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**MUNICIPAL SOLID WASTE MANAGEMENT IN THE CITY OF  
POLOKWANE MUNICIPALITY: ASSESSMENT OF THE CURRENT  
STATUS, PROBLEMS AND CHALLENGES**

by

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**(201463997)**

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the degree of**

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JOHANNESBURG

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## DEDICATION

This work is dedicated to my mother Mokgadi Morudu, my brother Milton Morudu, my wife Masina Litsoane-Morudu, and my children Shabi, Tumisho and Matome Morudu.



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I would like to thank God for giving me energy and strength to accomplish this research. I wish to express my gratitude to my supervisor, Prof. Gijbert Hoogendoorn and my co-supervisor, Dr Isaac Rampedi for their help, guidance, encouragement, and supervision throughout the research. They tirelessly pointed out my mistakes and made constructive criticisms, which contributed to successful completion of this research. My special thanks to my colleagues and friends for their contribution and support.

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## ABSTRACT

Municipal solid waste management involves all the functions of direct waste generation, storage, collection, source separation, processing, transport, treatment, recovery and disposal to landfill in a manner that it will not be harmful to the environment. Management of municipal solid waste is a complex problem, mainly because of the constantly increasing amount of waste and its resultant financial implications. Municipalities are responsible for waste management in cities, and they are experiencing challenges in order to provide an efficient and effective waste management service. The aim of this study was to generate an overview of the current state of municipal solid waste management and challenges related to its management thereof in the City of Polokwane Municipality.

Ninety questionnaires were administered randomly to selected residential areas of Flora Park, Nirvana and the Seshego Township where in each residential area 30 questionnaires were administered. Interviews were also conducted with key municipal official regarding their role, waste management practices as well as the waste minimisation initiatives in the municipality.

The findings of the study revealed that solid waste management in the City of Polokwane Municipality only involves collection from households, and transportation of waste to the landfill for disposal. This simply means that source separation, recovery, and re-use are not part of the management system. This situation is the result of challenges that the municipality is facing which include insufficient funding, ineffective implementation of legislation and policies coupled with lack of cooperation with the community, which result in illegal dumping.

The study concluded that there is much to be done in relation to proper waste management in the City of Polokwane because implementation of the municipal solid waste management is inadequate. It was therefore recommended that the municipality should work in collaboration with business and the community in order to address the challenges they are facing.

## LIST OF ACRONYMS AND ABBREVIATIONS

CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EPA	Environment Protection Agency
GDP	Gross Domestic Product
IDP	Integrated Development Plan
IWMP	Integrated Waste Management Plan
MSWM	Municipal Solid Waste Management
NEMWA	National Environmental Management Waste Act
NGOs	Non-Governmental Organisations
NWMS	National Waste Management Strategy
RSA	Republic of South Africa
StatsSA	Statistics South Africa
UNEP	United Nations Environment Programme
USEPA	United State Environment Protection Agency

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## CHAPTER 1: INTRODUCTION AND RESEARCH BACKGROUND

### 1.1 Introduction

Municipal solid waste is commonly known as garbage consisting of everyday items used and then thrown away such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This waste comes from homes, schools, hospitals, and businesses (Cheremisinoff, 2003; Erkut et al., 2008; Demirbas, 2011). In addition, Kassim, (2012) and Medina, (2010) refer to municipal solid waste as discarded materials for which municipalities are usually held responsible for collection, transport, and final disposal. Studies have been conducted on municipal solid waste and it was revealed that increasing population numbers, growing economy, rapid urbanisation and the rise in community living standards have greatly accelerated the municipal solid waste generation rate in developing countries (Guerrero et al., 2013; Singh et al., 2014; Zhang et al., 2010).

Management of municipal solid waste has become an issue of global concern (Kassim, 2012; Ezeah & Roberts, 2012). This result to an increase in health and environmental implications associated with solid waste management, which becomes a challenge in both developed and developing countries (Marshall & Farahbakhsh, 2013). Kathiravale and Yunus (2008) noted that waste generation has been part of humankind's pursuit of development through social and economic activities. However, the generation rate of municipal solid waste varies according to the economic and social standing of the country (Hasan, 2004).

### 1.2 Statement of the research problem

Management of municipal solid waste is a complex problem, mainly as a result of the constantly increasing amount of waste and its financial implications (Asim et al., 2012). Municipalities are mostly responsible for waste management in cities, and they have a challenge to provide an efficient system to the inhabitants (Pillai & Shah, 2014). Consequently, they often face problems beyond their ability to tackle problems, mainly due to lack of organisation, financial resources and necessary expertise to handle the increasing problem of solid waste management. This results in uncollected waste on

roads and other public places (Kgosiesele & Zhaohui 2010). Rapid growth in waste generation rates, high cost of waste disposal and depletion of landfill space results in open dumping. These areas easily become sources of contamination from the incubation and proliferation of flies, mosquitoes, and rodents, which in turn transmit diseases that affect people's health (Abul, 2010; Kadafa et al., 2013).

Al-Khatib et al. (2007) indicate that despite workable legislation, regulations and action plans which are now in place, waste disposal in developing countries is still largely random and uncontrolled, resulting in large quantities of waste remaining uncollected. Zhang et al. (2010) observe that most developing countries still have a long way to go to meet the standard of the developed countries with respect to management of solid waste and minimisation practices. It is believed that waste separation before collection will reduce the amount of solid waste generation and facilitate recycling of materials and reduce the overall cost of waste disposal (Zhang et al., 2010; Yuan et al., 2006). Therefore, there is an urgent need for recycling as a form of waste management and minimisation in order to stop the devastating effects of solid waste. Recycling should be encouraged and managed properly as it also provides a local source of income and reduces the amount of waste for disposal (Kassim, 2012).

### 1.3 Aim and the objectives of study

The aim of this study is to generate an overview of the current state of municipal solid waste management (MSWM) and challenges related to its management in the City of Polokwane Municipality.

The objectives of the study are:

- To identify the current status of solid waste management initiatives within the study area
- To investigate the problems in MSWM in the study area
- To examine perceptions of the community regarding MSWM in the study area

#### 1.4 Justification of the study

Solid waste management is a global issue which is a growing source of concern in both developed and developing countries because of increased urbanisation, changes in consumer patterns and industrialisation that all directly influence solid waste generation (Kadafa et al., 2013; Butu & Mshelia, 2014). There is a constant increase in the volume of solid waste being generated at a faster rate than the ability of the authorities to improve on the financial and technical resources needed to parallel this growth (Ogwueleka, 2009).

South Africa, like many other developing countries, has solid waste management challenges (Matete & Trois, 2008). This includes problematic issues like inadequate waste collection services, illegal dumping, unlicensed waste management activities, lack of space at the permitted landfills, insufficient waste minimisation and recycling initiatives, a lack of waste information, and lack of regulation and enforcement of legislation (Nahman & Godfrey, 2010). In cases where waste management regulations are in place, there may be no detailed information on how municipalities are enforcing and complying with the available laws and regulations to implement goals of waste management to promote the quality of the urban environment, generating employment and income, protecting environmental health and supporting the efficiency, and productivity of the economy (Ogwueleka, 2009; Musademba et al., 2011).

When the National Environmental Management: Waste Act No. 59 of 2008 (NEMWA) was published, it brought about a significant policy shift for waste management in South Africa which led to the introduction of a waste management hierarchy approach that advocates waste avoidance, reduction, re-use, recycling, and recovery as priority options with treatment and disposal as a last resort. In addition, the National Waste Management Strategy (NWMS) was also developed to address waste management aspects including the promotion of waste minimisation through re-use, recycling and recovery aiming to divert 25% of the recyclables from landfills in 2016. This target has not yet materialised (Fakoya, 2014; DEA, 2012a). Godfrey (2008) indicates that there is no reliable data in terms of the amount of waste generated, recycled and disposed and this makes management of waste in South Africa more difficult.

Recovery, re-use and recycling have been identified as appropriate waste minimisation strategies to manage the rapidly growing waste stream and ideally reach a situation of zero waste (DEA, 2012a). However, the management of municipal solid waste constitutes a challenge for the local governments, especially where proper records of waste generation, sources and composition are not maintained (Henry et al., 2006). Lino & Ismail (2012), as well as Ketlogetswe & Mothudi (2005) report that millions of tons of municipal solid waste are deposited in landfills daily and other dumping sites all over the country.

This study focuses on different aspects of MSWM systems such as collection, transportation of waste, and disposal, identifying the main problems and limitations that hinder improvement in the current MSWM practices as well as suggestions regarding measures to be taken to alleviate these problems. In the end, the study will be able to provide information on the current situation of waste management in the City of Polokwane and the surrounding residential areas. The study will reveal the composition of household waste produced in the area, and how waste is being treated. It will also provide some suggestions for improvement in the management of household waste for sustainable development, and offer information on municipal solid waste collection services available and waste disposal practices in the area.

Moreover, the study will generate an overview of MSWM challenges related to waste minimisation and recycling. The intention of this study is to highlight some good practice initiatives which may result to real improvements in the way waste is managed within the municipality. In so doing, it is hoped that other municipalities may learn from these approaches and identify simple and innovative solutions to solve some of the waste management problems in the short term, as a first step towards implementing best practice waste management approaches.



## CHAPTER 2: LITERATURE REVIEW

### 2.1 Introduction

Waste generation is an integral part of human activity influenced by social dynamics and economic development (Kadafa, 2013; Shekdar, 2009; Khatib, 2011). The amount of solid waste generated in the world is gradually increasing and most of the countries around the world are focusing on ways to approach the challenges posed by MSWM (Amuda et al., 2014). Although nature has the capacity to dilute, disperse, degrade, absorb and reduce the impact of unwanted residues in the environment, it becomes a challenge when the ecological imbalances have occurred where the natural assimilative capacity has been exceeded (Kadafa et al., 2013; Shekdar, 2009). Waste management has been identified as a challenge in the world, especially in the developing countries. Increasing population, economy growth, rapid urbanisation and the changes in community living standards have greatly accelerated solid waste generation (Song et al., 2014; Kassim, 2012; Kadafa et al., 2013). This situation results in increased volumes of waste illegally dumped leading to environmental pollution and subsequent health hazards (Amuda et al., 2014; Narayana, 2009; Al-Khatib et al., 2015; Lega et al., 2012; Zamorano, et al., 2009).

In a South African context, municipal solid waste is defined as waste that does not pose an immediate hazard or threat to health or to the environment, and includes domestic waste, building and demolition waste, business waste, and inert waste. Municipal solid waste is discarded materials arising from operational activities which have taken place in different land use areas (Butu & Mshelia, 2014). Municipal solid waste is defined by the Environment Protection Agency (EPA) as waste consisting of everyday items that are thrown away as they are of no further use. These are mainly produced by households, though similar wastes come from sources such as commerce, offices and public institutions (USEPA, 2013). Cointreau (2006) defines municipal solid waste as waste which is basically generated from different sectors of society such as households, educational, health and commercial institutions, as well as public places and which is taken care of either directly or indirectly by the municipal or local authorities (Williams, 2005). Similarly, the European Environmental Agency (EEA, 2009) defines municipal solid waste as waste from households, and other waste

which because of its nature or composition is similar to waste from households. Every unwanted or non-useful solid substance generated in any human population is referred to as solid waste (Kaseva & Mbuligwe, 2003). However, the definition used in different countries varies reflecting the diverse waste management practices (USEPA, 2013; Ngoc & Schnitzer, 2009; Demirbas, 2011).

## 2.2 Municipal solid waste generation sources and compositions

There are many different sources of solid waste in municipal areas. Waste comes from the residential population, commercial establishments and public and private institutions. In most countries, solid waste is defined in terms of certain categories according to legislation. However, in reality, anything and everything that is discarded ultimately has to be managed by the municipalities (Shekdar, 2009). Municipal solid waste is generated by households, commercial activities and other sources whose activities are similar to those of households and commercial enterprises, for example, wastes from offices, hotels, supermarkets, shops, schools, institutions, and from municipal services such as street cleaning and maintenance of recreational areas (Ngoc & Schnitzer, 2009). Households are considered major sources of solid waste in comparison to other sources of generation such as educational and commercial institutions or from cleaning of public places such as streets (Magutu & Onsongo, 2011).

The major types of municipal solid waste are food wastes, paper, plastic, rags, metal and glass, with some hazardous household wastes such as electric light bulbs, batteries, discarded medicines and automotive parts. These wastes are mostly generated by two categories of society: the household/residential sector and the business/commercial sector. The industrial sector generally disposes of the waste they generate. Therefore, such wastes do not constitute part of that encountered on a daily basis (Kofoworola, 2007). In the municipal solid waste stream, waste is broadly classified as organic and inorganic (Hoornweg & Bhada-Tata, 2012).

Waste composition is influenced by many factors such as level of economic development, cultural norms, geographical location, energy sources, and climate as well as economic status of the area (Cheremisinoff, 2003). Abagale et al. (2012) note

that as the country urbanises and populations become wealthier, consumption of inorganic material increases, thus increasing the amount of waste generation. This is confirmed by Hoornweg and Bhada-Tata (2012) who find that low and middle-income countries have a high percentage of organic matter in their urban waste stream, ranging from 40% to 85% of the total amount of waste. Paper, plastic, glass, and metal fractions increase in the waste stream of middle and high-income countries. Similarly, Shekdar (2009) indicate that the proportion of recyclables is high in the developed economies, while degradable organic matter is high in the low gross domestic product (GDP) countries. Nevertheless, it becomes a problem in terms of waste management if the quantities are not known and if waste composition is not available to measure success in waste management.

### 2.3 Solid waste management best practice and possible approaches

Solid waste management is the systematic administration of activities that provide source separation, storage, collection, transportation, transfer, processing, treatment, and disposal of solid waste (Abila & Kantola, 2013; Agwu, 2012). Solid waste management normally has three basic components: collection, transportation and disposal (Pillai & Shah, 2014). Various ways of managing solid waste are disposal by either burying or burning, reduce or re-using, recycling and energy generation (Awosusi, 2010). Awosusi (2010) further comments that waste management is the selection and application of suitable techniques, technologies and management programmes to achieve specific waste management objectives and goals. Cheremisinoff (2003) confirms that various techniques exist to reduce the quantity of waste and its impact on the environment. Abila and Kantola (2013) add that irrespective of waste management strategies which may include prevention, reduction, re-use and recycling, the appropriate management of municipal solid waste still links to major environmental concerns.

Ogwueleka (2009) concludes that MSWM refers to the collection, transfer, treatment, recycling, resources recovery and disposal of solid waste in urban areas with the aim to promote the quality of the urban environment, generate employment and income, and protect environmental health and support the efficiency and productivity of the economy. Mbue et al. (2015) propose that the objective of solid waste management is

to remove discarded materials from inhabited places in a timely manner to prevent the spread of diseases, to minimise the likelihood of fires, and to reduce aesthetic insults arising from putrefying organic matter. The other objective of solid waste management is to reduce the quantity of solid waste disposed of on land by recovery of materials and energy from solid waste in a cost-effective and environmentally friendly manner (Pillai & Shah, 2014; Ogwueleka, 2009; Otchere et al., 2014).

Management of municipal solid waste continues to be a high priority for communities in the 21<sup>st</sup> century which has led to the introduction of integrated approach as an important element of sound practice waste management (USEPA, 2011). The approach involves integrated waste management for designing and implementing various waste management systems and for analysing and optimising existing systems. Furthermore, integrated waste management is based on the concept that all aspects of a waste management system should be analysed together, since they are in fact interrelated and developments in one area frequently affect practices or activities in another area (UNEP, 2005). Makgae (2011) observes that using this approach, waste management can be planned in advance because the nature, composition and quantities of waste generated can be predicted and as a result, an orderly process of waste management can succeed.

Although MSWM involves collection, transportation, re-use, recycle recovery and disposal, MSWM practices are distinct according to country (Cheremisinoff, 2003; Shekdar, 2009). Waste management services are rendered by the local government (municipality) or private service providers and may be carried out by employing the hierarchy of waste management (UNEP, 2005). Therefore, waste management hierarchy has been considered and prioritised to ensure waste reduction and volume reduction both at primary and secondary sources.

#### 2.4 Solid waste management hierarchy

The hierarchy is regarded as one of the important foundations of contemporary MSWM systems and has been popularly adopted for the development of policies related to waste management both on regional and national level, especially in developed countries (UNEP, 2005). The hierarchy's function is to aid in the management of waste

while ensuring little impact on the environment. As such, it is employed in the development of policies for resource management, for handling challenges of landfill scarcity, pollution control (of water and air), and to safeguard public health (UNEP, 2005; DEA, 2012a).

