

**A Model for Public-Private-Partnership on Solid Waste Management towards
Sustainable Cities: The Case of the City of Johannesburg Metropolitan**

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Declaration

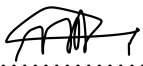
I Thabang Khoza hereby declare that the submitted Research Dissertation at the University of Mpumalanga for the Master of Development Studies degree which is titled A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan its original and of my own work. I declare that the Research Dissertation has not been submitted before or currently at any other institution and all the sources have been acknowledged fully. The data and images provided within the dissertation are of my own work unless specified through referencing and scientifically acknowledging the sources.

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DEDICATION

I Dedicate this master's Dissertation to myself Thabang Khoza for always being resilient to all the challenges I encountered throughout my academic journey and always having hope that things will look up one day and here we are today.

ACRONYMS

- **4IR:** Fourth Industrial Revolution
- **CoJ:** City of Johannesburg
- **DLG:** Developmental Local Government
- **IDP:** Integrated Development Plan
- **ISWM:** Integrated Solid Waste Management
- **MFMA:** Municipal Financial Management Act
- **MSA:** Municipal Systems Act
- **MSW:** Municipal Solid Waste
- **NDP:** National Development Plan
- **NGO:** None Governmental Organization
- **PFMA:** Public Finance Management Act
- **PPE:** Personal Protection Equipment
- **PPP:** Public-Private Partnerships
- **SDG:** Sustainable Development Goals
- **SOC:** State Owned Company
- **UNDP:** United Nations Development Program
- **WtE:** Waste to Energy

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To the officials from the Pikitup SOC and City of Johannesburg Metropolitan Municipality, I hope the data generated, recommendations, and the model developed within the research study will be of great assistance towards waste management.

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ABSTRACT

Solid waste management has become one of the global challenges in the sustainable development of many cities of developing economies around the world as municipalities and the public sector authorities are having difficulties in effectively managing waste due to rapid population growth, urbanization, industrialization, and economic growth. To effectively manage waste within cities around the world and reduce the financial burden and shortcomings faced by the public sectors in providing waste management service deliveries to communities, public-private partnerships (PPP) were developed and are currently being implemented in developed and developing countries. The implementation of the public-private partnerships came about as a result of failures emanating from the public sectors towards waste management. Public-Private Partnerships are implemented to assist the public towards the collection, transportation, and disposal of municipal solid waste properly, as the costs to provide those kinds of services are too high for the public sector. The PPP agreements have provided an effective business environment for the private waste management companies as they have entered into multiple agreements for waste management services, which include the construction of landfill sites and leasing them to the public sector. Furthermore, the PPP agreements that are in place have managed to successfully assist the public sector with waste management services, but that has not been enough, as the public sector is still financially battling to procure private services due to poor financial revenue.

The research study explored the forms and conditions of public-private partnerships in cities, described the characteristics and indicators of sustainable cities, and evaluated the processes and strategies used for solid waste management in cities, which assisted in the development of the PPP model for solid waste management within cities. This research study adopted the inductive research design and a qualitative research approach, which resulted in 21 one-on-one, semi-structured interviews with sampled participants who voluntarily participated. The research study has made revelations with regards to the three research objectives, and that within the city of Johannesburg there are PPP agreements that are in place for waste management services, which involve the public sector procuring waste compactor trucks for the collection of waste, transportation, and disposing of waste, which are contractually found. Furthermore, the PPP agreements within the city of Johannesburg also involve the public sector leasing landfill sites from private companies for the disposal of waste and financially reimbursing the private companies and contractors. In relation to the indicators of sustainable

cities, it was discovered that the city of Johannesburg is not sustainable economically, socially, and environmentally due to multiple factors that have contributed to the influx of solid waste generation. The findings also illustrated that the city of Johannesburg has multiple strategies and processes being implemented for managing waste in the city that involve different role players from the public and private sectors. Moreover, the research study discovered that there's a gap within the existing PPP agreements within the city of Johannesburg, as waste management services are not integrated within the city's Integrated Development Plan (IDP), which has resulted in no community participation initiatives for waste management projects. Therefore, the developed PPP model has regarded community participation as a driver for inclusivity, formalization, and legalization of informal waste collectors towards the enhancement of a circular economy and waste minimization in communities.

