

**A study on working conditions and health status of waste pickers working
at landfill sites in the City of Tshwane Metropolitan Municipality.**

by

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Submitted in accordance with the requirements for the degree of

MASTERS OF SCIENCE

in the subject

ENVIRONMENTAL MANAGEMENT

at the

UNIVERSITY OF SOUTH AFRICA

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May 2016

DECLARATION

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ACKNOWLEDGEMENTS

All Glory and Honour to Him who gives me strength, thank You Lord.

I would like to extend my gratitude to the following people and organisations for the various roles they played towards the accomplishment of this work:

- To my supervisor, Mr. Chris Loans, thank you for your words of encouragement and walking the journey with me. To my co-supervisor, Prof. S. J. Moja, thank you for directing me in the right direction.
- To City of Tshwane Metropolitan Municipality who allowed me to conduct the research. Thank you to Ms. Mosidi Ngati and Mr. Frans Dekker for providing me with relevant information every time I needed it.
- To UNISA M & D Support Programme, thank you for funding my study.
- To my husband, Thabiso Makola, your love and support pulled me through.
- To my son, Thato Makola, every time it got tough, you gave me every reason to smile.
- To my family, your continuous support and prayers reminded me that giving up was not an option.
- To my brother Mava Mothiba and his wife Asanda Mothiba, thank you for taking care of my son when I had to attend weekend workshops.
- To everyone who was involved but not mentioned here, thank you for your contribution; and
- To all waste pickers, thank you very much for your patience and for your contribution in this study. This study would not have been possible without your participation.

ABSTRACT

Waste management is a global phenomenon and a challenge to all nations. There is a need to ensure that waste is handled in an environmental friendly and healthy manner. The high rate of unemployment in South Africa leads to elevated poverty, which is one of the most serious socio-economic problems in developing countries. This leads to people opting to work anywhere, particularly in the informal sector for survival.

Waste picking is classified as a type of informal employment. In South Africa, the last stage in the life cycle of waste disposal is at the landfill sites. Landfill sites are normally located on the outskirts of towns and away from communities for safety and health reasons. This study researched the working conditions and health status of waste pickers working at some landfill sites in the City of Tshwane Metropolitan Municipality, namely Ga-Rankuwa, Onderstepoort and Hatherly.

The study used a multi method approach, where both qualitative and quantitative factors of research were utilized. Data was gathered through survey questionnaire with a sample of 176 waste pickers at three landfill sites, together with unstructured interviews with municipal workers. The researcher also observed how waste pickers work at the landfill sites. Some of the findings of this study are that:

- About 66 % of waste pickers at the landfill sites were females with an average age of 45 years.
- A majority (93 %) of waste pickers did not reach matric and were not employable in the formal sector.
- Most waste pickers (53%) work 5 days and a few (41%) work 6 days per week.
- Only 22% of participants reported injury at work and 41% consulted the clinic or hospital due to injury or illness.

Descriptive statistical results of the study revealed that waste pickers view their health to be fair as compared to their peers but were not satisfied with their working conditions. Waste pickers are aware of stigma including health challenges associated with working at a landfill site and the need of acting appropriately in protecting themselves.

Key words: waste pickers, landfill site, working conditions, health status, waste recycling, integrated waste management, waste picking.

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GLOSSARY OF TERMS

Cooperative –organization comprising various waste picking networks which come together with a common purpose.
Developed country – a country that has evolved through the demographic transition, is technologically advanced, capital-intensive, highly urbanised and wealthy.
Developing country – a low-income country with an economy that is largely based on agriculture, which may be going through the demographic transition, is often in the process of industrialization, and usually has few resources to spare to solve its own socio-economic and environmental problems.
Epi-Info – is a public domain suite of software tools for analysis designed for the global community of public health practitioners.
Landfill site – site or a process for the disposal of non-hazardous waste, based on burying it in depressions in the ground then compacting it to reduce the volume and finally covering it with soil and landscaping it to look like part of the surrounding land.
Leachate – is any liquid that in passing through matter, extracts solutes, suspended solids or any other component of the material through which it has passed.
Material Recovery Facility – a specialized plant that receives separates and prepares recyclable materials for marketing to the end-user manufacturers.
Multi-method – is the use of more than one approach to the research problem in order to enhance confidence in ensuing findings.
Nyaope – it is a drug used by young men in some communities in CTMM.
Qualitative – Relating to or expressed in terms of quality, it gathers in depth understanding of human behaviour and the reason that governs the behaviour
Quantitative – Related to or expressed in terms of quantity (numbers).
Random sampling – where a sample is selected in such a way that each member of the population has an equal chance of being selected, subset of individuals chosen from a larger set

Reclaimers – refer to people who identify goods from waste that is disposed and sell the waste as goods for either recycling or reuse. (For this study reclaimers is used interchangeably with waste pickers)
Recycle – To reclaim or reuse old material in order to make new products
Triangulation – refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings.
Waste – any material that is unused and rejected as worthless or unwanted.
Waste management – is the collection, transport, processing or disposal, managing and monitoring of waste materials.
Waste picker – a person who salvages reusable or recyclable materials thrown away by others to sell for personal consumption

ABBREVIATIONS

CoJ	City of Johannesburg
CTMM	City of Tshwane Metropolitan Municipality
DEAT	Department of Environmental Affairs and Tourism
EU	European Union
IWM	Integrated Waste Management
IWMP	Integrated Waste Management Plan
IWMSA	Institute of Waste management in South Africa
MDG	Millennium Development Goals
MRF	Material Resource Facility
MSW	Municipal Solid Waste
NEMA	National Environmental Management Act
NEM: WA	National Environmental Management Waste Act
WIEGO	Women in Informal Employment: Globalizing and Organizing

CHAPTER 1: ORIENTATION OF STUDY

The purpose of this chapter is to provide a frame of reference for the research and introduce an overview of working conditions and the risk to the health of waste pickers in City of Tshwane Metropolitan Municipality (CTMM). An overview of both the Constitution of South Africa (Act No. 108 of 1996) and National Environmental Management Act (Act No. 107 of 1998) in relation to well-being of people is undertaken. This study focused on waste pickers working at three landfill sites in Tshwane Municipality, namely Ga-Rankuwa, Onderstepoort and Hatherly.

The chapter further presents the research problem, rationale of study, aims and objectives of the study, limitations of the study, the research methodology and the chapter overview for the study.

1.1 Background

Disposal of solid waste in a landfill is the primary disposal method used in South Africa, as in most developing countries (Ketlogetswe and Mothudi, 2005; Karani and Jewasikiewitz, 2007). Solid waste refers to refuse and other discarded materials and semi-solid materials emanating from households, industrial, commercial and agricultural activities. According to Godfrey and Oelofse, (2008), in the past, solid waste was deemed something to be discarded, and without any value, but this has however, recently changed. Lately, municipal waste produced from residential and commercial sources, has become an economic resource for other people. Solid waste that is not well-handled can however, pose serious environmental and health risks, with negative implications to human life and environmental sustainability (Kum *et. al.* 2005). Landfill sites release a wide range of harmful pollutants such as leachate, gases and particulate matter that have the potential to cause human illness and contamination of the air, soil and bodies of water (Koshy *et. al.* 2007).

In South Africa, many landfill sites practise picking. Usually poor people resort to picking in order to earn a living and typically do so under unhealthy and unsafe conditions (Oelofse and Strydom, 2010).

For some individuals and families, waste picking has become a way of survival and the activities of waste pickers fall within the informal economy. They make a living reclaiming recyclable waste predominantly from landfill sites and selling it to recycling companies on site or buy bulk companies/ centres. Waste pickers collect materials discarded as waste and add value to them by sorting, cleaning, and at times altering the physical shape to facilitate transport or by combining materials to make commercially viable products.

The health and safety risks associated with informal recycling include occupational health risks posed to waste pickers and community health risks posed to the public. The nature of the work waste pickers are involved in exposes them to potential pathogenic bio-aerosols that may lead to the spread of various diseases. Waste pickers are at risk of exposure to diseases as they come into direct contact with decomposed, highly mixed waste streams composed of organic material (Pilusa and Muzenda, 2013). The use of heavy machinery in landfill operations also posed a safety risk to waste pickers and could become a risk factor when salvaging on landfill sites.

A number of pieces of legislation govern waste in South Africa and they include the following:

- The South African Constitution Act (Act 108 of 1996),
- The National Environmental Management Act 1998 (Act 107 of 1998),
- Local Government Municipal System Act 2000 (Act 32 of 2000),
- The Environmental Conservation Act (Act 73 of 1989),
- Health Act (Act 63 of 1977),
- Occupational Health and safety Act (Act 85 of 1993),
- Air Quality act (Act 39 of 2004) and
- National Environmental Management: Waste Amendment Act, 2014 (Act 26 of 2014).

According to Bill of Rights of the Constitution of South Africa, Act 108 of 1996, and Section 7-24:

“Everyone has the right

- a) to an environment that is not harmful to their health or well-being; and

- b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
 - i. prevent pollution and ecological degradation,
 - ii. promote conservation
 - iii. Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.” (DEAT, 1999)

There is also The National Environment Management Act (Act 107 of 1998) (NEMA), which provides for co-operative environmental governance by establishing principles for decision making on matters affecting the environment. The Act defines environment as follows:

“Environment means the surroundings within which humans exist and which is made up of,

- i. The land, water and atmosphere of the earth,
- ii. Micro-organisms, plant and animal life,
- iii. Any part or combination of i and ii, and the inter-relationship among and between them,
- iv. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.”

One principle drawn from Chapter 1, Subsection 2 of Section 2 of NEMA principles is placing people first in environmental management. It states that, “environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably”

From the above legislation, The Constitution of South Africa and the National Environmental Management Act, the well-being of waste pickers and their working conditions are considered in this study and play an important role in the holistic approach of solid waste management.

1.2 Problem Statement

Monitoring the activities and external influences around a landfill site is complex, time consuming and expensive, but it needs to be determined. The challenges of waste pickers working at landfill sites require thorough study because of the potential health

risks posed by these sites on them. The abundance of fleas and offensive odours at the landfill sites, along with the lack of proper protective devices, make working conditions even more unhygienic. Hatherly is the only landfill site where people reside around a landfill site, to be closer to the site and avoid commuting to work. A general problem in epidemiologic studies of landfill sites, whether studying single or multiple sites, is that there is insufficient information regarding potential human exposures from landfill sites (Vrijheid, 2000). A number of community health surveys worldwide have investigated a some of the health problems, including musculoskeletal problems, skin problems, respiratory symptoms, gastrointestinal problems, vision and hearing challenges, fatigue, headaches, psychological disorders and allergies (Vrijheid, 2000). In the three-landfill sites in this study, some of the problems mentioned above were analysed along with documentation of the working conditions of the waste pickers.

1.3 Rationale of the Study

Waste management is an issue that affects the world as a whole and the subject has been embedded in national environmental policies. South Africa being one of the developing countries, has also committed itself to ensuring environmental protection through a number of policies and acts (Kidd, 2008). Due to the large quantities of recyclable materials in the waste streams arriving at landfill sites, informal salvaging is widespread within CTMM.

Waste can be a threat to both human health and the environment if not properly managed. Considering that solid waste can be a resource used to provide employment opportunities, it is necessary to educate people, especially waste pickers on good waste management practices. Researchers have noted that little attention is given to the human health risks to which waste pickers are exposed (Chofqi *et. al.*, 2004; Mwiganga and Kansime, 2005; Chattopadhyay *et. al.* 2008; Noel, 2010).

Waste pickers pick through waste and sell recyclables to agents on site. This practice leads to increased health and safety risks for the waste pickers, as well as operating problems for the landfill personnel. Waste pickers collect plastics, paper, glass bottles, rubber materials and ferrous and non-ferrous metals from landfill sites, which can be risky as this exposes them to various infectious agents and toxic substances that may cause illness or harm them (Ray *et. al.* 2004). As much as it is understandable that they earn a living from this practice and at Hatherley living in close proximity to the landfill

site, they are creating a security problem for the management of the site. There is a need to investigate the circumstances or reasons why they have chosen to become waste pickers at landfill sites. This will have broad social and economic benefits for the country in general and to the City of Tshwane Metropolitan Municipality in particular, as they develop policies aimed at improving waste management in the city.

1.4 The Aim and Objectives

The primary aim of this research is to study the perceived health status and the working conditions of waste pickers working at three landfill sites in the City of Tshwane Metropolitan Municipality, namely Ga-Rankuwa, Onderstepoort and Hatherly. The specific objectives of the study are:

- To identify the health status of waste pickers
- To document the working conditions of waste pickers
- To explore health protection behaviours, knowledge of health risks, health and safety attitudes and practices among waste pickers
- To explore the challenges faced by waste pickers.

1.5 Study Area

The proposed study area comprises of three landfill sites in the City of Tshwane Metropolitan Municipality (CTMM) namely: Ga-Rankuwa, Onderstepoort and Hatherly. The CTMM is located in the transitional area between the Highveld and the Bushveld, approximately 50 km north of Johannesburg in the northeast of South Africa. It lies in a warm, well-sheltered, fertile valley, surrounded by the hills of the Magaliesberg range, 1 370 m above sea level. The average range of monthly rainfalls and temperatures for summer and winter are (22-136) mm and (25-38) °C and (6-51) mm and (22-30) °C respectively.

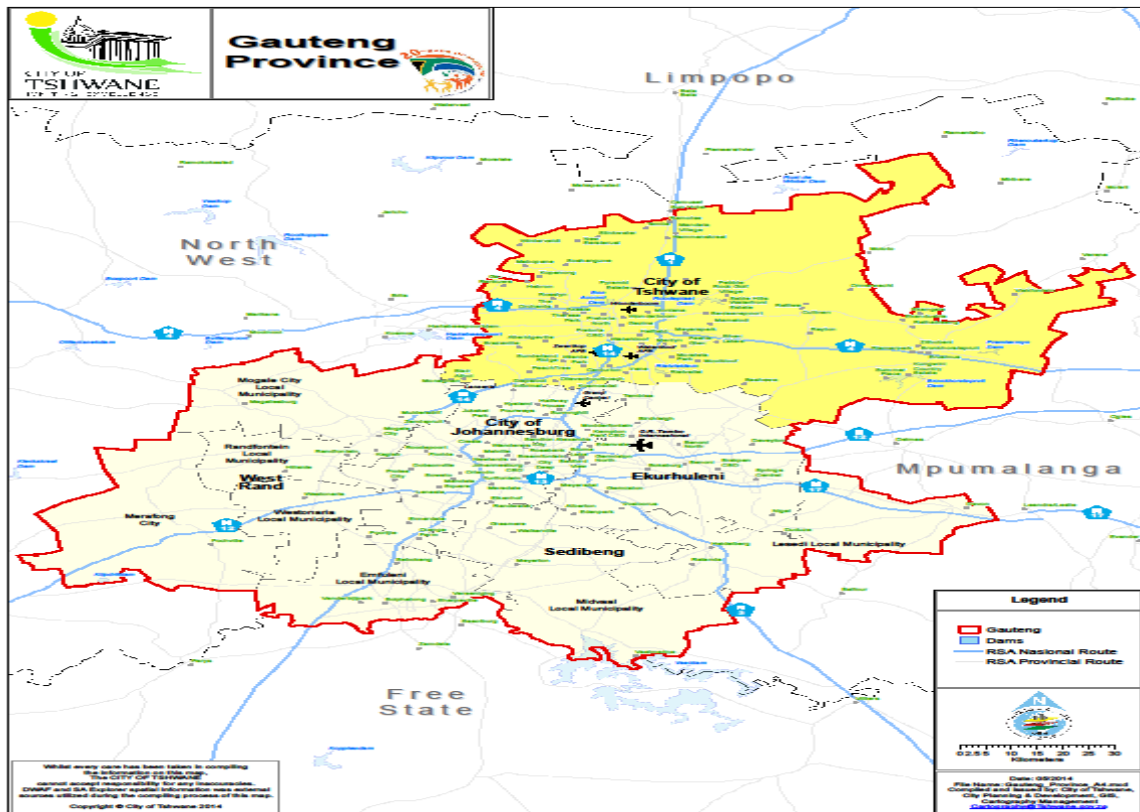


Figure 1-1: City of Tshwane Metropolitan Municipality in Gauteng

Source: CTMM, 2014

The above figure illustrates how the City of Tshwane Metropolitan Municipality spreads over Gauteng Province.

1.6 Research Methodology

Based on the research problem, as well as the rationale of the study, the researcher opted to use a multi-method design where both quantitative and qualitative approaches were used to get insight about the research problem. In the study, a quantitative approach in terms of questionnaires administered to waste pickers as well as a qualitative approach through unstructured interviews with municipal workers was conducted. The researcher also made personal observations, every time there was a visit to the site, with field notes.

Completion of questionnaires and interviews with municipal workers was conducted on-site, except for landfill site managers from the municipality, who provided the information from their offices. Waste pickers were randomly selected at the landfill

sites and all procedures, regarding ethics and the need for the research, were thoroughly explained to all participants.

Data captured was analysed to determine key patterns and trends regarding the research problem. Charts, tables and graphs were used to describe the data accordingly.

1.7 Limitations of the study

The study was limited to only three sites although there are five operating landfill sites in the CTMM. It was established that some respondents had issues of trust with researchers from previous experiences, where there was no feedback given to them. Some in the past had their pictures displayed in newspapers without their consent, and this made them suspicious of the research intentions. One site taken out of the research study was Soshanguve because of previous challenges they have had with other researchers where they were promised compensation as part of the research.

The researcher had difficulty in getting more waste pickers to participate in the study, as they did not want the research to distract them from working. Any activity taking them away from their work is not welcomed since it interfered with their work. Similarly, completion of questionnaire was taken as an unnecessary time consuming exercise.

