.U. & Vasquez, E. 2016. A virtuous circle: Integrating waste pickers into solid waste Management. Available from: Available from: https://Worldbank. org/voices/virtuouscircle-integrating-waste-pickers-solid-wastemanagement [Accessed 12 April 2023]

Chen, F.U., Luo, Z. & Yung, Y. 2018. Enhancing municipal solid waste recycling through reorganizing waste pickers: A case study in Nanjing, China. *Waste Management and Research,* 36(9), 767-778.

Chitaka, T.Y., Moyo, T., Gihring, K. & Schenck, C., 2022. The myth of livelihoods through urban mining: The case of e-waste pickers in Cape Town. *South African Journal of Science,* 118, 1-8.

Chironda, M. 2022. Recycling is about so much more than waste: Africa Climate Crisis in South Africa. Available from: http://artmotion.co.za/south-africa-recycling-is-about-so-much-more-than-waste-africaclimatecrisis/ [Accessed 9 March 2023]

Clausager, N., Stoisser, M., Demaria, F. & Todt, M., 2020. How Waste Pickers in the Global South are Being Sidelined by New Policies. *The Conversation*, 1(3), 1-15.

Coban, A., Ertis, I.F. & Cavdaroglu, N.A. 2018. Municipal solid waste management via multi-criteria decision-making methods: A case study in Istanbul, Turkey. *Journal of cleaner production*, 180, 159-167.

Colombijn, F. & Morbidini, M. 2017. Pros and cons of the formation of waste – pickers corporative: a comparison between Brazil and Indonesia, 44(2), 91-101.

Creswell, J.D. 2018. Research design: Qualitative, quantitative, and mixed methods approach. *Journal of building construction and planning research*, 8(4), 14-37.

Cruvinel, V.R.N., Marques, C.P., Cardoso, V., Novaes, M.R.C.G., Araújo, W.N., Angulo-Tuesta, A., Escalda, P.M.F., Galato, D., Brito, P. & Da Silva, E.N., 2019. Health conditions and occupational risks in a novel group: waste pickers in the largest open garbage dump in Latin America. *BMC public health*, 19(1), 1-15.

CSIR. 2018. Integrating informal waste pickers into the economy. Available from: https://www.csir.co.za/integrating-informal-waste-pickers-economy [Accessed on 21 January 2023]

Dayaram, T., Erwin, K., Fleetwood, T.K., Khanyile, A., Mlotshwara, N. & Sibanda, P. 2022. Working with waste: Hazards and mitigations strategies used by waste pickers in City of Durban. *International Environmental res public health*, 19(20), 12986.

De, L., Hammarberg, K. & Kirkman, S. 2016. Qualitative research methods. *Human reproduction,* 31 (3), 12-18.

DFFE. 2019. Working of waste, South Africa. Available from: https://www.dffe.gov.za/ [Accessed 16 May 2023]

DFFE. 2020. Working of waste, South Africa. Available from: https://www.dffe.gov.za/ [Accessed 16 May 2023]

DFFE. 2022. Regulations, Norms and Standard and Guidelines: Republic of South of Africa. Available from: https://www.dffe.gov.za/ [Accessed 16 May 2023].

De Jager, N. 2018. City wins waste pickers integration award: Joburg,1-3. Available from: https://joburg.org.za/media_/Pages/Media/Media%20Statements/2019%20Media%20Statements/2019%20October/City-wins-waste-pickers-integration-award. [Accessed 22 February 2023].

De Wet, P. & Maleka, T. 2021. Helping South Africa s waste pickers face the COVID-19 crisis and beyond: United Nations Industrial Development Organization. Available from: https://www.unido.org/stories/helping-south-africas-waste-pickers-face-covid-19-crisis-and-beyond [Accessed 22 February 2023]

Devendran, A.A., Mainali, B., Khatiwada, D., Golzar, F., Mahapatra, K. & Toigo, C.H., 2023. Optimization of Municipal Waste Streams in Achieving Urban Circularity in the City of Curitiba, Brazil. *Sustainability*, 15(4), 3252.

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

Dias, S., 2018. Three ways waste pickers can be included in the new circular economy. *Equal Times*, *23,* 1-12.

Dias, S.M. & Fernandez, L. 2020. Formalisation from the ground: The case of waste pickers' s cooperatives. *Research handbook on development and the informal economy,* 263.

Douglas, H., 2023. Sampling techniques for qualitative research. In *Principles of social research methodology* (pp. 415-426). Singapore: Springer Nature Singapore.

Dube, R. 2020. How recycling helps the environment and boosts the economy. Available from: https://www.bbc.com/news/uk [Accessed 24 March 2023].

EjAtlas, 2020. Waste pickers under threat. New waste management policies undermine the informal recycling sector in the global South. Available from: https://www.commondreams.org/views/2020/03/02/worlds-waste-pickers-under-threat [Accessed 4 March 2023].

Ecowize, 2017. Critical programs: Waste Management. Available from: https://www.ecowize.co.za/ [Accessed 19 February 2023].

Edenvale News, 2023. Refuse collection and the role of waste pickers, in Bedfordview, South Africa. Available from: https://www.citizen.co.za/bedfordview-edenvale-news/local/news-headlines/ [Accessed 24 March 2023].

Edokpayi, J.N., Njoku, P.O. & Odiyo, J.O., 2019. Health and environmental risks of residents living close to a landfill: A case study of Thohoyandou Landfill, Limpopo Province, South Africa. *International journal of environmental research and public health,* 16(12), 2125.

Edokpayi, J.N., Shale, K. & Uhunamure, S.E. 2021. Occupational health risk of waste pickers: A case study of Northern Region, of South Africa, 2021. Available from: https://www.hindawi.com/journals/jeph/2021/5530064/ [Accessed 2 February 2023].

eNCA. 2020. How waste pickers save in South African municipalities. Available from: https://www.enca.com/news [Accessed 11 January 2023].

Eneogwe, I.C. & Umunnakwe, H.C. 2021. Environmental impacts of improper solid waste management; Enyimba City, 41(8), 543-548.

EMP. 2023. Greater Letaba Municipality: Environmental Management Plan. Available from: https://www.greaterletaba.gov.za/sstaff/pages/sites/letaba/documents/idp/ [Accessed 11 June 2023].

EPA. 2017. Managing and reducing wastes: A guide for commercial buildings, United States. Available from: https://www.epa.gov/sites/default/files/ [Accessed 11 April 2023].

EPA. 2020. Recycling Economic information report: Sustainable Materials Management. Available from: https://www.epa.gov/sites/default/files/ [Accessed 11 April 2023].

EPA. 2021. National recycling strategy: Circular economy. Available from: https://www.epa.gov/sites/default/files/ [Accessed 11 April 2023].