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CHAPTER ONE: INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Introduction and Background

The world is facing different kinds of challenges that have negatively impacted the social, economic, and environmental aspects found in the society, whereby one of the most burning issues affecting the world at large is the issue of solid waste and illegal dumping within the society (Lazola, 2023). It has been clarified by many researchers and academics that conserving the environment plays a critical role in ensuring that there's sustainable development within the developing countries and cities, as there's an interrelation between the environment and development as stated in the White Paper on Environmental Management Policy (Policy, 1997). Multiple communities around the world have been negatively affected by solid waste and illegal dumping, which has caused environmental degradation and a halt towards the development of the communities (Jakeni, 2024). The inception of the Rio summit in 1992 came as a result of the environmental degradation faced by communities around the world due to illegal dumping, as the main agenda of the Rio summit, which was held in Brazil, was to find a way forward on how the environment can be conserved and preserved in order to protect the earth through proper management of activities that enhance environmental degradation (Policy, 1997). Furthermore, Rissa (2022) illustrates the fact that solid waste management and illegal dumping have been big issues for municipalities in developing countries.

Solid waste management has been found to be a challenge for developing countries, whereby Rissa (2022) states that the issue of mismanagement of solid waste and illegal dumping is enhanced by the social disorganization within the society. It has been noted by multiple scholars that mismanagement of solid waste and illegal dumping might be influenced by different issues, but Rissa (2022) states that one of the most common influences towards mismanagement of solid waste, pollution, and illegal dumping is the low rates of waste collection from responsible stakeholders. Jakeni (2024) states that solid waste and illegal dumping can be influenced by multiple issues, but on the other hand, mismanagement of solid waste and illegal dumping also results in negative issues within the society whereby the health and safety of the community will be threatened. Abel (2014) illustrates that municipal solid

waste and illegal dumping are global environmental problems whereby illegal dumping does not only affect the dumping location but also affects the nearby locations.

Abel (2014) highlights the fact that mismanagement of solid waste is mostly influenced by a growing population within a country or specified location based on the fact that any human activity will result in some sort of waste. Furthermore, it has been noted that whenever there's population growth or development in a town or city, the quantity of waste increases in that geographical area, which tends to lead to scattered waste, which is socially and environmentally unacceptable (Swanepoel, 2024). The issue of solid waste and illegal dumping within the society can be interlinked with the ineffective or lack of waste management policy implementation, which later on affects the living conditions of the society (Joël, 2019). Municipal solid waste has been a big problem for developing countries, particularly African countries, whereby the municipal solid waste (MSW) collection strategy has been ineffective, which has resulted in the World Bank stating that Africa is only able to generate 0.65 kg/capita/day of municipal solid waste, which is predominantly lower than the European continent, which generates approximately 1–1.75 kg/capita/day (Joël, 2019). It has been highlighted by Joël (2019) that sub-Saharan African countries have an ineffective municipal solid waste system, which results in severe consequences towards the environment and human health. Moreover, it has been noted that there's a low collection rate of waste in Sub-Saharan communities, whereby Joël (2019) states that the low rates of waste collection have risen from 39% to 70%. As it has been noted that excessive solid waste quantity and illegal dumping are influenced by different factors, it should also be noted that the failure of the municipal solid waste collection treatment is influenced by different factors such as insufficient capital, expertise, poor waste management systems, infrastructure, a rise in urban migration, and geo-environmental constraints, as African countries are characterized by a difficult topography (Joël, 2019).

Municipalities around the world are governed by different constitutions and regulations that will promote service delivery in different communities in order to ensure sufficient quality of life (Bonolo, 2016). Waste management within the society is the priority of municipalities, as they are considered to be the primary stakeholders when it comes to service delivery of waste collection within the South African communities, as stated in the White Paper on Developmental Local Government 1998 (Koma, 2012). Municipalities in South Africa are

mandated to collaborate with civilians found in the society in providing service delivery that will improve the social, economic, political, and environmental aspects (Koma, 2012). The management of solid waste within the society is the priority of municipalities by providing efficient and effective ways on how to collect, refuse, and collect waste through the implementation of different waste management policies, tools, and partnerships (Bonolo, 2016).