1.8 Chapters Overview

- Chapter 1 introduced the challenges faced by waste pickers, working conditions, health risks and the overview of what the Constitution and NEMA say in terms of the well-being of all people. It further presented the research problem, aims and objectives and the rationale for the study.
- Chapter 2 entails the literature review completed for the study. It focuses on global perspectives of waste management and waste picking. It also focuses on the working conditions of waste pickers, their perceived health status and outlines integrated waste management.
- Chapter 3 details the research design and methodology used to undertake the study. Details about the three-landfill sites are included and the researcher describes methodology limitations encountered.
- Chapter 4 provides the results of the study, interpretation of data collected as well as the discussion of the results.

- Chapter 5 presents a summary of the study. The chapter concludes with recommendations to relevant stakeholders.

1.9 Concluding Remarks

The chapter covered information that relates to waste management and waste pickers in the City of Tshwane Metropolitan Municipality in general. It was of common understanding that waste pickers are self-employed at the landfill sites owned by municipalities and they are at the sites at their own risk. A landfill site has detrimental effects on the health of all workers from the harmful pollutants they produce and waste pickers are the highest number of those affected as they spend most of the time at the sites working. Waste pickers at landfill sites work under harsh and dangerous conditions, as the sites are ideally not suitable for sorting and picking.

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CHAPTER 2: LITERATURE REVIEW

In this chapter, the researcher reviewed the literature on waste management and waste picking. An in-depth analysis of the challenges in waste picking, including the working conditions and effects of working at a landfill site were reviewed from the literature available. Integrated waste management was outlined and related how recycling and waste pickers fitted within the hierarchy of waste management principles.

The issues of waste pickers at landfill sites have started many debates in the waste management field. Unemployment is very high in developing countries and people will work anywhere to provide for their families despite the risks and conditions in which they work.

2.1 General Trends in Waste Management

Waste management, which is the generation, collection, processing, transportation and disposal of solid waste, is important for both environmental and public health reasons. For this study, waste is any material that is unused and rejected as worthless or unwanted. Waste can be solid, liquid, gaseous, radioactive or any combination thereof and may originate from domestic, commercial, agricultural, construction, institutional or industrial activities (Mnyani, 2003; Middleton, 2008; Bosman, 2009). In this study, the researcher focuses on general waste or domestic waste.

Municipalities have been using a variety of waste disposal mechanisms such as land disposal at landfill sites and incineration but landfill disposal has been the most preferred method (Pichtel, 2005; Williams, 2005). Landfill disposal of waste is preferred because it is cheap and simple; the sites are readily available and it can be used for the disposal of a variety of waste streams. At CTMM, there has recently been a challenge of landfill sites being full and nearing closure. The space is limited and the idea of starting a new landfill site is expensive. There was a growing concern about the dangers caused by the large volume of waste that is disposed of at landfills. Environmentalists began to campaign for a paradigm shift in waste management whereby the emphasis would be placed more on waste reduction, minimization, re-use and recycling and less on landfill disposal (Pichtel, 2005; Williams, 2005). In the waste management field, it may take a while for that paradigm shift to become a reality.

The improper management of waste materials is a global environmental challenge arising from unrestrained human activities. Waste has a negative impact on the environment and poses risks to health if not handled well. The challenge of waste management is affected by various reasons including increases in population, economic growth, production of goods and an increase in expenditure on consumables which pushed up the rate of waste generation (Mnyani 2003: Pichtel 2005).

2.1.1 Global Trends of Waste Management

Refsgaard and Magnussen (2009) reported that approximately 3% of Europe's total greenhouse gas emissions originate from landfill sites and a study by Zhang *et. al.* (2010) revealed that methane emissions from landfill sites in Germany have in the past accounted for 25% of Germany's total methane emissions. Due to the harmful nature of methane emissions, Germany has made great strides in the past few decades in enforcing legislation to improve waste management standards at landfill sites.

The Miron Quarry municipal waste landfill site in Montreal generates copious quantities of methane and other gases, including a rich mixture of volatile organic compounds, some of which are recognized or suspected human carcinogens. Among men living in the exposure zone closest to the site, elevated risks were observed for cancers of the stomach, liver and intra hepatic bile ducts, trachea, bronchi and lungs. Among women, rates of stomach cancer and cervix uteri cancer were elevated, but breast cancer was less expected (Goldberg *et.al.* 1995). Monitoring of pollutants around landfill sites indicates that detectable levels of pollution tend to be confined to the immediate proximity of the site (USEPA, 1999).

The global trend in waste management is towards sustainable waste management with an emphasis on recycling, reusing, reducing and prevention of waste material. Many countries are trying to limit the use of incineration and landfills and the space is limited in terms of landfill sites.

2.1.2 Waste Management Trends in African Countries

Municipal waste management and landfill management constitute crucial health and environmental problems within governments in African countries. Solid waste management in Accra, Ghana, is privatised in many areas, but the country has challenges with serious solid waste management issues that are threatening the

outbreak of some communicable diseases with their attendant negative effects on human resources (Menel, 1994). In the past, municipal solid waste disposal practices in Ghana have not been environmentally friendly (EPA, 2002). According to the government of Ghana, serious leachate generation occurs at some landfill sites, especially after rainfall as the leachate gushes out into areas at the foot of the waste dump, but still waste pickers are picking in those areas. Leachate that contains pathogens is a direct risk to human health and a source of contamination to underground water and surface water.

In Gaborone, the fence erected around the landfill site has disintegrated (Rankokwane and Gwebu, 2006). This makes it difficult for proper site management and results in unmonitored access. Most of the waste pickers there are young people (over 60%). Many are school dropouts engaged in self-help activities or supplementing households, unlike in other countries where waste pickers are adults.

2.1.3 Waste Management in South Africa

It is estimated that up to 85% of the municipal solid waste generated in South Africa is land filled (Lumby, 1996). While it is recognised that there are many well operated landfill sites in South Africa that follow international best practices, of the 1280 known public and private landfill sites (general and hazardous) in the country, only 44% are duly authorised through permits (DEAT, 2006). Of those permitted, compliance with permit conditions is seldom audited and often unknown (Godfrey and Oelofse, 2008).

In Cape Town, residents living near a landfill site have complained of mercury levels from the site. A study by Dalvie and Ehrlich (2005), concluded that the urinary mercury levels of residents in the exposure area were not of major health concern as levels were well below the reference values for community exposure and below levels associated with health problems. However, there was an area effect indicating greater mercury absorption among these residents. Higher environmental mercury exposure was not ruled out, although point sources were not identifiable in the data available.

Waste pickers who salvaged food disposed of at the landfills also exposed themselves to poisonous food. In October 2011, a teenager died after ingesting a toxic substance he picked up at a Buffalo City Metro dumpsite (Nini, 2011). Most landfills in South

Africa practised co-disposal of hazardous, building and municipal solid waste. Best practice encourages that these different solid waste materials should be disposed of in permitted hazardous waste landfill sites such as Klerksdorp regional waste disposal facility, Necsa Pelindaba landfill site for radioactive waste, and Holfontein for chemicals/toxic waste.

2.1.4 Waste Management in Gauteng

People have been reclaiming reusable and recyclable materials from the landfill sites in the Tshwane area for at least thirty years (Samson, 2010). The situation in Tshwane is that the council and waste pickers have both engaged in activities seeking to improve the work and livelihoods of waste pickers. As a result, instead of evicting the waste pickers, the municipality sought to uplift them, and assist them to become entrepreneurs so that they could support themselves. This is different at other municipalities in Gauteng, where landfills have private owners. The waste pickers are given limited periods of coming in to collect on site as it is believed that waste pickers would interfere with the proper management of the landfill site. In some municipalities, there was a limit as to the number of waste pickers allowed on site, also because of efficient management of the site.

2.2 Overview of Waste Picking

Waste picking is an informal type of work where a waste picker salvages reusable or recyclable materials thrown away by others to sell for personal consumption. Reno (2009) citing Mydans (2006) and Erlanger (2007) stated that waste picking is portrayed as something done out of necessity, and the people doing it were suffering from abject poverty. Waste picking plays an important role in reducing the amount of waste that needs to be collected, transported and dumped and it helps to prolong the lifespan of landfill sites. Worldwide, millions and millions of people make a living by recovering and recycling waste (Medina, 2008). The distinguishing characteristic of the work life of waste pickers is that they are not paid in an institutionalised or regular manner for waste they collect (Gill, 2007).

According to Medina (2007), waste pickers receive very low incomes; they are usually dirty with an unpleasant appearance and are given very low status in society. Waste pickers are involved in an informal activity that is unregulated, labour-intensive,

requiring low technological skills and paying very low wages (Medina, 2007). Their work is most often regarded as representing an adaptive response to severe conditions of living in poverty without any alternative means of livelihood. Since waste picking is unregulated, those involved in it usually become victims of labour exploitation by waste recycling companies or the intermediaries. Waste pickers target mostly landfill sites since large volumes of waste are deposited onto the landfill site. Once the waste disposal trucks offload, waste pickers rush to search and remove all the recyclables of interest before the waste is compacted.

2.2.1 Waste Picking in Developed Countries

Waste picking has acted as a response to widespread poverty, unemployment and lack of social security services, even in developed countries. Although waste picking is often associated with the developing countries, history shows that developed countries have been part of the recycling work from the earliest times up to the present. Waste picking or recycling in developed countries as in developing countries plays a significant role in both economic development as well as environmental management. Scavenging, as it has been called, has been used as an adaptive response to the scarcity of commodities (Medina, 2007). Most parts of the developed world reused and recycled pieces of old pottery to manufacture new pottery. In most parts of Europe, and particularly Spain, rag collectors (waste pickers) used to collect old rag (worthless pieces of cloth) for manufacturing paper. (Medina, 2007)

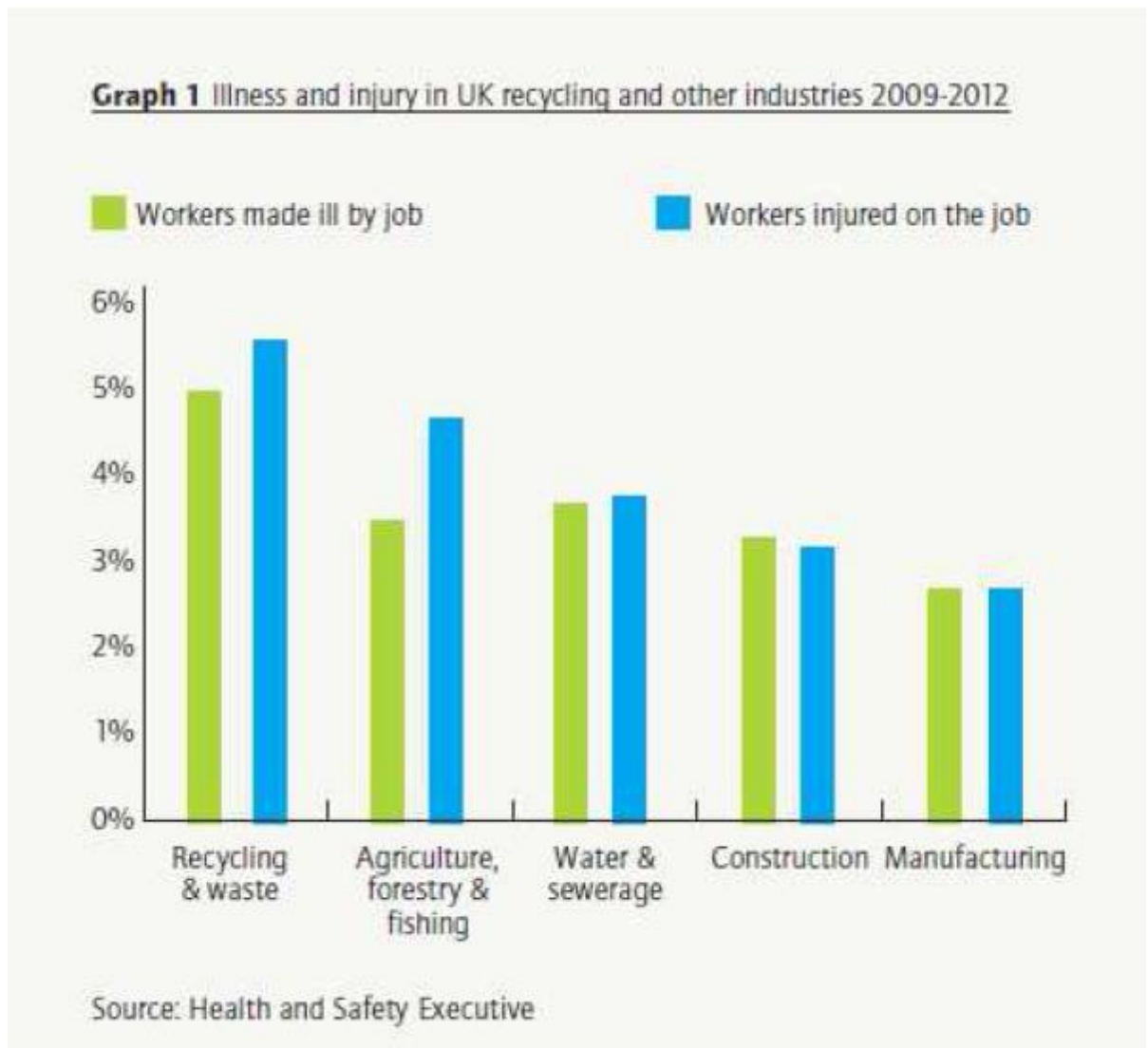
In developed countries, three factors contributed to the rapid increase in scavenging and these factors were:

- Increased generation of waste in urban areas,
- The industrial revolution, which increased the demand for raw materials and
- Large numbers of people who were willing to scavenge or get involved in waste picking (Medina, 2007).

Moving from a system based on dumping to one based on sanitary landfill represents the most financially realistic option for developing economies to improve waste management. Waste pickers have to leave the landfill site to establish other ways of involving themselves in the recovery of materials where conditions are more favourable. Solid waste recycling is now becoming a common practice in developed

countries as more people become more conscious of pollution problems caused by uncontrolled waste generation and disposal (Morris and Dickey, 1991).

Working conditions in the waste sector across the EU are often harsh with people exposed to health hazards and plenty of accidents throughout the process of collection to recycling (ETUI, 2014). For example, the UK's waste treatment and recycling industry have higher risks to building workers, see graph below (ETUI, 2014).



Source: European Trade Union Institute (ETUI), 2014 (Health and Safety Executive)

Figure 2-1: Illness and Injury in UK's recycling and other industries, 2009-2012.

From the above figure, the graph shows that the recycling and waste industry

workforce experiences more injuries and ill health more than other industries. Therefore, health and safety are major concerns for those who work in the waste industry.

2.2.2 Waste Picking in Developing Countries

Waste pickers in Brazil have been around for more than half a century, but it was not until 1990 that they first started organizing themselves and forming cooperatives (WIEGO, 2012). In 1973, the city shut down its open dump after a landslide killed dozens of waste pickers who worked at the site. The authorities then built a sanitary landfill in its place. The waste pickers who had worked in the dump were barred from working at the new landfill site. For this reason, many began collecting recyclables in the city streets. The city later made an agreement with the activist waste pickers in 1993 that it would pay rent and electricity on the waste pickers' very own warehouse space. In 2003, it called for the unemployed, especially single mothers, to sign up for work at the new site. People, who had never touched recyclables in their lives, suddenly turned to sorting recyclables at the new site.

In Botswana, as in most African countries, communities regard landfill waste pickers as a shameful nuisance and they receive negative media coverage and stereotyping from their communities (Rankokwane and Gwebu, 2006). Rarely, is it appreciated that landfill waste picking is a vital component of a viable waste management strategy. The urban poor lack employment opportunities, so this strategy is preferred to begging in the street and stealing (Tevera, 1993). This view on waste picking represents a survival response. He further remarked that the number of waste pickers is likely to increase as the unemployment situation worsens in other African countries like Zimbabwe.

Several city authorities have moved from what can be conceptualised as 'waste management' to that of 'resource recognition' as they attempt to incorporate social and environmental goals into the solid waste management system. In that context they acknowledge that the individuals who are regarded as waste pickers are in fact, recyclers who need incorporation into citywide waste management systems in ways that benefit them and the city environment.

According to Groundwork (2014), approximately 500 waste pickers marched through the streets of Pietermaritzburg in December 2014, after three years of waiting for the material recycling facility (MRF) at the New England Road landfill site. Having an MRF at the landfill site means that recyclable waste is diverted from the landfill, therefore, creating better working conditions and improved incomes. Expansion of the cooperative membership is considered a future objective in order that no waste pickers are found on the landfill but rather at the MRF centre in Pietermaritzburg. No pickers are allowed on eThekweni Municipality's (Durban Solid Waste) landfill sites (Groundwork, 2014). Initially strict access control was introduced and enforced. There was upgrading of fences and operating hours enforced. The municipality engaged with the recycling industry to formalise the picking at the landfill. Currently, only four registered recyclers are collecting recyclables from the site. Each recycler identifies pickers to work for the day and provides them with the required personal protective equipment (PPE). Waste pickers have access to identified sorting areas located at landfill sites at specified periods and are paid based on the waste volumes collected. Tzaneen Municipality also only allows registered waste recycling groups on the landfill to collect recyclables.

The City of Johannesburg (CoJ) IWMP acknowledges that informal recycling (waste picking) is prevalent and uncoordinated, which results in problems such as poor data management, unsustainable business practices as well as many health and safety issues (CoJ, 2011). However, the CoJ recognises the positive role that waste pickers can play in the realisation of its goal of sustainable waste minimisation, reusing, reducing and recycling. CoJ aimed to achieve a 20% reduction of domestic and commercial waste streams disposed to the landfills by the end of 2015, and one of the activities identified in the IWMP to reach this target is to develop and implement a reclaimers' management system that includes:

- Registration of waste pickers on landfill site,
- Issuing of personal protective equipment (PPE) to registered waste pickers,
- Training of waste pickers about health and safety issues on a continuous basis.