EPA. 2022. Guide to the facts and figures report about materials, waste, and recycling; United States Environmental Protection Agency. Available from: https://www.epa.gov/sites/default/files/ [Accessed 11 April 2023].

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

Ferraz, C. 2020. Waste pickers responsible for 90% recycling at greater risk: COVID 19 in Brazil, *Environment and Urbanization*, 23, 1-5.

Ferronato, N., Alarcón, G.P.P., Lizarazu, E.G.G. & Torretta, V., 2021. Assessment of municipal solid waste collection in Bolivia: Perspectives for avoiding uncontrolled disposal and boosting waste recycling options. *Resources, Conservation and Recycling*, *167*, 105234.

International Labour Organization (ILO). 2023. Waste pickers cooperatives and social and solidarity economy organizations. Available from: https://www.ilo.org/global/topics/cooperatives/publications/WCMS_715845/lang--en/index.htm [Accessed 1 March 2023].

Jerie, J. 2016. Occupational risks associated with solid waste management in the informal Sector of Gweru, Zimbabwe, 2016.

Jordaan, C. 2022. Complacency as the enemy in waste recycling: Earth recycling, Johannesburg. Available from: https://mg.co.za/thoughtleader/opinion/2022-10-12-complacency-is-the-enemy-in-waste-recycling/ [Accessed 4 March 2023].

Gall, M., Wiener, M., de Oliveira, C.C., Lang, R.W. & Hansen, E.G., 2020. Building a circular plastics economy with informal waste pickers: Recycle quality, business model, and societal impacts. *Resources, Conservation and Recycling*, *156*, 104685.

Gebre, T. & Gebremedhin, B. 2019. The mutual benefits of promoting rural urban interdependence through linked ecosystem services: Global Ecology and Conservation, 20(2019).

Godfrey, L. & Oelofse, S. 2017. Historical Review of Waste Management and Recycling in South Africa, *Resources*, 6(4), 57-58.

Godfrey, L. 2021. Quantifying economic activity in the informal recycling: Informal waste reclaimers, South Africa, 117(9), 138-144.

Gowda, B., Yashin, M.P., Dinesh, S. & Pawar, S. 2022. Design and Fabrication of Automated Paper Recycling Machine: A Review. *International Journal of Research in Engineering and Technology,* 9*,* 145-149.

Grove, S.K. 2017. The practice of nursing research: Appraisal, synthesis, and generation of evidence. *Open journal of nursing*, 10, 1-11.

Gutberlet, J., & Carenzo, S. 2020. Waste Pickers at the Heart of the Circular Economy: A Perspective of Inclusive Recycling from the Global South. *Worldwide Waste: Journal of Interdisciplinary Studies*, 3(1): 6, 1–14.

Gutberlet, J., Kain, J., Nyakinya, B. & Oloko, M. 2016. Bridging weak links of solid waste management in informal settlements. *The journal of environment and development*, 26(1), 106-131.

Gutberlet, J. & Uddin, S. 2018. 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(6), 299-310.

Gutberlet, J., Sorroche, S., Martins Baeder, A., Zapata, P. & Zapata Campos, M.J., 2021. Waste pickers and their practices of insurgency and environmental stewardship. *The Journal of Environment & Development*, 30(4), 369-394.

Gutberlet, J. & Oloko, M. 2022. Organized waste pickers as environmental educators: peer to peer and bottom-up generated knowledge informing public policy, Brief 3. Available from: https://gupea.ub.gu.se/bitstream/handle/2077/70909/PB3_EDU_eng_web.pdf?sequence=1 [Accessed 4 March 2023].

Harrisberg, K. 2019. Living off trash: South Africa's waste pickers reclaim the streets: Thomson Reuters Foundation News. Available from: https://www.reuters.com/article/us-safrica-waste-cities-feature-idUSKCN1T00XF/ [Accessed 12 April 2023].

Hammer, C. 2017. Brazil brings its informal waste pickers: waste pickers in Curitiba. Available from: https://apolitical.co/solution-articles/en/brazil-brings-informal-waste-pickers-cold [Accessed 21 May 2023].

Hande, S. 2019. The informal waste sector: A solution to the recycling problem in developing countries. *The journal of field actions*, 19(20), 28-35.

Holt, D.L. & Steinfield, L. 2019. Towards a theory on the reproduction of social innovations in subsistence marketplaces. *Journal of product Innovation Management*, 36(6), 764-799.

HSE. 2020. Waste & recycling sector workplan: targeted inspections. Available from: https://cdn.ca.emap.com/wp-content/uploads/sites/6/2021/02/HSE-Workplan-February-2021.pdf [Accessed 25 May 2023].

IDP. 2018/2019. Integrated Development Plan: Greater Letaba Municipality, Limpopo, South Africa. Available from: https://www.greaterletaba.gov.za/sstaff/pages/sites/letaba/documents/idp/GREATER%20LETABA%20MUNICIPALITY%20DRAFT%20IDP.pdf [Accessed 28 February 2023].

IDP. 2019/2020. Greater Letaba Municipality: Integrated Development Plan. Available from:

https://www.greaterletaba.gov.za/sstaff/pages/sites/letaba/documents/idp/GREATER%20LETABA%20MUNICIPALITY%20DRAFT%20IDP.pdf [Accessed 28 February 2023].

IDP. 2021/2022. Greater Letaba Municipality: Integrated Development Plan. Available from: https://www.greaterletaba.gov.za/sstaff/pages/sites/letaba/documents/idp/GREATER%20LETABA%20MUNICIPALITY%20DRAFT%20IDP.pdf [Accessed 28 February 2023].

IDP. 2022/2023. Greater Letaba Municipality: Integrated Development Plan. Available from: https://www.greaterletaba.gov.za/sstaff/pages/sites/letaba/documents/idp/GREATER%20LETABA%20MUNICIPALITY%20DRAFT%20IDP.pdf [Accessed 28 February 2023].

International Labour Organization (ILO). 2023. Waste pickers cooperatives and social and solidarity economy organizations. Available from: https://www.ilo.org/global/topics/cooperatives/publications/WCMS_715845/lang--en/index.htm [Accessed 18 February 2023].

Fisk, T. 2021. Waste picker's role in plastic pollution reduction. Available from: https://www.iucn.org/news/environmental-law/202104/waste-pickers-role-plastic-pollution-reduction-ones-we-cannot-leave-behind [Accessed 8 February 2023].

IWMP. 2021/2022. Integrated Waste Management Plan: Greater Letaba Municipality, Limpopo, South Africa. Available from: https://www.greaterletaba.gov.za/sstaff/pages/sites/letaba/documents/idp/GREATER%20LETABA%20MUNICIPALITY%20DRAFT%20IDP.pdf [Accessed 28 February 2023].