Rise in the quantity of municipal solid waste and illegal dumping within communities is also enhanced by population growth; hence the city of Johannesburg has been affected by a large quantity of municipal solid waste, illegal dumping, and pollution due to the fact that the population growth within the proximity of Johannesburg city has increased to 6,198,000 by 2.10% from the population of 2022 as recorded in Macrotrends (2023). The population increase in the City of Johannesburg has been a stumbling block for managing municipal solid waste due to the fact that Johannesburg falls under the Gauteng Province, which is considered to be one of the smallest provinces in South Africa while having the largest population in South Africa, which has led to insufficient land space to hide and store municipal solid waste, which has resulted in a lot of illegal dumping and ineffective municipal solid waste strategy within the City of Joburg municipality (Bonolo, 2016).

The research dissertation managed to identify the gap in knowledge and develop a model towards a public-private partnership model for municipal solid waste strategy in managing municipal solid waste and curbing illegal dumping in the city of Joburg through stakeholder engagements and participation to enhance a sustainable city. The identification of the gap in knowledge and development of a model for public-private partnership on municipal solid waste is a result of the high rates of illegal dumping and excessive quantity of municipal solid waste generated within Johannesburg and the need for partnership between the public procurements responsible for managing municipal solid waste and other non-government stakeholders within the city that have an interest in municipal solid waste.

Chulumanco, (2023) states that there's more than 1,900 hot spots of illegal dumping in the metropolitan municipality. Municipal solid waste management and illegal dumping have been a burning issue in the metropolitan area due to the data provided by Pikitup SOC, which states that in the 2022-2023 financial year they collected 76,757 tonnes of illegally dumped waste,

which is believed to be caused by residents and businesses within the city's proximity (Chulumanco, 2023). Moreover, municipal solid waste and illegal dumping are problems faced by every community, and the municipalities are mandated to tackle that problem through the Municipal Solid Waste Management strategy, which is informed by the South African Constitution of 1996, which clearly states that municipalities should remove, dispose refuse, and dispose of municipal solid waste within the society (Polasi, 2020). It has been noted by the UNEP 2020 report on Municipal Solid Waste that once the MSW strategy is effective and efficient in achieving its objectives, then urban reforms will be successful and competent local governance will be achieved as the sustainability of the MSW will enhance sound municipal solid waste management (Polasi, 2020).

Amr (2022) has stated that municipal solid waste is regarded as waste that is produced by commercial, industrial, institutional sectors and residents found in the city and is collected by the designated service providers. The increase in population growth, industrial development, and urbanisation within the city of Johannesburg has resulted in an increment in solid waste production, hence a new municipal solid waste management company that was developed and implemented in 2001 called Pikitup, with the City of Johannesburg as the main shareholder. A municipal solid waste management strategy is characterised by multiple legislations and policies that seek to ensure effective service delivery in relation to treatment, processing, transporting, sorting storage of solid waste in order to ensure a clean, safe, and healthy environment that is free from illegal dumping (Amr, 2022). Hence this research dissertation developed a model for public-private partnership on solid waste management within the Johannesburg Metropolitan municipality, which is characterised by a large quantity of waste generated, illegal dumping, and an ineffective solid waste management strategy.

It has been noted by Polasi (2020) that solid waste management is a big environmental problem for South Africa as a whole, whereby income growth within cities has seen a rise in waste generation. Due to the increase in waste generated, many municipalities in South Africa adopted the strategy of landfill sites towards the management of municipal solid waste, whereby the landfill sites are used to store all the collected solid waste within the municipality. Solid waste and illegal dumping within the municipalities, especially cities, has risen as there's no land to store and process the generated waste due to urbanisation and population growth. Polasi (2020) highlights that many municipalities in South Africa have run out of landfill space.

It has been estimated that South African households generate 12.7 million metric tonnes of waste per year, whereby 29% of the waste is uncollected, which results in mismanagement of municipal solid waste and illegal dumping; hence, this research dissertation developed a model for Public-Private Partnerships on solid waste management for sustainable cities.