(CoJ, 2011)

2.3 Working Conditions of Waste Pickers

Waste pickers work in conditions that are physically taxing as they work for long periods in the sun, carry their recycled materials and have no time to rest. From the kind of environment they work in, they are susceptible to diseases. It was proposed that they should be provided with low cost or free protective gear, such as gloves, boots, and clothing to prevent injuries and reduce infections from pathogens (Ojeda-Benitez *et. al.*, 2002, Wilson *et. al.* 2006, Hina and Devadas, 2008) but this has caused a lot of controversy. Experiences in Calcutta, India, showed that the waste pickers sell the provided personal protective equipment (PPE) and they continue to work without protection (UNEP, 1996). According to landfill operations manager, (Personal communication, 9 March 2015) of Tshwane municipality, it was explained that waste pickers cannot be supplied with protective equipment, because they are not city council employees. The CTMM official further stated that some would take the protective gear to sell and so the cycle would go on. The other point that he made was that it needed to be clarified as to what was safe when working as a waste picker at a landfill site. Was wearing two of your own trousers considered safer than wearing an overall? The working conditions of waste pickers could be difficult to improve as they were self-employed and there was no employer-employee relationship between them and waste traders or municipalities.

Local authorities disregard waste pickers in any effort to improve the working conditions of people (Rogerson, 2001). They are stigmatised by authorities who have a negative, hostile attitude towards them. According to Chirkamane *et. al.*, 2010, some of the common problems experienced by waste pickers was harassment, insecure earnings, lack of legal protection, lack of social security and unfair practices by traders.



Figure 2-2: A woman carrying recycled material

Figure 2-2 shows a woman carrying material she has recycled on her head, walking to where the waste will be weighed and sold for immediate payment. It is evident from this figure that recycling is a physically demanding work for waste pickers.

2.4 Health Effects Associated With Working at Landfill Sites

Several studies of the possible health effects on populations living in close proximity to landfills have been published which resulted in great controversy over the possible detrimental health effects of solid waste management on the public. The controversy is possibly due to differences in risk communication, risk perception and the conflicting interests of various stakeholders. The knowledge that solid waste may pose a serious risk to both the environment and human health is well-known (Medina, 2005). Waste pickers' health is exposed at every stage when they handle waste. The waste pickers are the immediate population at risk as they are exposed to various types of toxic compounds, where some of these compounds are present in waste and some are formed during the combustion process.

Economic hardship occasionally pushes waste pickers to consume recovered food, risking stomach infections and parasites (da Silva *et. al.*, 2005). Food poisoning may cause diarrhoea, parasite infection and nausea. There have been numerous documented self-reported respiratory ailments, such as decreased lung functions, lung infections, and eye irritations because of fuel exhaust and burning waste (Gomez-Correa *et.al.* 2008 and Ray *et.al.* 2004).

Over the past decade, public concern in the United Kingdom and elsewhere regarding potential hazards to health from waste disposal practices has been mounting (Bridges *et.al.* 2001). The health and safety risks associated with informal recycling included occupational health risks. These were high in some developing countries due to manual handling (for example, direct contact with broken glass) and a lack of protective equipment, resulting in direct contact with waste. Unpleasant odours, nuisance dust, perceived untidiness and potentially explosive levels of methane have been the main dread factors of landfills (Lisk, 1991; Pleus and Kelly, 1996). Despite advanced landfill technology and progress in developed countries, risks posed to human health and the environment continues to raise ongoing concern (UNEP, 2011). Waste pickers interviewed in the studies by Gutberlet and Baeder (2008) and Nguyen *et.al.* (2003) reported some sort of pain or discomfort in the limbs and back. Frequent kneeling, occurs while sorting and collecting solid waste and was thus associated with lower-extremity pain. In addition, inhalation of bio-aerosols and of smoke and fumes produced by the open burning of waste could cause health problems.

Table 2-1: Perceived hazards at the landfill

Hazard	Remarks
Accidents	When activity becomes very busy, there is intense jostling among the scavengers as they race for arriving vehicles whilst trying to avoid injuries by the compacting caterpillars. However, in spite of maximum caution on the part of the drivers, serious accidents are sometimes inevitable.
Cuts and burns	There can be minor accidents resulting from stepping onto or handling broken glass or sharp metals. Cuts and wounds due to sharp objects further resulted in infection and inflammation of the exposed skin. In some cases, this could result in tetanus. These experiences have led to some of the scavengers using shaped rods to pick up recyclables. Some complained of burns by latent fires, flammable and corrosive substances.
Eye irritation	Most of the scavengers complained about pain in their eyes. This was due to the smoke, particulates and dust at the landfill. Eye irritation is a result of inadvertent rubbing of the eyes with dirty hands during the scavenging process.
Respiratory diseases	Most of the scavengers reported constant coughing and sneezing, wheezing and chronic colds. These could be associated with continuous inhalation of smoke, dust particulates, and corrosive gaseous emissions. Some reported cases of tuberculosis

	and attributed these to unsanitary conditions and unhealthy practices at the landfill.
Dental problems	Toothache was commonly reported by the scavengers. This could be the result of consumption of poisonous waste food.
Parasitic and digestive Gastrointestinal problems	Most scavengers reported constant constipation and severe stomach aches. Diarrhoea is also a common ailment. Foods and drinks contamination by flies and insects cause intestinal infection because proper sanitation facilities are totally absent whilst unhygienic conditions prevail in the area. One of the products collected at the landfill, usually by illegal scavengers, was waste food. This food was considered “expired” or spoilt and unfit for human consumption. Those who ate such products risked getting botulism/food poisoning. In many cases, these products were disposed of in the same container with poisonous waste.
Backache and pains	Bending and carrying heavy loads of scavenged items caused backache and pains in the arms and legs. These pains often resulted in slower work amongst the scavengers. Such pains could be due to occupational trauma and poor nutrition.
Skin diseases	These were due to non-adherence to basic health standards such as the non-use of protective clothing. Untreated skin lacerations were frequent.
Low morale and behavioural problems	The moods and emotions of the scavengers varied according to the availability of recyclables and working conditions. When unsatisfactory conditions prevailed, many psychological and psychosomatic problems could arise, causing insomnia, excessive worry, hypertension and depression. Such conditions could predispose individuals to homicidal and suicidal risks. Aggressive as well as provocative behaviour was a universal trait among the entrepreneurs who appeared to operate under the “survival of the fittest” setting.

Source: Rankokwane and Gwebu, 2006.

There are various perceived hazards at the landfill as shown in the table above. These are the most common hazards that are associated with landfills and those that waste pickers in Gaborone experienced (Rankokwane and Gwebu, 2006).

2.5 Integrated Waste Management

An integrated waste management system is one of the national principles that regulate environmental matters (RSA, National Environmental Management Act 107 of 1998). The principle also requires that waste be avoided, or where it cannot altogether be

avoided, it should be minimized and reused or recycled, where possible and otherwise treated and/or disposed of in a responsible manner (Jain *et. al.*, 2005).

According to Slack *et. al.*, (2005), the adverse impacts of waste management are best addressed by establishing integrated programs for solid waste management. It was further stated that in these programs all types of waste and all facets thereof are considered together. The long-term goal is that each municipality develops an integrated waste management plan and implement it accordingly. Integrated waste management ensures that the management of solid waste is planned more sectorally and in advance (CTMM, IWMP, 2014). The CTMM revised its integrated waste management plan in December 2014 and all details and plans on how the city was going to manage its waste are in that document. Integrated Waste management involves five steps as in Figure 2-3 below with the least favourite at the top of the pyramid and the most favoured at the bottom. The waste management hierarchy provides the framework to consider strategies to reduce dependence on landfill space and to find alternative uses for waste.

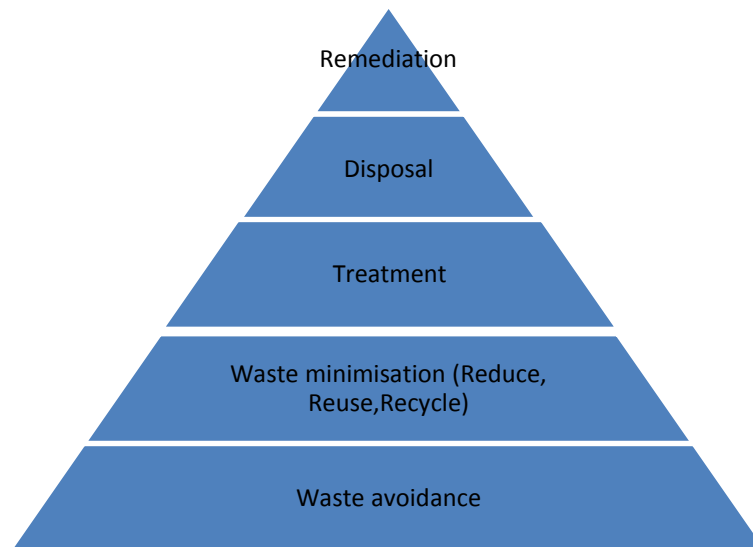


Figure 2-3: Waste management hierarchy

2.5.1 Waste Avoidance

Waste avoidance is the first step in the waste hierarchy, where there should be avoidance of generation of waste at all costs. This strategy can be achieved by preventing generation of waste through cleaner production or cleaner technologies

(Bosman, 2009). These technologies mainly involve the use of good quality raw materials and the generation of very small amounts of by-products or even no by-products at all.

2.5.2 Waste Minimisation (Reduce, Reuse and Recycle)

The aim of this strategy is to ensure that minimisation and recycling procedures are practised by all sectors of society as part of the broader initiative focusing on cleaner production. The strategy involves early sorting of waste deposits at source. Waste minimization is about changing behaviours and encouraging the implementation of what is termed the 3R's in waste minimization, namely; Reduce, Reuse and Recycle. Waste reduction is the process of reducing the amount of waste that is disposed of. The term reuse means the repeated use of a product or material in its same form for either the same or a different purpose. Whereas the term recycling refers to the reprocessing of discarded waste materials for reuse, which involves, collecting, sorting, processing and converting into raw materials which can be used in the production of new materials.

Waste pickers should ideally work at the sorting site according to the waste hierarchy and not at the landfill sites. In other words, the primary goal of waste pickers should be to reduce the quantities that could otherwise be transported and be disposed of in landfill sites. Recovery of waste at the source is highly recommended and unfortunately the sorting facilities are not necessarily located nearer to where waste is dumped.

Recycling activities have increased in most countries globally and this is due to the benefits that emanate from recycling. Recycling has several advantages according to Bagchi (2004) and Williams (2005) namely:

- It creates job opportunities.
- It reduces environmental pollution.
- It saves natural resources.
- It saves the costs of manufacturing new products from raw materials.
- It reduces informal scavenging at the landfill sites.

- It reduces the amount of waste that is deposited into the landfill site thus saving space.
- It reduces litter.
- It minimizes the use of virgin materials and saves energy in producing new ones.

Various materials that can be recycled and these include paper, glass, both ferrous and non-ferrous metals, plastics, used motor oil, building rubble, wood waste and yard waste (Cheremisinoff and Ferrante, 1992; Pichtel, 2005 and Williams, 2005). Recovery of recyclable materials may take place at source, at drop off centres, at buy-back centres, at Material Recovery Facilities or at the landfill site. A Material Recovery Facility (MRF) can generate a range of recyclables that can be recycled back into the community. Buy-back centres also provide an opportunity for capturing of recyclables. Williams (2005), believes that source separation of recyclables from waste increases their value and higher earnings. At-source recycling is preferred because recyclables at that stage are not yet contaminated (Williams, 2005).

2.5.3 Waste Treatment

Different countries use different processes for waste treatment. Some countries that have a space problem prefer to use incineration, whereas other countries like South Africa opt for landfill disposal as their preferred form of disposal and treatment. According to National Environmental Management: Waste Act (Act 59 of 2008), herein referred as NEM: WA (2008), treatment means “any method, technique or process that is designed to change the physical, biological or chemical character or composition of waste or remove, separate, concentrate or recover a hazardous or toxic component of waste or destroy or reduce the toxicity of waste, in order to minimize the impact of the waste on the environment prior to further use or disposal”. Waste treatment involves thermal treatment processes that include incineration, pyrolysis and conversion of waste into energy (Bosman, 2009). These processes aim either to reduce the volume of waste that is likely to be disposed of in landfills or for the generation of energy from waste.

During incineration, combustible waste is broken down to non-combustible residues such as ash, gas and water by burning at high temperatures (Bosman, 2009). These residues are then disposed of to landfills at reduced quantities of waste and the gases

produced are released into the atmosphere (Mnyani, 2003). This causes an environmental risk in the form of air pollution, which is another challenge in waste management.

2.5.4 Waste Disposal

Waste disposal is the least preferred method of waste management in the waste management hierarchy (Williams, 2005). Waste disposal means the burial, deposit, discharge, abandoning, dumping, placing or release of any waste into, or onto, any land (NEM: WA, 2008). Because of concerns with environmental pollution and public health and safety, there has been a shift away from promoting land filling of waste. Emphasis on waste management is lately emphasised on waste avoidance, minimization and reduction at source with the provision that a smaller volume of waste will be land filled (NEM: WA, 2008).

Waste discharged at landfill sites is dangerous to both humans and the environment. When biological processes take place, biodegradable waste degrades and neutralizes to form inert waste. During this process, there is production of methane and carbon dioxide and formation of greenhouse gases. It is these greenhouse gases, that are dangerous and which should be avoided (Williams, 2005). One way of avoiding these gases is by recycling more waste and diverting it away from the landfill.

2.5.5 Remediation

Remediation involves the removal of contaminants from soil or groundwater as a means to protect the environment. Principles such as ‘polluter pays principle’ ensures that the responsible party remediates as necessary and remains liable for any pollution caused (DEA, 2010). It is action that is taken to correct or treat a pollution problem that usually involves the clean up.

2.6 Concluding Remarks

This chapter has reviewed the literature on waste management relating it to waste picking. Due to high unemployment rates in the world, there are many people entering the informal economic sector, in this case as waste pickers. They see it as a means of survival despite the risks and the conditions they work in. Proper analysis of where waste pickers fit into the integrated Waste Management hierarchy has to be dealt with

as this may have an impact on improving working conditions and decreasing exposure to toxic elements at the landfill sites.

From the literature, it is acknowledged that recycling activities are not only necessary, but an alternative way of minimising waste at the landfill sites. Waste picking should be effective, must not pose risks to health and marginalise waste pickers. There is also a lack of data on active waste pickers at landfill sites, especially in South Africa. The reality is that there are many of them and this calls for concern from all stakeholders in waste management.

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CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

This chapter provides a description of the research design and methods selected for this study. The chapter also explains and describes some of the geographical characteristics relevant to this study area. The study adopted a multi-method research design, with both quantitative and qualitative features. The researcher has also included methodology limitations, indicating some of the challenges experienced during data collection.

3.1 Research Design

A multi-method research design was adopted in this research project to address the quantitative and qualitative aspects of the research problem. As stated by Leedy and Ormrod (2010), multi-methods design, is the use of more than one approach to the research problem in order to enhance confidence in ensuing findings.

In this research project, a methodological triangulation was used and this refers to the use of more than one method for gathering data. Multiple sources of data were collected with the hope that they will converge to support the research problem, and any contradictions within the data were reconciled. Data was acquired by means of questionnaires completed by waste pickers and unstructured interviews with municipal workers. The researcher also made her own observations during site visits and made field notes on her findings.

3.1.1 Quantitative Approach of Study

Creswell (2005), defines survey designs are “procedures in quantitative research in which investigators administer a survey to a sample or to the entire population of people in order to describe the attitudes, opinions, behaviour or characteristics of the population”. Due to the population number being big, the researcher used a sample of the population. According to Mokhtar (2005), generalizations processed from sample to population is the intention of a quantitative researcher and in a research, only a single sample of the subjects is studied and generalization is made back to the population from which that sample was chosen.

A questionnaire by Nguyen *et. al.* (2003), which was previously used in a similar study in Vietnam, was adopted for this study. The researcher had aimed at getting

200 waste pickers to participate in the study, but with Soshanguve landfill site omitted from the study, the researcher managed to get 176 completed questionnaires. The questionnaire had both open ended and closed ended questions. The open-ended questions were meant for the researcher to get a clear understanding and deep insight on challenges faced by waste pickers.

3.1.2 Qualitative Approach of Study

The major assumption in qualitative studies is that there is no single reality and each narrative is knowledge on its own (van Rooyen and Engelbrecht, 1995). The researcher opted to look at this approach to validate what is in the questionnaires. The selection of a research design depends on the nature of the problem being investigated and the purpose of the study (Royse, 2004). The researcher, herself, while at different sites, made field notes. There were also unstructured interviews conducted with municipal workers at the landfill sites to get insight into how they work with waste pickers.

3.2 Methodology

Methods of collecting data are discussed below. These include the population and sample, sampling and procedures followed in collecting data.

3.2.1 Population and Sample

Population refers to the entire population of the study, and in this research, the population represents all waste pickers working at landfill sites in the CTMM. When we conduct research, more often than not, we use a sample to learn about the larger population from which the sample has been drawn (Leedy and Ormrod, 2010). The reason for using a sample is that it is not always possible to get information from the entire population.

The sample should be carefully chosen so that through it, the researcher is able to see characteristics of the total population in the same proportions and relationships that would be seen if the researcher were to examine the whole population (Leedy and Ormrod, 2010). A sample is no more representative of the total population than the degree to which it has been selected. In this research project, the researcher used a sample of waste pickers.

3.2.2 Sampling

Park (2008), in the dictionary of environment and conservation, describes sampling as the process of selecting a representative set of specimens from the full population so that the subset can be used to make inferences about the population as a whole. Random sampling was used in the study, where a sample was selected in such a way that each member of the population had an equal chance of being selected. Participants were representative of all waste pickers at each site and were older than 18 years as the research required. Basic demographic information such as age and level of education was required from all participants. This was done at the three-landfill sites relevant for the research project.

3.2.3 Data Collection

Data was collected using several methods to address the research objectives and the research problem. The researcher used questionnaires, unstructured interviews and observations at the landfill sites.