IWMP. 2021/2022. Integrated Waste Management Plan: Greater Tzaneen Municipality, Limpopo, South Africa. Available from: https://www.greatertzaneen.gov.za/documents/idp/The%20Final%20IDP%202021%2022%20adopteds_04062021.pdf [Accessed 2 March 2023].

Kakar, I.S., Mallya, A., Whittaker, L., Tolhurst, R. & Garimella, S., 2022. Intersecting Systems of Power Shaping Health and Wellbeing of Urban Waste Workers in the Context

of COVID-19 in Vijayawada and Guntur, Andhra Pradesh, India. *Social Sciences*, 11(8), 333.

Kasinja, C. & Tilley, E. 2018. Formalization of informal Waste Pickers Cooperatives in Blantyre, Malawi: A feasibility Assessment. *Sustainability*, 10(4), 1149.

Kaza, S. 2020. Waste workers are protecting our communities during COVID-19: Sustainable cities. Kaza, S. 2020. Available from: https://worldbank.org/ sustainablecities/waste-workers-are-protecting-our-communities-during-covid-19. [Accessed 12 January 2023].

Khoza, S., 2019. *Socio-economic rights in South Africa: A resource book*. Community Law Centre, University of the Western Cape.

Khunou, K. & Makwarela, M. 2018. Household recycling plan leaves waste pickers fighting for crumbs. Available from: https://www.businesslive.co.za/bd/opinion/2018-07-04-household-recycling-plan-leaves-waste-pickers-fighting-for-crumbs/ [Accessed 26 January 2023].

Koen, L. & Fourie, E.S., 2023. Waste pickers and the law: Contradictory and fragmented regulation in three metropolitan municipalities. *Development Southern Africa*, 40(2), 373-389.

Krige, J. & Panchia, Y. 2020. Amid lockdown, South Africa's waste pickers suffer most. Available from: https://www.aljazeera.com/news/2020/4/8/amid-lockdown-south-africas-waste-pickers-suffer-most [Accessed 6 March 2023].

Kumar, S., Smith, S.R., Fowler, G., Velis, C., Kumar, S.J., Arya, S., Rena, Kumar, R. & Cheeseman, C., 2017. Challenges and opportunities associated with waste management in India. *Royal Society open science*, 4(3), 160764.

Lawhon, M. & Markina, A. 2022. Permission to appropriate: Waste pickers guidelines for contesting and consolidating claims to waste on the streets of Tshwane, in South Africa, *Geoforum*, 137, 52-60.

Likar, M. 2022. Accumulation of Sanitary Landfill and Waste disposal process in chemicals. *International Journal of waste Resources,* 12(488),1-2.

Made, F., Ntlebi, V., Kootbodien, T., Wilson, K., Tlotleng, N., Mathee, A., Ndaba, M., Kgalamono, S. & Naicker, N., 2020. Illness, self-rated health and access to medical care among waste pickers in landfill sites in Johannesburg, South Africa. *International Journal of Environmental Research and Public Health*, 17(7), 2252.

Mafata, M. 2021. Johannesburg informal waste reclaimers collect world wildlife fund award. Available from: https://www.groundup.org.za/article/informal-waste-reclaimers-receive-prestigious-award-world-wildlife-fund/. [Accessed 16 May 2023].

Majithia, A.S. 2018. Can waste pickers help solve Delhi's towering trash problem. Available from: https://www.wiego.org/blog/can-waste-pickers-help-solve-delhi%E2%80%99s-towering-trash-problem [Accessed 11 January 2023].

Mapa, M.T., Powell, J.C., Asis, A.H.B., Sakke, N. & Gulasan, A., 2019. Waste scavenging and its contribution for survival and urban recycling in Kota Kinabalu City, Sabah, Malaysia. *The Indonesian Journal of Geography*, 51(2), 183-189.

Markham, A.N. & Buchanan, E., 2015. Ethical considerations in digital research contexts. *Encyclopedia for social & behavioral sciences*, 1, 606-613.

Mbata, S. 2020. South African Waste Pickers Association: Global alliance of waste pickers, South Africa,1-3. Available from: https://groundwork.org.za/ [Accessed 21 January 2023].

Mbata, S. 2021. International Waste Pickers Day: A struggle for recognition, dignity, and a better waste life- cycle,1-4. https://groundwork.org.za/international-waste-pickers-day-a-struggle-for-recognition-dignity-and-a-better-waste-life-cycle/ [Accessed 11 January 2023].

Mbatha, S. & Bonner, M. 2022. South African Waste Pickers Association biennial: The waste picker revolution. Available from: https://wastepickers.org.za/ [Accessed 11 January 2023].

Mansour, M. & Shafy, H. 2018. Solid waste issue: Sources, Composition, disposal, recycling, and valorisation. *Egyptian journal of petroleum*, 27(4), 1275-1290.

Marello, M. & Helwege, A. 2017. Solid waste management and Social Inclusion of Waste pickers: Opportunities and Challenges, 45(1), 108-129.

Marnce, C. 2021. Strengthening waste picker organising in Africa. Available from: https://policycommons.net/artifacts/2621606/strengthening-waste-picker-organising-in-africa-u-n-i/3644278/ [Accessed 30 January 2023].

Matshili, R. 2019. Waste Pickers collect up to 90% of recyclables saving municipalities millions: Pretoria News. Available from: https://showme.co.za/pretoria/news/waste-pickers-collect-up-to-90-of-recyclables/ [Accessed 3 February 2023].

Maziotis, A. & Senate, M.M. 2021. The cost of reducing municipal unsorted solid waste: Evidence from municipalities in Chile. *Sustainability*, 13(12), 6607.

Mehlwana, L. 2020. Waste pickers in Port Elizabeth navigate double burden of lockdown and hunger: City press South Africa. Available from: https://www.news24.com/citypress/news/waste-pickers-in-port-elizabeth-navigate-double-burden-of-lockdown-and-hunger-20200708 [Accessed 23 July 2023].

Mayerhoff, R. 2020. Ghana's Ambitious Plan to Minimize Plastic Waste. Available from: https://www.forbes.com/sites/sap/2020/10/22/ghanas-ambitious-plan-to-minimize-plastic-waste/?sh=13683ef6a327 [Accessed 11 August 2023].

Mlotswa, D.V., Orante-Barrón, V.R., Mothudi, B.M., Mofokeng, S.J., Ngubeni, G.N., Poelman, D. & Noto, L.L. 2022. Thermally stimulated luminescence properties of MgTa2O6 prepared by solid-state chemical reaction. *Journal of Luminescence*, 252, 119375.

Mndebele, M. 2021. Waste reclaimers as unappreciated and unprotected. Available from: https://allafrica.com/stories/202101260432.html [Accessed 10 June 2023].