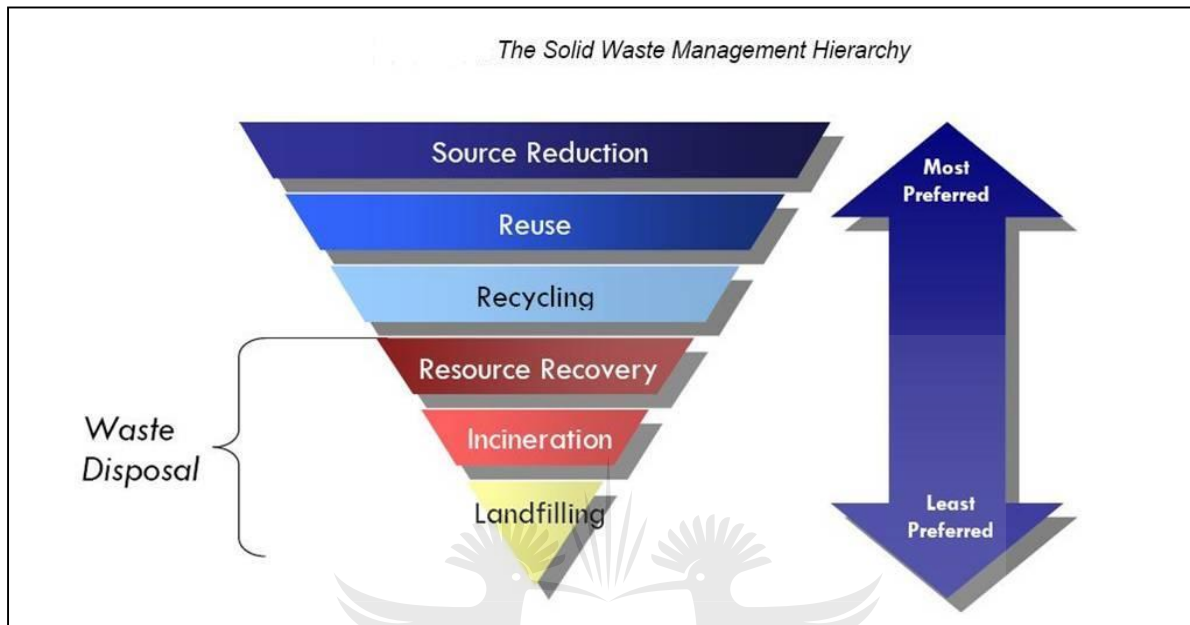


Figure 1: Waste management hierarchy (DEA, 2012a).

The concept of a waste hierarchy is widely used to implement waste minimisation strategies. Among others, these are the most recommended and compatible approaches for waste management that provide a framework for the development of sustainable municipal waste management services (White et al., 1999). Waste management hierarchy promotes the principles of waste prevention, waste reduction, re-use and recycling of which the basic goal is to minimise environmental pollution by introducing appropriate management measures to reduce generation of waste. The integration of the principles includes waste prevention, re-use, resource recovery, recycling, waste treatment and waste disposal by landfill as a last resort (Babalola et al., 2010; Makgae, 2011; Greben & Oelofse, 2009).

Waste prevention occupies the topmost stage of the waste management hierarchy (Muzenda et al., 2012). Waste prevention is considered the highest priority in waste policy in several regions (Gentil et al., 2011; Abila & Kantola, 2013). Medina (2010) asserts that society as a whole would benefit from a successful implementation of a waste prevention programme.

The next best option for solid waste management is re-use and this encompasses the utilisation of an item after its initial use, either for a purpose similar to that which it was intended or for an entirely new one (DEA, 2012a). This has been illustrated in the re-utilisation of bottles or plastic bags from stores (Williams, 2005). Abila and Kantola (2013) explain that the integrated waste management approach promotes the re-use of products and materials. Re-use consists of the recovery of items to be used again, perhaps after some cleaning and refurbishing (Medina, 2010).

After the re-use of materials and products, recycling comes next in the integrated waste management hierarchy. Waste can be recycled which involves the process of sorting, collecting, preparing, reprocessing and remanufacturing used materials into new or original forms (Mohee et al., 2015). Recycling makes a considerable contribution to environmental benefit, proving that source separation will be more important in dealing with municipal solid waste in future (Song et al., 2013; Abila & Kantola, 2013). It is feasible to recycle a large variety of materials such as plastics, wood, metals, glass, textiles, paper, cardboard, rubber, ceramics, and leather (Medina, 2010).

According to Muzenda et al. (2012) recovery is the second best waste management option which goes together with re-use and recycling. Recovery contributes to utilising the resources embedded in waste and saving raw material. This is the recovery of energy in the form of heat, electricity and fuel from non-recyclable materials through the application of various processes including combustion, gasification and anaerobic digestion (USEPA, 2015). Energy recovery from waste is one viable alternative source of energy (Abila & Kantola, 2013).

The final and least desirable step in the hierarchy of waste management is treatment and landfilling. Prior to disposal at landfill, waste must be treated either by chemical and or physical means (Muzenda et al., 2012). Although it is the most widely used option, landfilling is ranked the lowest in the hierarchy of waste owing to the lack of utilisation of the resources in the waste. It remains the most common waste treatment method in the world mainly because it is the cheapest method for organised waste management (Makgae, 2011; Vilas, 2015).

## 2.5 International approaches to municipal solid waste management

Many cities in Asia, Europe, America and Africa face serious problems managing their wastes (Zhang et al., 2010; Demirbas, 2011; Coelho et al., 2015). The major problems are the insufficient collection and inappropriate final disposal of wastes (Medina, 2010). Despite spending increasing resources on waste management, many cities particularly in Africa and Asia collect less than half of the waste generated (Amuda et al., 2014; Shekdar, 2009). Most wastes are disposed of in open dumps, deposited on vacant land, or burned by residents in their backyards. Insufficient collection and inadequate disposal generate significant pollution problems and risks to human health and the environment (Medina, 2010). The importance of solid waste management is now recognised at international, national and regional level (Kassim & Ali, 2006). The issue of MSWM is a challenge throughout the world, in both developed and developing countries (Kassim, 2012).

### 2.5.1 Municipal solid waste management in Asia

In Asia, the management of solid waste requires urgent attention, especially in countries such as China, India and Malaysia, and Singapore that have been categorised as emerging industrialised countries (Badgie et al., 2012). In addition, Asian countries are among those contributing to higher rates of municipal solid waste (Dhokhikah & Trihadiningrum, 2012). Open dumping, landfill and others waste management methods such composting and incineration are the most popular solid waste treatment methods in developing Southeast Asian countries. Although Badgie et al., (2012) discouraged the use of open dumping and landfill, these waste management methods are still dominating in Asia. This was confirmed by Dhokhikah and Trihadiningrum (2012) that the proportions were open dumping by more than 50%, followed by landfill ranging from 10-30%, and composting by less than 15% and then incineration by 2-5%. The open dumping technique has been applied to manage waste for many years, since it is a method that can handle the huge quantities of waste generated per day. This method is applied because it is generally the least costly and therefore the most common method to treat solid waste due to the percentage of organic material content (Ngoc & Schnitzer, 2009).

Massive urbanisation and rapid development of China's urban economy have increased their generation of municipal solid waste. As a result, MSWM has become a major challenge confronted by China, especially the urban areas (Tai et al., 2011). China is one of the countries that brought about an unprecedented increase in the amount of solid waste generation. Zhang et al. (2010) point out that no other country has experienced as large and fast an increase in solid waste quantities as that which China is now facing. Phillips and Thorne (2011) noted that in recent years, China has adopted a Western lifestyle in many of its urban areas, which has resulted in an increase in its generation of municipal solid waste. The challenges now being faced by solid waste management in China include reducing the quantity of waste from the source, promoting the recycling of solid waste, improving disposal levels and reforming solid waste management systems (Bijaj & Kumar, 2013). Tai et al. (2011) added that in order to control the pollution caused by MSW and reduce the pressure of waste disposal, some well-developed regions such as Beijing and Shanghai have initiated the source-separated program.

Generally, China still has a long way to go in the management of solid waste with respect to solid waste recycling, treatment technology and management strategy when compared with many more developed countries like Germany, Sweden, Japan, and the United States (Zhang et al., 2010). The growing impacts of this waste generation are gaining attention and MSWM is becoming a major issue. As a result, different governments have established various kinds of laws and regulations to enhance MSWM, while some developed countries such as Germany and Japan have achieved remarkable results in MSWM and cyclic economy using source-separated collection (Tai et al., 2011).

According to Zhang et al., (2010) government of China is not fully involved in recycling initiatives, therefore recycling and recovery is usually conducted by the informal sector or scavenging, which takes place at all levels and at every stage of waste management. When the scavengers sort through and remove the recyclables from the waste collection containers, they also often scatter about the remaining unwanted waste on the street (Yuan et al., 2006). Therefore, both the recycling rates and technical level of recycling of municipal solid waste in China are lower than most other countries (Huang et al., 2006).



Although incineration is one of the waste management options in China and has numerous advantages such as significant volume reduction, municipal solid waste disposal is predominantly by means of landfill wherein more than 90% of waste generated in China is still going to the landfill. In some cities, the waste management method is open dumps mainly because it is cost-effective and can accommodate large fluctuations in the amount and type of waste. Despite the involvement of government through the development of a comprehensive technical municipal solid waste landfill standard for China, the reality is that landfills are often poorly operated and good landfill practices are not well understood in the country (Zhang et al., 2010; Zhan et al., 2008; Yuan et al., 2006).

Management of solid waste is one of the most challenging problems in India's cities and towns. Increasing population levels, rapid economic growth and rise in community living standards accelerate the rate of generation of municipal solid waste in Indian cities. Most of the urban areas are currently facing a serious problem of land and water pollution due to the generation of huge quantities of solid waste and their open dumping (Archana et al., 2014). Currently, India produces about 48 million tonnes of urban solid waste annually (Agarwal et al., 2005). Bijaj and Kumar (2013) indicate that generation is overriding the population growth in Indian megacities and this is confirmed by the projection made that solid waste collection will rise to 235 million tonnes in financial year 2041.

According to Agarwal et al. (2005) MSWM continues to remain one of the most neglected areas of urban development in India. In many cities almost more than half of the solid waste generated remains unattended (Rathi, 2006). This results in waste collection efficiency being low, even in high-income cities. Often a substantial amount of waste is left to rot on the streets and/or is dumped into low-lying areas, canals and rivers (Kaushal et al., 2012; Kumar et al., 2009). This gives rise to unsanitary conditions especially in densely populated areas, which in turn may have serious health and environmental consequences (Agarwal et al., 2005; Kansal, 2002). Kaushal et al. (2012) identify factors responsible for such low collection efficiency as a lack of appropriate collection systems, inadequate collection facilities such as waste disposal bins, collection vehicles, lack of funds, and a lack of enforcement of appropriate regulations.

India is facing a lack of resources and technical expertise necessary to deal with the disposal of municipal solid waste which led to adoption of waste dumps and open burning as a waste management option. These methods have been continuing for years as the principal method of waste disposal (Kaushal et al., 2012). This is mainly because India lacks well-formulated guidelines and policy structure regarding waste management services, in the absence of which the municipal agencies have not been performing their duties in this aspect satisfactorily. Although a few rules exist in various municipal acts which govern the day-to-day running of these agencies, they have not served much purpose as a result of lack of enforcement (Gupta et al., 1998).

Zia and Devadas (2007) attempted to introduce a solid waste management system by analysing the major problems in India created by poor waste management services. A study by Archana et al. (2014) concludes that the present policy and infrastructure are inadequate in dealing with the enormous quantity of municipal solid waste generated. In addition, the establishment of new regulations for more effective and efficient integrated solid waste management system is also seen as necessary to define and implement waste management regulations (Jin et al., 2006).

Malaysia as a developing country encounters problems in terms of technology, manpower and land scarcity as well as with facilities that are insufficient to cope with the ever-increasing rate of waste generation (Badgie et al., 2012). Kathiravale and Yunus (2008) observe that capital city of Kuala Lumpur is usually the centre of attention for waste management problems owing to the congestion and overproduction of municipal solid waste. Kathiravale and Yunus (2008) further indicate that although Malaysia has a high development rate combined with strict environmental regulations enforced, because of the scarcity of land for waste dumping, landfilling of the waste generated has been the main option. This was confirmed by the fact that 50-70% of waste is collected and disposed of, while 20% to 30% is dumped illegally into rivers or is burnt. Ngoc and Schnitzer (2009) note that many landfills are unsanitary because of land acquisition problems, insufficient collection, disposal fees, and insufficient number of landfills.

In response to the solid waste management problems, the government of Malaysia adopted a strategy based on pollution control and prevention through the enforcement

of the Environmental Quality Act of 1974. The Act gives the government power to impose control on solid waste management facilities, particularly where it involves incinerators or landfills, through the Environmental Impact Assessment (EIA) provisions. The government has also issued EIA guidelines for municipal waste management, sewage and disposal (Badgie et al., 2012).

### 2.5.2 Municipal waste management in Europe

The common practice of waste management in the United Kingdom has been either to recycle, treat or dispose of waste at the end of a process. However, these are the least desirable ways of dealing with the problem. Ideally, it would be most environmentally acceptable to eliminate completely the generation of waste (EEA, 2013). Lino and Ismail (2012) reported that a recycling programme is one of the priorities of the government. Initiatives such as mass disclosures and continuous propaganda programmes, together with the continuous evaluation of the recycling systems are some of the strategies adopted to stimulate public adhesion. Because of a gradual increase in the amount of municipal solid waste, recycling operations have also increased in the United Kingdom and the situation has resulted in MSWM being high on the policy agenda (Fischer & Potter, 2011; Gentil et al., 2011).

Targets for diversion of waste from landfill have been set and progress has been recorded (Tonglet et al., 2004; Bench et al., 2005). In addition, governmental agencies in the European Union have established waste-related policies to reduce the environmental impacts of waste management, including reducing the amounts of waste (Gentil et al., 2011). Municipal waste management strategies were also developed at a local level, aiming to achieve more sustainable waste management practices with their focus on different aspects of the waste management hierarchy which includes waste reduction, re-use, recycling/composting and residual waste management (Fischer & Potter, 2011).

In Germany, MSWM involves different public and private sectors where the responsibility for waste disposal, transportation and recycling is being shared. Nonetheless, the municipality is also responsible for collection and transportation of waste for management where different waste types are separated and

treated/recycled by different public and private enterprises (Schwarz-Herion et al., 2008).

Schwarz-Herion et al. (2008) explain that three different waste types are gathered in different waste bins that are located in the resident's home. These are residual waste, reusable materials and bio-waste. These are collected separately to avoid combined collection of residual waste with other waste streams. Another system has been introduced, involving assorted reusable waste bins for dry and wet wastes to ensure that these wastes do not mix. In support of the system of MSWM in place, Germany has required consumer product packaging to be recycled since 1991 and more recently, automobile and electronics manufacturers have volunteered to take back their products and to meet recycling targets for these products at the end of their lives (Phillips & Thorne, 2011).

### 2.5.3 Municipal solid waste management in the United States of America

MSWM is a growing problem in the United States. Like many other parts of the world, the United States generates approximately 210 million tonnes per year (Massawe et al., 2014). However, the United States Environmental Protection Agency (USEPA) has collected data on the generation and disposal of waste in the United States for years; this data can be used to measure the success of waste reduction and recycling programmes across the country (USEPA, 2012).

About 63% of municipal solid waste in the United States is being landfilled while 12% of waste goes for energy recovery and 25% is taken for recycling. This was said to be the result of lack of state incentives and public misperception (Themelis & Mussche, 2013). In order to deal with the problem, many states and cities have responded by requiring households to recycle, where some even have specific goals such as requiring 50% recycling of municipal solid waste. Analyses have been done to check whether municipal solid waste recycling is beneficial or not, particularly recycling with curbside collection of recyclables, and the system has proved to be working (Phillips & Thorne, 2011). Municipalities across the country have successfully used these approaches as tools to minimise impacts of waste, mainly by voluntary recycling efforts

and encouraging proper disposal of wastes through training and awareness-raising (Massawe et al., 2014).

In addition, USEPA is helping change the way society protects the environment and conserves resources for future generations by going beyond recycling, composting, and disposal. Building on the familiar concept of reduce, re-use, and recycle, the agency is employing a systematic approach that seeks to reduce materials use and associated environmental impacts over their entire life cycle. This is called “sustainable materials management” (USEPA, 2012).

#### 2.5.4 Regional approach to municipal solid waste management

Management of municipal solid waste is one of the major environmental problems encountered by many countries, especially the developing ones like Nigeria (Ogwueleka, 2009). The problem of waste generation, disposal and management grew in Nigeria because of overwhelming population growth, rapid industrialisation coupled with scientific and technological advancement which embraced every field of human endeavour. This resulted in indiscriminate dumping of refuse in gutters, roadsides, drainages, bushes, streams, rivers and other unauthorised places, causing drainage blockage, flooded roads and the spread of offensive odours and diseases (Momoh & Oladebeye, 2010; Agwu, 2012). Amuda et al. (2014) note that these wastes usually end up as illegal dumps on streets, open spaces and wasteland.