Data was acquired through questionnaires and the researcher explained in advance the questionnaire to the participants well so that all would understand the questionnaire and be able to respond. Some respondents did not know how to write, so the researcher and a field worker helped them to complete the questionnaire. According to Leedy and Ormrod (2010), a survey research is acquiring information from one or more groups of people about their characteristics, opinions, attitudes or previous experiences by asking questions and tabulating the answers. For this research project, the researcher opted to follow that explanation and used questionnaires for the survey.

The researcher conducted unstructured interviews with municipal workers to learn more about how they work with waste pickers. The researcher also made physical observations of the landfill sites in order to have clarity on how waste pickers work, and made field notes regarding the findings.

3.3 Study Area

The study was limited to waste pickers working at three landfill sites in the City of Tshwane Metropolitan Municipality.

3.3.1 Background of CTMM

The City of Tshwane Metropolitan Municipality (CTMM) was established in 2005 and when founded, was made up of 13 former city and town councils. The incorporation of Metsweding District Municipality in 2011 into CTMM added a significant amount of rural and semi-urban area to Tshwane's eastern boundary. The City of Tshwane Metropolitan Municipality's area increased from 2 198 km² in 2010 to 6 368 km² after the incorporation of Metsweding. The CTMM has a population of approximately 2.9 million people which is made up of 911 536 households as determined through the 2011 Census (City of Tshwane IDP, 2013).

3.3.2 Landfill Sites in CTMM

CTMM has 10 landfill sites (of which five are operational and five are closed). The actual annual volume of waste disposed to landfill in the Tshwane area alone (i.e. excluding Metsweding) was estimated at 1 443 290 m³ in 2011 (Statistics provided by CTMM's Operations officials).

According to a statement made by CTMM's operations official (9th March 2015), out of the five operational sites, the smaller sites, which are Soshanguve, Ga-Rankuwa and Bronkhorstspuit, received between 14 000 and 18 000 tons of waste per month while the two larger sites, Hatherly and Onderstepoort received between 150 000 and 250 000 tons of waste per month. The biggest challenge was the lack of waste information data at all the sites. There is no comprehensive database capturing management information systems in place to produce reliable data and management information, and there are no weighing bridges at the sites.

For this research project, the researcher focussed on three landfill sites, which are Ga-Rankuwa, Onderstepoort and Hatherly. The reason for choosing these three was that Soshanguve waste pickers did not want to be part of the research although the researcher had permission to conduct research at four sites.

3.3.2.1 *Ga-Rankuwa Landfill Site*

The landfill site was opened in 1995 and has a footprint of approximately 41.9 Ha. The remaining site life (in years) recorded in 2012 was 49 (CTMM, IWMP, 2014). The site is classified G:M:B- which means that it accepts general waste with a

maximum rate of deposition greater than 150 tonnes/day, but less than 500 tonnes/day and it does not generate any leachate (CTMM, IWMP, 2014).

Salvaging of waste for recycling takes place on site and according to the waste pickers' committee at that site, there are 56 waste pickers on site who come on a daily basis to sort waste from the site. The site is located less than 5 km from a residential area.



Figure 3-1: Types of waste dumped at Ga-Rankuwa landfill site

Figure 3-1 shows the kinds of waste that is dumped, which the waste pickers then go through and isolate recyclables for collection. They collect different waste materials among others; plastic bottles, cardboard boxes and plastics. One waste picker may collect only bottles while another collects only boxes but there are those who choose to collect everything, depending on what is available, on any particular day.



Figure 3-2: Bags of collected material

Figure 3-2 shows bags of collected material from the landfill site. These bags will be moved to the designated area for sorting. The bags are then carried in a van that waste pickers themselves have hired and each waste picker contributes a monthly fee to pay the transport owner.

3.3.2.2 *Onderstepoort Landfill Site*

The landfill site was established in 1997 and has a footprint of approximately 51, 8 Ha with a remaining life span of seven years (Hill & Associates, 2011). Due to the closure of the Kwaggasrand landfill site in December 2013 and the diversion of that waste to Onderstepoort, the current estimated remaining site life span is less than two years. The site is classified as G: M: B- meaning the general waste, with a maximum rate of deposition (MRD) greater than 150 tonnes/day but less than 500 tonnes/day and non-leachate generating site.

The site is not fenced but there is some kind of order on site. There is recycling taking place on site, which is rather organised. According to the waste pickers committee, 256 waste pickers work on the site. They have divided themselves into groups to work on certain weekends but all of them work during the week.



Figure 3-3: Heap of waste dumped at Onderstepoort

Figure 3-3 shows waste that is dumped at the Onderstepoort landfill site. The waste pickers go through all of it to collect what can be recycled.



Figure 3-3: Dust generated by trucks

Figure 3-4 shows fugitive dust generated by trucks when dumping. Some waste pickers wear masks to minimise inhalation of fine contaminated dust through nose and mouth. Inhalation of fine dust can lead to respiration and lung problems.

3.3.2.3 Hatherly Landfill Site

Hatherly is the largest landfill site in CTMM with a footprint area of 96 Ha. The site was established in 1998 and is classified as G: L: B- meaning it accepts general waste and has MRD: >500 tonnes/ day and is non-leachate generating site. This site is quickly running out of landfill space, as now there is additional waste, which was previously directed to the now closed Garstkloof landfill site. The site is also very close to railway lines and it is in close proximity to a residential area.

There are many waste pickers at this site because it is the largest site in the city. When Kwaggasrand landfill site closed, more waste pickers chose to go to this site. According to the waste pickers' committee, there are between 500 and 600 waste pickers on site. The large number of waste pickers on site has led to many challenges, resulting in the researcher only managing to get cooperation from two cooperatives of waste pickers and the rest choosing to be uninvolved in the research.



Figure 3-4: Illegal dumping outside Hatherly landfill site yard

Figure 3-5 illustrates the challenges of illegal dumping outside the Hatherly yard. People indiscriminately and do not bother going into the site to dispose waste. Small cars also dump along the road and add to the problem.



Figure 3-5: Dust caused by trucks at Hatherly landfill site

From Figure 3-6 there is evidence of fugitive dust created by truck movements at the landfill site. Waste pickers leave the material they want to sort there and this sometimes makes it hard for trucks to turn or pass as they are offloading the waste.

3.4 Ethical Consideration

This study involves human beings and the issue of ethics is very critical. Various steps are considered which a researcher must follow before embarking on a study like this, and they are stipulated below.

3.4.1 Informed Consent

Informed consent is a necessary condition in any research project. According to Mack *et. al.* 2005, a prospective participant should be informed of the purpose of the research project, what is expected from them, the time that will be required from them and the expected risks and benefits of the research project. No one should be forced to participate in any research project and participation must be voluntary (Babbie and Mouton, 2011). From the above statements, the researcher followed all ethical considerations, informed participants about their rights during the research project and even the right to withdraw from the research project if they chose to do so.

3.4.2 Management of Information

The researcher also has to protect the privacy, anonymity and confidentiality of the participants (Bhattacharjee, 2012). All data in this research was treated anonymously and it was made clear to all participants that their personal details and other information would be kept confidential.

3.4.3 Ethical Clearance

Ethical clearance was obtained from UNISA's ethics committee before the researcher started with the research (Ref No: 2014/CAES/179). The only people who would have access to the research information would be the researcher and the academic supervisors. The notes made by the researcher concerning the research project and information obtained from the participants would be destroyed after the completion of the study and the research report will become a public document that will not contain any information identifying participants and their areas of residence. Participants will in no way be able to be traced back. All the requirements were explained to all the participants by the researcher.

3.5 Data Analysis

The data collected will be analysed using statistical software, Epi-Info, where descriptive analysis using graphs, charts and numbers will be used to analyse data.

3.6 Methodology Limitations

The researcher has decided to include the experiences encountered during the research methodology in this chapter so that other researchers would be able to learn more on how challenging it could be during this data collection phase and could improve on their methodologies early in the research project.

Data collection was probably the most challenging phase of the whole research project as it depended on other people. Firstly, the researcher could not include Soshanguve as waste pickers at that landfill felt that previous researchers took information and never brought feedback even though they took time off from work to be part of the research.

The researcher then moved to Ga-Rankuwa landfill site where some of the waste pickers did not want to be part of the research project. Their reasons for not

participating were experiences with other researchers in the past and non-governmental organisations that had funding to help waste pickers, but did nothing to help. It was unfortunate that at Ga-Rankuwa, a few years previously, some of the materials recycled by the waste pickers were taken away by an NGO. Those who took part in the research project did not even waste time in completing the questionnaires and completed them in one day. The problem was that they had to stop work to complete the forms. When the trucks arrived, they alerted the researcher that money was passing them by and the researcher with her field assistant had to help them with completion of the questionnaire, which the researcher felt was rushed.

Working with waste pickers at Onderstepoort was more organised, although some were hesitant to participate in the research study. The site had many young people who did not believe that their names would be kept anonymous. Some women said they were once in newspapers, without their consent, even when the researcher had promised not take photographs to publish. Because of it being a larger site than Ga-Rankuwa, the researcher had to go there several times, as the only time the waste pickers would complete the questionnaires was during their breaks. Waste pickers did not have the luxury to stop working in order to complete the questionnaires.

The largest site, Hatherly, was the one with more challenges and as the researcher had stated earlier, it was not possible to work with all waste pickers on site, but only with two cooperatives that worked on that site. Initially during the meeting convened with all waste pickers, the majority agreed to be part of the research project. This later changed as they suspected that the researcher wanted to expose them to other offices and being prohibited from entering the premises. The researcher was alerted of her own safety risk as the waste pickers were fighting amongst themselves although there were ongoing negotiations to resolve the disputes. After months of persuasion, two cooperatives agreed to participate in the research. Questionnaires were distributed among members of the cooperative. Prior to distribution of questionnaires, they had asked the researcher to train four of the young waste pickers in completing the forms so that they would be able to help the older people to complete them. At this site, waste pickers themselves worked as field workers in helping the researcher to complete questionnaires.

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CHAPTER 4: RESULTS AND INTERPRETATION

The aim of this chapter is to present an analysis of the results on the findings after interacting with 176 waste pickers from three-landfill sites in Tshwane. The results cover demographics, working conditions, health status, personal protection behaviours, challenges and experiences of waste pickers working at the landfill sites. The results obtained are integrated and interpreted to provide a more comprehensive understanding of the different aspects that were discovered during this study.

The information that was obtained from the municipal workers was discussed as part of challenges and experiences that waste pickers had come across. In addition, the information contributed as baseline data of attitudes and practices of risky behaviours that waste pickers followed. Management of solid waste is crucial and still applies to waste pickers at landfill sites. Failure to pay serious attention to solid waste management may lead to injuries and illnesses. Waste pickers should always protect themselves while at work.

The first section presents the waste pickers' demographic characteristics including gender, age, their level of education and age of entering the informal sector, the socio-economic status and income analysis.

The second section discusses the working conditions at the landfill sites. Aspects such as the demanding nature of their work and their workplace safety are reviewed.

The next section focuses on the perceived health status of the waste pickers. This was a subjective assessment, where the researcher relied on what the waste pickers had said and no further tests were conducted for this study.

Finally, yet importantly, the discussion on the health protection behaviours was based on the observations made and the information obtained from the municipal workers. The challenges and experiences of waste pickers at the landfill sites were also summarised.

The chapter will conclude with the researcher's remarks on the findings and interpretation.

4.1 Demographic Characteristics of Waste Pickers at Landfill Sites

Epi-Info version 7 was used to describe the characteristics of a population, such as gender, age, education level and earnings.

4.1.1 Gender Profile

A sample total of 176 waste pickers' participants from three landfill sites in CTMM was used. Figure 4-1 presents the gender distribution of participants as 66% females and 34 % males, picking waste at the landfill sites. The study of waste pickers in Pretoria by Schenck and Blaauw (2011) revealed that there were more males (97.2%) picking on the streets than females.

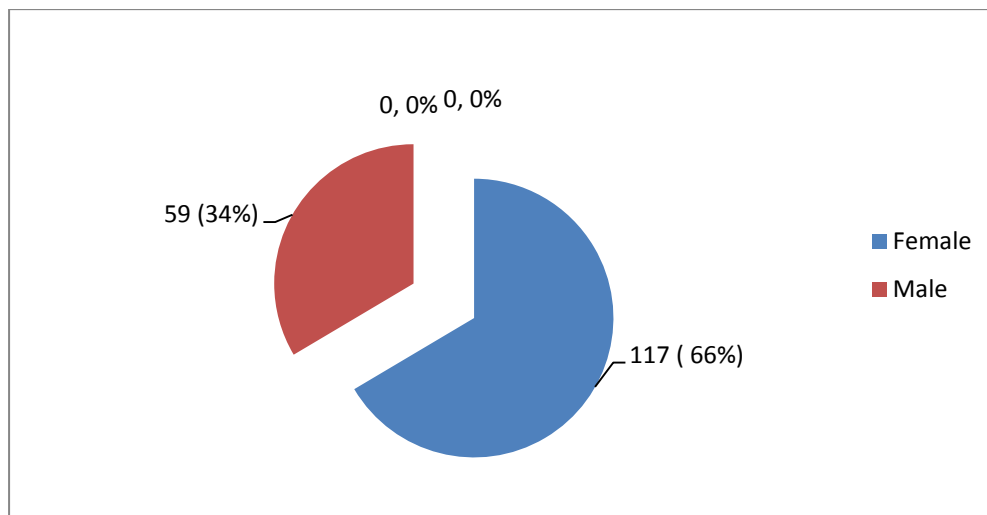


Figure 4-1: Gender profile of waste pickers at the three-landfill sites (n=176)

According to Viljoen (2014), waste pickers on the streets have to cover long distances looking for recyclables and carry heavy loads of waste. The larger number of females at the landfill sites may be related to the fact that at the landfill sites they do not have to cover long distances searching for recyclable materials.

The gender distribution patterns of participants at the different sites are shown in Figure 4-2. These results show that there are still more females at different sites than males, except at the Onderstepoort site where the males were more by five participants than females.

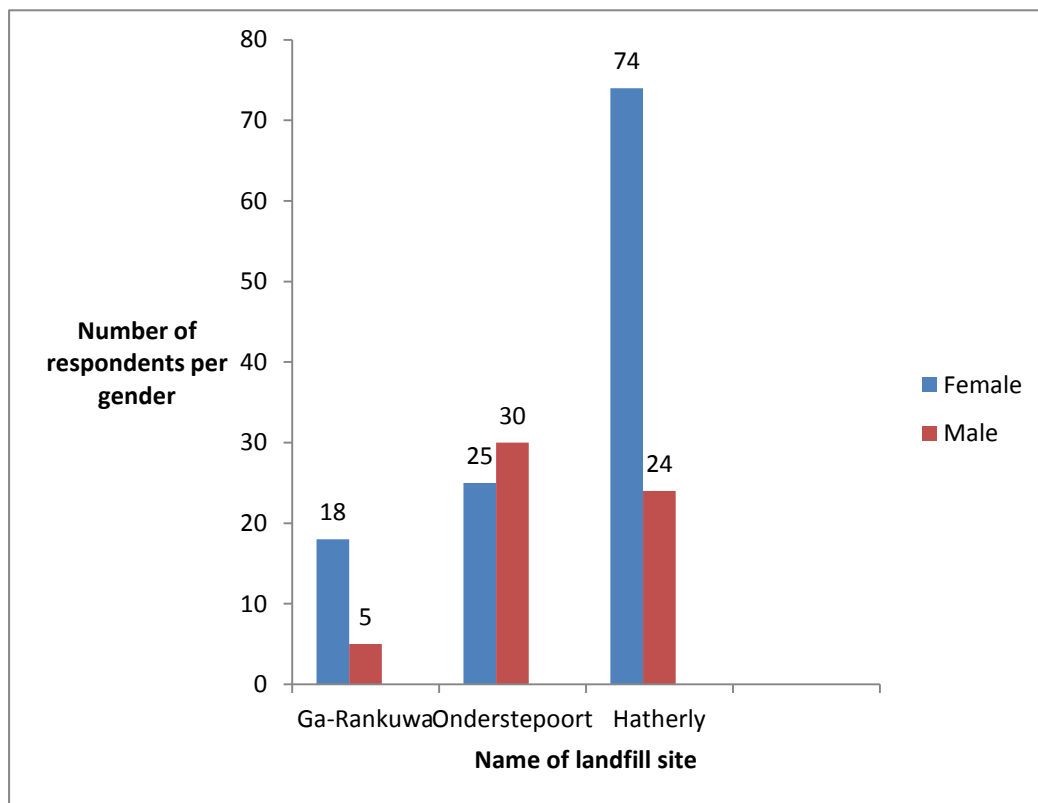


Figure 4-2: Gender profile of waste pickers per landfill site

There can be several factors as to why the numbers were not evenly distributed. A number of males did not want to form part of the study, as they did not want to talk about their health status, whereas most females were open in revealing their health status. Other waste pickers did not want to be part of the study because of bad experiences when similar kind of studies were undertaken and no feedback was given to them on their findings.

4.1.2 Age Profile

The high unemployment rate in South Africa has led to people entering the informal sector in numbers. In CTMM, the waste pickers at the landfill sites have made rules concerning pickers entering the sites. One of the rules is that they do not allow children on site and no people under the age of 18 are allowed. Figure 4-3 presents the age distribution of waste pickers from all sites combined. From the study, the youngest person was 22 years old and the oldest was 76 years old. The mean age was 45 years with a median of 44 years.