Modise, A. 2019. Waste pickers having potential to add value to economy. Available from: https://www.sowetanlive.co.za/opinion/columnists/2019-05-24-waste-pickers-have-potential-to-add-value-to-economy/ [Accessed 20 April 2023].

Morais, J., Corder, G., Golev, A., Lawson, L. & Ali, S., 2022. Global review of human waste-picking and its contribution to poverty alleviation and a circular economy. Environmental Research Letters, 17(6), 063002.

Mothiba, M. 2017. *A review of the working conditions and health status of waste pickers in some landfill sites: City of Tshwane Metropolitan Municipality, South Africa.* Doctoral Thesis, Unisa.

Nathanson, J.A. 2023. Waste pickers collect food waste, help combat climate change: Solid waste management. Available from: https://apnews.com/article/food-waste-climate-change-waste-pickers-961bb5db3c93ec8cf95ca26b02cdb764 [Accessed 20 April 2023].

Naveen, B. 2021. Scenarios of waste management nexus, Bangalore. *Energy Nexus 1*, 100004.

Nene, W. 2018. Separation @ source programme reaches, Midrand region. Available from: https://www.citizen.co.za/midrand-reporter/news-headlines/2018/07/17/separationsource-programme-reaches-midrand/ [Accessed 3 March 2023].

Ngcuka, O. 2022. Waste is one biggest environmental challenge, in Joburg. Available from: https://www.dailymaverick.co.za/article/2022-07-06-waste-is-one-of-joburgs-biggest-environmental-challenges-says-councillor/ [Accessed 13 March 2023].

Nowicki, L. 2019. Reconsidering South Africa's approach to waste pickers: Groundup. Available from: https://www.groundup.org.za/article/reconsidering-south-africas-approach-waste-pickers/ [Accessed 11 March 2023].

Ntuli, N. 2017. Waste pickers thriving in hidden economy – study: Waste pickers save South African municipalities. Available from: https://www.iol.co.za/sunday-

tribune/news/waste-pickers-thriving-in-hidden-economy-study-11487238 [Accessed 21 February 2023].

Nuswon, 2020. A call for intervention and support for scrap and waste pickers in Nigeria: International Alliance of waste pickers. Available from: https://globalrec.org/2020/11/20/call-for-intervention-support-scrap-waste-workers-nigeria/ [Accessed 1 February 2023].

Vernier, J., 2021. Extended producer responsibility (EPR) in France. *Field Actions Science Reports. The journal of field actions*, (Special Issue 23), 22-25.

Omosimua, I.J., Oluranti, O.I., Obindah, G. & Busayo, A., 2020. Working Conditions and Career Aspirations of Waste Pickers in Lagos State. *Recycling*, 6(1), 1-2.

Our Endangered world, 2023. Top Environmental Organizations, in India. Available from: https://www.ourendangeredworld.com/india/ [Accessed 19 February 2023].

Oxford, T. 2020. The war on waste pickers, University of the Witwatersrand, Johannesburg. Available from: https://www.wits.ac.za/curiosity/stories/the-war-on-waste-pickers.html [Accessed 6 March 2023].

Pachauri, R. & Singh, V. 2022. Toxic waste handling for waste pickers, in Asia. Available from: https://www.switch-asia.eu/site/assets/files/3433/waste-picker-guidebook-eng-version.pdf [Accessed 16 March 2023].

Para, F. 2022. The struggle of waste pickers: From being considered trash, to being recognised as workers, in Columbia. Available from: https://www.antitraffickingreview.org/index.php/atrjournal/article/view/492 [Accessed 16 March 2023].

Paul, K. & Bhattacharjee, P., 2022. Livelihood status and health condition of waste pickers in Sylhet City Corporation: a study. *Space and Culture, India,* 9(4), 16-27.

Paulo, S. 2016. Waste pickers at solid waste policy, Brazil. Available from: https://www.scielo.br/j/asoc/a/GrwgLFsQbf7dNSXB64GqVTg/ [Accessed 16 March 2023].

Paulo, S. 2020. Down in the Covid 19 posed new challenges to worlds waste pickers: Committee of waste energy. Available from: https://www.economist.com/international/2020/12/19/covid-19-has-posed-new-challenges-to-the-worlds-waste-pickers [Accessed 16 April 2023].

PETCO. 2022. Plastic recycling: Plastic bottles trash. Available from: https://petco.co.za/wp-content/uploads/2022/09/PET-FAQs_2022_FINAL_v2.pdf [Accessed 16 April 2023].

Petterson, D. 2016. How waste pickers integrated. Available from: https://infrastructurenews.co.za/2016/05/19/how-do-we-integrate-waste-pickers/ [Accessed 6 February 2023].

Pikitup. 2020. Impact of waste management: Tariff increase on Joburg residents, Johannesburg. Available from: https://joburg.org.za/documents_/Documents/TARIFFS/Tariffs%20Impact/REFUSE%20TARRIF%20(3).pdf [Accessed 26 January 2023].

Pholoto, L. 2021. Essential considerations for a resilient and equitable waste and recycling sector: Urban lockdown lessons, South Africa. Available from: https://wwfafrica.awsassets.panda.org/downloads/lessons_from_lockdown_plastics.pdf [Accessed 23 January 2023].

Polit, D.F. & Beck, C.T. 2017. *Nursing Research: Generating and Assessing Evidence for Nursing Practice* (10th ed.). Philadelphia, PA: Wolters Kluwer.

Postman, Z. 2018. Hope for Johannesburg waste pickers: Groudup, in Johannesburg. Available from: https://www.groundup.org.za/article/hope-johannesburg-waste-pickers/ [Accessed 23 January 2023].

Postman, Z. 2019. Integrate informal waste pickers into economy: Pretoria. Available from: https://www.groundup.org.za/article/Integrate-informal-waste-pickers-into-economy/ [Accessed 23 January 2023].

Provencal, J. 2020. RePATRN: experience with informal waste pickers in Ghana. *The Journal of field actions*, 22, 17-71.

Rashtriya, P. 2016. Waste pickers meaning in government rules: Integrating women workers in national development, 2(2016).

Rasmeni, Z. & Madyira, D. 2019. A review of the current municipal solid waste management practices in Johannesburg City Townships., *Procedia Manufacturing*, 35, 1025-1031.

Regenize. 2023. Support waste pickers: Zero waste solutions. Available from: https://www.regenize.co.za/support-waste-pickers [Accessed 4 February 2023].

Rischar, H. 2023. Environmental research and Education: Municipal Solid Waste Management, EREF. Available from: https://erefdn.org/eref-municipal-solid-waste-etextbook/ [Accessed 24 February 2023].

Rosaldo, M., 2022. Dilemmas of Co-production: How Street Waste Pickers Became Excluded from Inclusive Recycling in São Paulo. *Latin American Politics and Society,* 64(2), 67-92.