Abila and Kantola, (2013) link mismanagement of municipal solid waste with poverty, poor governance, urbanisation, population growth, poor standards of living, and low level of environmental awareness and inadequate management of environmental knowledge. The problems of municipal waste management in Nigeria are diverse and numerous. According to Abila and Kantola (2013), these problems are economical, technological, psychological and political, varying from poor funding, poor legislation and implementation of policy, limited infrastructure and professional level of awareness, to poor recovery and recycling programmes and disposal techniques. Amuda et al. (2014) state that poor financing of public waste services provision also influence the poor state of MSWM in Nigeria. Kadafa (2013) shows that only 20% of the annual budget allocated is spent and it covers only 20% of waste management in

most cities in Nigeria. These problems are further complicated by political, economic and social factors (Imam et al., 2008).

The problems associated with inadequate management of solid waste have been realised in the country. However, the prominently used municipal waste management technique in Nigeria is open dumping, landfill, followed by open burning, (Abila & Kantola, 2013). The commonly practised waste management option involves the collection of mixed waste materials and subsequent dumping at designated dumpsites (Kadafa, 2013). Longe et al. (2009) add that the municipal waste of different sources are mixed and co-disposed without any form of segregation and sorting. Recycling which is an environmentally friendly option, is not fully adopted. As such there are no formal recycling sectors in Nigeria. Waste is recycled informally by scavengers who buy unused valuables from people and also go to legal and illegal dumpsites in search of recyclable materials (Abila & Kantola, 2013).

According to Kadafa (2013), the situation was exacerbated by the fact that there is no landfill regulation or standard that provides a basis for compliance and monitoring. Ezeah and Roberts (2012) note that the legal framework supporting waste management in Nigeria is weak. Awosusi (2010) points out that the constraints to effective solid waste management are not limited to lack of policy or laws, but extend to poor infrastructure, education, social awareness of problems and solutions, and lack of institutions promoting sustainable environmental actions. Babalola et al. (2010) indicate that although waste management hierarchy has been adopted by most industrialised nations as the approach for developing solid waste management strategies, Nigeria is still lacking because of environmental regulations in place and the extent to which the waste management options are used within the country.

Like any other developing countries, Ghana is also experiencing MSWM problems. Fei-Baffoe et al. (2014) comment that management of solid waste has become a major problem overwhelming practically all communities of the world today as a result of growing human population, changes in habits and lifestyle, rising disposable income, technological and scientific advancement, and increasingly greater production and consumption of new products. The rapid increase in population and business activities

has presented several challenges which have been accompanied by a rapid increase in the volume of solid waste generated from production and consumption activities.

The study by Miezah et al. (2015) shows that rate of waste generation in Ghana was 0.47 kilograms per person per day, which translates into about 12 710 tonnes of waste per day for the current population at over 27 million. Nationally, biodegradable waste (organics and papers) was 0.318 kilograms per person per day and non-biodegradable or recyclables (metals, glass, textiles, leather and rubbers) were 0.096 kilograms per person per day. Against this backdrop of mounting waste production, municipal authorities seem unable to organise adequate collection and safe disposal of waste within their jurisdiction. This problem proves to be very difficult and seemingly impossible to control or manage, and thus threatens public health and the environment (Fei-Baffoe et al., 2014).

The study conducted by Mensah et al. (2013) clearly indicates that only about 10% of the waste is properly managed through landfilling and incineration. The same study elaborated on the improper dumping of waste at unauthorised places, inappropriate technologies for landfilling and the weak enforcement of the environmental regulations that led to great environmental burden. Otchere et al. (2014) report that most of the cities in Ghana practise the open dump system of waste disposal in a more or less uncontrolled manner. Fei-Baffoe et al. (2014) add that all wastes collected within the metropolis are disposed of at a municipal dumpsite. The municipal dumpsite is a poorly managed area where authorities operating the area are engaged in open burning of waste at the site to reduce the volume of waste, but this releases toxins and carcinogens especially from plastic materials.

Mensah et al. (2013) indicate that sorting and recycling of the municipal waste has not been realised in Ghana. The most predominant way of dealing with municipal waste is through land filling, incineration or recycling of the insignificant portion of these wastes. Hence solid waste from the metropolis does not go through processing or treatment. This is simply because wastes generated at the various points of generation are bundled together without undergoing any form of separation. This practice of handling waste at source without any form of waste separation has been a serious

obstacle to any form of processing or treatment that relies on recycling or recovery programmes.

Fei-Baffoe et al. (2014) identify lack of waste management personnel, lack of finance, lack of appropriate technologies and lack of law enforcement as the constraints to effective solid waste management operations. Furthermore, the study by Mensah et al. (2013) shows that the problems are coupled with lack of land for efficient waste disposal, lack of awareness on effective management and the non-implementation of strict environmental policies.

According to Gakungu et al. (2012), most countries in the world experience challenges in managing waste. The challenges include reducing generation of waste, separation, change of habits, collection, transport, treatment, re-use and disposal of the waste. Gakungu et al. (2012) suggest that the challenge of solid waste management is real in Kenya owing to inefficient collection systems and disposal systems which are not environmentally friendly. Sumukwo et al. (2012) add that the problem of solid waste in most of Kenyan municipalities emanates from high waste generation, lack of disposal sites, inadequate waste collection by local authorities, and household or individual poor disposal habits.

This is confirmed by the fact that 30% to 40% of all solid waste generated in urban areas is uncollected, and less than 50% of the population is served (Sumukwo et al., 2012). These researchers emphasise that 80% of collection vehicles are out of service or in need of repair, and they argue that if the issue of sustainable solid waste management in Kenya is not considered urgently, all the towns in Kenya will be engulfed in waste. The capacity to provide disposal services by Nairobi city declined because of their inability to keep all municipal solid waste collection trucks at full operational capacity (Henry et al., 2006).

In Kenya, local authorities are charged with the responsibility of collecting and disposing of solid and liquid municipal wastes within their areas of jurisdiction (Henry et al., 2006). The growth in municipal solid waste generation has been rapid, while the capacity to collect and safely dispose of the material has been on a general decline. At present, municipal solid waste is disposed of in open dumps which lack proper



environmental pollution control and monitoring. Gakungu et al. (2012) add that the solid waste collected is disposed of in rubbish pits by the municipality – a preferred mode of disposing waste.

In 1999, in order to deal with the environmental challenges, the country reviewed its laws and related policies and enacted the Environmental Management and Coordination Act. The Act gives rights and confers duties to individuals to safeguard and enhance the environment. It guaranteed every Kenyan a clean and healthy environment. These provisions also envisaged protection of the environment for the benefit of the present and future generations (Gakungu et al., 2012).

Despite the availability of law and other related policies in place, no consideration of environmental impacts was paid in the selection of dumpsites in Kenya (Henry et al., 2006). Although there is sufficient legislation covering waste management, local authorities lack the capacity to implement them due to economic constraints to offer efficient management of municipal solid waste. The authorities are now willing to embrace new ideas that can improve the management of municipal solid waste (Henry et al., 2006).

There have been efforts by non-governmental organisations (NGOs) working with communities to recycle waste such as paper, plastic and metals. Sorting and separation of municipal solid waste for recycling was seen gaining importance in various sectors, although, it was done by scavengers driven by poverty and a desire to earn a living (Muniafu & Otiato, 2010). Furthermore, the Ministry of Local Government has approved the involvement of the private sector through privatisation of some of the services to improve management of municipal solid waste collection and disposal, and the result has been improved efficiency.

## 2.6 National approach to municipal solid waste management

South Africa, like many other developing countries, has solid waste management challenges (Matete & Trois, 2008). As an emerging nation, South Africa is facing the challenge of meeting high standards in service delivery with limited resources. This includes problematic issues like inadequate waste collection services, illegal dumping,

unlicensed waste management activities, lack of airspace at permitted landfills, insufficient waste minimisation and recycling initiatives, a lack of waste information, and lack of regulation and enforcement of legislation (Nahman & Godfrey, 2010).

The national waste information baseline study conducted by the Department of Environmental Affairs (DEA) in 2012 revealed that approximately 108 million tonnes of waste was generated in 2011, of which 98 million tonnes were disposed to the landfills. From overall volume of waste, 59 million tonnes was general waste, 48 million tonnes was unclassified waste and the remaining 1 million tonnes was hazardous waste. Only 10% of the generated waste in South Africa was recycled in 2011 (DEA, 2012a). The total urban waste (domestic waste) generation in the country is estimated at about 15 million tonnes per year; industries are reported to contribute about 25 million tonnes of waste per year excluding mining waste which contribute high volume of solid waste (Oelofse, 2008; DEA, 2012a). This is about 0.7 kilograms of solid waste per person per day, which is more typical of developed countries than of a developing country (Greben and Oelofse, 2009; DEA, 2012b). This simply tells that the country has a serious problem and that it needs to change from being a throwaway society.

Greben and Oelofse, (2009) report that in 2005, the five largest South African metropolitan municipalities (City of Johannesburg, City of Tshwane, Nelson Mandela Municipality, Ekurhuleni Municipality and eThekweni Municipality) were estimated to have disposed of 8.9 million tonnes of municipal solid waste to the landfills. This resulted from the economic and population growth, which led to the increased waste generated, causing huge pressure on waste management facilities. Therefore land was required for the landfill sites – land which could have been used in other more productive ways. Although landfilling is generally considered the most practical waste management method in South Africa, the scarcity of available land in close proximity to areas of waste generation as well as uncontrolled landfill gas (CH<sub>4</sub>) and leachate emissions from organic waste, have caused landfilling to become a less attractive option (Greben & Oelofse, 2009).

South Africa decided to move towards a sustainable waste management regime and adopted the internationally accepted waste management hierarchy that involves waste minimisation at source, recovery, re-use and recycling of unavoidable waste, with

disposal to landfill as the last resort. The National Environmental Management: Waste (Act No. 59 of 2008) was published and brought about a significant policy shift for waste management in South Africa which led to the introduction of a waste management hierarchy approach (RSA, 2009). In addition, the NWMS was also developed to address waste management aspects including promoting waste minimisation through re-use, recycling and recovery aiming to divert 25% of the recyclables from landfill in 2016 (DEA, 2012a).

It is within the waste hierarchy that waste minimisation emerges as a tool to integrate waste reduction, re-use and recovery or recycling (Ogola et al., 2011). South Africa also supports the waste management hierarchy approach that focuses on cleaner production, waste minimisation, re-use, recycling and waste treatment prior to disposal (Greben & Oelofse, 2009). Couth and Trois (2009) indicate that although recycling targets have been set, progress made so far to meet those objectives has not been very encouraging as targets are far too ambitious, and insufficient financial resources have been allocated at the municipal level which contributes to failure of the municipality to fulfil their mandate. In addition, recycling is taking place, but the informal waste pickers dominate, where the majority of recyclers use materials recovered directly from the landfills supplied from waste pickers nationwide. McKenzie (2012) confirms that the remainder of the waste stream is generally landfilled since options such as energy and chemical recovery are not widely used in many African countries.

Although it is believed that minimisation of municipal solid waste and diversion from landfill are necessary in order for countries to manage waste sustainably and achieve legislative compliance, municipalities are still facing problems resulting from poor response to their efforts to encourage waste minimisation at source. Oelofse and Godfrey (2008) find that implementation of the waste hierarchy through reduction and recycling targets requires clarity concerning what can be reduced or recycled.

The obstacles preventing South African local municipalities from providing sustainable waste management service range from budget restrictions to illegal dumping, service backlogs, lack of effective by-laws to insufficient skills development (Greben & Oelofse, 2009). Achankeng (2003) notes another major problem that the waste

management workforce is too small to enable the municipalities to achieve their targets. Musadamba et al. (2011) further indicate that although waste management regulations are in place, there may be no detailed information on how the municipalities are enforcing and complying with the available laws and regulations to implement goals of waste management.

## 2.7 Legislative framework governing waste management in South Africa

The issue of solid waste management in South Africa is governed by diversity of the legislative framework ranging from the Constitution to municipal by-laws and national policies and regulations (RSA, 2009). The Constitution of the Republic of South Africa require everybody to live in an environment that is not harmful to their well-being and to have the environment protected, for the benefit of the present and future generations (RSA, 1996).

The constitution therefore led to the development of the National Environmental Management Act, (Act No.107 of 1998) which advocated for the various government departments to support and collaborate on environmental issues. The Act encouraged cradle-to-grave management, polluter-pay principle, sustainable development and environmental protection. The Act also compelled state departments in charge of environmental management to develop and implement a plan for environmental management and ensured that local government was in accordance with the plan (RSA, 1998a). This Act led to the formation of other legislation relevant to environmental management.

In July 2008 the National Environmental Management: Waste Act, (Act No. 59 of 2008) came into effect. The Waste Act provided a holistic approach to regulating waste management in the Republic of South Africa. It adopted the internationally recognised waste management hierarchy which considers the disposal of waste as a last resort and encourages the reduction of waste entering the system. The Waste Act was published to reform the law regulating waste management in order to protect the health of the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development (RSA, 2009).

In order to address the growing waste concerns facing South Africa, the DEA also published the National Waste Management Strategy (NWMS) in 2012 following the implementation of the Waste Act. The NWMS is an integrated waste management framework, whose approach is “from cradle to grave” or from waste generation to waste disposal. The ultimate aim of the strategy is to effect the realisation of the objectives of the National Environmental Management Waste Act. The NWMS sets the priority areas for the implementation of this Act which include driving the recycling economy, implementing a varied regulatory system, creating jobs and small, macro, and medium enterprises, promoting public awareness and supporting waste service delivery (DEA, 2012a).

The Constitution assigns the responsibility for waste collection services and disposal to local government. Furthermore, the delivery of municipal services is defined in the Municipal Systems Act (Act No. 32 of 2000) which was enacted to address the imbalance in service delivery. The Act requires that municipalities strive to ensure that services are provided to local communities in a financially and environmentally sustainable manner, and that local communities have equitable access to such services. The Act further defines alternative approaches to service delivery and the processes to be followed when alternatives are considered (RSA, 2000).

## 2.8 Role of government in waste management

Government plays an important role in developing and enforcing waste management standards, providing funding, and managing day-to-day operations of solid waste management activities. Solid waste services can be divided into three broad intergovernmental functional components, namely policy-making, service provision and regulations (DEA, 2012b). Each of these service components represents one or more broad functions with associated activities. The functions are assigned to one or more of the various levels of government.

All three spheres of government have roles and responsibilities related to waste management activities. National government, through the DEA has to set policy, legislate, coordinate, enforce, monitor and build capacity. The responsibility of the provincial government is to develop environmental implementation plans, monitor

compliance with those plans, develop and enforce provincial regulations for general waste collection and support local government in implementing waste management activities. Local government is assigned waste management which includes refuse removal, refuse dumps and solid waste disposal. Powers at local government are split between district and local municipalities (Madubula & Makinta, 2012; CSIR, 2011).

The Constitution assigns responsibility for refuse removal, refuse dumps and solid waste disposal to local government. District and local municipalities have roles and responsibilities that differ, but also complement each other, as outlined in the Municipal Structures Act (Act No. 117 of 1998). The role of the district municipalities in South Africa is to ensure integrated development planning (IDP) for the district as a whole. This includes the development of a framework for IDPs and ensuring that integrated waste management plans (IWMPs) inform the IDP process. They also promote bulk infrastructure development and services for the district as a whole. In this case, the infrastructure refers to the establishment of regional waste disposal sites and bulk waste transfer stations that can be used by more than one local municipality in the district (RSA, 2008b).

The local municipalities are responsible for compiling and implementing IWMPs and integrating these into IDPs including running public awareness campaigns and collecting data for the waste information system. Local municipalities are also responsible for the provisioning of specific services, including the removal and disposal of waste in line with national norms and standards. Municipality-specific standards for separation, compacting and storage of solid waste that is collected as part of the municipal service, may be set and enforced by the municipality. They are also required to implement and enforce waste minimisation and recycling which include encouraging voluntary partnerships with industry and waste minimisation clubs (CSIR, 2011).

Despite the roles allocated to them, both district and local municipalities are still encouraged to practise the principles of corporate governance to avoid conflict between overlapping functions. Combining efforts where there are similar initiatives may achieve better results (CSIR, 2011). National and provincial government are compelled by the Constitution to support municipalities with the execution of their

duties and this necessitates cooperative governance mechanisms as established by the Waste Act (RSA, 2009).

## 2.9 Municipal solid waste management challenges in general

There are several challenges that influence poor waste management in many developing countries and make it difficult for the authorities to keep up their roles in waste management (Otchere et al., 2014). These challenges include among others inappropriate technologies and processes, ineffective enforcement, illegal dumping, lack of financing, lack of training and human resources, lack of political support, lack of legislation, rapid increase in waste generation and limited data regarding this increase, and lack of public awareness (Otchere et al., 2014; Musadamba et al., 2011; Karija et al., 2013). These challenges are exacerbated by that fact that system for managing wastes in many developing countries is primitive and cannot cope with the huge volumes of wastes being generated (Ahmed & Ali, 2004). Butu and Mshelia (2014) argue that governments around the world are trying to do their best in waste management, but that communities' socio-cultural characteristics are counterproductive.