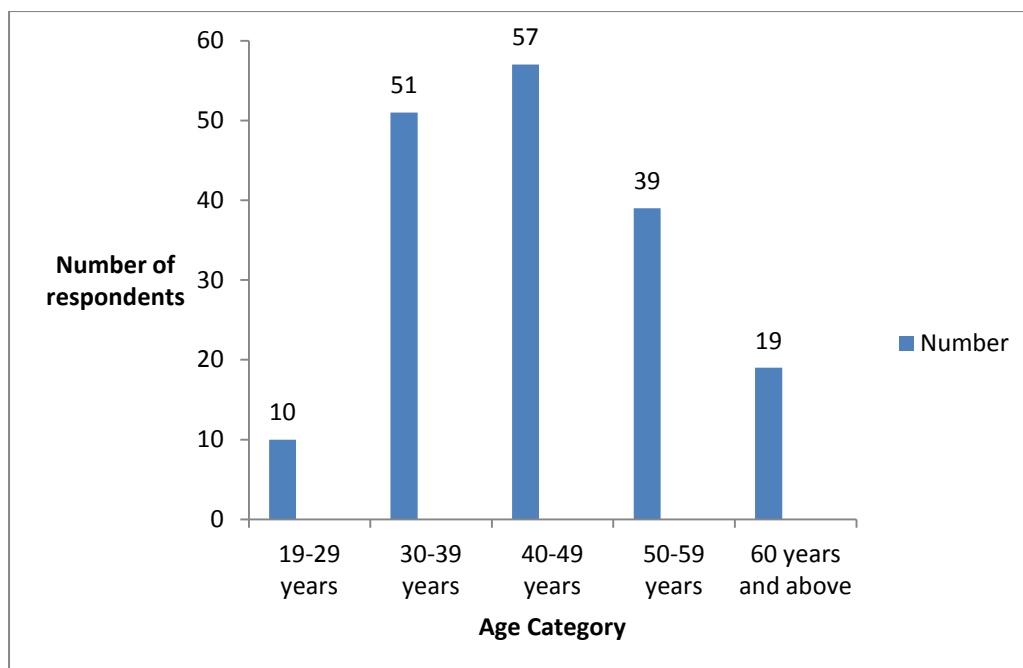


Figure 4-3: Age category of waste pickers

It is important to note that the majority of waste pickers are in the age group that is perceived as economically active, and most of them have families they have to provide for. Taking up work at the landfill was a viable occupational option for them with benefits, Medina (2000). The findings of this study and that of Medina (2000) are similar to those reported by Tevera (1994), where the same age groups (≥ 30 years) constituted the larger proportion of waste pickers at landfills.

4.1.3 Educational Level

Working in the informal sector does not require any kind of formal education; hence, there are more people without formal education at the landfill sites. Waste pickers are known to have low literacy levels, are unskilled and have low levels of education (Samson, 2010; Schenck and Blaauw, 2011).

Figure 4-4 reveals the result of the education level attained. As the education levels were very low, the researcher divided the education level in terms of grades to get a clearer picture of the level of waste pickers' education. From Figure 4-4, 13% of the waste picker had never been to school, 23% had their highest education level between

grade 1 and grade 5. The highest percentage was 57%, with those who had their highest education level being between grade 6 and grade 11. It is worth noting that 6% of waste pickers obtained grade 12 as their highest qualification and only 1% revealed that they had post matric qualifications. Qualifications from the 1% were at the then FET colleges in electrical, plumbing and engineering fields.

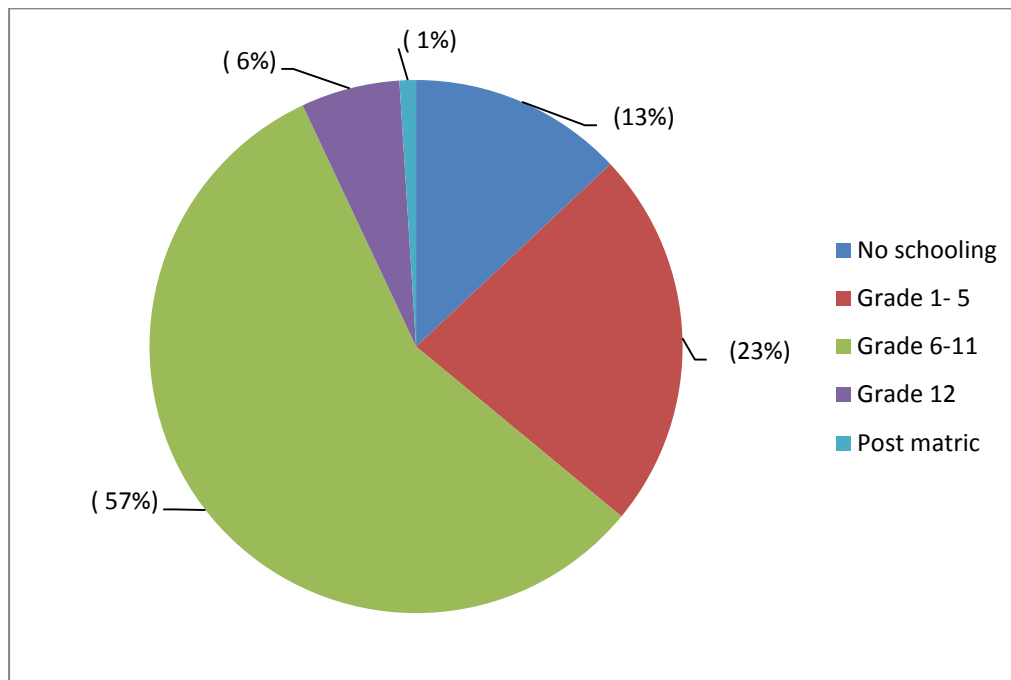


Figure 4-4: Highest level of education attained

The findings revealed that 38% of the waste pickers would still like to further their education, whereas the remaining 62% did not want to further their education. Those who wanted to further their education, wanted to study nursing, handwork, teaching and a majority wanted to obtain Grade 12. The reasons given by the 62% for not wanting to improve their education were that, some felt they were too old, others wanted to support their families and the rest thought some members of the community would make fun of them when they went back to school with their children. The majority of waste pickers indicated that financial challenges were the main reason for them leaving school early and looking for ways of sustaining themselves.

4.1.4 Age of Entering the Informal Sector

From the literature reviewed, it was established that waste pickers had been picking for a long time in CTMM. Some of the waste pickers had started picking at other landfill sites before moving to CTMM. Figure 4-5 presents the distribution of the age when the waste pickers entered the informal sector in waste picking. It is worth noting that this is the range in years from working at other sites as well, meaning their age when they started working as waste pickers at landfill sites in general not just at CTMM. The highest percentage was 49%, where waste pickers entered the industry when they were between the ages of 31 and 40 years. Those who entered the industry at ages of between 18 and 30 (43%) followed.

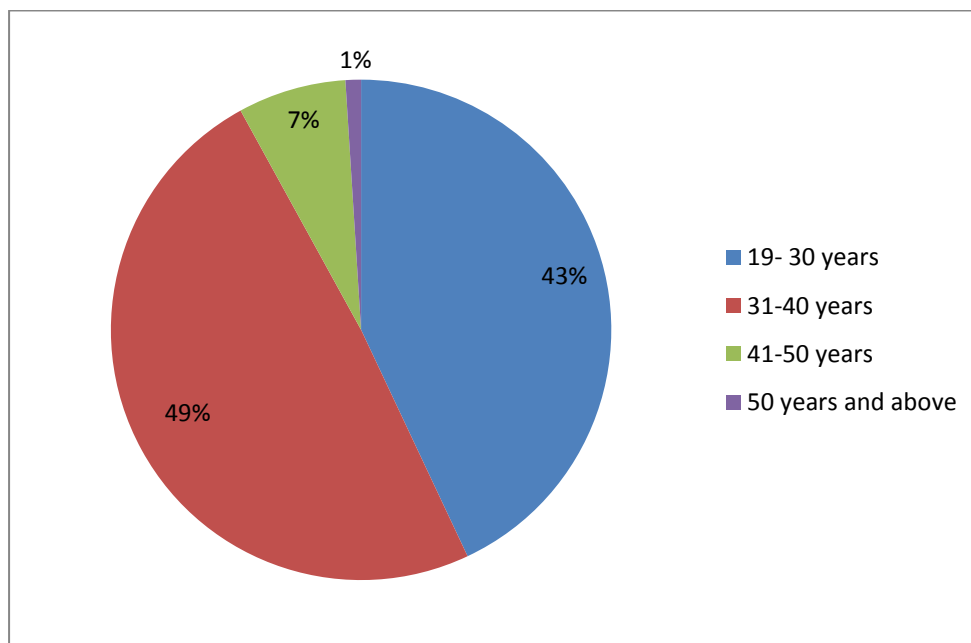


Figure 4-5: Age distribution of entering the informal sector

Based on the percentages represented in Figure 4-5 and noting the high rate of unemployment in the country, many waste pickers entered the industry because of their low levels of education, which make them unemployable in the formal sector. About 7% of the waste pickers said they entered the industry at ages between 41 and 50, while only 1% entered the industry when they were above 50 years of age.

4.2 Socio-Economic Status and Income Analysis

The socio-economic status refers to the social and economics of a population in order to understand how these affect their lives. The income analysis will give an indication of how waste pickers live and if they are satisfied with their earnings.

4.2.1 Mode of Transport Used to Work

Some of the respondents in this study do not stay near the landfill site, but how they travelled to work was of importance. The reason was to establish how much of their money was spent on transportation. Most of those who stayed closer were from the village that is closer to the Hatherly landfill site.

Table 4-1: Mode of transport to work

Mode of transport	Bicycle	Bus	Lifts	Taxi	Train	Walk
Total Percentage	4%	2%	1%	48%	5%	40%
Ga-Rankuwa	1%	1%	0%	13%	0%	9%
Onderstepoort	0%	1%	1%	25%	5%	1%
Hatherly	3%	0%	0%	10%	0%	30%

From the above table, the higher percentages for the mode of transport used were taxis and walking to work. It was found that 48 % of the waste pickers used a taxi, while 40 % walked to work. From those walking, the majority were from Hatherly and Ga-Rankuwa as those sites were not far from the community. There was 5% of the waste pickers who used a train to work, 4% that used bicycles, and 2% that used buses while 1% relied on lifts. At the Onderstepoort landfill site, many waste pickers used a train as their main transport whereas at Hatherly, most waste pickers walk to

work, as they do not stay far away from the landfill site. The Onderstepoort landfill site was the only one with participants who reported using a train, and a very low percentage (1%) of them used lifts. About 3% of the waste pickers from Hatherly site said they used bicycles as compared to 1% of the participants from Ga-Rankuwa that used bicycles. The use of buses was not that popular among the waste pickers, with only 1% from both Ga-Rankuwa and Onderstepoort using a bus to work.

4.2.2 Experiences of Abuse

From the literature overview, it seemed that there were people who still saw waste picking as dirty and of low class. However, there seemed to be a shift from that to a more positive one, even though there were still waste pickers who felt that they were emotionally abused. From the 176 waste pickers in the study, 62% revealed that they had never experienced any form of abuse whereas 38 % experienced some kind of abuse. The respondents listed different kinds of abuse. Most males and females said that their peers laughed at them for being in the industry and were marginalised whereas younger waste pickers said they were afraid to tell some of their friends about the kind of work that they were involved in.

4.2.3 Aspects that Waste Pickers Like and Dislike about Their Work

The knowledge of aspects that waste pickers like or dislike would help with identifying challenges that they experience regarding their social and economic needs. Table 4-2 below presents different reasons why waste pickers liked their work. The main reason that waste pickers at landfills liked their work was that they were able to provide for their families. When the age distribution was analysed, the majority of waste pickers (84%) were in their forties and had families. About 5% of the participants said their work kept them away from crime. It is worth noting that those who mentioned crime were all males. Others (3%) liked their work because it made them to be self-employed and they did not have to report to anyone. 3% did not like anything specific about their work. This group was mainly in the youth category under the age of 30. About 1% of the waste pickers liked their work because they made new friends at work; 2% said they were just doing the work to keep busy. The remaining 2% said they liked everything about their work.

Table 4-2: Aspects that waste pickers like about their work, n=176

LIKES	PERCENTAGE
Providing for family	84%
Not involved in crime	5%
Self employed	3%
Nothing	3%
Keeping busy	2%
Everything	2%
Making new friends	1%

The waste pickers also revealed the negative perceptions about of their work and their reasons are as shown in Table 4-3 below. Majority of waste pickers (22%) emphasised that they did not like working in an unclean environment as opposed to the perception held by communities saying that they liked working in dirty environments. The researcher noted that waste pickers came to work neatly dressed and changed into their working clothes when they arrived at work. About 18% said low monetary rewards were a concern because they worked hard all day and received very little money for all the hard work. The challenge of young men on drugs was only observed at Hatherly, where 15% of the waste pickers said that there were young men around the landfill site who are hooked on nyaope, which is a form of drug and that those hooked on this drug bullied them and at times stole their recyclable materials. About 14% of the waste pickers complained of the physically demanding nature of the work. They said they are compelled to work even if they are tired. A further 9% of the waste pickers did not like the fact that they had to work in the sun almost all day while bending. Lastly, there were waste pickers who disliked

everything (13%) about their work and 9% had nothing to dislike about the work they did.

Table 4-3: Aspects that waste pickers dislike about their work, n=176

DISLIKES	PERCENTAGE
Working in unclean environment	22%
Hard work and very little money	18%
The young men on drugs (nyaope)	15%
Can be too tiring	14%
Everything	13%
Nothing	9%
Bending and working in the sun	9%

Despite all that the waste pickers disliked about their work, they wanted to be able to provide for their families and that was emphasised as the main reason they worked at the landfill sites.

4.2.4 Daily Earnings of Landfill Waste Pickers, Is it enough?

Income in the waste industry depends on the kind of waste stream a waste picker was working on. Gill (2007), found that different waste streams yielded different returns for waste pickers. Waste pickers collect, sort the waste and are then paid afterwards. There were waste pickers who had managed to start cooperatives, taking their recyclable materials directly to buy-back centres instead of selling to the buyers on site. They have seen this as a way of cutting out the intermediary and increasing their profits.

As most women do not recycle metal and steel, men who collected these recyclables tended to earn more money than others did. Figure 4-6 below outlines the distribution of waste pickers' earnings and shows the difference according to gender.

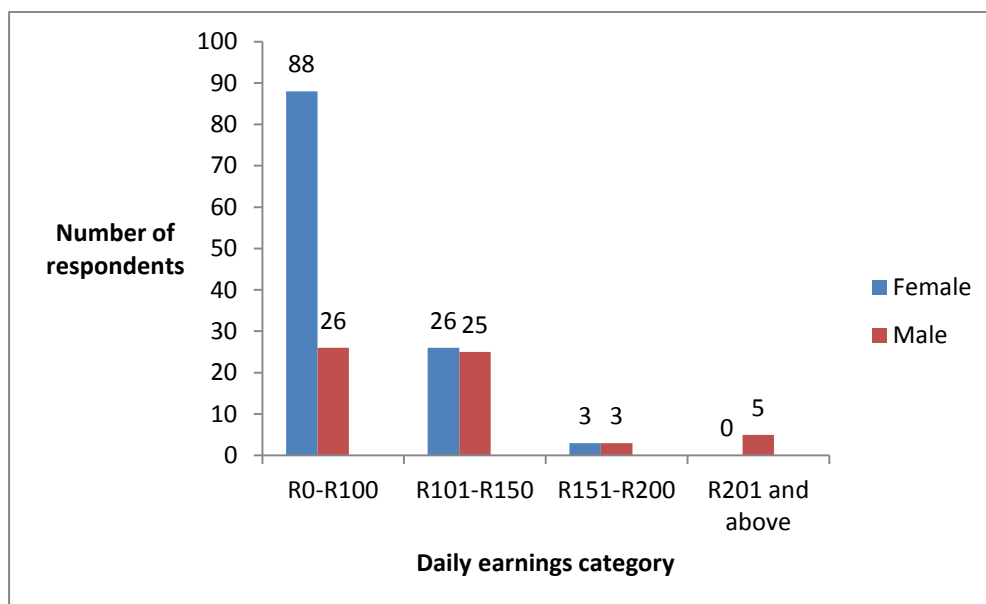


Figure 4-6: Daily earnings distribution of waste pickers according to gender

When asked if the earnings were enough, 84% of the waste pickers saw their daily earnings as not enough, 14% said they viewed the earnings as enough whereas 2% said they did not know if the earnings were enough.

4.2.5 Borrowing Money

Waste pickers were asked if given a chance to borrow money, how they would use the money. There were different responses to the question including some of the waste pickers saying they would never borrow money. From Figure 4-7, 38% said that they would use the money borrowed for their family's education. This included education for themselves, their children and their grandchildren. Not far from the majority using the money for education, 31% said they would build proper houses if they were borrowed money and did not want to live in shacks. Furthermore, 22% of waste pickers said they wanted to start their own businesses given a chance to borrow money. From those who wanted to start their own businesses, most of them said the business would be in waste management as they had seen that the buyers made more

income. There were 7% of the respondents who said they would never borrow money even when given the opportunity to do so. Lastly, 2% said they would borrow money to support their children in every way possible.

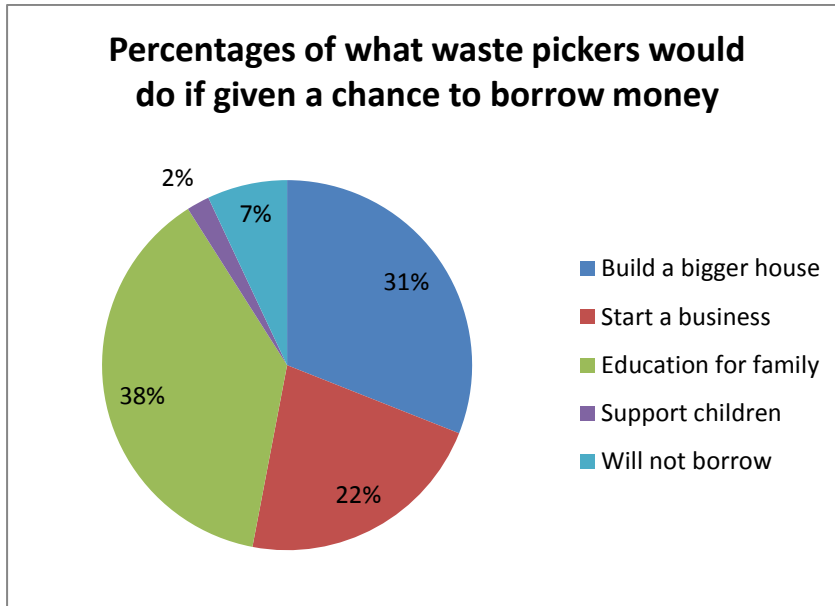


Figure 4-7: Percentage of waste pickers that would likely borrow money

4.3 Working Conditions of Waste Pickers

From the literature, waste pickers suffered ergonomic challenges due to the physically taxing nature of their work and psychological and social disadvantages from their low social status. Below are the findings on how waste pickers worked.