Ross, W. 2018. A gentle integration: Johannesburg waste pickers and Gauteng government. Available from: https://www.zafiri.com/johannesburg-waste-recyclers-project-johannesburg-gauteng-south-africa/ [Accessed 4 April 2023].

Rutkowski, J. 2015. Expanding worldwide urban solid waste recycling: The Brazilian social technology in waste pickers inclusion. *Waste Management and Research*, 33(12), 1084-1093.

SA news. 2020. Lockdown relief secured for waste picker: The department of environment, forestry, and fisheries. Available from:

https://www.goodthingsguy.com/people/lockdown-relief-secured-waste-pickers/ [Accessed 22 July 2023].

Samson, M., Timm, S., Chidzungu, T., Dladla, N., Kadyamadare, G., Maeka, K., Mahlase, M., Mokobane, A., Molefe, K. and Ndlovu, L., 2020. Lessons from waste picker integration initiatives: Development of evidence-based guidelines to integrate waste pickers into South African municipal waste management systems. University of the Witwatersrand.

Samson, M. 2021. Johannesburg as the threatening to side slide informal waste pickers: University of Witwatersrand, South Africa. Available from: https://www.wits.ac.za/news/latest-news/opinion/2021/2021-05/johannesburg-is-threatening-to-sideline-informal-waste-pickers-why-its-a-bad-idea.html [Accessed 2 June 2023].

Sapuay, G.P. 2020. Improving municipal solid waste management through recycling: Solid waste management. *Association of the Philippines*, 9(1), 22-30.

Sasaki, S., Watanabe, K., Lee, K., Widyaningsih, N., Baek, Y. & Araki, T., 2020. Recycling contributions of dumpsite waste pickers in Bantar Gebang, Indonesia. *Journal of Material Cycles and Waste Management*, 22, 1662-1671.

Seamster, L. & Purifoy, D., 2021. What is environmental racism for? Place-based harm and relational development. *Environmental Sociology*, 7(2), 110-121.

Sewa, R.A. 2016. Waste Pickers as recognized in new government rules: International Alliance of waste pickers, India. Available from: https://globalrec.org/2016/09/01/waste-pickers-get-a-meaning-in-government-rules-in-india/ [Accessed 12 February 2023].

Scheinberg, A. 2018. Waste picker integration guidelines. Available from: https://wasteroadmap.co.za/wp-content/uploads/2021/02/Waste-Picker-Integration-Guidelines.pdf [Accessed 2 May 2023].

Shrestha, N. 2021. For waste pickers: Man’ s trash becomes another one’ s treasure. Waste management. Available from: https://www.iol.co.za/news/environment/for-waste-

pickers-one-mans-trash-becomes-another-ones-treasure-52886b8f-2243-4d55-b108-4eca0f90693c [Accessed 2 May 2023].

Simatele, D.M., Dlamini, S. & 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.

Singh, R., 2021. Integration of informal sector in solid waste management: Strategies and approaches. Centre for Science and Environment. Available from: https://www. cs e india. org/integration-of-informal-sector-in-solid-waste-management-10886. [Accessed 28 May 2023].

3S Media, 2020. Future planning at city of Johannesburg. Available from: https://issuu.com/glen.t/docs/resource_may_2020/s/10631610 [Accessed 4 January 2023].

Soni, A., Patil, D. & Argade, K., 2016. Municipal solid waste management. *Procedia Environmental Sciences*, 35, 119-126.

Stats SA, 2022. Department of Statistics South Africa: Republic of South Africa. Available from: https://www.statssa.gov.za/ [Accessed 22 January 2023].

Steelman, Z.R., Hammer, B.I. & Limayem, M., 2014. Data collection in the digital age. *MIS quarterly*, 38(2), 355-378.

Streefkerk, R. 2020. Qualitative vs. Quantitative Research. *Scientific Research*, 8(9), 1-121.

Strydom, W.F. 2018. Barriers to household waste recycling: Empirical evidence from South Africa. *Natural resources and the environment*, 3(3), 7-18.

Sudibyo, H., Pradana, Y.S., Budiman, A. and Budhijanto, W., 2017. Municipal solid waste management in Indonesia-A study about selection of proper solid waste reduction method in DI Yogyakarta Province. *Energy Procedia*, 143, 494-499.

Suss, R. 2023. Informal waste workers in urban waste management organised by cities alliance. Available from: https://www.citiesalliance.org/newsroom/news/cities-alliance-news/empowering-informal-workers-urban-waste-management [Accessed 27 March 2023].

Taiwo, O.E. & Venter, C. 2019. The role of waste pickers in municipal solid waste. *Research Journal for Interdisciplinary studies*, 6(51), 1-4.

Te Taiao, M. 2021. Ministry for the environment: Our sustainability monitoring report. Available from: https://www.nzta.govt.nz/assets/resources/tiakina-te-taiao/tiakina-te-taiao-sustainability-monitoring-report-october-2021.pdf [Accessed 27 February 2023].

Thompson, W.M. & Sons. 2023. Guide to landfill sites: Recycling and Landfill. Available from: https://www.thompsonquarries.co.uk/your-complete-guide-to-landfill-sites-what-is-a-landfill [Accessed 7 May 2023].

Thoni, V. & Mater, S. 2019. Solid waste management in the occupied Palestine territory, East Jerusalem. Available from: https://www.cesvi.eu/wp-content/uploads/2019/12/SWM-in-Palestine-report-Thoni-and-Matar-2019_compressed-1.pdf [Accessed 17 May 2023].

Toker, T. & Yilmaz, E.O. 2022. Analysis the effects of assessment and evaluation applications and exam formats in distance education. *Educational Studies.* 9(1), 37-83.

Torgovnik, J. 2018. Waste Picker Integration Guidelines for South Africa: Department of Environment, Forestry and Fisheries. Available from: https://wasteroadmap.co.za/wp-content/uploads/2021/02/Waste-Picker-Integration-Guidelines.pdf [Accessed 7 March 2023].

Uddin, S.M.N., Gutberlet, J., Ramezani, A. & Nasiruddin, S.M., 2020. Experiencing the everyday of waste pickers: A sustainable livelihoods and health assessment in Dhaka city, Bangladesh. *Journal of International Development,* 32(6), 833-853.

Walsh, J. 2020. Reclaiming the streets: Informal recycling system, Johannesburg. Available from: https://citymonitor.ai/sustainability/reclaiming-the-streets-johannesburgs-informal-recycling-system [Accessed 13 March 2023].

Whitemay. 2021. Demography: Resource Encyclopaedic entry. Available from: https://education.nationalgeographic.org/resource/demography/ [Accessed 18 March 2023].