## 2.10 Overview of solid waste management in the developing and the developed countries

The standards of waste management are still poor and outdated in many developing countries, coupled with poor documentation of waste generation rates and composition, inefficient storage and collection systems, disposal of municipal wastes with toxic and hazardous waste, indiscriminate disposal or dumping of wastes and inefficient utilisation of disposal site space (Kadafa et al., 2013). Kofoworola (2007) notes that management of urban municipal solid waste is a big problem in cities resulting from lack of sufficient equipment to collect the waste, unavailability of the waste collectors, and indiscriminate dumping of waste. Lack of implementation of government policies on MSWM is also identified as a major challenge.

Although the problem of solid waste management is a global issue, it differs in developed and developing countries. It is assumed that the developed countries are

well positioned to deal with municipal solid waste and the reasons for waste collection and disposal are well understood and accepted and workable regulations are now in place (Kassim, 2012). Solid waste management has over time evolved and improved to its current state in most developed countries owing to changes brought by the development of concurrent legislative requirements (Williams, 2005). Nonetheless, it is argued that developed countries are still experiencing problems because there are huge volumes of municipal solid waste deposited in landfills although they are facing shortages of land for landfill (Kassim, 2012; Henry et al., 2006; Kadafa et al., 2013).

Mulenga et al. (2004) assume that solid waste management is given low priority in developing countries because priority is shifted to other pressing challenges. Where solid waste management is priority, transportation equipment is out of service or in need of serious repair or maintenance. In situations where waste is effectively collected and transported, it usually ends up at improper waste disposal sites where it poses a hazard to the environment. Other aspects which contribute to this situation include the low level of awareness of municipal authorities concerning the environmental and public health impacts resulting from mismanagement of the waste systems that systematically contribute to placing MSWM last among local priorities (Couth & Trois, 2012; Ferreira et al., 2007).

Kassim (2012) on the other hand, believes that the environmental issues are now being taken into account by current society and this is confirmed by an increasing number of environmental legislations being developed which are also focused on the challenge of the management of solid waste. This simply means that proper ways to manage waste have been realised. However, techniques applied more in developed countries are not always directly applicable in developing countries because of socio-economic and cultural differences (Thomas-Hope, 1998; Greben & Oelofse 2009).

A study conducted by Troschinetz and Mihelcic (2009) has shown that developed countries generally generate high quantities of waste compared to developing countries. Khatib (2011) comments that the developed countries have successfully managed to decrease the amount of waste to landfill by applying different treatment methods to the waste generated, such as recycling, re-use, composting, energy recovery and all the recyclables going back into the systems. Some developed



countries such as Germany and Japan have achieved remarkable results in MSWM and recycling economy by utilising source-separated collection at source that involves the whole process of collection, transportation, disposal and recycling (Zhang et al., 2010). However, the situation is different in other countries where residents have a tradition of recycling only items of high value. Collecting recyclables has become a major source of income for some underprivileged people (Tai et al., 2011).

## 2.11 Conclusion

The literature review confirmed that management of municipal solid waste is one of the major challenges worldwide in both developed and developing countries. This is the result of various factors including inadequate collection, recycling or treatment, and uncontrolled disposal of waste in dumps leading to severe hazards such as health risks and environmental pollution. In addition, the challenges faced by the authorities range from financial constraint, inappropriate technologies, inadequate personnel, and law enforcement by the authorities.

Broad policies relating to waste management are in place, and the government is committed to ensuring that the policies and legislative requirements are in line with international policies and agreements. However, the lack of enforcement of regulation and compliance means such policies are not effectively implemented. Although most of the developed countries have success stories to tell, some are still experiencing problems because there are millions of tonnes of municipal solid waste deposited in landfills daily and at other dumping sites all over the world.

These problems have made MSWM a priority, where waste reduction and recycling before disposal have become the preferred waste management approach. It has been realised that the focus of MSWM should not only be technology-centred strategies but also people-centred approaches. Even though the fundamental objectives of any solid waste management programme are to minimise environmental pollution, these goals become unachievable in the absence of sustained funding, affordable local technology and lack of a participatory approach to integrated solid waste management.

Consequently, economically developed countries, particularly those in Europe and Asia, have been forced to consider alternative waste disposal methods and

technologies. Decreasing land availability for landfilling, pressure from environmental protection groups and political pressure as well as energy requirements, have forced them to investigate alternative policies and develop new strategies. However, it is worth noting that successful implementation of the developed policies and strategies require the involvement of all stakeholders.



## CHAPTER 3: RESEARCH METHODOLOGY AND THE STUDY AREA

### 3.1 Introduction

This chapter provides a description of the research design and methodology selected for the study. The chapter also explains some socio-economic and geographical characteristics relevant to the study area. The study adopted a mixed research design with both quantitative and qualitative approaches employed. The strengths and the weaknesses of these approaches are also highlighted. This is followed by a discussion of the research methods, which are presented along with a description of the study location, questionnaire design, selection of sites and sample households, limitations of the study, data collection and methods of data analysis used in this study. A brief description of the characteristics of the data used in the analysis is then presented.

### 3.2 Research design

Saunders et al. (2007) define methodology as the theory of how research should be undertaken, including the theoretical and philosophical assumptions upon which the research is based and the implications of these for the method or methods adopted. Similarly, Creswell (2003) defines method as techniques and procedures that are used when gathering information. This study employed both quantitative and qualitative approaches, known as the mixed methods approach. A mixed research approach is described as combining quantitative and qualitative techniques and approaches in a single study (Creswell, 2009). A mixed methods design is useful to capture the best of both quantitative and qualitative approaches. Quantitative research generates numerical data or information that can be converted into numbers, while qualitative research generates non-numerical data (Neuman, 2014). Data from the residents and authority was gathered using both qualitative and quantitative research methods in order to achieve the research objectives.

### 1.2.1 Quantitative approach

The data for quantitative research is measurable, often through experiment or through questionnaires administered to respondents, and can be interpreted by means of statistical instruments (Neuman, 2014). Quantitative methods characteristically refer to standardised questionnaires that are administered to individuals or households, which are identified through various forms of sampling (Neuman, 2014). In addition, quantitative approach offers the researcher opportunity for decision-making about the type of case or samples to select in order to know how to measure relevant factors and which research techniques such as questionnaires or experiments are to be employed (Choy, 2014; McLaughlin et al., 2016).

A quantitative researcher carefully records and verifies information, usually in form of numbers, and transfers the data into computer-readable format (Neuman, 2014). Quantitative data can help establish correlations between given variables and outcomes. Such data should allow others to validate original findings by independently replicating the analysis. A researcher also considers alternative interpretation of the data by comparing the results of the study with previous studies and draws out its wider implications (Choy, 2014; Mouton, 2013).

Choy (2014) indicates that both approaches have their own strengths and weaknesses. One of the advantages of quantitative methods is the fact that it can provide a wide coverage of the range of situations and it is suitable when time and resources are limited. Although the strengths are clearly mentioned, Allwood (2012) notes that a disadvantage of this approach is that it provides very little understanding of the actions demonstrated by people and makes it difficult to predict any changes in the future.

### 1.2.2 Qualitative approach

In addition to the quantitative approach, this research also takes a qualitative approach to the subject of MSWM and focuses on the study of literature relating to solid waste management. It addresses both the management methods used as well as the various

waste reduction and disposal technologies utilised globally. According to Hancock et al. (2007), qualitative research attempts to broaden and deepen one's understanding of how things came to be the way they are in our social world. This approach can be best used when exploring how people experience something, or what their views are. The advantage of this approach is that it provides rich and detailed information about affected populations (Balarabe-Kura, 2012). The approach also provides a data collection process that requires limited numbers of respondents. However, the approach has its own weaknesses involving data that is not objectively verifiable, and it needs skilled interviewers to successfully carry out the primary data collection activities (Choy, 2014).

Hancock et al. (2007) support the use of the qualitative approach particularly on this type of research where it allows the researchers to employ semi-structured interviews that involve a number of open-ended questions. Hancock et al, (2007) further added that not all qualitative data collection approaches require direct interaction with people. In a situation like this, observation can be used as data collection technique. In this study, the environment has been observed, confirming the occurrence of illegal dumping. In addition, qualitative data was gathered through in-depth interviews with authority in varying roles within the solid waste management system. Quantitative data was gathered from a questionnaire survey conducted on the households and at individual level within the chosen study area.

### 3.3 Data collection methods

Both primary and secondary data collection methods were used in this study where primary data was obtained through questionnaires and interviews. Although field observation was not originally planned as a method to collect data, it became another useful method of data collection for this study. The image captured when collecting data by means of questionnaires confirm this statement. Secondary data was collected from government publications and reports, scientific literature and published journals relevant to MSWM.

### 3.3.1 Questionnaires to households

Questionnaires were administered to selected residential areas of Polokwane Municipality namely Flora Park, Nirvana and the Seshego Township with varying socio-economic status and race groups represented in the municipality. Questionnaires were distributed randomly to 30 households from each selected residential areas within the study area and they were directed to the head of the household. The questionnaires focused on dynamics of household waste in terms of type, practices, attitudes associated with household waste disposal, as well as knowledge of solid waste management practices by households. The objective of the random method of survey was to ensure that there is no biased feedback in the findings, and to explore public opinions and perceptions of solid waste management practices in the study area. The choice of sample size was informed by the need to obtain detailed information about the MSWM situation from relevant and important informants in the study area. The questionnaires were in English, but were explained in Sepedi where there was a need to accommodate those who could not understand English.

### 3.3.2 Interviews with the authority

Structured interviews were used to collect data from the municipal officials responsible for waste management. These interviews were conducted with the key municipal officials regarding their role as the municipality in MSWM. In addition, data was obtained regarding waste management practices being used and initiatives in place for waste minimisation in the municipality. Furthermore, focus was placed on key municipal informants to collect data on challenges facing the municipality with regard to solid waste management. This includes the collection of waste from households to the final destination for disposal. Formulated questions were asked, following a determined pattern. However, follow-up questions were also posed for further clarification on questions and responses during the course of the interview. The questions were open-ended in order to obtain as much data as possible.

### 3.4 Ethical considerations

The researcher read the written research consent letter to each participant to ensure that they understood the content of the consent and research being undertaken before conducting the interview. The letter included the purpose of the study and the measures taken to ensure confidentiality and anonymity. The participants were also informed that their participation was voluntary and that completing and signing questionnaires would be considered as consent to participate in the research. The questionnaires were administered by the researcher in both English and Sepedi when there was a need based on the preference of the participant. The researcher recorded the responses of the participants on the anonymous questionnaire form during the interview.

### 3.5 Data analysis and interpretation

The analysis method is determined by the collected data which pertains to the information collection procedure of the questionnaire survey and the assessment of municipal solid waste from households destined for landfilling as elaborated upon in the methodology. The principal methods of gauging valuable information from data collection are both qualitative and quantitative analyses. The two most important collection methods employed in this study are questionnaires and interviews. Responses from household members served as the basis for review in the analysis. Data was then captured and processed using Microsoft Excel. Thereafter the data was tabled, and these tables were presented in the final research report. The data obtained from this analysis comprised the composition of the waste, the types of waste available for recycling and the amount of waste to be landfilled, as well as the waste management initiatives within the study area. Data on the challenges facing the municipality and residents regarding solid waste management was also analysed using Microsoft Excel. Taking these issues into consideration, the questionnaire was structured to effectively examine the perceptions and views of the respondents and their households regarding MSWM.

In terms of interpretation or presentation, data collected by means of interviews and structured questionnaires was stored in Microsoft Excel, analysed, and interpreted by

means descriptive statistics for generating results. The results were then presented by means of bar graphs, tables and histograms.

### 3.6 Description of the study area

The area of study is Polokwane Local Municipality located within the Capricorn District at coordinates 23°.9112 S, 29°.4618 E in the Limpopo province (see Figure 2). The municipality shares its name with the biggest town in Limpopo, called Polokwane. Locally, it shares borders with three other local municipalities within Capricorn District as well as local municipalities in Mopani and Waterberg Districts. It is the largest metropolitan complex in the north and is a major economic centre with 38 wards. The municipality serves as the economic hub of the Limpopo Province, and has the highest population density in the Capricorn District. Situated on the outskirts in several clusters are less formal settlement areas, which are experiencing enormous influx from rural urban migration trends (StatsSA, 2011).

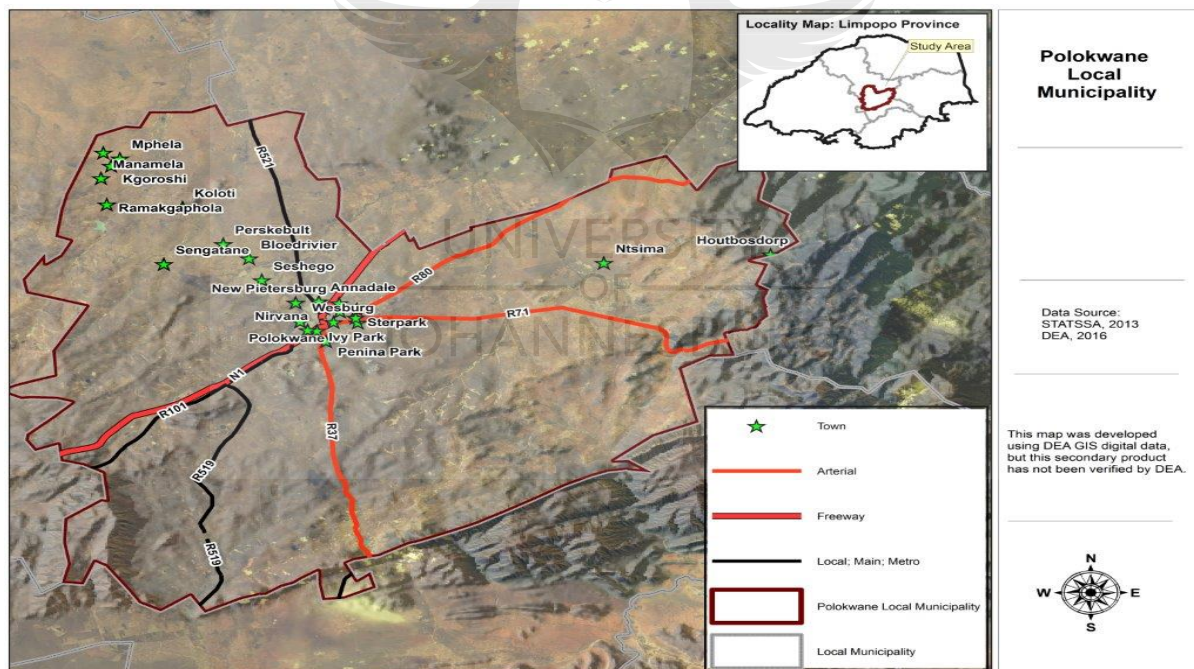


Figure 2: Location of the study area.

The demarcated suburbs are distinctive and vary in socio-economic status and intrinsic socio-cultural characteristics, including dominant race groups. This variety was the primary reason for choosing these suburbs. Flora Park is dominated by both Black and White population. Nirvana has the Indian and Coloured population as its



largest race groups while Seshego has the Black population as its predominant race group. The selection of these areas was considered to be a representative cross-section of the race groups that constitute the population of the Polokwane Municipality.

Polokwane Municipality was chosen as a study area given its unique position of being the largest and the most populated city in Limpopo Province. The city also serves as a key centre for commercial activities as it is the provincial commercial capital. It is important to assess the status of MSWM within the area, considering its significant population size and projected increase, and the problems encountered in implementing the waste management hierarchy. Households are one of the main sources of municipal solid waste in the study area. Consequently, the attitude and character of this group to waste generation may be regarded as critical, and thus should be given more attention so that the programmes to be put in place by the waste management authorities produce desired results.

### 3.7 Limitations of the study

The research was carefully planned but there were some unavoidable limitations that the researcher came across during the study, particularly during the data collection phase. Some households refused to open their gates to attend to the interviewer perhaps because of the precarious security situation in the area at that time. This setback was however circumvented by moving to the next available household. Although 90 households have been reached and interviewed, the sample taken does not represent the whole population of the study area. However, the information obtained was still reasonably sufficient to make a judgement regarding the current state of municipal waste management and the challenges thereof.

The researcher also experienced about three months of delay before being granted consent to conduct an interview with a municipal official. This was the result of several protocols that had to be observed within the municipality, and perhaps also because certain administrative barriers were unclear to the researcher. Most of the time officials could not even respond to the researcher's emails or answer the researcher's calls when trying to find out about the progress regarding the request. This also delayed the researcher's access to the municipal officials dealing with waste management in the

municipality. It is worth noting that although it did not come easily, consent to conduct the interview was finally granted and one municipal official under waste management division offered the researcher an opportunity to conduct an open-ended interview as planned. This interview was conducted via telephone because of time limits, and only one official was interviewed instead of the four officials originally anticipated to be interviewees.