4.3.1 Working Days per Week of Waste Pickers

Working days of waste pickers varied, as they were all independent and self-employed. The findings presented in Figure 4-8, show that most of the waste pickers (53%) worked five days per week and 42% worked six days a week. There were waste pickers who worked seven days a week (4%), 0.55% worked either three or four days a week. At Onderstepoort landfill site, they had divided themselves into groups for working on Saturdays. Waste pickers worked all day and took breaks when going to eat and rest. The larger sites, Onderstepoort and Hatherly, had people selling food and cooking on the site so that waste pickers could buy food from them. They do

not position themselves near where the waste is dumped, but near where the sorting of the waste takes place.

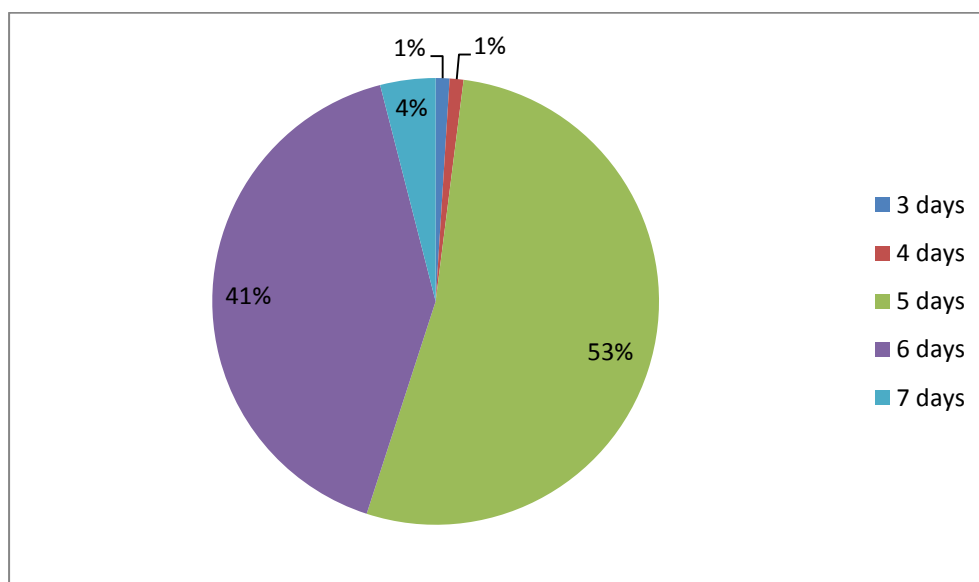


Figure 4-8: Percentages of working days per week

4.3.2 Availability of Support Structures at Landfill sites

There are support structures in terms of committees at all sites available for waste pickers. From the study, 97% said they helped each other on site, while only 3% felt everyone was independent at the site and they did not need to help each other. The municipal workers supported the waste pickers by making their work easier with the provision of mobile toilets and access to drinking water. It was observed that municipal workers were well informed about how waste pickers operated and knew when they had their weekly meetings and tried to help with some of the challenges they encountered.

Each site had a weekly meeting at which they discussed their experiences, challenges and their plans. The waste pickers' committee served as a forum where all waste pickers were able to communicate with other waste pickers from other sites. They also supported each other as waste pickers during times of bereavement and other social issues. There were also rules set by waste pickers at the landfill sites to be complied with. For example, no alcohol is allowed on site and if they were found with alcohol

there would be a fine or suspension from that particular landfill site imposed for transgression of the rules. In addition, no pregnant women or children were allowed on site. These are some of the examples that supporting structures facilitated at the landfill site. Onderstepoort landfill site was rather more organised in terms of supporting structures.

4.3.3 Physical Demands of Working at a Landfill Site

Working at a landfill site is physically demanding, as there are instances where the waste pickers have to carry their bags to sorting areas as was observed in Figure 2-2 in the literature review section. Figure 4-9 shows big bags filled with recyclable materials that still have to be moved from the dumping site to the sorting site.



Figure 4-9: Bags filled with recyclable materials

There were vans on the landfill sites that worked there only to help carry the bags to the sorting sites with a compensation agreement in place. At the Ga-Rankuwa site, as there were not many waste pickers, the pickers themselves hired a van that would take bags filled with recyclables to the sorting site. From this study, 90% of waste pickers indicated that they lifted heavy objects and bags containing different recyclables around the site as shown in Figure 4-10.



Figure 4-10: A woman carrying a bag of recyclables

4.3.4 Weather Conditions that Waste Pickers Work under

Most waste pickers worked in all weather conditions, as they survived on what they gathered on that day. From the study, 66% of them revealed that they worked all the time including when it rained. They further added that they wore plastics and raincoats when it rained, but the researcher was never able to observe that. The municipal workers at the landfill sites confirmed that they had observed waste pickers wearing plastics on rainy days. The remaining 34% revealed that they did not work when it rained, as they would be exposing themselves to the risk of ill health.

4.3.5 Injuries at Work

From the study, 78% revealed that they had never been injured while at work, whereas 22% reported injuries while at work. The injuries include bottle cuts, metal cuts; tripping and falling while running for trucks, falling from trucks (see Table 4.4 below). Worth noting is that 2% said that they had been beaten by waste dumpers. When asked the reasons for that, the researcher was told that some of the some people coming to dump waste as they did not want waste pickers near their vans and when some waste pickers went closer, those there to dump waste would go out and beat

them. This is in line with the findings in some literature where waste pickers are deemed filthy and dirty people.

Table 4-4: Injuries at work

TYPE OF INJURY	PERCENTAGE/ %
Bottle/Glass cut	56
Wire cut	13
Injured by metal	8
Tripped and fell	13
Fell from truck/van	8
Beaten by waste dumper	2
n= 39 (22% of total)	

From the above Table, 56% were injured by bottle and glass cuts. Some waste pickers reported that they were not wearing gloves when they sustained injuries. This highlighted the need to use personal protective wear. Some said the bottle cuts were sustained on their legs and as they were moving around in heaps of waste searching for recyclables.

4.3.6 Safety at Landfill Sites

Working at a landfill site has its risks. From the survey, most of the respondents did not feel safe working at the landfill site but stated that they had no options, because they needed this source of income to survive. The responses were divided according to gender as shown in Figure 4-11, with 85% of females not feeling safe at the workplace compared to 78% of males. Among males, 19% said they felt safe and 2% said they were not sure if they were safe or not. Females who felt safe at the

workplace amounted to 13% and 2% indicated they were not sure if they were safe or not. Waste pickers mentioned fast truck drivers and compactors as some of the reasons they did not feel safe at work. Other waste pickers reported that they did not always know what was being dumped when the truck tipped the waste. Anything could be off loaded and it was not safe.

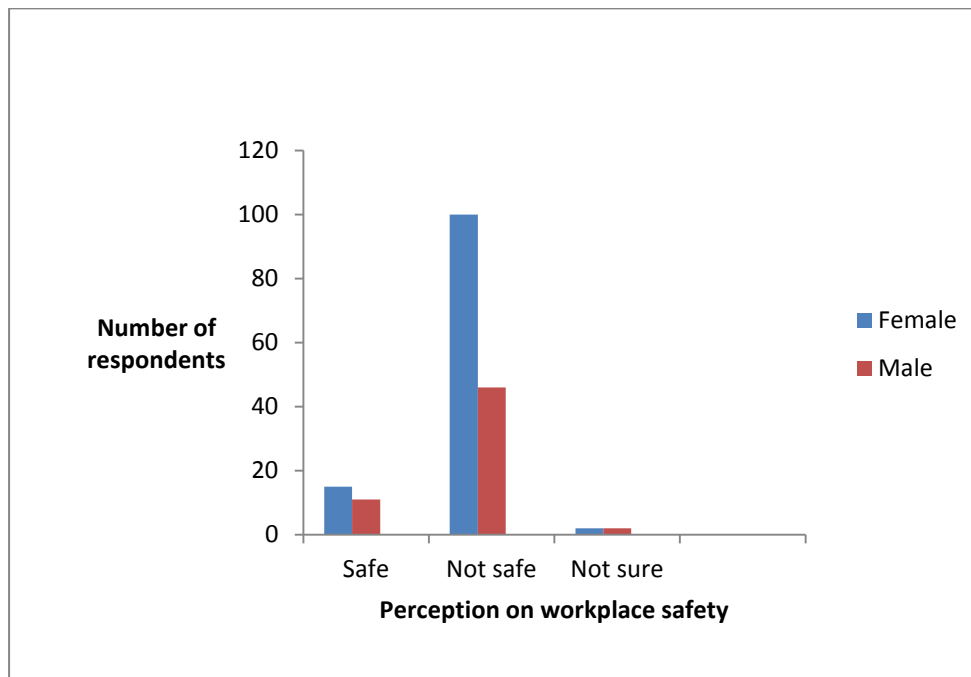


Figure 4-11: Female and male perception of workplace safety

4.3.7 Tools Used to Collect Waste

From the study, 98% of the respondents indicated that they did not use tools when working; the remaining 2% indicated that they sometimes used tools to carve and clean bricks that had cement attached as in Figure 4-12. Bricks were stacked and a van was hired to take the bricks to where they were staying so that they could build their houses with these bricks.



Figure 4-12: Cleaned stacked bricks recovered from waste

4.4 Analysis of Waste Pickers' Health Status

The environmental health risks to which people working at landfill sites exposed themselves to could be serious and required thorough investigation. In this study, subjective assessments were gathered and the study was based on the responses obtained.

4.4.1 Perceived Health Status

Waste pickers rated their health and the majority of the respondents reported their health to be fair when compared to their peers with only those between the ages of 19 and 29 reporting that their health was excellent when compared to their peers (Figure 4.13). It was worth noting that the majority of waste pickers later revealed that they could not have said that their health was poor because of the fear of eviction from the landfill site. This was one of the shortcomings of a subjective assessment as people responded untruthfully with the view to protecting their right to work.

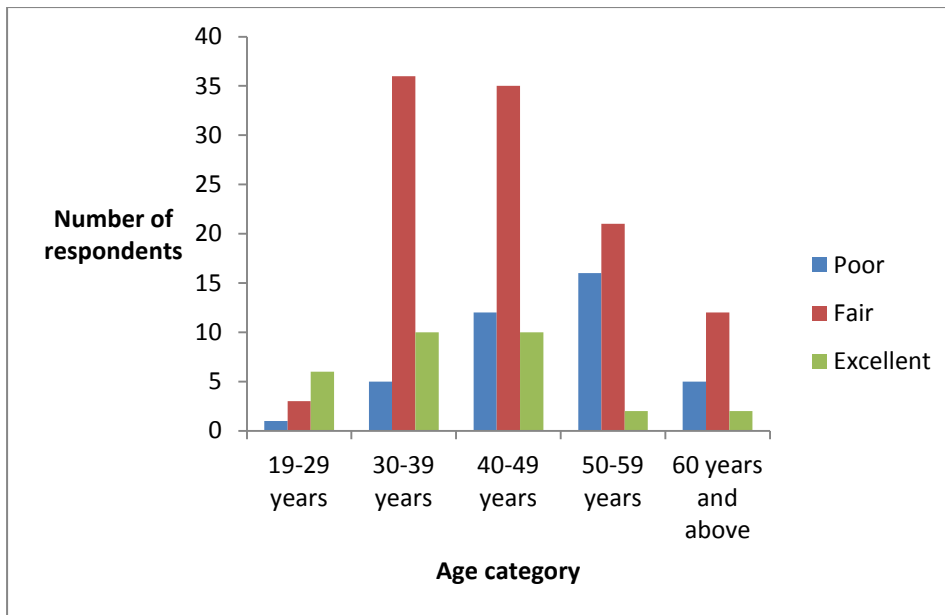


Figure 4-13: Perceived health status according to age category

Despite the different risks and illnesses that waste pickers experienced, they still considered their health status as fair as compared to ordinary members of the community. This could be a way of confirming that working at a landfill site had its advantages and they were surviving well. From this study, 22% of the respondents viewed their health status to be poor, while 59% viewed their health to be fair and 17 % of respondents saw their health as excellent when compared to their peers as in Figure 4-14.

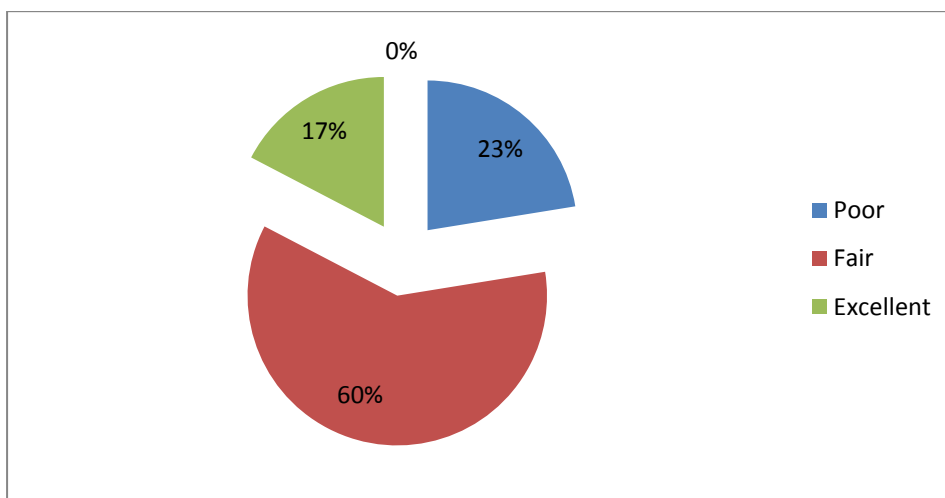


Figure 4-14: Perceived health status of waste pickers

4.4.2 Medical Consultation in the Last Six Months

In this study, 59% of the respondents said they never had any medical consultation in the last six months, whereas 41% revealed they had consulted either a clinic or hospital. Of those who visited the clinic/hospital, their consultation reasons are in Table 4-5.

Table 4-5: Reasons for medical consultation, n=72 (waste pickers who consulted in the past six months)

CONSULTATIONS	NUMBER
Bottle cut	1
Eyes check up	5
Joints	6
Lungs	7
Chest pains	13
Headache	10
Cough/Flu	10
TB treatment	5
Asthma treatment	15

From the results shown in Table 4-5, the majority of people reported being on asthma treatment and some complained of chest pains. A number of the respondents suffered serious headaches and had lung problems. Headache problems appear to be a prevalent condition among waste pickers, and have shown to be one of the recurring complaints in other studies as noted by Nguyen *et.al.* (2003). There were respondents who mentioned that they had consulted doctors because of flu and coughs. Some of the respondents consulted doctors due to joint problems and eye ailments. From the

study, there were people who mentioned that they were on TB treatment and visited the clinic regularly.

4.4.3 Health Problems experienced in the Last Six Months (Prevalence of Diseases)

Waste pickers were asked about the prevalence of certain diseases in the last six months and they gave their responses as in the table below.

4.4.3.1 Musculoskeletal Problems

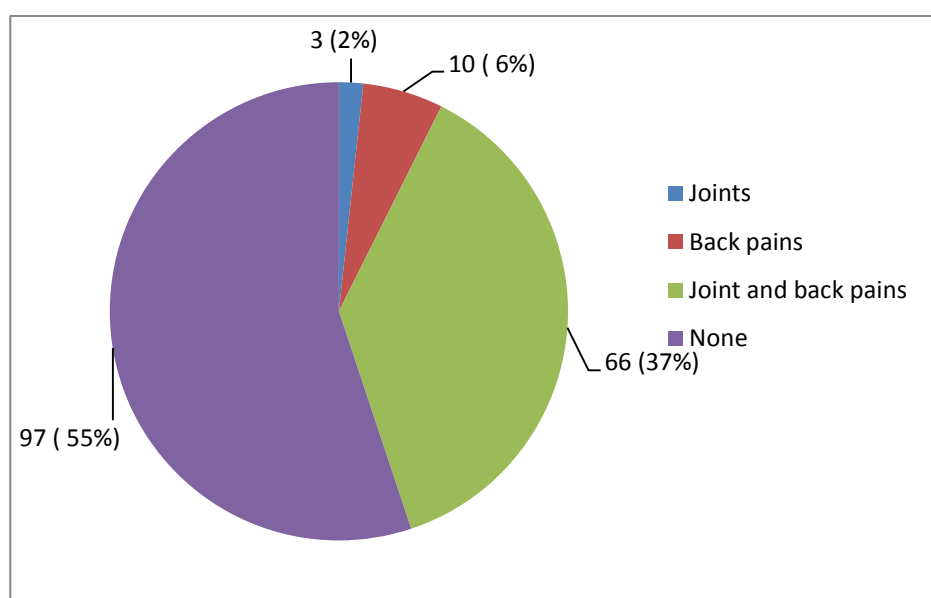


Figure 4-15: Number of waste pickers with musculoskeletal problems

In this study 55% of the respondents reported that they had no musculoskeletal problems as in Figure 4-15. About 37 % had both joint and back pain problems, whilst 6 % of the respondents had only back pain problems and 2 % had only joint problems. The respondents' reasons for the different musculoskeletal problems ranged from bending for long periods while working and walking for long distances. Older people believed that their problems had nothing to do with their work but was due to aging. The findings were similar to those found in Vietnam, where Nguyen et.al. (2003) reported that many waste pickers surveyed had back pain, which was attributed to the constant bending motion required to search for waste recyclables.