Wiego, 2016. Struggles and Victories: Waste Pickers on the Frontline. Available from: https://www.wiego.org/resources/struggles-and-victories-waste-pickers-frontline-september-2016-april-2017 [Accessed 8 April 2023].

Wiego, 2019. Waste Integration in South Africa (WISA): Women in formal Employment Globalizing and organizing. Available from: https://www.wiego.org/waste-integration-south-africa-wisa [Accessed 8 April 2023].

Wiego, 2021. New calculator reveals the amount of equivalent C02 mitigated by waste picker activity: Publications and Resources. Available from: https://www.wiego.org/resources/new-calculator-reveals-amount-equivalent-co2-mitigated-waste-picker-activity [Accessed 28 April 2023].

Wiego, 2023. Empowering Informal Workers, Securing Informal Livelihoods. https://www.wiego.org/wiego-working-papers [Accessed 28 April 2023].

Velis, C.A., Hardesty, B.D., Cottom, J.W. and Wilcox, C., 2022. Enabling the informal recycling sector to prevent plastic pollution and deliver an inclusive circular economy. *Environmental Science & Policy*, 138, 20-25.

Viljoen, S.M., 2022. Resistance to reform property: A 'resilient property' perspective. *South African Journal on Human Rights*, *38*(1-2), 24-45.

Xu, A., Baysari, M.T., Stocker, S.L., Leow, L.J., Day, R.O. & Carland, J.E., 2020. Researchers' views on, and experiences with, the requirement to obtain informed consent in research involving human participants: a qualitative study. *BMC medical ethics,* 21(1), 1-11.

Yu, D. 2020. Waste pickers in informal self-employment: Over worked and on the breadline. *Development South Africa,* 37(4), 1-4.

Yukalang, N., Clarke, B. & Ross, K., 2018. Solid waste management solutions for a rapidly urbanizing area in Thailand: Recommendations based on stakeholder input. *International journal of environmental research and public health*, 15(7), 1302.

APPENDICES

APPENDIX 1: QUESTIONNAIRES FOR WASTE PICKERS AT TZANEEN LANDFILL SITE

TITTLE: AN EVALUATION OF THE ROLE OF WASTE PICKERS IN MUNICIPAL SOLID WASTE MANAGEMENT AT GREATER LETABA MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

Researcher	Ms. Shoroma Lerato Maite
Landfill Site	Tzaneen Landfill Site
Date of Interview / Observation	16 September 2021
Questionnaire no	

Please tick with X, on the following multiple choices questions

Questions	**Waste pickers answers**
1 Gender	1. Male 2. Female
2 Age	1. 18 – 25 years old 2. 26 – 35 years old 3. 36 - 45 years old 4. 46 – 55 years old

Questions	Waste pickers answers
3 Race	1. Black 2. White 3. Coloured
4 What is your monthly income according to the tonnes of waste sorted?	1. R1000 2. R1001 – R2000 3. R2001 – R3000 4. R3001 – R4000 5. R4001 – R5000 6. R5000
5 What is your employment status?	1. Employed 2. Unemployed 3. Self employed
6 What is your education level?	1. Primary 2. Secondary 3. Tertiary 4. No formal education
7 Where do you reside as waste picker?	1. Greater Letaba Municipality 2. Tzaneen Municipality 3. Both Tzaneen and Greater Letaba Municipality
8 What is the municipal role in terms of sorting or separation of reclaimable waste?	1. Collection 2. Transportation 3. Storage 4. Recovery 5. e) Disposal
9 Where does solid waste from Greater Letaba municipality collected from?	1. CBD 2. Certain geographical areas 3. All Areas

Questions	Waste pickers answers
10 Where is majority of solid waste collected from, which you are reclaiming?	1. Household 2. Landfill
11 What are the types of solid waste are you collecting in the landfill site?	1. Cans 2. Plastics 3. Bottles 4. Papers 5. Boxes
12 What transport do you use to collect recyclables?	1. Pick up bakkie (Van) 2. Refuse Trucks 3. Small car
13 How much tonnes of solid waste do you collect yearly?	1. 1-10 (t) 2. 10-100 (t) 3. 100-500 (t) 4. 500- 900 (t) 5. Specific----------
14 Are you aware of health risks of solid waste?	1. Yes 2. No
15 Are you aware of environmental risks of solid waste?	1. Yes 2. No
16 Do you use protective clothing or equipment during sorting?	1. Yes 2. No

Questions	Waste pickers answers
17 Where do you store your recyclables, after sorting?	1. Designated area, impermeable 2. Designated area, permeable
18 What is your relationship with landfill manager?	1. Good 2. Bad
19 What is your contribution towards waste management	1. Positively 2. Negatively
20 What are the main challenges in terms of solid waste management, does you come across as waste pickers?	1. Injury while sorting 2. Lack of PPE 3. Odour
21 What are the other challenges in terms of solid waste management, does you come across as waste pickers?	1. Lack of PPE 2. Odour
22 Are buy back centres, user friendly?	1. Yes 2. No
23 What is your role on the environment as waste pickers	1. Keep the environment clean 2. Assist in waste minimisation
24 What is your role as waste pickers in the landfill site?	1. Saving the lifespan of the landfill site 2. Reclaiming of waste

Questions	Waste pickers answers
25 How did you benefits as waste pickers while working in the landfill site?	1. Getting an income 2. Reduce the quantity of solid waste, from the landfill site
26 Did you get any support from the municipality?	1. Yes 2. No 3. Sometimes
27 Did you comply with the landfill site regulations?	1. Yes 2. No
28 How is the landfill site condition?	1. Good 2. Bad
29 Do you separate solid waste from all other waste?	1. Yes 2. No
30 Do you package recyclables solid waste materials at the recycling facility?	1. Yes 2. No
31 Is the market high on the selling of recyclables materials?	1. Yes 2. No
32 How many times do you collect recyclables and package for selling? (month)	1. Once in a month 2. Twice in a month
33 Did you feel appreciated?	1. Yes 2. No

Questions	Waste pickers answers
34 Are municipal employer having attitudes towards you?	1. Yes 2. No
35 Does the municipality provide you, with a recycling workshop?	1. Yes 2. No 3. Sometimes
36 Did you get any funding from the municipality?	1. Yes 2. No 3. Sometimes
37 Did you have accessibility in the landfill site?	1. Yes 2. No 3. Sometimes
38 Do you practice recycling or reclaiming recyclables items, during bad weather condition?	1. Yes 2. No 3. Sometimes