The city of Johannesburg metropolitan municipality falls under the Gauteng Provincial Government, whereby the municipality is regarded as the engine for South Africa's economy as it is considered the most advanced commercial city in Africa. It has been noted that the city of Joburg is characterised by world-class facilities such as telecommunications, health, water, education and logistics, which play a big role in the migration of humans from other municipalities to Johannesburg. The City of Joburg is regarded as home to millions of people, which include the rich, poor, refugees, and multiple global corporations and SMMEs that play a very important role towards the economy of Johannesburg. Advancement and world class facilities within the city's proximity have played a critical role in the population growth of the city, which increased to 6,198,000 in 2023, which later on resulted in its consequences for the environment (Macrotrends, 2023). Furthermore, the city of Johannesburg is characterised by multiple racial groups such as Black African, white, coloured and Indian.



(Municipalities of South Africa, 2024)

Figure 1: Locality of the City of Johannesburg Metropolitan Municipality

The city of Johannesburg is a 1,625 km² area that consists of four landfill sites that play a major role in ensuring a sustainable municipal solid waste strategy. Pikitup SOC is a company owned by the City of Johannesburg Metropolitan Municipality that approximately collects 1.4 million tonnes of municipal solid waste from households, which will be disbursed to 12 waste management depots that are located within the proximity of 33 garden refuse sites. The municipal solid waste strategy is aligned with the National Development Plan vision 2030 and Sustainable Development Goal 11, which advocate for safe, resilient, and sustainable cities and human settlements during rapid population growth and urbanisation. This research study discovered the gap in knowledge towards the development of a public-private partnership model that seeks to manage solid waste with an intention to create sustainability for the city of Joburg. The research study looked at the engagements, participation, and collaboration of multiple stakeholders from the public and private sectors. Furthermore, the research study also focused on the role landfill sites and garden refuse sites play in reducing solid waste within the city. This research study managed to develop a public-private partnership model for cities on how to manage solid waste, as it is a common problem in the world affecting the sustainability of cities.

1.2 Statement of the Problem

It has been emphasised by Khawaja (2021) that the partnership between the public and private sectors will reduce the budget constraints of the public sector when tackling the problem of solid waste management and illegal dumping, as the private sector will also contribute financially to the implementation of recycling plants. Polas (2018) states that the City of Johannesburg does not have a clear plan for tackling the issues of waste management and illegal dumping within the city; hence, the calls for an effective partnership between the private and public sectors within the city in order to deal with the issue of solid waste, whereby the roles, powers, costs, and responsibilities will be shared amongst the sectors as stated by Emmanuel (2022).

The City of Johannesburg Metropolitan Municipality is largely being affected by mismanagement of solid waste and illegal dumping, which has questioned the competency of the Metropolitan Municipality and the Municipal Solid Waste Strategy that they have in place. The city does not have an effective strategy that will sufficiently manage solid waste (Polas,

2018). As it has been noted by Polas (2018), that the city of Johannesburg does not have an effective strategy for the management of solid waste and best suitable strategy is through the collaboration of the private sector and public sector. The existing PPP agreements for solid waste management in Johannesburg run on a short term basis which is quite unusual for PPP contractual agreements (Madiba, 2023). Furthermore PPP agreements for solid waste management in Johannesburg only consists of the public sector and private sector no other role players that have an interest in solid waste management.

The main purpose of this research dissertation is to develop a model that enhances effective and efficient PPP agreements for the management of solid waste as there are already PPP agreements in place that seek to tackle waste management issues. Moreover, the research dissertation managed to develop a comprehensive PPP model that focuses on the broader scope of role players and society as available literature does not highlight the role played by civilians and community organisations in the management of solid waste management in Johannesburg. Public-Private Partnerships within the city of Johannesburg have played a significant role towards service delivery and rejuvenating the city of Johannesburg (Lushaba, 2024). The PPP agreement between the metropolitan and Jozi my Jozi entity that consists of CBOs and business entities within the city have played a significant role towards waste management through the clean-up operations and repairing of infrastructure (Lushaba, 2024). PPP agreements have proven to be effective in enhancing service delivery in Johannesburg as they mobilise additional source of funding for delivering projects such as the construction and operation of the Gautrain by the Bombela consortium which entered into a long term PPP agreement with the Gauteng Provincial government (Mashwama, 2018).