4.4.3.2 Skin Problems

From the survey of 176 waste pickers, 146 of the respondents said that they did not have any skin problems whereas nineteen people stated that they frequently suffered from rashes, whilst ten of them had cuts on their hands and six people complained of irritated skin. There was only one person who complained of bruises. These findings are presented in Figure 4-16 below.

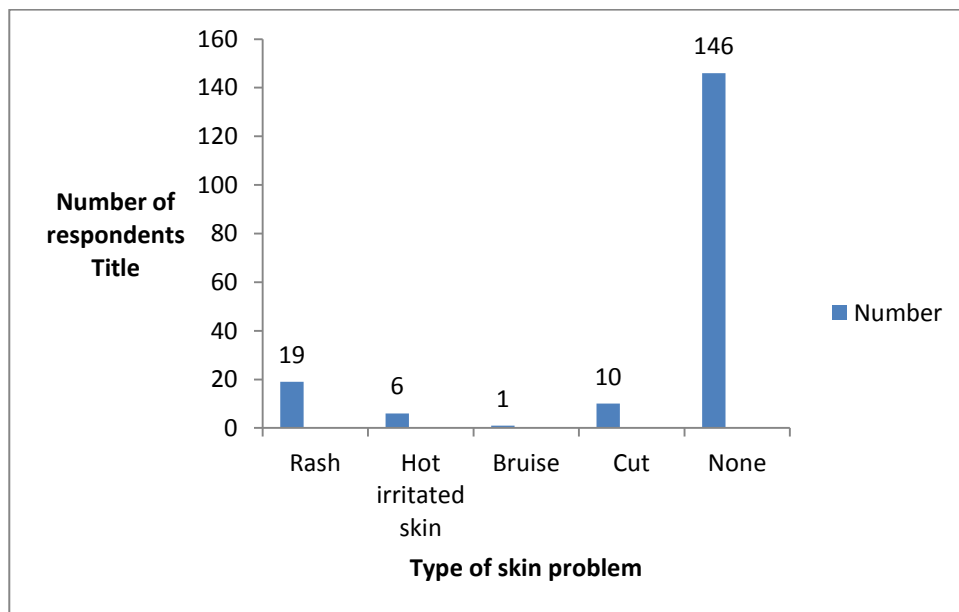


Figure 4-16: Number of waste pickers with skin problems

Although there were quite a few of the respondents who had irritated skin symptoms, there were respondents who attributed skin irritation and rashes to bathing with unclean water near the landfill site (see Figure 4-17 below). They revealed that they often had to buy clean water in drums and if they did not have enough money they just boiled the unclean water for bathing before they went home. Other waste pickers indicated that they did not use water from nearby wells, but opted to change clothes and bath themselves only when they arrive at their homes. It was to their advantage because by not using the water from the nearby wells they were protecting themselves from skin illnesses.



Figure 4-17: Unclean water that some waste pickers use for bathing

4.4.3.3 Respiratory Problems

Many people complained about respiratory problems in this study than any other illnesses. Figure 4-18 show 25 % of the respondents reported suffering from both coughing and shortness of breath. Although the majority of respondents (55%), said they did not suffer from any respiratory problems, the remaining 45% reported some kind of respiratory problems. There were 19% of the respondents who complained of regular coughs and 1% reported shortness of breath. The findings agreed with a previous study by Oyelola *et.al.* (2011), where it was reported that coughing appeared to be a frequent problem for waste pickers working at landfill sites.

Not many of the waste pickers suffered from shortness of breath only. A few mentioned that they suffered from chest pains and the majority of them were males. Gutberlet and Baeder reported in 2008 that previous studies elsewhere showed that chest pain occurrences increased the longer they spent working at the landfill site. It is worth noting that chest pains may be affected by lifestyle, including smoking and heavy drinking. It was of interest to note that the majority of people who reported respiratory problems were those who had worked at the landfill sites for longer periods, which is over five years.

The majority of waste pickers did not wear masks to protect themselves from dust and any other toxins they could inhale while at work.

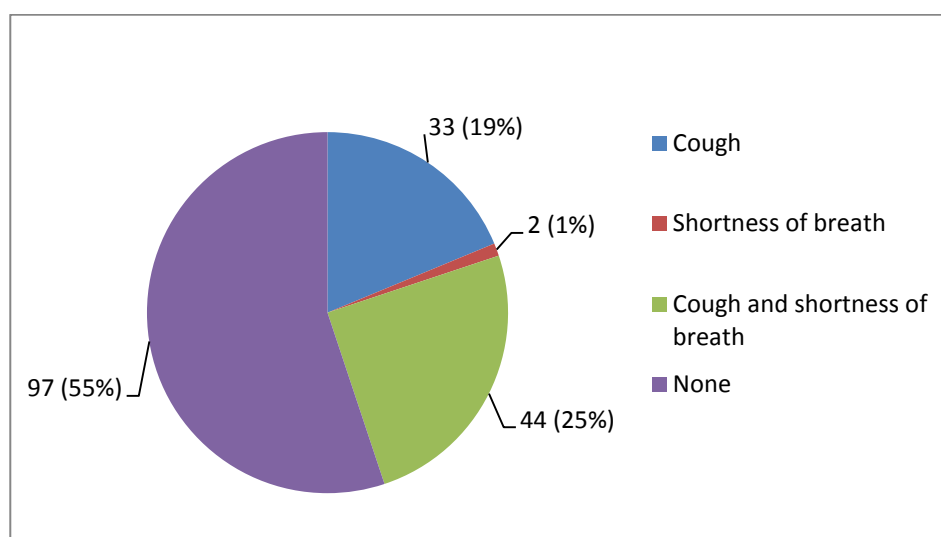


Figure 4-18: Number of waste pickers with respiratory problems

It was further reported that of those who suffered from coughing and shortness of breath, there were some who were on TB and/or asthma treatment and this had nothing to do with the work they were involved in. Respiratory problems were prevalent during dry periods as landfill surfaces that produced dust possibly contaminated with inhalable toxic chemical from the waste and from the surroundings as reported in the study by Gwisai *et.al.* (2014).

4.4.3.4 Gastrointestinal Problems

The majority of people in this study did not experience gastrointestinal problems. The minority that reported to have had gastrointestinal problems in the previous six months were eleven in total as presented in Figure 4-19. From the eleven, four had suffered from diarrhoea, three had experienced stomach pains whilst four of them reported to have suffered from both diarrhoea and stomach pains. The diarrhoea cases could have been attributed to unsafe handling and direct contact with waste and other disease vectors that waste pickers were exposed to at work (Nguyen *et.al.* 2003).

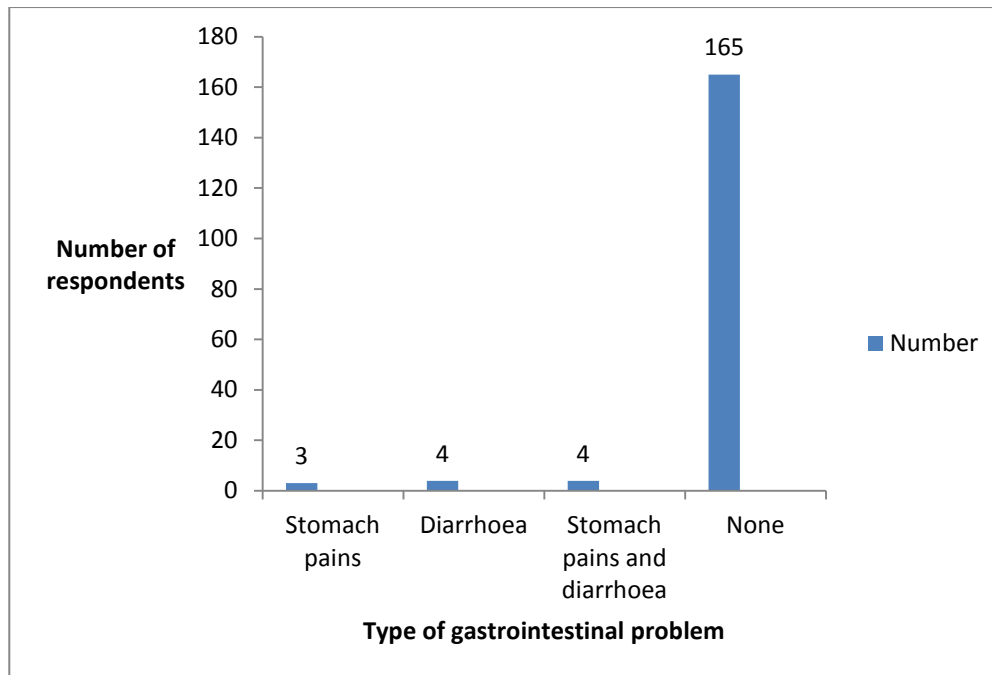


Figure 4-19: Number of waste pickers with gastrointestinal problems

On some days, waste pickers would get vegetables from the Tshwane market but for this study, it was not concluded that they took them for their own consumption. The researcher heard different views about the food that waste pickers would get from the landfill sites. Waste pickers took some bags of vegetables from the landfill site as shown in Figure 4-20.



Figure 4-20: Example of food that some waste pickers take from the landfill site

4.4.3.5 Vision and Hearing Problems

From the study, 68% of the respondents had no vision problems and 89% had no hearing problems. It was worth noting that the majority of those who reported vision and hearing problems were people over 50 years of age.

4.4.4 Causes of and Beliefs about Health Problems

From the study, the highest percentage (43%) believed that their illnesses were work related whilst 34 % of waste pickers said they were not ill at all and did not suffer from any of the illnesses listed in the above paragraph. About 19% of the respondents believed their illnesses were not work related; some of the respondents in this category were people who were undergoing treatment for TB and asthma. Some respondents mentioned that they had asthma before they started working at the landfill site and that was found to be the same with those on TB treatment. The minority (4%) reported that they did not know if their illnesses were work related.

Of those who reported that they believed their illnesses were work related, the reasons given for their beliefs were the following:

- Smell at the dump
- Exposure to sun for long periods
- Bending for long periods
- Dust at the landfill site
- Others coughing but still reporting for work
- Chemical fumes
- Use of unclean water when washing and bathing
- Oil spills in eyes from a truck

4.5 Health Protection Behaviours

The issue of personal protective equipment plays a big role in management of solid waste. From the research, there was a concern that waste pickers not protecting themselves when working at the landfill sites. It was observed that the majority of waste pickers did wear boots and gloves but not many of them wore masks when

working. The municipal workers on site also said they hardly saw waste pickers wearing masks as they complained that the masks made it difficult for them to breathe. When asked if they had tried using them, many waste pickers said no, but they did not think the masks were comfortable. The other reason was that most of them found the protective gloves from the waste at the landfill site and they were previously used. They did not want to use masks that had been used before. They also did not want to buy their own masks.

An observation about the protective gloves they used was that most of them did not have matching pairs as they were salvaged from waste (see Figure 4-21 below). There was a preference between females and males in the use of gloves. Most men preferred the plastic gloves shown while many women said the gloves shown were a bit heavy on their hands and preferred cloth gloves, which were lighter, and as most women did not recover metals, they were comfortable with the gloves they were using. The researcher also observed that most women wore hats but only a few men did so.



Figure 4-21: Gloves used

Municipal workers also informed the researcher that almost all waste pickers wore boots, even though many of them wore oversize boots. Those who did not wear boots

wore closed shoes. They had never observed waste pickers wearing sandals or open shoes while at work.

4.5.1 The use of Personal Protection Equipment

Waste pickers were aware of how they should protect themselves when at the workplace and they were aware of the risks to injury if they did not use personal protective equipment (PPE). Figure 4-22 shows the number of waste pickers who made use of different personal protective equipment according to gender from the 176 participants.

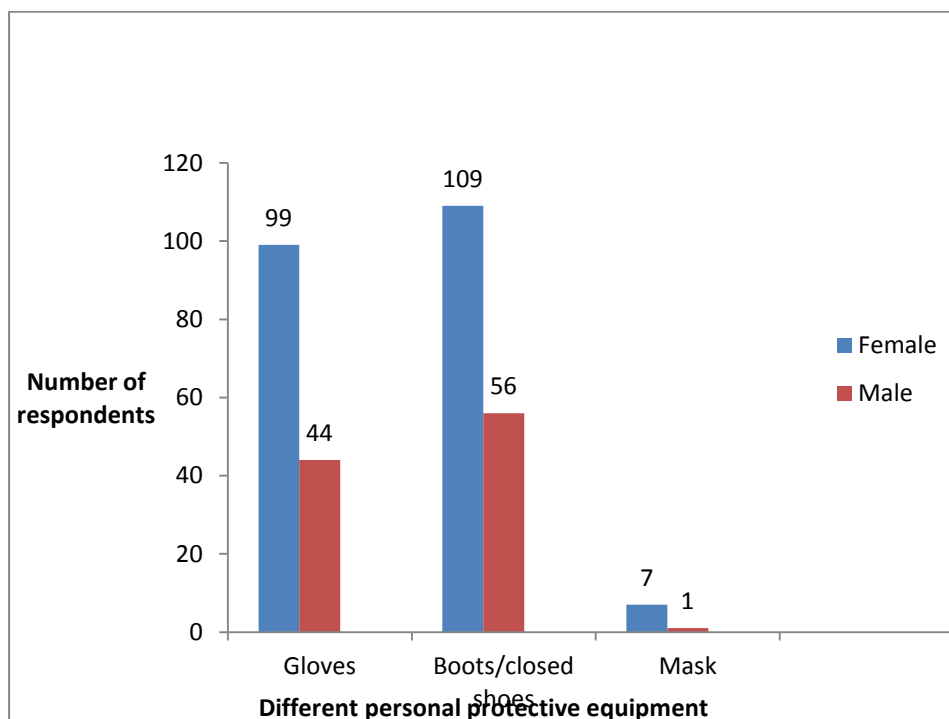


Figure 4-22: Number of waste pickers who made use of different PPE

The use of personal protective equipment was further presented according to the different landfills as in Figure 4-23. The percentages showed almost the same patterns, except in Ga-Rankuwa, where 65% of waste pickers indicated that they used gloves while working, which is much lower than other landfill sites that are at 82% and 84%. It was established that the municipality had had several programs with waste pickers, educating them about the use of personal protective equipment. Despite all the training, it was still a challenge to get them to use some of the PPE, especially

the masks. Many waste pickers complained about the dust and yet did not wear masks. Proper preventative measures for protecting themselves were available but not utilised effectively.

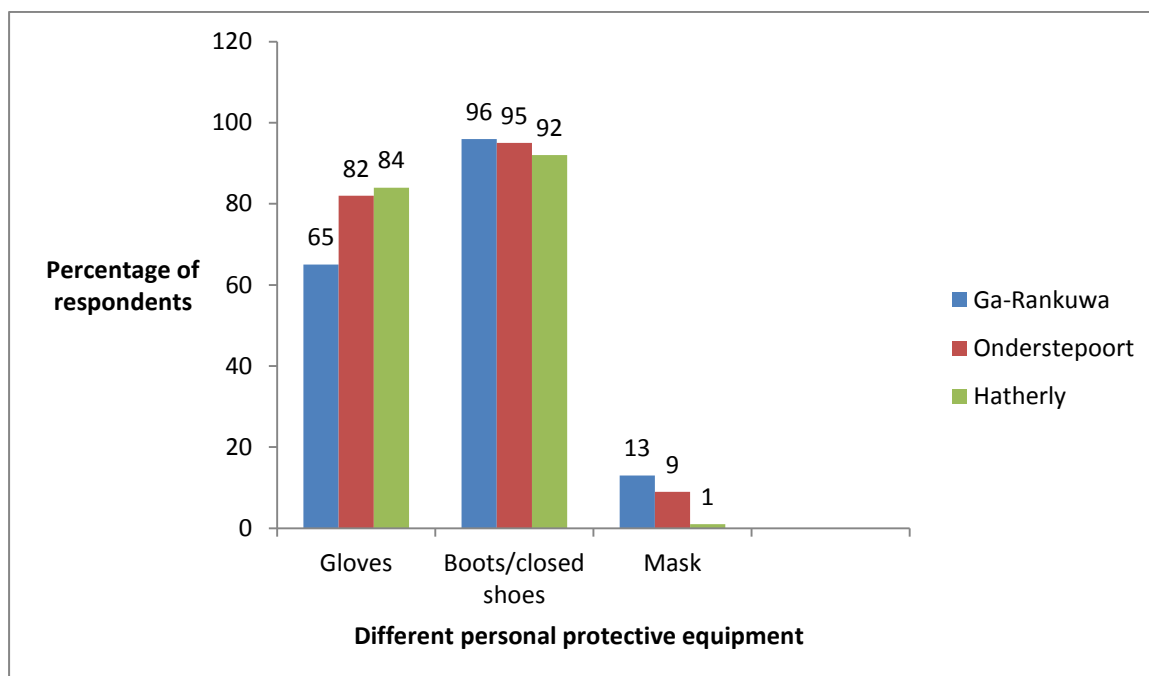


Figure 4-23: Percentage on the use of PPE per landfill site

4.5.2 Exposures at Landfill Sites

Waste pickers were asked about the different exposures they had come across when at work and their responses are presented in Figure 4-24. From Figure 4-24, 96% stipulated that they had come across sharp metal edges and broken glass. This result was alarming, as only 81% of them had said that they wore gloves. From the survey, 95% of waste pickers said they were exposed to dust, and saw this as one of the reasons for some of their respiratory problems.

About 91% of waste pickers said, they were exposed to flies, rats and mosquitoes, whereas, 24% of waste pickers said they were exposed to faeces, blood, which they classified in terms of sanitary pads and nappies with faeces, dumped at the landfill sites. This was to be expected because of the kind of waste that was dumped. There were more flies before compacting than after. The high percentage of exposures

should be alarming to waste pickers and this should give them every reason to use personal protective equipment.