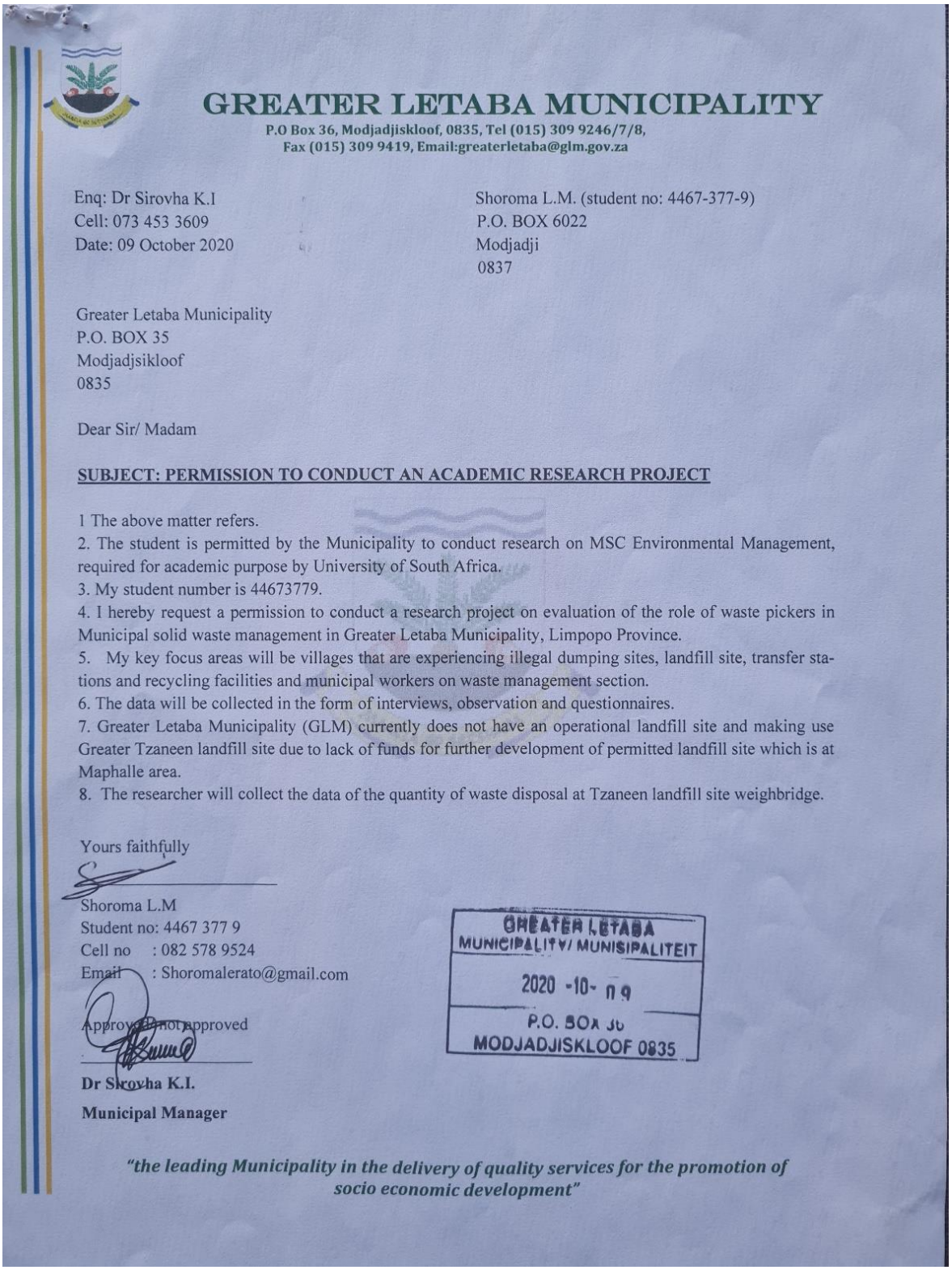
APPENDIX 2: OBSERVATION CHECKLIST FOR WASTE PICKERS AT TZANEEN LANDFILL SITE

TITTLE: AN EVALUATION OF THE ROLE OF WASTE PICKERS IN MUNICIPAL SOLID WASTE MANAGEMENT AT GREATER LETABA MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

Aspect	**Yes**	**No**	**Comments**
1. Access control available in the landfill?			
2. Appropriate signage at entrance			
3. Is solid waste separated from all other waste?			
4. Is waste stored in labelled bins/receptors?			
5. Are there any people collecting solid waste from landfill?			
6. Any excessive odours noted?			
7. Any excessive noise Observed?			

Aspect	Yes	No	Comments
8. Are workers wearing protective clothing			
9. Is solid waste landfilled?			
10. Is solid waste treated separately?			
11. Is Storm water managed adequately?			

APPENDIX 3: PERMISSION LETTER TO CONDUCT RESEARCH



GREATER LETABA MUNICIPALITY

P.O Box 36, Modjadjiskloof, 0835, Tel (015) 309 9246/7/8,
Fax (015) 309 9419, Email:greaterletaba@glm.gov.za

Enq: Dr Sirovha K.I
Cell: 073 453 3609
Date: 09 October 2020

Shoroma L.M. (student no: 4467-377-9)
P.O. BOX 6022
Modjadji
0837

Greater Letaba Municipality
P.O. BOX 35
Modjadjsikloof
0835

Dear Sir/ Madam

SUBJECT: PERMISSION TO CONDUCT AN ACADEMIC RESEARCH PROJECT

1 The above matter refers.
2. The student is permitted by the Municipality to conduct research on MSC Environmental Management, required for academic purpose by University of South Africa.
3. My student number is 44673779.
4. I hereby request a permission to conduct a research project on evaluation of the role of waste pickers in Municipal solid waste management in Greater Letaba Municipality, Limpopo Province.
5. My key focus areas will be villages that are experiencing illegal dumping sites, landfill site, transfer stations and recycling facilities and municipal workers on waste management section.
6. The data will be collected in the form of interviews, observation and questionnaires.
7. Greater Letaba Municipality (GLM) currently does not have an operational landfill site and making use Greater Tzaneen landfill site due to lack of funds for further development of permitted landfill site which is at Maphalle area.
8. The researcher will collect the data of the quantity of waste disposal at Tzaneen landfill site weighbridge.