The developed Model for Public-Private Partnership on Solid Waste Management towards Sustainable Cities relates to Sustainable Developmental Goal 11, which advocates for safe, resilient, and sustainable cities and human settlements during rapid population growth and urbanisation. Sustainable Development Goal 11 has multiple targets that it needs to achieve after a certain period, whereby one of the most relevant SDG 11 targets is Sustainable Development Goal 11.3, which advocates for inclusive and sustainable urbanisation, and Sustainable Development Target 11.6, which seeks to reduce the environmental impacts of cities with regards to effective waste management within a city's proximity. The National Development Plan vision 2030 aligns with SDG 11, as the NDP vision 2030 states that it wants

to create an environmentally healthy society with zero carbon emissions by implementing the waste management strategy, improving the recycling infrastructures, and encouraging the composition of organic domestic waste in order to enhance the local economy, whereby that is a clear indication that curbing illegal dumping and developing models for solid waste can play a positive role in stimulating the economy and fighting the triple challenges of inequality. Poverty and unemployment since solid waste can be used for job creation, technological advancement, and income generations (NDP, 2013).

1.3 Research questions

The general research question of this study is how Public-Private-Partnerships on solid waste management could be realized towards achieving sustainable cities? From this general research question, the following specific research questions were formulated:

- What are the forms and conditions of Public-Private-Partnerships in cities?
- What are the characteristics and indicators of sustainable cities?
- What are the processes and strategies of solid waste management in the cities?

1.4 Research Aim and Objectives

The aim of this study is to develop a model for Public-Private Partnership for sustainable cities towards managements of solid waste.

- To explore the forms and conditions of Public-Private partnerships in cities.
- To describe the characteristics and indicators of sustainable cities.
- To evaluate the processes and strategies of solid waste management in cities.

1.5 Significance of the Study

The research study is very important as it managed to develop a model for a public-private partnership on solid waste with an intention to create a sustainable city that is in line with the Sustainable Development goals. This research study has managed to provide a systematic model for municipalities towards tackling municipal solid waste problems by advocating and enhancing collaborations between the private sector, public sector, and informal waste

collectors who are community members. It has been noted by multiple researchers, scholars, and empirical data that the city of Johannesburg does not have an effective strategy towards tackling solid waste within the city. Different characteristics of public-private partnerships and sustainable cities were outlined within the research dissertation as different stakeholders provided empirical data, which assisted in outlining and describing different perceptions and experiences with regards to the collaboration of the public and private sectors towards formulating a solid waste strategy towards service delivery in their respectful communities and the impactful role played by community members in the management of municipal solid waste within communities. This research study provided a wide range of knowledge on the importance of public-private partnerships in dealing with solid waste in enhancing human health and reducing environmental impacts caused by mismanagement of municipal solid waste and unstable public-private partnership agreements. This research study provided a systematic model for public-private partnerships that advocates for community participation and inclusivity of informal waste collectors to deal with issues surrounding municipal solid waste, illegal dumping, waste pollution, enhancing sustainability through job creation, and reducing poverty within the city of Johannesburg.

1.6 Definition of Terms

Municipal Solid Waste (MSW): is regarded as unwanted trash or waste generated by residents, businesses and institutions within a geographical area that needs to be disposed of at the correct specified dumping and landfill sites (EPA, Wastes—Non-Hazardous Waste—Municipal Solid Waste, 2016). The Municipal Solid Waste can be referred to as waste such as bottles, food scrapes, paper, appliances, paint, batteries, product packaging, clothing, and furniture that is unwanted and excludes waste generated while creating a product (EPA, 2016). The municipal solid waste is regarded as waste that is collected by the municipality from the designated bins and dumping locations, which will be transported and stored in landfills or municipal dumping sites that are designed to sort out solid waste. Many professionals have defined municipal solid waste into different contents, whereby some the engineering professions refer to municipal solid waste as materials that do not have value anymore towards the owner (Tchobanoglous, 2012).