## CHAPTER 4: DATA ANALYSIS AND PRESENTATION

### 4.1 Introduction

This chapter analyses and presents key results of this research on the current status, problems and challenges of MSWM. Initially, the chapter discusses the type of waste generated, storage methods, correlation between community willingness to participate in separating waste prior to collection and knowledge with regard to solid waste management issues. The current waste management status, including various solid waste management methods that are being utilised by the residents of Nirvana, Seshego and Flora Park within the city of Polokwane municipality, is analysed, followed by a discussion of attitudes and perceptions to determine the potential for community participation in solid waste management.

The role of the municipality in solid waste management as well as the problems and challenges facing both the communities from the selected study areas and the municipality are discussed. Finally, the contribution of the municipality is explored in terms of using waste management hierarchy as a tool to address MSWM problems. In a nutshell, data obtained from the field is presented in this section using tables, graphs, pie charts and descriptive methods. Solid waste management practices and the opinions of different participants are presented.

### 4.2 Demographics of key respondents

It is worth noting that the study areas were selected based on their socio-economic characteristics which reflect different socio-economic statuses, race groups and differing socio-cultural beliefs. Data on gender, age, employment status and income is comprehensively outlined.

#### 4.2.1 Gender

As indicated in Table 1 below, 90 people were interviewed. Of these, 49 respondents were male, representing the highest contributors in this study. Twenty-one male respondents came from Nirvana followed by 16 from Flora Park and 12 from Seshego.

Female contributions came from 41 respondents during the interviews. Eighteen of these were from Seshego followed by 14 from Flora Park and 9 from Nirvana.

Table 1: Gender and age of respondents

Demographics	Number of respondents	Seshego	Flora Park	Nirvana	Total
<b>Gender</b>	<b>90</b>				
Male		12	16	21	49
Female		18	14	9	41
<b>Age</b>	<b>90</b>				
18-30		6	9	4	19
31-40		9	8	8	25
41-50		9	6	11	17
51-60		4	3	1	8
60+		2	4	6	12

#### 4.2.2 Age

Table 1 above reveals that 19 respondents fall between the ages of 18 and 30 years. An additional 25 respondents fell within the age range of 31 to 40 years while those aged between 41 and 50 years were represented by 17 respondents, and the 51 to 60 year range was represented by eight respondents. The remaining 12 respondents represented the age above 60 years.

#### 4.2.3 Employment status

Table 2 below shows that the largest single proportion of 42 respondents from the study areas are employed, while 21 respondents are unemployed and 11 respondents are self-employed. This was followed by 9 retired respondents and 7 students.

Table 2: Employment status and the monthly income

Demographics	Number of respondents	Seshego	Flora Park	Nirvana	Total
<b>Employment status</b>	<b>90</b>				
Employed		20	13	9	42
Unemployed		5	6	10	21
Self-employed		1	2	8	11
Retired		2	4	3	9
Student		2	5	0	7
<b>Monthly Income</b>	<b>90</b>				
5 000-10 000		11	11	4	26
10 100-20 000		6	4	8	18
20 100- 30 000		2	3	2	7
30 100- 40 000		4	1	3	8
40 100-50 000		0	0	1	1
50 100-60 000		0	0	0	0
60 100+		0	0	0	0

#### 4.2.4 Average monthly income

The average monthly income of respondents was also considered an important variable that could influence people's knowledge and perception of solid waste management. From the data obtained in Table 2 above, only 26 of the respondents earned between R5 000 and R10 000 per month, representing the lowest income group followed by 18 respondents earning between R10 100 and R20 000. The middle income group is represented by seven respondents earning between R20 100 and R30 000 and eight of the respondents earning between R30 100 and R40 000, while the highest income earner (one respondent) earned between R40 100 and R50 000 per month. This shows that the area of study is dominated by low- to middle-income groups. It is interesting to note that no one earned more than R50 000 per month.

### 4.3 Municipal solid waste management system

#### 4.3.1 Municipal solid waste composition

In terms of the waste generated from each household in the selected suburbs, it was found that food waste (organic waste) dominated, where the waste components were similar across all 90 households interviewed. About 89 respondents generate paper and plastic, while both garden waste and glass come from 82 respondents while the proportion of cans in the waste was estimated to come from 80 respondents. The situation in this regard is understandable since everyone prepares food in their households, and as such, food waste is generated every day.

#### 4.3.2 Waste storage and handling

The study revealed that all 90 respondents from the three selected residential areas indicated that they store their waste in black plastic refuse bags before collection. The refuse bags are kept in their yard until the day of collection where they are taken out for easy access by the municipal waste collectors. Although some respondents indicated that a waste collection truck comes once a week which made it difficult for them owing to high volumes of waste accumulated, it was not a problem for all. In a situation where collectors are delayed in turning up to collect the waste, members of the household take their waste to any piece of vacant land or to the waste skips if available in the area. However, not all of them take their waste to those areas because some of them have large waste bins keep their waste in the bins until the collection truck comes.

#### 4.3.3 Level of satisfaction on waste collection service

The level of satisfaction was done to rate the satisfactory level of the respondents with respect to waste collection service. The majority of respondents indicated that they are satisfied with the current situation of waste collection service once a week in their suburbs. The current collection service was satisfactory for 77 respondents, followed by eight who were not satisfied; four were very satisfied and one respondent was not

sure about the satisfaction level. Furthermore, those who showed dissatisfaction indicated that they would prefer the municipality to increase the frequency of waste collection to more than once a week because the level of waste generation is not stable.

#### 4.3.4 Waste collection ratings

Waste collection ratings were conducted to check the performance of the municipality in terms of waste collection. Respondents rated the municipal waste collection as follows: nine respondents indicated that it was very good, while 50 respondents rated waste collection service as good, 16 rated it as being acceptable, two considered it poor and three respondents rated it as very poor. This rating is a clear evidence that most of the people are happy with the service provided by the municipality in their areas.

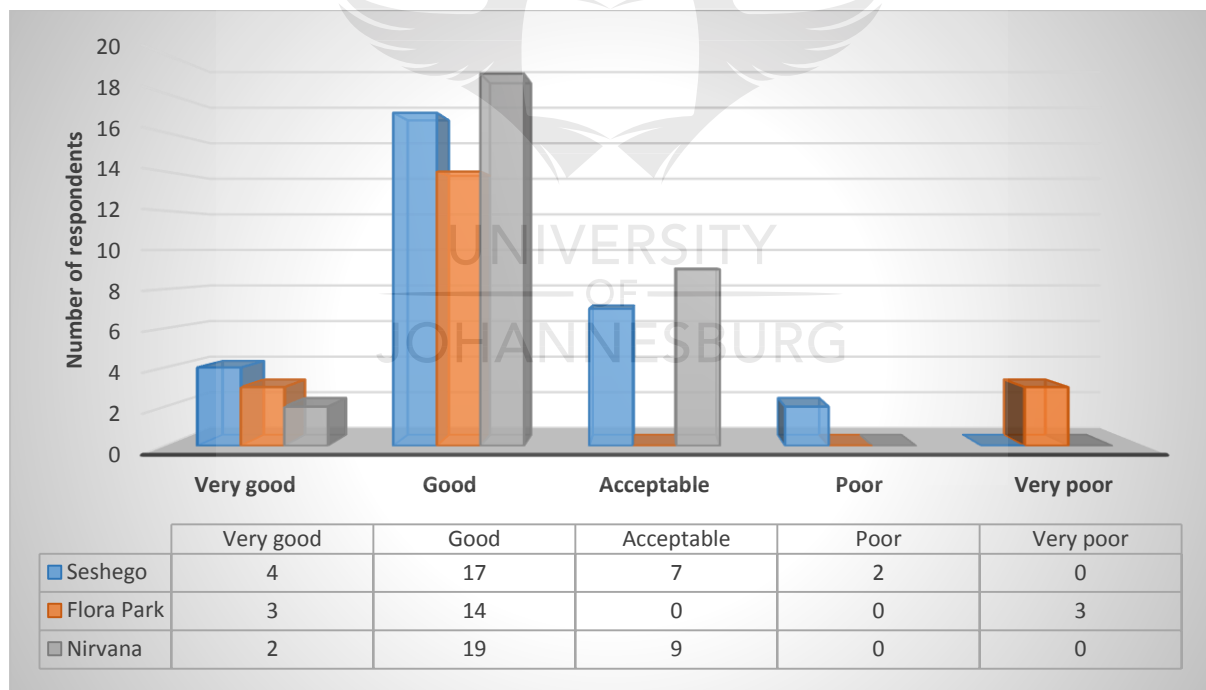


Figure 3: Waste collection service ratings

#### 4.4 Public perception on waste management

##### 4.4.1 Willingness to sort waste

This was done to gauge the level of willingness to sort waste. Of the total 90 respondents interviewed, 53 indicated that they were willing to sort their waste provided the necessary resources and facilities are made available, while 37 of the respondents indicated that they were not willing to sort their waste.

Table 3: Level of willingness to sort waste

<b>Respondents Answers</b>	<b>Seshego</b>	<b>Flora Park</b>	<b>Nirvana</b>	<b>Total</b>
<b>Yes</b>	18	21	14	<b>53</b>
<b>No</b>	12	9	16	<b>37</b>

The provisions of refuse bags for each household, and different skip containers for different recyclables being placed in a reasonable and convenient distance from the residents, were seen as a solution for waste-sorting. Some respondents added that awareness or education in households regarding solid waste sorting could yield good results if properly implemented. However, those respondents who were unwilling to sort waste said it was time-consuming and thus discouraged its practice. Some indicated that it would be expensive as it requires more refuse bags for different recyclables, while others said that sorting has no direct benefits for them. In addition, some indicated that sorting of waste seems to be useless because the waste collectors mix waste when collecting, even when they found it sorted. Some were not ready to sort waste as they indicated that the local authority has the responsibility of general handling and sorting of waste materials.

This was supported by the findings of UNEP (2005), in that local residents' preferences for particular types of waste service, their willingness to sort recyclable materials at source, their willingness to pay for the service, and their capacity to move waste to the collection points, all have an impact on the overall waste system. In addition, incentives can affect residents' preferences and behaviour.



#### 4.4.2 Public views on separation of waste at source

The respondents' views were identified by asking their views on separation of waste at source. As shown in Figure 4 below, the majority of them indicated that separation of waste source is actually a good practice and this came from 23 of respondents across all the suburbs. Furthermore, 12 respondents from all the selected suburbs indicated that separation helps the recyclers. Only one respondent believed that mixing all waste together with the recyclables does not make sense. Two respondents indicated that it was expensive for them, as it would require more refuse bags which the municipality does not provide. Four of the respondents indicated that separation of waste is a time-consuming process.

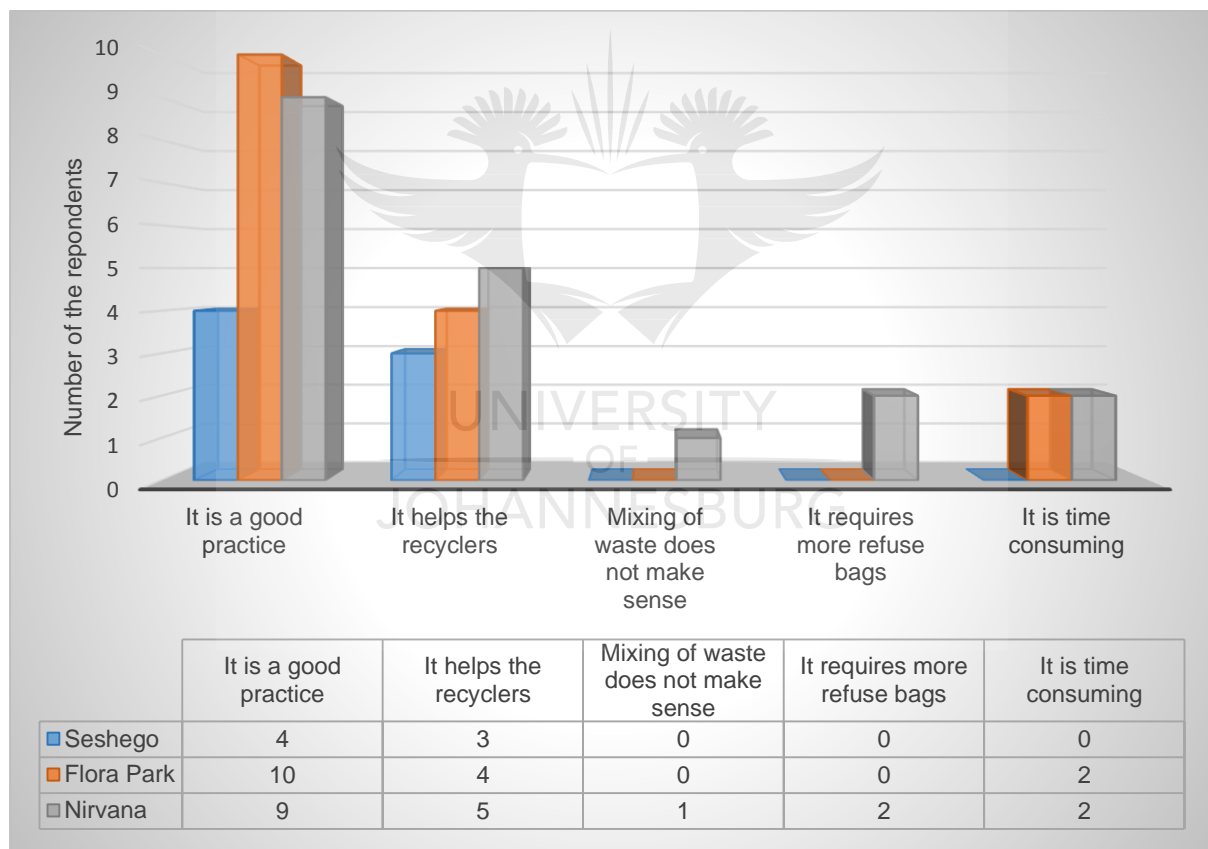


Figure 4: Public views on separation of waste at source

Figure 4 above shows that the majority of the respondents are aware of the importance of separating waste at source. Some of them indicated that they always separate, regardless of the fact that the collectors mix waste when collecting.

#### 4.4.3 Willingness to recycle waste

Table 4 below shows an overwhelming response by the respondents from all three selected suburbs that they would be willing to recycle, based on the provision that the municipality offered incentives in the form of a rates reduction or money-back guarantee. Those households who will practise recycling based on incentives numbered 26 from Seshego, 29 from Flora Park and 24 from Nirvana which makes a total of 79 respondents. A few of these mentioned that they were willing to recycle, even if they did not get anything in return, because they would do it for their health and for the environment. Only 11 of 90 respondents (four from Seshego, one from Flora Park and six from Nirvana) indicated that they are not willing to recycle even if incentives are provided.

Table 4: Willingness to recycle waste

<b>Respondents Answers</b>	<b>Seshego</b>	<b>Flora Park</b>	<b>Nirvana</b>	<b>Total</b>
<b>Yes</b>	26	29	24	<b>79</b>
<b>No</b>	4	1	6	<b>11</b>

Based on Table 4 above, it appears that people are willing to recycle although there are some obstacles such as distance to the recycling facilities that discourage them from doing it. Zhang et al. (2016) indicate that the distance of a recycling facility from the individual household is the most influential factor that determines ease of access to recycling facilities. Zhang et al. (2016) suggest that the shorter the distance, the easier to recycle, and the more likely an individual will be to recycle.

#### 4.4.4 Awareness of recycling facility

The overall results shows that 57 respondents were not aware of the recycling facility in their area while only 33 were aware. Five respondents from Seshego, 14 from Flora Park and 14 from Nirvana indicated that they are aware of any facility around, and a number of them indicated that they would be willing to recycle. The highest number of

respondents (25 from Seshego, 16 from Flora Park and 16 from Nirvana) indicated that they are not aware of a recycling facility in the area.

Table 5: Awareness of recycling facility in the area

<b>Respondents Answers</b>	<b>Seshego</b>	<b>Flora Park</b>	<b>Nirvana</b>	<b>Total</b>
<b>Yes</b>	5	14	14	<b>33</b>
<b>No</b>	25	16	16	<b>57</b>

The need to improve public awareness of recycling and community participation in waste management has been widely recognised by researcher as necessary to create sustainable waste management systems and to promote environmental citizenship among community members.

#### 4.4.5 Type of waste recycled

Respondents were asked about the type of waste materials (recyclables) which the available recycling facility would recycle. The responses shown in Figure 5 below indicate that most of the respondents (totalling 57) were not sure about the type of waste being recycled. However, 17 knew that plastics, and six knew that papers were being recycled in the area. A further five respondents were aware that metals were recyclable, three knew about glass, and two respondents understood that cans were being recycled in Polokwane.