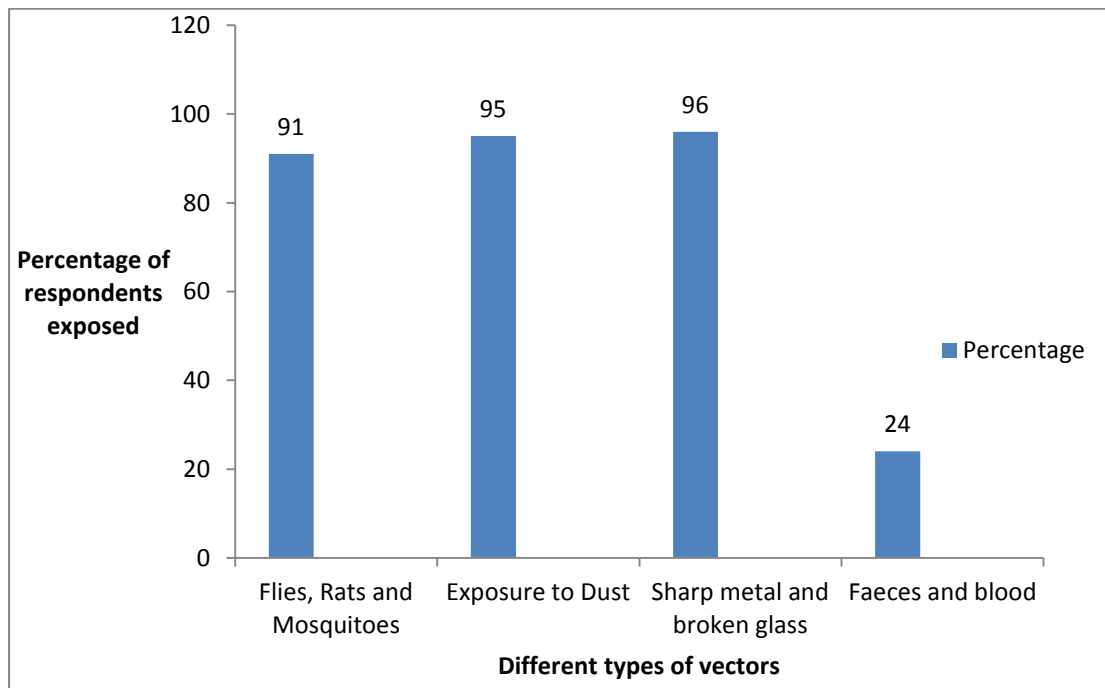


Figure 4-24: Percentage of respondents exposed to different vectors

The landfill site is a working area and it will always have dust as in Figure 4-25.



Figure 4-25: Dust at the tipping point

One of the observations made by the researcher was that the municipal workers tried to reduce the amount of dust by sprinkling with water along the road where trucks travelled at all three sites under study as in Figure 4-26 below, but there was no way of sprinkling water when the waste was being dumped.



Figure 4-26: Water sprinkling along the roadside at the landfill sites

4.6 Concluding Remarks

The study portrays a picture of people working in seriously harsh conditions in order to support their families. Waste picking is an informal sector activity that has not yet attracted much official attention. Waste pickers are aware of the dangers at the landfill sites as the majority of them consider a landfill site to be an unsafe working place.

The socio-economic parameters from the findings give an overview of how society marginalises waste pickers whereas all they want is to be able to support themselves and their families. The low income associated with the hard labour needs some reviewing with buy-back centres and on-site buyers. Despite their tough working conditions, waste pickers continue to work daily in search of recyclable materials that

will generate earnings from which they can afford to pay for the education of their children.

Waste pickers risk their health and injuries in the hope of being able to survive their adverse state of poverty. Their low level of literacy works to their disadvantage in finding employment in the formal sector. However, some waste pickers have been in the sector for many years and have found that they have throughout all the years managed to support their families with the little income generated from waste picking. The health status of waste pickers is of great concern for public health reasons as they travel from their homes and communities on a daily basis and come back from the landfill sites with the risk of spreading illnesses to their families.

There are still challenges that they experience at the landfill sites that need serious attention from all stakeholders. Waste management at the landfill sites should be addressed with a critical eye. Although waste pickers are self-employed, their well-being needs to be taken care of as in the literature reviewed in this study.

4.7 References

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CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter provides a summary of the results drawn from the aim and objectives of the study in Chapter 1. This will be followed by limitations of the study and recommendations to stakeholders in waste management. Gaps and scope for further research are outlined, as well as a conclusion of the study.

5.1 Summary

The main aim of the study was to study the perceived health status and the working conditions of waste pickers working at landfill sites. The following four objectives were stated in chapter 1 and their findings are summarised below.

5.1.1 Objective One: To Identify Health Status of Waste Pickers

The majority of waste pickers (60%) in this study viewed their health status to be fair as compared to their peers, though 59% reported that they did not consult any clinic/hospital or doctor in the previous six months. There were high percentages of respondents who said they were not ill and did not suffer from any illnesses inquired about in the study. About 55% of the respondents said they had not suffered from musculoskeletal and respiratory problems. Of the 176 waste pickers taking part in this study, 146 said they had not experienced skin problems while 165 of them did not have any gastrointestinal problems. Lastly, 68% and 89% of the respondents had no vision and hearing problems respectively.

Of the respondents who reported ill health, 43% believed that their ill health was work related whereas 19% believed it was not work related and could be due to aging. It is worth noting that these were the perceptions held by the waste pickers themselves.

5.1.2 Objective Two: To Document Working Conditions of Waste Pickers

Waste pickers at landfill sites put themselves at risk of injuries. The majority of the respondents reported that the landfill sites were not safe to work at, with 85% of females and 78% of males agreeing on that matter. The remaining 22% of the

respondents reported injuries at work. It can be said that the majority did not sustain injuries, but a 22% injury rate at the workplace is a concern. Working at a landfill site is physically demanding and when you take a break, you lose money by not finding more recyclables. Waste pickers reported that they continued to work even when they were tired to be able to get some earnings on a daily basis. From the study, 90% of the respondents revealed that they lifted heavy objects on a daily basis and yet were not paid enough money for their hard labour.

There are supporting structures on site, and 97% of waste pickers reported that they helped each other when the need arose.

5.1.3 Objective Three: To Explore Health Protection Behaviours, knowledge of health risks, health and safety attitudes and practices among waste pickers

Waste pickers are aware of the health risks and they need to take health precautions while on site. The majority of them used personal protective equipment, although only 4.5% of the respondents reported using masks. This is a very low percentage of mask users since a landfill site is a dusty area. Some were complaining about chemical fumes, and yet they attested to not wearing a mask with the belief that it was uncomfortable to work with them on.

Waste pickers at all the sites in the study were careful about how they worked on site and some reported attending training on health protection behaviours.

5.1.4 Objective Four: To Explore the Challenges and Experiences faced by Waste Pickers

The challenges were different for each site. As Ga- Rankuwa is a small landfill site and has fewer waste pickers, the challenges were less. The waste pickers at that site reported that they worked well with municipal officers and they were provided with a mobile toilet and drinking water. Their municipal officers gave them time to search for recyclables and they had a sorting site where they were able to sort out what they had salvaged from waste.

The challenges at Onderstepoort were more to do with buyers on site who were paying different amounts for the same recyclables. There was more organization in terms of cooperatives and they worked well with municipal workers.

They were provided with mobile toilets and drinking water. The waste pickers at Onderstepoort had hired a security company to guard their recyclables at night. There were small structures constructed at the site, which were used for storage and changing facilities. The researcher would like to point out that the structures, which some people called shacks were not there for waste pickers to sleep in, as many members of the community would believe. Waste pickers leave the site at 5.30 pm daily and the security company takes over the security function.

The largest landfill site had more challenges and more people. Unfortunately, the researcher only managed to have two cooperatives for this study and the majority of waste pickers at this landfill site did not participate in the study. As the landfill site is located not far from the community, there were other challenges such as young men on drugs who stole some of the recyclables left on site. Waste pickers at Hatherly hired a security company to manage order at the entrance, as there was no proper gate at the site.

5.2 Limitations of the Study

The study was conducted in CTMM where the landfill sites are not privatised and fall under the municipality's care. The applicability of this study to the rest of South Africa is therefore limited, as most privately operated landfill sites do not even allow waste picking on site.

There was reluctance by some waste pickers to answer the questionnaire as they felt that this might create problems with the municipal offices and put them at risk of being evacuated from the landfill sites.

The time limit for answering the questionnaire was too short, as waste pickers could not elaborate further on some of the questions asked.

The high illiteracy of waste pickers made it difficult for the researcher and field worker to cover all who could not write, in the time available.

Some people were very sensitive when asked about their health status. The researcher found males did not feel comfortable talking about their health status.

5.3 Recommendations

This section draws upon what was learnt through the review of literature and the findings in the sector. The recommendations are intended to guide policy makers and stakeholders in waste management, including recycling companies and waste pickers.

5.3.1 Waste Management Stakeholders and Policy Makers

It is recommended that waste management stakeholders need to work with policy makers in establishing a good working environment for all. There should be policies regulating how and what should be disposed of at the landfill sites. Measures of ensuring compliance must be investigated. The waste pickers at landfills are self-employed but work on the municipal premises; therefore, there should be strict regulations and control at all landfill sites. The Municipality should erect fences and improve safety and security at the landfill sites.

Policy makers should look at integrating waste pickers or their organizations into the formal solid waste management systems. Recycling forms part of the waste hierarchy and for recycling to be more effective, there should be accommodation of waste pickers in the whole value chain. Diverting recyclable waste to the MRF's will help waste pickers sift through waste before it is deposited and buried in the landfill sites in a safe way. The reality is that they are working under unhygienic conditions, so to help them work in better conditions and not put their health at high risk for occupational diseases, there should be alternative measures employed.

There is a need for public awareness on recycling and waste picking to remove stigmatization and marginalization of waste pickers. This may reduce the exploitation to which waste pickers sometimes succumb. A regulatory framework based on waste classification systems should control all waste treatment facilities.

5.3.2 Waste Pickers

Waste pickers are encouraged to form cooperatives and decrease exploitation by buyers on site. It was worth noting that if waste pickers at landfill sites were very organized; it may make it easier for them to organize regular training on health protection behaviours including emergency first aid training.

It was observed that there were no first aid kits on site; it is recommended that waste pickers have a basic first aid kit on site in case of emergencies.

It must be emphasised that waste pickers should use proper personal protective equipment and be encouraged to go for regular medical consultations.

5.4 Gaps and Scope for Further Research

The study focussed on the working conditions and the health status of waste pickers at landfill sites. The researcher identified gaps in research regarding the health status of waste pickers working at landfill sites. Currently, there is limited research in South Africa on risks of working at a landfill site and there is a wide scope for future research. More research is still required on the health effects of mismanagement of solid waste pickers. The study concentrated on subjective assessment of waste pickers' health, but further research on objective assessments is necessary and critical in finding the reality of waste pickers' health status. More on the epidemiological study of landfill waste pickers should be addressed as this is a concern for public health.

There are gaps identified in the benefit of sorting at source. Waste pickers risk their health and injury while sorting waste to recover materials that could be recycled. If there was proper education and people were made more aware of the need to recycle then waste pickers would be able to look for recycling material in safer working conditions where only recyclable items were found.

There is a need for more research to limit the large amount of waste that is disposed of at landfill sites; there are proposed projects within CTMM on conversion of waste to energy. This could lead to creation of more space on landfill sites and avoid early closure of the landfill sites.


The majority of waste pickers said they were working there to be able to provide for their families and to be able to educate their children. Research into how their children are progressing is crucial, as it would be interesting to know how far they are continuing with their education and if they eventually become employed in the formal sector.

5.5 Conclusion

This study intends to facilitate improvement in the working conditions of waste pickers and to raise awareness of their health status. Like everyone, waste pickers have the right to an environment that would not cause harm to their health. Objective assessments need more research to be undertaken for reasons of public health management in our communities and to facilitate an improvement in the waste management field.

APPENDICES

Appendix A: Permission letter to conduct research by City of Tshwane Metropolitan Municipality

 <p>CITY OF TSHWANE IGNITING EXCELLENCE</p>	<p>Research and Innovation Department</p> <p>Research and Innovation Department Eco- Origin Building First floor Block F 349 Witch-Hazel Avenue Highveld X79 Pretoria 0001 PO Box 440 Pretoria 0001 www.tshwane.gov.za Tel: 012 358 2000 / 012 358 1428 Fax: 123 358 4464 Email: Zukiswano@tshwane.gov.za www.tshwane.gov.za www.facebook.com/CityOfTshwane</p>
My ref: Access letter	Tel: 012 358 4559
Your ref:	Fax: 012 358 4464
Contact person: Pearl Maponya	Email: PearlMap3@tshwane.gov.za
Section/Unit: Knowledge Management	
TO: Ms Mathema Mothiba	DATE: 28/11/2014
65 Villa Nova	
265 Jean Avenue	
Lyttelton	
0153	

APPROVAL TO CONDUCT RESEARCH IN THE CITY OF TSHWANE MUNICIPALITY

Your request to conduct research on the topic *"Health status and working conditions of waste pickers living near and working on landfill sites in the Tshwane Municipality"* has been reviewed and we are pleased to inform you that permission is hereby granted for you to conduct research in the City of Tshwane Metropolitan Municipality.

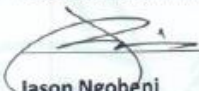
Research will be conducted in collaboration with the Department of Environmental Management and at the following landfill sites as mentioned by you in your proposal:

- Onderstepoort
- Ga-Rankuwa
- Soshanguve
- Heatherly

Research and Innovation Unit will coordinate the whole process till the end; therefore any communication should be through the Unit.

Please be informed that upon completion of the study, the researcher is required to present the findings at the seminar which will be organised by the Research and Innovation Special unit, and a copy of the final results should be submitted to the Unit and this will be shared on the Knowledge Zone Portal.

The researcher is also required to sign a Confidentiality Agreement.

 Jason Ngobeni CITY MANAGER	<u>15/12/2014</u> DATE
--	----------------------------------

Kgoro ya Dimyakitiko le Mphahatso • Departement Navorsing en Innovasie • Lefapha la Bobadisi le Boithlamadi
Ndzawulo ya Ndzaviso na Masungulelo • UMnyango Wezobuchule Nocwaningo
Research and Innovation Department

Appendix B: Ethical clearance from UNISA



CAES RESEARCH ETHICS REVIEW COMMITTEE

Date: 27/11/2014

Ref #: **2014/CAES/179**

Name of applicant: **Ms MP Mothiba**

Student #: **32634374**

Dear Ms Mothiba,

Decision: Ethics Approval

Proposal: Health status and working conditions of waste pickers living near and working on landfill sites in the Tshwane municipality

Supervisor: Mr C Loans

Qualification: Postgraduate degree

Thank you for the application for research ethics clearance by the CAES Research Ethics Review Committee for the above mentioned research. Final approval is granted for the duration of the project, **subject to the submission of the permission letter from the relevant authority.**

Please consider point 4 below for further action.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the CAES Research Ethics Review Committee on 27 November 2014.

The proposed research may now commence with the proviso that:

- 1) The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
- 2) Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the CAES Research Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*



University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
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www.unisa.ac.za

- 3) 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.
- 4) No data collection may take place until the permission letter has been submitted.
- 5) Although no mention is made of the use of photographs, the nature of the study may require that photographs be taken. Should this be the case, permission must be obtained first from the relevant authority and submitted to the Committee.

Note:

The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the CAES RERC.

Kind regards,



Signature

CAES RERC Chair: Prof EL Kempen



Signature

CAES Executive Dean: Prof MJ Linington

Please note conditions
good luck.



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Appendix C : Research survey Questionnaire

Waste Pickers Survey Questionnaire

Age

Male

Female

Are you married

Yes

No

1. Of the people in your household, who earns the most income?
2. What type of work does he/she do?
3. What is your average daily income at this job?
4. Do you feel that you have a good enough income to get by in daily life?
5. If there were a place for you to borrow money from, what would you use it for?
6. What is your highest qualification?
7. If given the opportunity, would you continue with your education? Why or Why not?
8. How old were you when you began collecting waste?
9. Do you and your peers help each other when you encounter problems at work?
10. How many days per week do you work?
11. What do you like about your job?
12. What do you dislike about your job?
13. How do you get to work?
14. Do you wear any of the following items when you are collecting waste?
Gloves...Masks...Sandals...Closed shoes...Boots...
15. Do you lift objects while working?
16. When you work, are you exposed to any of the following?:
 - Airborne dust
 - Flies/ Mice/ Mosquitoes
 - Sharp metal/ broken glass
 - Faeces/ Blood
17. Under what weather conditions do you work?
18. Have you ever been subject to any physical or any kind of abuse from your peers because of your line of work?
19. Have you ever been injured at work? If yes, elaborate.
20. Do you feel safe at work? Why or Why not?
21. Compared to your peers, do you consider your health to be? Poor.....Fair.....Excellent
22. In the past six months, did you ever visit a doctor, clinic, hospital or health worker? If so, for what?
23. In the past six months, have you experienced any of the following problems? Please tick and then put a cross where it has not been experienced.
 - a. JOINTS/ MUSCULOSKELETAL:
 - i. Joint pain
 - ii. Back pain

iii. Other (please specify)

b. SKIN:

- i. Rash
- ii. Hot irritated skin
- iii. Cut
- iv. Bruise
- v. Other (please specify)

c. RESPIRATORY:

- a. Cough
- b. Coughing with blood
- c. Shortness of breath
- d. Other (please specify)

d. GASTROINTESTINAL:

- a. Stomach ache
- b. Diarrhoea
- c. Bloody stools
- d. Other (please specify)

e. Vision problems

f. Hearing problems

24. Do you believe that any of the above illnesses were work-related? Please explain.

Appendix D: Draft manuscript

Title: A study on working conditions and health status of waste pickers at some landfill sites in the City of Tshwane Metropolitan Municipality.

Authors: M. P. Mothiba, C. Loans and S. J. Moja

Journal: Waste Management

Year: 2016

Appendix E: Turnitin Originality Report

MSc Environmental Management dissertation by Mp Mothiba

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