Yours faithfully

Shoroma L.M
Student no: 4467 377 9
Cell no : 082 578 9524
Email : Shoromalerato@gmail.com

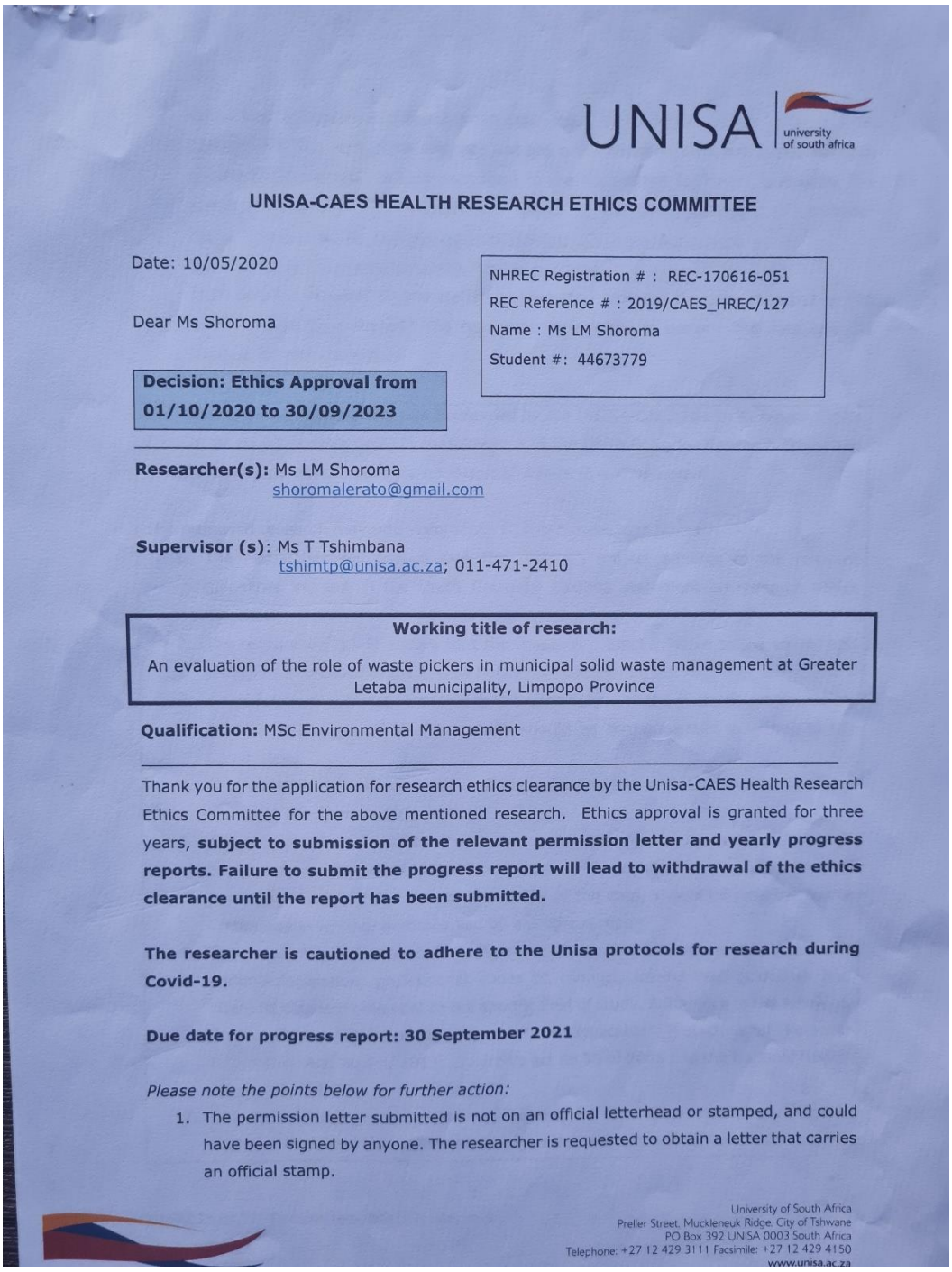
GREATER LETABA
MUNICIPALITY/ MUNISIPALITEIT
2020 -10- 09
P.O. BOX 36
MODJADJISKLOOF 0835

Approved/not approved

Dr Sirovha K.I.
Municipal Manager

"the leading Municipality in the delivery of quality services for the promotion of socio economic development"

APPENDIX 4: ETHICAL CLEARANCE LETTER



UNISA university of south africa

UNISA-CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 10/05/2020

NHREC Registration # : REC-170616-051
REC Reference # : 2019/CAES_HREC/127
Name : Ms LM Shoroma
Student #: 44673779

Dear Ms Shoroma

Decision: Ethics Approval from 01/10/2020 to 30/09/2023

Researcher(s): Ms LM Shoroma
shoromalerato@gmail.com

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

Working title of research:

An evaluation of the role of waste pickers in municipal solid waste management at Greater Letaba municipality, Limpopo Province

Qualification: MSc Environmental Management

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 for three years, **subject to submission of the relevant permission letter and yearly progress reports. Failure to submit the progress report will lead to withdrawal of the ethics clearance until the report has been submitted.**

The researcher is cautioned to adhere to the Unisa protocols for research during Covid-19.

Due date for progress report: 30 September 2021

Please note the points below for further action:

1. The permission letter submitted is not on an official letterhead or stamped, and could have been signed by anyone. The researcher is requested to obtain a letter that carries an official stamp.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

2. Unisa has a standard consent form that must be used to obtain consent from participants. The researcher may not use any other consent form, and is requested to 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
3. More detail is required on the statistical analysis – how will the data collected by the questionnaire be analysed? The researcher is advised to provide the data analysis method for each objective.

*The **medium risk application** was **reviewed** by the UNISA-CAES Health Research Ethics Committee on 01 October 2020 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 will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
3. 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.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. 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.
6. 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.
7. 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

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

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

8. 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 **2020/CAES_HREC/127** 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 SR Magano
Acting Executive Dean : CAES
E-mail: magansr@unisa.ac.za
Tel: (011) 471-3649

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX 5: WEIGHBRIDGE TABLE

APPENDIX 5.1: Data from 2019 to 2020

No	Descript	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Marc	Apr	May	Ju
1.	Recycling (out)	481.00	596.00	551.00	608.00	537.00	529.00	0.00	537.00	455.00	0.00	116.00	45.00
2.	QTY of solid waste (Modjadjiskloof)	875.00	418.00	447.00	335.00	396.00	421.00	773.00	396.00	392.00	120.00	307.25	352.00

APPENDIX 5.2: Data records from 2020 to 2021

No	Descript	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Marc	Apr	May	Ju
1.	Recycling (out)	0.00	386.00	0.00	0.00	0.00	454.00	445.00	502.00	554.00	480.00	411.00	42
2.	QTY of solid waste (Modjadjiskloof)	591.00	392.00	502.00	865.00	649.00	781.00	879.00	972.00	817.00	574.00	226.00	23

APPENDIX 6: EDITING LETTER

Marieta Grundling (MBA)

366 Rosemary Street
Grootfontein Country Estates
Pretoria, 0081
081 354 1596
edit@profeditmba.co.za
16 October 2023

To Whom It May Concern

This serves to confirm that the dissertation: **An evaluation of the role of waste pickers in municipal solid waste management at Greater Letaba Municipality, Limpopo Province, South Africa** by **Shoroma Lerato Maite** was edited. The language, presentation, referencing system (both in-text and against the Reference List), were checked and corrected.

M Grundling
16 October 2023