Sustainable development: This concept is referred to as the transformation of the standard of living within communities, whereby the transformation is not only limited to the standard of

living but also the economic, social, political and environmental sectors, as the development needs to be sustainable on a long-term basis by benefiting solving the problems of the past, benefiting the present, and also having a positive impact for future generations, as stated in the White Paper on Environment Management Policy of 1997 (WPEMP, 1997).

Sustainable cities: It's a specific geographical area that has been developed to contain social, economic and environmental issues that might occur through urban planning processes (Meyer, 2023). The most important aspect of a sustainable city is to enhance an eco-friendly environment through the enforcement of policies and legislatures that will seek to protect the environment, economy and society from present and future challenges (Meyer, 2023). Sustainable cities enhance urban development through the development of public green spaces ,effective waste removal and infrastructure provision (Meyer, 2023)

Sustainable development Goals: Are regarded as ambitious goals that need to be implemented and achieved in 2030 in order to development the world by tackling issues such as poverty ,inequality and the environment (WHO, 2025).Before the adoption of the Sustainable Development Goals in 2015 we had Millennium Development Goals which only focused on the needs of the western countries and instead of the world at large (Sanjigadu, 2022).The utilisation of Sustainable Development Goals after 2015 it meant that current challenges faced by the world in all spheres will be tackled and also predicting future challenges that might occur and providing mitigation strategies for future challenges in order to enhance sustainability (Sanjigadu, 2022).

Public-Private Partnership (PPP): is regarded as a collaboration between the public sector or government together with the private sector institutions, whereby there's a contract formulated for the private sector institutions that will be joining forces with the public sector to play a critical role towards service delivery duties that were intended for the public sector (TreasuryZA, 2017). During the public-private partnership, the powers, roles, responsibilities and costs will be shared between the public and private sectors, whereby the private sector will invest in public procurement projects with an intention to get a return on investment. The PPP process seeks to remove the financial burden from the public sector when it comes to the costs and resources for administration and legislation of public procurement initiatives (TreasuryZA, 2017).

National Development Plan: Is an action plan that is in line with the constitution of South Africa which seeks to address multiple issues such as poverty, inequality, unemployment and climate change challenges that South Africa is facing (National Planning Commission, 2012). The NDP is a policy document that the South African government seeks to follow as a guideline for achieving vision 2030 which is in line with Sustainable Development Goals in order to enhance the capacity of the state as the main purpose is to transition from an apartheid state to a democratic state through multiple development projects (National Planning Commission, 2012).

Hazardous Waste: It has been noted by WPEMP (1997) that any waste that is not regarded as radioactive waste but that is classified as a danger to human health or the environment based on the characteristics it has, such as chemical reactivity, ecotoxicity, explosive character, corrosive qualities, and carcinogenic qualities. It has been noted by the EPA, (2022) that hazardous waste is mostly managed by the Resource Conservation and Recovery Act (RCRA), which was passed in 1976.

Solid Waste: The concept of solid waste seeks to differentiate between the seven types of waste as solid waste specifically refers to waste produced by human behaviour and households. Waste such as food scraps, bottles, tins, paper, plastic and clothing are referred to as solid waste (Rambuda, 2020). Therefore solid waste is also categorised by industrial waste, medical waste and hazardous waste produced by households (Rambuda, 2020).

Ecosystem: White Paper on Environmental Management Plan of 1997 illustrates ecosystems as components that are non-living or abiotic, such as plants, animals, and microorganisms within a specified community (WPEMP, 1997). Most of the time when researchers and scholars refer to the effects of different activities towards the ecosystems, it is the referral of the water, solar energy, oxygen and carbon dioxide, which play a very critical role in building up the ecosystems and play a critical role in ensuring the quality of life within communities is sufficient (WPEMP, 1997).

Urbanisation: is referred to as the relocation of humans from rural classified areas to urban classified areas with an intention to look for a better quality of life, which will result in the growth of settlement density and the land cover will increase within the urban areas

(Satterthwaite, 2014). Urbanisation does not only focus on the migration of people from rural to urban areas; it is also characterised by innovative economic activities and developmental activities such as the development of vacant land by constructing institutions and infrastructure that will improve the quality of life within those geographical areas (Satterthwaite, 2014).