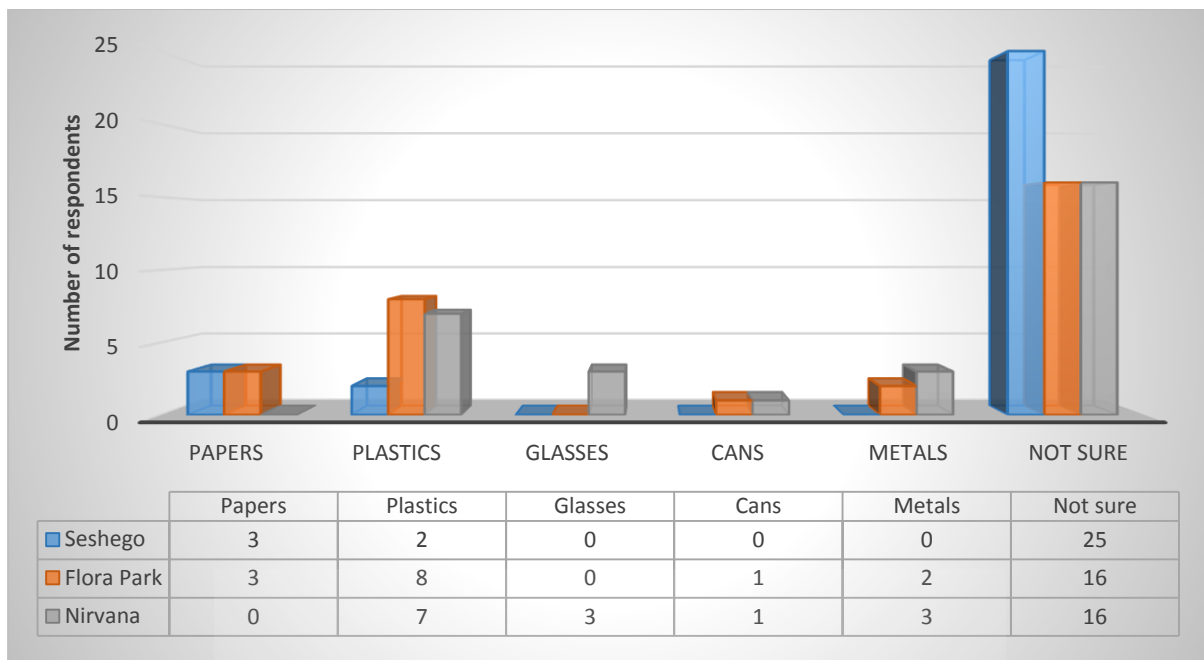


Figure 5: Type of waste recycled

This shows that there is a serious lack of knowledge among most respondents regarding what constituted recyclable materials. Papers, plastics, glass, cans and metals were understood to be recyclables by the minority of residents.

#### 4.4.6 Current solid waste management practice

The analysis for the preferred solid waste management practice in the study area shows that 51 respondents prefer landfill disposal to any other waste management options, followed by 33 respondents who support recycling. Six respondents mentioned re-use, and two from Seshego in particular mentioned open dumping as their preferred option. Burning was not favoured by anyone as their preferred management option.

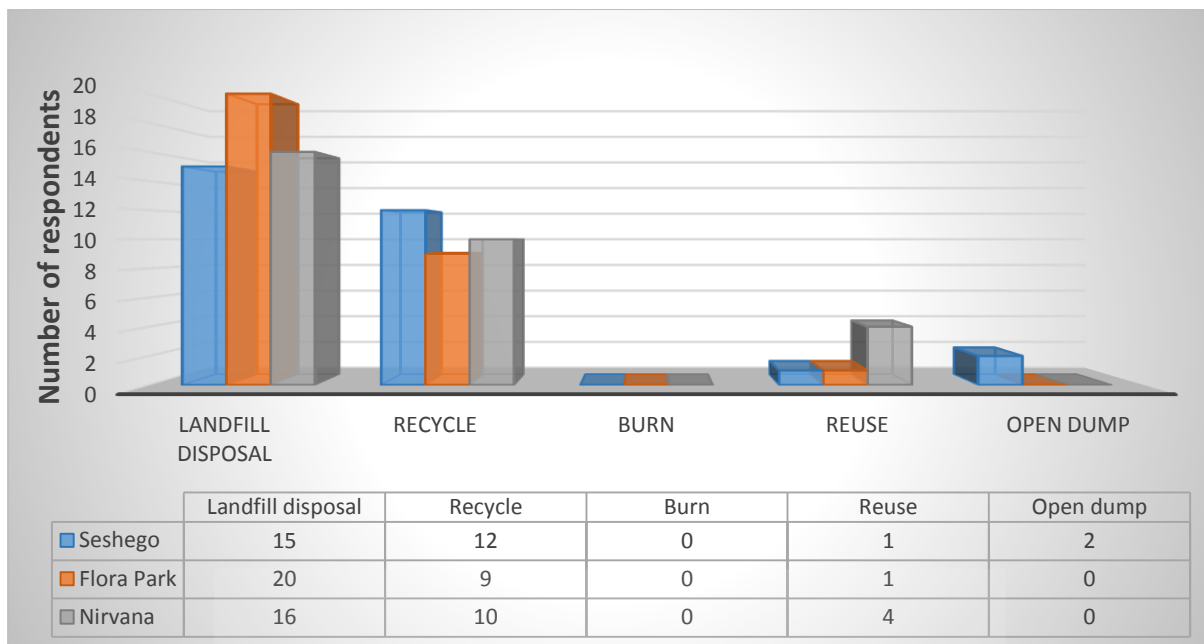


Figure 6: Preferred methods for solid waste management

The study results indicate that much work is still needed to be done regarding solid waste management in the study area. Most of the residents are not informed about how to handle municipal solid waste because of the excessive amount of recyclable materials that is finally disposed of at the landfill. The analysis of solid waste management practices in the study area show that a high number of respondents prefer landfill disposal to any other waste management option, followed by recycling and then re-use as their preferred options. It is interesting to note that of all 90 respondents, no one mentioned burning as their preferred management option. Although open dumping was observed during the study survey, it was explained that it only happened when the collector did not come to their area and this was confirmed in Seshego.

#### 4.4.7 Public views on illegal dumping and littering

All the respondents gave their views regarding illegal dumping and littering in the area. The majority of households (47) across all three suburbs in the study are of the opinion that illegal dumping and littering are unacceptable, and 33 indicated that it should stop, while 10 suggested that the offenders should be fined.

This reflects that South Africans are aware of the unpleasant effects of illegal dumping and littering in South Africa. Their responses indicate that they are at least conscious

of negative solid waste disposal practices. Most of them alluded to the fact that illegal dumping is not good for their health or for the environment; therefore it should stop. Some indicated that the municipality should enforce the law and fine people involved in illegal dumping and littering at unauthorised areas within the municipal area.

Table 6: Public views on illegal dumping and littering

Areas of study	It is unacceptable	It should stop	Fine people involved	Makes no difference	It is a person's choice
Seshego	17	8	5	0	0
Flora Park	17	10	3	0	0
Nirvana	13	15	2	0	0
TOTAL	47	33	10	0	0

The Illegal dumping sites are unauthorised solid waste dumpsites where residents dump solid wastes indiscriminately. Many unused lands are converted to solid waste dumps illegally. In fact, the local authority is unable to enforce the environmental and waste management laws, hence residents do whatever they like with their waste, including illegal dumping in the area. In order to deal with growing tendency of illegal dumping, proper waste management policies need to be enacted and implemented. (Igbinomwanhia, 2011).

#### 4.4.8 Challenges encountered by the community

The biggest problem or challenge that the community is currently facing is illegal dumping as shown in Figure 7. Of 90 respondents, 22 in Seshego, one in Flora Park and eight respondents in Nirvana confirmed this.

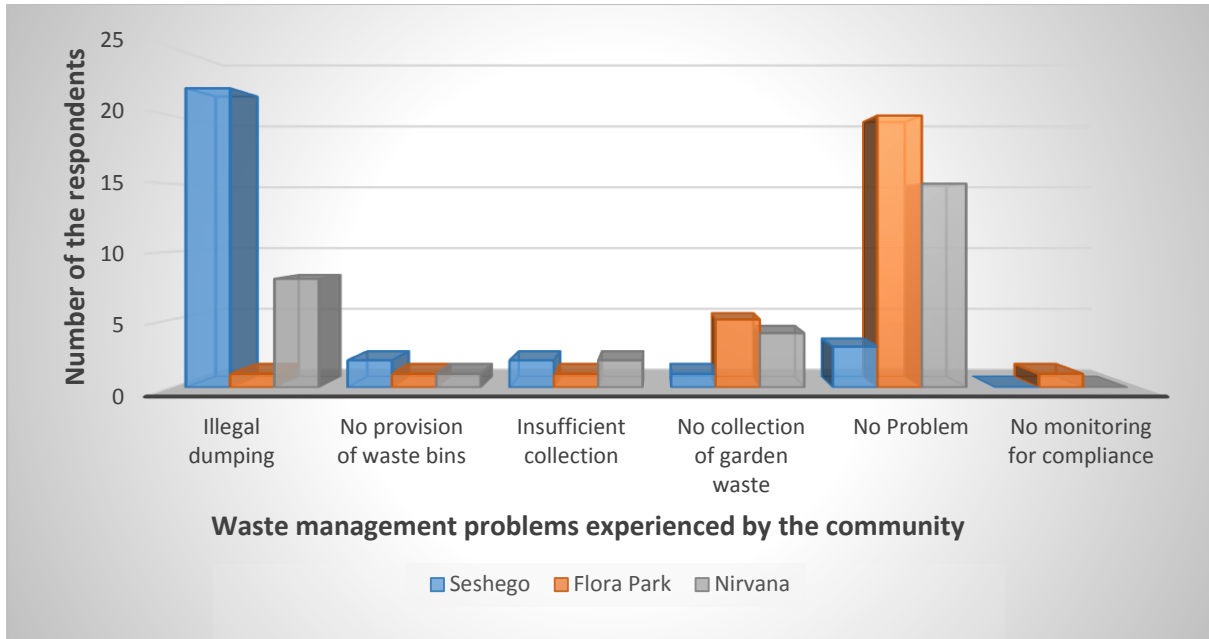


Figure 7: Problems encountered by the community

On the other hand, Figure 7 also shows that 38 respondents do not have any problems relating to waste management. The highest number of these respondents were in Flora Park (20) followed by Nirvana with 15 respondents and three respondents in Seshego.

Figure 8 below shows that illegal dumping is indeed a problem in the area. People continue to dump illegally even where there is a sign indicating “no dumping” with the amount of the fine to be imposed on the culprit.



Figure 8: Illegal dumping site in Seshego

It is the researcher's opinion that this can be influenced by the socio-cultural characteristics of the community living in those areas. Although the study revealed that the Black community also dominates Flora Park suburb, Seshego is a well-known Polokwane Township dominated by a low-income Black community. It is assumed that this influences the behaviour of the community, particularly in waste handling.

#### 4.5 Local authority responsible for municipal solid waste management

According to the key informant from the municipal office, the role of the municipality is to provide waste receptacles and when the receptacles are provided, then the waste collection service comes in. Their role also involves development, management and execution of solid waste management projects within the municipal area.

##### 4.5.1 Municipal solid waste management system

The process of MSWM encompasses all the functions of direct waste generation, storage, collection, source separation, processing, transport, treatment, recovery and disposal to landfill in such a way that they are harmless to humans, plants, animals, the ecology and the environment generally (Agamuthu, 2011; Agwu, 2012). However, solid waste management in the City of Polokwane Municipality only involves collection from households, and transport of the waste to the landfill for disposal – which simply means that source separation, recovery, and re-use are not part of the management system. This was confirmed by the key informant from the municipality who indicated that sorting of waste happens only informally before collection and at the landfill site by the informal waste scavengers. Joshi and Ahmed, (2016) discuss the situation where there is no organised or scientifically planned segregation of municipal solid waste either at household level or at disposal. Sorting of waste is mostly accomplished by the unorganised sector and is seldom practised by waste producers. Segregation and sorting takes places under very unsafe and hazardous conditions and the effectiveness of segregation is fairly low as the unorganised sector separates only those valuable discarded constituents from the waste stream which can guarantee them comparatively higher economic return in the recycling market.



#### 4.5.1.1 Collection of waste

Prior to collection of waste, the residents place their plastic bags carrying waste on the street outside the yard for collection. In areas like Seshego, sometimes the waste bins are gathered at one place on a specific day of collection. This is when waste scavenging occurs, searching the waste plastic bags for valuables and recyclables before collection. This explains the way in which sorting of waste is done informally at the household level since the municipality is not fully involved in recycling. This action sometimes causes a mess on the street although it reduces the volume of waste to be transported to the landfill, which fulfils the aim of waste avoidance and reduction to achieve waste minimisation and reduce the amount of waste entering the waste stream as required by the waste management hierarchy.

The waste collectors do house-to-house collection of waste using trucks with waste loaders. The driver stops continuously on the street in the residential area and the evacuators get off the truck to collect waste brought out by the households or stored at the front of each residential yard. The whole process is done manually, including carrying and lifting up of the waste plastic bags into the truck.

#### 4.5.1.2 Transportation of waste to the landfill site

After the collection, the waste-transporting truck drives directly to Polokwane (Weltevreden) waste disposal landfill site, which has been in existence and operation for about 15 years.

#### 4.5.1.3 Disposal of waste at the landfill

Landfill is the oldest and most commonly used waste disposal method in the suburb areas of study. Currently, it is regarded as the safest option compared to other options mainly because of lack of capacity and resources to implement other options. As the waste collection truck enters the gate of the landfill disposal site, it gets weighed to determine the volume of waste transported for disposal and recorded before disposal. Thereafter, the waste scavengers approach the truck while offloading the waste, to search for and sort the valuable and recyclable items to sell them to the recycling

companies available in the area. Pushing and levelling of waste emptied from collection trucks is done by a bulldozer, followed by the use of a compactor to press the waste further down and the waste gets covered; this practice occurs on a daily basis.

#### 4.5.2 The views of the municipal official on waste scavenging

According to the key informant from the municipality, waste scavengers might be seen as disturbing, but they are contributing to waste minimisation and play an important role in waste disposal reduction. The discussion is underway between business and the municipality to formalise the waste scavengers. However, some of these waste scavengers are reluctant to be formalised because they think they would not make the amount of money they are currently making if under someone's supervision.

#### 4.5.3 Alignment of municipal waste management practices with legislation

Compliance monitoring is conducted through inspections to ensure that the licence operational conditions are adhered to. The recommendations of the internal audit are also used as a tool to ensure compliance. In addition, it was indicated that although the municipal by-law is outdated, a new by-law has been developed and is under review as part of public participation. Once the Limpopo Department of Economic Development, Environment and Tourism signs it, the by-law will be endorsed for implementation.

#### 4.5.4 Solid waste management problems experienced by the authority

People's attitude and behaviour was mentioned as one of the problems facing the municipality. People tend to litter and dump waste everywhere with the perception of creating jobs for the waste-pickers and collectors. This behaviour becomes a problem because the available resources are then diverted to deal with illegal dumping instead of doing the actual job.

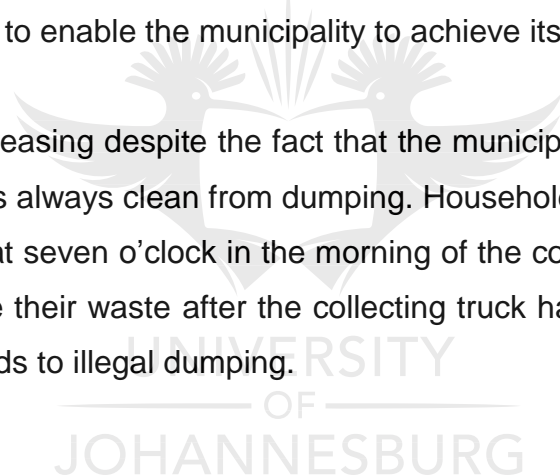
It is a sad truth that the issue of waste management is not given as much attention as other services within the municipality. Priority is given to other services like water

supply and sewage systems as well as housing. Waste management always comes last in the IDP agendas and it is mentioned as the additional service to be rendered to the community and the city as a whole.

Members of the public do not understand their roles in waste management and they do not want to take responsibility as they believe that it is the municipality's responsibility to ensure that waste management service is catered for.

Lack of capacity and resources including insufficient budget makes it difficult for the municipality to improve waste management services, particularly when considering the expansion of the residential areas. Despite its effective system of waste collection, the municipality is facing problems of poor response to its efforts to encourage waste minimisation at source. Another major problem is that the waste management workforce is too small to enable the municipality to achieve its vision.

Illegal dumping is increasing despite the fact that the municipality is trying its best to ensure that the area is always clean from dumping. Households are expected to take out their waste bags at seven o'clock in the morning of the collection day. A problem arises when they take their waste after the collecting truck has already passed, and this in most cases leads to illegal dumping.



## CHAPTER 5: RESULTS AND DISCUSSION

This chapter discusses the key findings that were presented in the previous chapter as per the research objectives. This section focuses on the current status of MSWM in the area of study and the challenges that are being experienced in dealing with waste management. MSWM systems, challenges and perception of the local community regarding waste management are the main points of discussion.

### 5.1 Role of the community in waste management.

It has been said several times that waste separation in the study area is done informally by the waste scavengers. Although they create chaos in the areas where they are involved, they are clearly playing an important role in waste reduction. They move from open dumps to landfill sites in search of recyclables that can be sold to enable them to generate income. Joshi and Ahmed (2016) confirm that indeed the role of waste scavengers is very important in MSWM. However, their role in the waste management stream had not been given any recognition by the local authority despite the fact that waste scavengers save almost 14% of the municipal budget annually and they are generally deprived of the right to work. According to an estimate in India, the waste scavengers reduce up to 20% of a load on transportation and on landfill (Joshi & Ahmed, 2016).

The role of women in waste management and promotion of sustainable development can be pivotal. In most cases, women are directly concerned with waste management at home. This is mainly because they spend most of their times at home taking care of the household chores and keeping the surrounding environment clean (Gani et al., 2012). However, the situation in the study area is different because women are now considered for formal employment which makes them absence from home during working hours. This is in contrary to the historical times where females were excluded from formal employment especially in professional positions.

## 5.2 Current municipal solid waste management practice

### 5.2.1 Waste generation and storage

The study revealed that the proportion of food waste was quite high followed by plastic and paper waste. This is well understood when considering that household activities involve the use of material packaged in plastic and paper. Similar situation was confirmed in a study conducted in Nairobi where it was found that 50% of the waste generated was food waste (Henry et al., 2006). This simply means that most of the waste generated in the study area can be recycled, reused and even used to generate manure through composting.

In terms of storage in the study area, waste is stored in black refuse bags and kept in the house or even outside the house until the day of collection. However, other storage containers are being used in cases where the black refuse bag cannot be afforded. This practice is common in most areas. In Zanzibar, waste generated is usually stored in plastic which later delivered to the communal collection centres by residents themselves, but sometimes waste is kept outside the house for door-to-door collection services (Ally et al., 2014). Furthermore, the study conducted in Nigeria by Igbinomwanhia (2011) confirmed that refuse bags are used for storing waste before collection for disposal.

### 5.2.2 Waste collection

It was found that the municipality in the study utilises the primary collection system of door-to-door collection where waste is directly collected from the generator to the collection point, mainly a large waste skip, as well as secondary collection from shared communal containers to the final disposal points. Zhang (2010) states that waste collection system is mainly influenced by the socio-economic status of the community in the areas where the high-income class is treated better than middle and low-income class. But in Polokwane, waste is collected in the same manner regardless of the area and income class. All income groups (suburbs and townships) are treated equally when it comes to waste management, although the rates for service are not equal. In addition, the service is rendered by municipal workers. Kadafa et al. (2013) confirm

that it is the responsibility of the households to ensure that their waste bins are placed in front of their houses for ease of collection.

### 5.2.3 Waste separation and recycling

Municipal solid waste in the study area is generally composed of organic waste which includes food waste and garden waste, and recyclable waste (which include papers, plastics, glass, and metal). Currently, the waste is collected in a mixed state, but residents can volunteer to participate in the source-separated collection. The recyclable materials from daily use are often collected at the household level by scavengers patrolling around the residential areas. The recyclables are taken to the recycling facilities around the area.

Since the informal collectors of recyclables are not controlled, they do not collect on a regular basis, and sometimes this leads to a situation where the recyclables are sorted at the landfill. It was admitted by the municipal official that financial constraints is the main reason for inadequate collection and disposal of municipal solid waste. The national and provincial governments are always encouraging recycling as the implementation of waste management hierarchy which focuses on recycling, re-use, and recovery as waste reduction strategy at the local level. Nevertheless, the local authority is not doing enough in terms of recycling or waste reduction initiatives. The recyclables with commercial value are typically collected and traded by the private sector while treatment of the rest of municipal solid waste is still the task of the municipal government (Troschinetz & Mihelcic, 2009).

### 5.2.4 Landfill disposal

The results of the study showed that a high volume of municipal solid waste is disposed in the landfill without any form of treatment after collection except for informal sorting of valuable waste. Waste disposal in the area of study is predominantly by means of landfill because it is regarded as cost-effective and it can accommodate a large fluctuating amount of waste. The findings are similar to the finding of another study conducted in Nigeria by Nkwocha et al. (2011) which showed that most of the households did not recycle their solid waste but disposed of it at the landfill. Another

study by Ogola et al. (2011) recorded that waste collected is not sorted into recyclables but is all disposed of at the final landfill unsorted. Otchere et al. (2014) believe that landfill is the final functional element in the solid waste management system.

Emelumadu et al. (2016) further confirm that for the majority of households waste ends in the sanitary landfill. It was further indicated that landfill disposal of waste is the most expensive and traditional approach, that the rate of sending waste to landfill is increasing, and that the greatest waste generators are urban areas. Contrary to this view, Kofoworola (2007) argues that landfilling requiring land is regarded as one of the least costly options of municipal solid waste disposal. Nonetheless, allocation of land for waste disposal is practically impossible since areas with the highest generation and concentration of solid waste are also areas with a serious scarcity of land.

#### 5.2.5 Awareness of the recycling facility in the area

The results revealed that there is a lack of knowledge regarding the recycling facility in the area and this may be interpreted as lack of community involvement in waste management by the local authority. Typically, people are more likely to participate in waste management activities only when they observe others in their vicinity doing this activity. In developing countries, recycling programmes are rare, so the wealthier members of the country rely on informal recyclers as the behaviour norm (O'Connell, 2011).

### 5.3 Challenges related to municipal solid waste management

This study revealed that inadequate infrastructure and funding are some of the greatest obstacles to successful waste management practices in the area. Yavini and Musa (2013) confirm this finding, indicating that allocation of resources including financial resources for solid waste management is assigned a low priority compared to other municipal activities, resulting in inadequate funds for waste management. It was indicated earlier that waste-sorting for recycling activities is mainly done by the scavenger. Unfortunately, these informal waste collection systems make it more difficult for regulating and implementing an efficient and standardised waste

management system (Zhuang et al., 2008). In addition, searching through the solid waste may have a negative impact on the health and hygiene of these scavengers and waste-collectors (Yuan et al., 2006). When the scavengers sort through and remove the recyclables from the waste collection containers, they also often scatter about the remaining unwanted waste on the street. This litter can cause health problems and environmental concerns (Yuan et al., 2006).

It should be noted that waste separation before collection reduces the amount of solid waste generation, facilitates recycling of materials, and reduces the overall cost of waste disposal. Although some of this separation is already happening through the efforts of waste-pickers, separation at source before collection at the household level is not a common practice in the area of study. In this case, the local authority (municipality) has to be blamed, because during the survey, about 88% of the respondents indicated that they are willing to sort their waste because they see it as a good practice. Some indicated that sorting is a waste of time because in spite of sorting, the municipal waste collectors mix it when collecting and sorting becomes useless. Some indicated that sorting is expensive since it requires more refuse bags which the municipality does not provide. As a result, waste recycling and waste separation are going to be difficult steps to achieve in a community which is still disposing of waste in improper ways. It is a challenge to ask community members not only to dispose of waste correctly, but also to separate it before disposing of it in several waste containers.

Illegal dumping was also mentioned as one of the problems or challenges facing the municipality. Waste generated is carelessly thrown anywhere and this is the most visible aspect that shows poor waste management in the area. It was indicated that illegal dumping is influenced by the fact that the municipality does not provide waste skips to all areas. Where the waste skips are provided, they are not emptied timeously and this leads to residents throwing their waste on the ground next to the full skips. The area eventually becomes an open dumping site. Because the provision of the waste skips does not alleviate illegal dumping, it is perceived as promoting such dumping. Illegal dumping is seen by Sankoh et al. (2013) as a serious health hazard and leads to the spread of infectious diseases.



Another major constraint discovered in the area of study is the lack of education and awareness of effective waste management practices. Although education and awareness programmes are being conducted in parts of the municipal areas, the areas of study had not yet been covered. It should be noted that even though citizens are aware of recycling and other sustainable waste management techniques, this does not necessarily translate into participation in activities such as recycling initiatives. The community must be encouraged through awareness campaigns to use the best waste management options and the importance of such options to their health and the environment. This awareness was noticeably lacking in the area of study. The lack of interest in the environment creates a culture of non-participation of communities in decision-making processes.

There is a lack of technical capacity in the municipality to enable them to create a link between themselves and the community. This lack of communication not only affects the level of service delivery but it also prevents the municipality from going out to people regarding the challenges of solid waste management. Kassim (2006) suggests that people can cooperate if, and only if, they are included in the planning of the activities they should be part of and if they are aware of activities going on in their area. The municipality has not launched any awareness campaign to share its vision with the community on the issue of waste collection or recycling and to help the community acknowledge their responsibilities towards their areas in general and waste management in particular. Municipal officials complain about the negative behaviour of the public, their lack of awareness or sense of belonging, but they do not make any attempt to go out to the community to change this situation.

Another problem arose from the lack of appropriate places to store waste, which ends up in storage bags in the households before collection. As such, the waste storage bags are vandalised and torn by domestic animals, especially dogs and cats, in the process of looking for food, hence spreading the waste around household premises. Scavenging by animals need to be addressed for the success of the solid waste management endeavour.

#### 5.4 Community perceptions of municipal solid waste management

When it comes to environmental problems in general and solid waste management practices in particular, the ongoing challenge in Polokwane community as a whole remains the lack of awareness and public ignorance, resulting in negative behaviours concerning the collection and disposal of waste. Examples of such behaviours are carelessly throwing garbage into the public street, or disposing of waste right next to the provided waste container instead of inside it, disposing of loose waste directly into the waste container instead of enclosing it in a tightly closed bag, physically moving the waste container to another location, and burning generated waste either inside the waste container or out in the open. Sankoh and Yan (2013) contend that such attitudes and perceptions appear to affect both community and authorities regarding solid waste management.

Although the respondents have indicated that they are willing to recycle, some indicated that they could not be involved in recycling activities because of expense, as they would be expected to take their recyclables to the respective recycling facilities and this would require transport and more refuse bags. Recycling was also perceived as a time consuming activity. This is in contrary to the positive view of Abagale (2012) that recycling of waste has numerous benefits and is environmentally friendly compared to the other methods of waste disposal. Henry et al. (2006) indicate that indeed with the increasing cost of raw materials, recycling provides a cheaper source of raw materials for manufacturing industries.

With regard to illegal dumping, some respondents have indicated that this practice is an unacceptable behaviour because it pollutes the environment, while others have commented that illegal dumping can be a risk to their health. However, illegal dump sites are still being observed in areas, particularly in Seshego and Nirvana, showing that people recognise the negative impacts of their actions when they see these impacts; they just need to be instructed about the consequences of their action. This environmental and health consciousness is evidence that people have a sense of responsibility for their homes and immediate environment. The perception that it is the responsibility of the municipality to keep public places clean has negative consequences for the cleanliness of the environment and their health.

Some people consider taking waste to landfill as the best method because the waste is buried in such a way that they will never see it once covered, not knowing or taking into consideration the consequences that waste burial in the landfill may do to the underground water as the decomposition is taking place and the methane gas that can be produced. These consequences need to be discussed in the community so that they will realise that landfilling is not the best way to get rid of the waste generated. However, public awareness of solid waste management issues should not be largely defined in terms of the removal of waste from neighbourhoods. Issues of where solid waste is disposed, how to manage it, how best to allocate resources, the implications of poor solid waste management, and other related issues must be discussed in a public context since the public is generally not aware of such issues.

Negative attitudes were observed, especially regarding separation of waste. Some households mix wet and dry waste in one waste storage bag, which makes the final sorting exercise difficult. Such a situation clearly shows that continuous sensitisation to the needs and benefits of solid waste management and general health education should be an integral part of solid waste management efforts.

## CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

This chapter provides a summary of the findings and recommendations related to the research problem and objective of the study. Recommendations aiming at improving the MSWM in the municipality are suggested, together with possibilities for further research in municipal solid waste.

The overall goal of this research was to generate an overview of the current state of MSWM and challenges related to its management in the City of Polokwane Municipality. The study was also meant to identify the strategies that should be promoted for improved management of municipal solid waste based on the extent of the existing barriers and incentives. The study established that solid waste sorting is not being practised in the City of Polokwane Municipality and that the level of knowledge regarding sorting is low. Sorting is only done by waste scavengers who are interested in the economic value of some waste material. A total of 88% of the study respondents were willing to sort waste, with an indication of the provision of the necessary facilities. This willingness to sort waste suggests that it is the responsibility of the municipality to ensure that collectors do not mix already sorted waste. Lack of awareness, inadequate funding, unaccountability, and poor implementation of legislation and policies are major reasons for the failure of MSWM.

A large amount of waste is still taken to the landfill for disposal. However, this study has revealed that the most promising strategy for improving solid waste management in the City of Polokwane Municipality is through diversion of waste from landfill by maximising re-use and recycling of waste. The community in the study is willing to recycle, although there is a need for municipality in collaboration with business groups and other relevant parties to work on encouraging and supporting the community to improve their working environment, with benefits to all concerned.

It is the researcher's view that although South Africa has the best environmental management legislation in place, there is a gap in terms of individual responsibility in contributing to a clean environment. The National Environmental Management Waste Act, (Act No. 59 of 2008) requires the municipalities to develop their own integrated waste management plan to guide them in implementing their roles. The NWMS

encourages the implementation of the waste management hierarchy which involves reducing, re-using, recycling, recovering and treating waste before disposing at the landfill. Again, Section 24 of the Constitution of the Republic of South Africa makes it clear that everyone has the right to live in an environment that is clean and healthy, without pollution. The principles of the National Environmental Management Act, (Act No. 107 of 1998) place the responsibility on everyone polluting the environment, to clean it. A National Waste Management Summit was held in Polokwane in 2001 to address waste problems in the country.

None of these Acts have regulations in place to make individuals accountable. The law lacks the provision of rules or penalties regarding littering on the streets or any form of offensive waste disposal behaviour from the public. Additionally, the law does not hold citizens responsible for the cleaning of their own surroundings, their yard and gardens, as well as roads or streets in their immediate vicinities. Most importantly, current law does not clearly state that garbage must be placed in the proper containers for disposal. Accordingly, within the current legal framework, any person who litters or throws waste in public places or roads is not penalised. This provision is only applicable to the licensed waste management facilities.

## 6.1 Recommendations

Emanating from the findings and the conclusions drawn from the study, the following recommendations are made:

- The steps in waste management, starting from household waste storage to waste separation for recycling, must be brought to the awareness of the community as their attitudes towards waste management can affect the whole waste management system.
- In order to promote separation of waste, collection points for different types of waste need to be established and implemented. Education and awareness campaigns should be conducted so that there is awareness regarding the importance of proper solid waste management, including sorting at source of generation, which will have a positive effect on the waste handling and disposal situation in the study area.

- Recycling activities are currently completely informal. The municipality together with NGOs and community-based organisations should work together to organise and formalise the activity so that the work is recognised as employment. The local governments should consider organising and managing the informal waste-sorting system so that it can be better regulated by the municipal institutions. Not only would this improve the efficiency and cleanliness of urban solid waste collection, but it would also provide job opportunities for informal waste collectors as well as protect their health and welfare.
- Some of the respondents in the area of study were not aware of any recycling facility in the vicinity. It was identified that one of the biggest obstacles to recycling was the lack of knowledge regarding, and market for, recyclable materials. There is clearly a need to make recycling a viable and profitable option.
- Encourage partnerships between private, municipal, and community organisations for the purpose of establishing recycling ventures that can be to the benefit of all.
- Develop laws and regulations relating to littering, illegal dumping, re-use, recycling and recovery of waste to promote waste reduction initiatives. This will give the authority power to prosecute those who are practising littering and illegal dumping.
- The local authorities are therefore encouraged to pursue the paths of Integrated Solid Waste Management and “Reduce, Re-use and Recycle” that place highest priority on waste prevention, waste reduction, and waste recycling instead of just trying to cope with ever-increasing amounts of waste through treatment and disposal. Such efforts will help cities to reduce the financial burden on city authorities for waste management, as well as reduce the pressure on landfill requirements.

Based on the recommendations above, there is a need for further research towards the improvement of MSWM. More research is needed to establish more insights on how to improve community engagement in municipal affairs.

Further research should be done to address specific issues within the waste management sector and requirements for appropriate waste minimisation initiatives, and further work should be conducted to develop targets and objectives for long-term waste minimisation strategies. It is hoped that the findings and recommendations of

this research will be useful to all local authorities, not only in Polokwane but nationwide. These findings can then be used to improve and facilitate more effective and appropriate solid waste management programmes.



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## APPENDIX A: QUESTIONNAIRES FOR HOUSEHOLDS

### PERSONAL INFORMATION

Area of residence: \_\_\_\_\_

Race group: \_\_\_\_\_

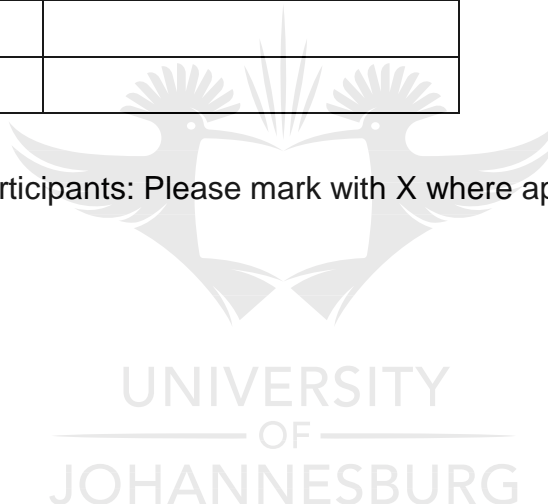
Occupation: \_\_\_\_\_

Average income per month: Please mark with X where applicable

5000-10 000	
10 100-20 000	
20 100-30 000	
30 100-40 000	
40 100-50 000	
50100-60 000	
60 100+	

Average age of the participants: Please mark with X where applicable

18-30	
31-40	
41-50	
51-60	
61 +	



### SOLID WASTE MANAGEMENT PRACTICE

1. What types of waste do you produce? Please mark with X on the appropriate box

Food waste	
Garden refuse	
Paper and plastics	
Beverage cans	
Glasses	
All of the above	
Others ( <i>please specify</i> )	

2. Is there any waste collection service provided at present in the neighbourhood?  
Yes or No.

a) If No, How is the household solid waste handled?

Burned	
Buried	
Dump on the street	
Take to landfill	
Other option ( <i>Please specify</i> )	

b) If Yes, where do you place your waste before collection

In a plastic refuse bag	
In a plastic rubbish bin	
In a metal rubbish bin	
Others ( <i>Please specify</i> )	

3. How often does the waste collector come around for waste collection in the area?

Once a week	
Twice a week	
Thrice a week	
Four times a week	
Everyday	

4. What is your level of satisfaction with the current waste/refuse removal in the area?

Very satisfied	
Satisfied	
Not satisfied	
Not sure	

5. Do you get charged for waste removal? Yes or No.

a) If yes, are you satisfied with the fees currently being charged for the services rendered by the waste collector? Yes or No

b) If no, could you please explain why?

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6. How would you rate the current solid waste management practices in the area?  
Please mark with X on the appropriate box.

Very good	
Good	
Acceptable	
Poor	
Very poor	

7. Are you willing to sort the waste that you generate? Yes or No. Please mark with X on the appropriate box.

Yes	
No	

8. Have you ever heard about separation waste at source? Yes or No.  
If yes. How do you feel about separating your waste into separate bags? Please mark with X on the appropriate box.

It's a good practice	
It helps the recyclers	
Mixing waste does not make sense	
It requires more refuse bags	
Its time consuming	

9. If there was a financial incentive for recycling, would you be willing to recycle? Yes or No  
If No, Could you explain why not?

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10. Have you observed waste scavenging in your neighbourhood? Yes or No  
If yes. What is your view about it?

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11. Do you know of any recycling facility around here? If yes, what type of waste do they recycle? Please mark with X on the appropriate box.

Papers	
Plastics	
Glasses	
Cans	
Metals	
Not sure	



12. What is your preferred method for waste management? Please mark with X on the appropriate box.

Recycle	
Re-use	
Burn	
Open dump	
Landfill disposal	

13. What is your view on littering or illegal dumping? Please mark with X on the appropriate box.

It's unacceptable	
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It should stop	
Fine people involved	
It makes no difference	
It's a person's choice	

14. Could you please tell me about any problems/challenges you have regarding waste management in the area?

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## **APPENDIX B: QUESTIONNAIRES FOR THE AUTHORITIES**

### GENERAL INFORMATION

AUTHORITY RESPONSIBLE: \_\_\_\_\_

DESIGNATION: \_\_\_\_\_

### **SOLID WASTE MANAGEMENT PRACTICE**

1. How do you undertake your municipal waste collection service? Please mark with X on the appropriate box.

By private contractor	
By municipal worker	
Both	
Others ( <i>Please specify</i> )	

2. Do you have sufficient resources allocated for waste management? Yes or No. If yes, Please indicate what are those resources. If No, please provide reasons why.

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3. How often do you collect waste from these localities (Nirvana, Flora Park and Seshego)?

Once a week	
Twice a week	
Three times a week	
Four times a week	
Everyday	

4. What is the overall responsibility of the municipality with regards to the management of municipal Solid Waste? Provide a brief explanation.

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5. Do you separate waste at source before collection? Yes or No. If No, please specify your option and why not..

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6. How do you manage your municipal waste?

Burn	
Recycle	
Re-use	
Recover	
Incinerate	
Landfill	
Other option ( <i>Please specify</i> )	

7. Explain why the above chosen management option is preferred.

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8. How much waste is normally generated and landfilled within the municipality annually?

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9. What are the programs/initiatives planned or currently in place to encourage waste re-use and recycling as means of waste minimisation to achieve the objectives of waste management hierarchy?

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10. What would you list as the causes of concerns or stresses that characterise the current municipal solid waste management practice in Polokwane?

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11. Do you have waste reclaimers that collect recyclables in the residential areas and at the landfill? Yes or No. If yes, what is your view about them? Please provide a brief explanation.

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12. How do you ensure that the municipal solid waste management practices of the municipality are in line with waste management legislation of the country?

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13. What are the problems/challenges encountered by the municipality in managing municipal solid waste?

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## **APPENDIX C: CONSENT REQUEST FOR HOUSEHOLDS**



UNIVERSITY  
OF  
JOHANNESBURG

University of Johannesburg

Faculty of Science

Department of Geography, Environmental  
Management & Energy Studies

Auckland Park

Johannesburg

15 July 2016

Dear Sir/Madam

### **REQUEST FOR CONSENT TO CONDUCT AND PARTICIPATE IN RESEARCH: MUNICIPAL SOLID WASTE MANAGEMENT WITHIN THE CITY OF POLOKWANE MUNICIPALITY: ASSESSMENT OF THE CURRENT STATUS, PROBLEMS AND CHALLENGES.**

My name is Mpho Morudu, a student from the University of Johannesburg enrolled for Master of Science (MSc) in Environmental Management. As part of this programme, I am conducting a research under the supervision of Prof. G. Hoogendoorn in the Department of Geography, Environmental Management & Energy Studies, at the University of Johannesburg.

The aim of this research is to assess the current situation, problems and challenges related to municipal solid waste management in the City of Polokwane Municipality. The study is focused on the residential areas namely: Nirvana, Flora Park and Seshego. This letter serves to request consent from the residents within Polokwane municipality. Your participation is voluntary and you can withdraw from participating at any stage without any negative consequences for your wellbeing and personal dignity. However, your participation/views as the municipal officials of the City of Polokwane Municipality are very important for the success of this research project. Furthermore, A complete confidentiality is assured, this simply means that the contents of this questionnaire is for academic purposes only and it will not be divulged to anyone to prejudice you in a personal capacity.

The results of this research will be available from the University of Johannesburg library or by direct communication with me. Should you require a feedback on the findings of this study, please mark with an “X” on the appropriate space provided.

Yes	No
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I would be extremely grateful if you could find time to participate by completing the questionnaire attached as Annexure A. This questionnaire is designed to facilitate the assessment of the current state of solid waste management initiatives in the study area. The information collected by this questionnaire for the selected areas in the study area will in turn be used to evaluate the status of the solid waste management. To enable an accurate assessment, it is important that all information requested in the questionnaire be provided as completely and accurately as possible. It will take about 30 minutes to complete.

Should you have any question regarding this, please do not hesitate to contact me at 082 255 8809, [godwin.morudu@gmail.com](mailto:godwin.morudu@gmail.com) or Prof. Gijsbert Hoogendoorn at 011 599 4628, [ghoogendoorn@uj.ac.za](mailto:ghoogendoorn@uj.ac.za)

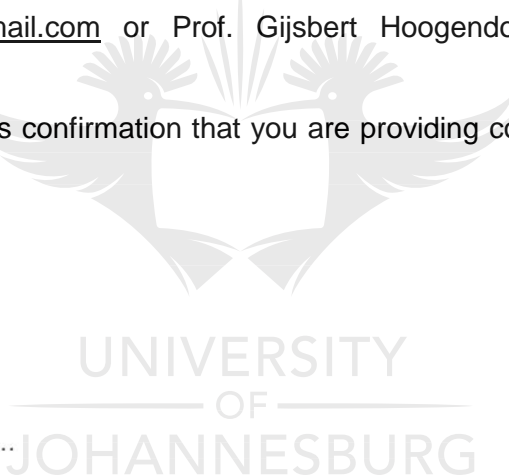
Please sign herein below as confirmation that you are providing consent for the study to be undertaken

Thank you in advance

Yours Sincerely



Mr Mpho Godwin Morudu



CONFIRMATION OF EDUCATED PRIOR INFORMED CONSENT IS PROVIDED BY COMPLETING AND SIGNING HEREIN BELOW SO THAT THE RESEARCH CAN BE UNDERTAKEN.

By signing this letter, I am giving a Prior Informed Consent to the Researcher to proceed with the research project.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## **APPENDIX D: CONSENT REQUEST FOR MUNICIPALITY**



University of Johannesburg

Faculty of Science Department of Geography,  
Environmental Management & Energy Studies

Auckland Park

Johannesburg

15 July 2016

Dear Sir/Madam

### **REQUEST FOR CONSENT TO CONDUCT AND PARTICIPATE IN RESEARCH: MUNICIPAL SOLID WASTE MANAGEMENT WITHIN THE CITY OF POLOKWANE MUNICIPALITY: ASSESSMENT OF THE CURRENT STATUS, PROBLEMS AND CHALLENGES.**

My name is Mpho Morudu, a student from the University of Johannesburg enrolled for Master of Science (MSc) in Environmental Management. As part of this programme, I am conducting a research under the supervision of Prof. G. Hoogendoorn in the Department of Geography, Environmental Management & Energy Studies, at the University of Johannesburg.

The aim of this research is to assess the current situation, problems and challenges related to municipal solid waste management in the City of Polokwane Municipality. The study is focused on the residential areas namely: Nirvana, Flora Park and Seshego. This letter serves to request consent from municipal officials within the municipality. Your participation is voluntary and you can withdraw from participating at any stage without any negative consequences for your wellbeing and personal dignity. However, your participation/views as the municipal officials of the City of Polokwane Municipality are very important for the success of this research project. Furthermore, A complete confidentiality is assured, this simply means that the contents of this questionnaire is for academic purposes only and it will not be divulged to anyone to prejudice you in a personal capacity.

The results of this research will be available from the University of Johannesburg library or by direct communication with me. Should you require a feedback on the findings of this study, please mark with an “X” on the appropriate space provided.

Yes	No
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I would be extremely grateful if you could find time to participate by completing the questionnaire attached as Annexure A. This questionnaire is designed to facilitate the assessment of the current state of solid waste management initiatives in the study area. The information collected by this questionnaire for the selected areas in the study area will in turn be used to evaluate the status of the solid waste management. To enable an accurate assessment, it is important that all information requested in the questionnaire be provided as completely and accurately as possible. It will take about 30 minutes to complete.

Should you have any question regarding this, please do not hesitate to contact me at 082 255 8809, [godwin.morudu@gmail.com](mailto:godwin.morudu@gmail.com) or Prof. Gijsbert Hoogendoorn at 011 599 4628, [ghoogendoorn@uj.ac.za](mailto:ghoogendoorn@uj.ac.za)

Please sign herein below as confirmation that you are providing consent for the study to be undertaken

Thank you in advance

Yours Sincerely



**Mr Mpho Godwin Morudu**

CONFIRMATION OF EDUCATED PRIOR INFORMED CONSENT IS PROVIDED BY COMPLETING AND SIGNING HEREIN BELOW SO THAT THE RESEARCH CAN BE UNDERTAKEN.

By signing this letter, I am giving a Prior Informed Consent to the Researcher to proceed with the research project.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## APPENDIX E: MUNICIPAL APPROVAL TO CONDUCT A STUDY

#492637

### REPORT CONTROL SHEET

SUBJECT: Report to conduct a research for Mr M.G. Morudu.  
# \_\_\_\_\_

SECTION A: SUBMISSION BY SBU MANAGER  
SBU: Corporate and shared Services NAME (AUTHOR): Ms. P. Mello  
SIGNATURE / SBU MANAGER: \_\_\_\_\_ DATE: 06/09/2016.

SECTION B: AUTHORISATION / SUBMISSION BY  
DIRECTORATE: Corporate and Shared  
SIGNATURE / DIRECTOR: \_\_\_\_\_ DATE: 08/09/2016

SECTION C: COMMENTS REQUIRED FROM: [TICK IN APPLICABLE BLOCK]

DIRECTOR: ENGINEERING SERVICES	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: DEVELOPMENT & ECON. PLAN	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: COMMUNITY SERVICES	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: CORP AND SHARED SERV.	<input checked="" type="checkbox"/>	SIGNATURE: _____	DATE: <u>08/09/2016</u>
CHIEF FINANCIAL OFFICER	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: COMMUNITY DEVELOPMENT	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: STRAT PLAN. MONITOR & EVAL.	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
MAN: COMMUNICATION & PUBLIC PART.	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____

SECTION D: SECRETARIAT & ADMINISTRATION  
REG. NO: \_\_\_\_\_ REG. DATE: \_\_\_\_\_ COMMITTEE CLERK: \_\_\_\_\_

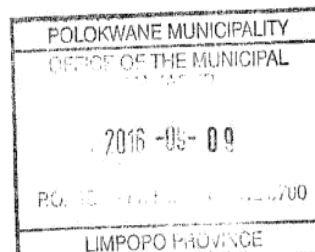
SECTION E: MUNICIPAL MANAGER  
APPROVED FOR SUBMISSION: Frango DATE: 2016/09/09  
REMARKS: \_\_\_\_\_  
**ALLOCATION TO SPECIFIC COMMITTEES**

FINANCE & LED	ENERGY	HOUSING	CULTURE, SPORTS, REC. & SPEC. FOCUS	ADMIN & GOV.
WATER & SANITATION	COMMUNITY SAFETY	ROADS, SWATER & TRANSPORT	WASTE & ENVIRON.	SPATIAL PLAN & DEV
LAND USE MAN.	LOCAL LABOUR FORUM	COUNCIL	MAYORAL COMMITTEE	

APPROVED ITO DELEGATED POWERS: \_\_\_\_\_ DATE: \_\_\_\_\_  
MM/ NUMBER ALLOCATED BY CAO – SECRETARIAT \_\_\_\_\_ MM/ \_\_\_\_\_

**APPROVAL OF EXECUTIVE MAYOR IN TERMS OF DELIGATED POWERS**

APPROVED ITO DELEGATED POWERS: \_\_\_\_\_ DATE: \_\_\_\_\_  
EM/ NUMBER ALLOCATED BY CAO – SECRETARIAT \_\_\_\_\_ EM/ \_\_\_\_\_



# 515557  
MS. P Mello (06/09/2016)

**DIRECTORATE: CORPORATE AND SHARED SERVICES**

**ITEM:**

**FILE REF:**

**REQUEST TO GRANT MR MG MORUDU PERMISSION TO CONDUCT HIS RESEARCH WITHIN POLOKWANE MUNICIPALITY**

**Report of the Acting Director: Corporate and Shared Services**

**Purpose of the Report**

To request approval from the Acting Municipal Manager to give permission to Mr MG Morudu to conduct research within Polokwane Municipality.

**Background and Discussion**

Mr MG Morudu is a student at University of Johannesburg studying Masters of Science in Environmental Management, request a permission to conduct his research within the Municipality and his topic of research is: "Municipal solid waste management in the city of Polokwane Municipality": Assessment of the current status, problems and challenges.

**The study will assist Polokwane Municipality in:**

In view of the potential contribution of this research to the advancement of ethical leadership practices in municipalities in general, and the theoretical contribution to the field of Environmental Management.

**Financial Implication**

There is no financial implication.

**Recommend**

1. That approval is granted for Mr MG Morudu to conduct his research within Polokwane Municipality.
2. That the findings emanating from the research study be shared with the Municipality before they are published.

*Permission Granted.  
for boye  
2016/09/09*