1.7 STRUCTURE OF THE DISSERTATION

Chapter One: This chapter is inclusive of the introduction and background of the research problem by breaking the research topic into different paragraphs. Furthermore, the introduction and background of the study are demonstrated through a funnel approach through a combination of literature from different scholars and researchers. Moreover, the chapter also contains the problem statement in relation to the identified research problem that has been the focus within the research study, whereby the problem statement provides systematic arguments about the problem of municipal solid waste at an international, continental, national, provincial, and local level. In this chapter, the research questions, aim, and objectives have been outlined systematically, followed by the definition of terms that are common within the dissertation. Therefore, the chapter also highlights the significance of the research dissertation.

Chapter two: In this chapter we have the combination of the literature review from different researchers and scholars who have provided substantial data in relation to the research problem and objectives. The literature in this chapter is outlined concurrently with the research objectives, together with the main themes and sub-themes that have been developed to have sufficient and rich literature that supports the research problem. Furthermore, the chapter is also characterised by three theoretical frameworks, namely the multi-actor environmental governance theoretical framework, the urban sustainability framework, and integrated solid waste management. Theoretical frameworks that have provided a direction to be taken for the formulation of arguments within the research dissertation.

Chapter three: This chapter is characterised by the research designs and methodologies that have been adopted to achieve the research objectives and assist in developing a PPP model for solid waste management. Furthermore, the chapter also provides a detailed explanation of how participants were selected and how the empirical data was collected, analysed, and interpreted. Moreover, the chapter also provides an overview of the ethical considerations that were applied throughout the research dissertation.

Chapter four: Focuses on the data analysis process that was conducted on the raw data generated from participants of the research dissertation. This chapter provides an important element of the research dissertation with regards to what the participants are saying with regards to the research problem and research questions. Data in this chapter is analysed through a thematic approach. Furthermore, the chapter is also characterised with visual data and observations made by the researcher during fieldwork.

Chapter five: This is where you find the discussion of the findings that emanate from the analysed data, which was conducted in chapter four of the research dissertation, whereby the findings are discussed with the inclusion of literature and theoretical frameworks. Subsequently, the discussion of findings is the discoveries made by the research dissertation with regards to PPP agreements with regards to management of municipal solid waste within cities. The chapter discusses the forms and conditions of PPP agreements, characteristics of urban sustainability, and processes and strategies implemented towards the management of solid waste.

Chapter six: It's a representation of the summary of findings, recommendations, and conclusion made with regards to the whole research study on its main research questions and objectives. Moreover, the chapter also involves a combination of recommendations for policy, action, and future research that are informed by the empirical data generated by the research dissertation.

1.8. Chapter summary

In this chapter, an introduction and the background of the research dissertation were provided through concise arguments from multiple researchers and scholars in relation to municipal solid waste within cities and the challenges experienced towards managing MSW. The introduction and background also provided an overview of the research problem that the dissertation was focusing on, which led to the formulation of research questions, objectives, and the aim that was developed to provide new knowledge and suggestions for the research problem at hand. To make it easier for the second person who will be reading the dissertation, the chapter provided definitions of terms that fully explained common terms being utilised throughout the research dissertation. Furthermore, a systematic structure of the dissertation was provided in the chapter in order to make the reader aware of what to expect in the dissertation as it is

characterised by different chapters .Moreover, the significance of the study was provided as it highlighted the importance of conducting this research dissertation, which explored the forms and conditions of public-private partnerships in cities, described the characteristics and indicators of sustainable cities, and evaluated the processes and strategies of solid waste management in cities, which led to the development of the PPP model for managing MSW effectively. The following chapter consists of the literature review that was conducted for this research study, which is presented systematically in correlation with the research objectives, themes, and sub-themes to provide a larger scope of secondary data that relates with the research objectives. Furthermore, the following chapter provides the theoretical frameworks that have been adopted within this research study that support the research findings and arguments.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORKS

This chapter is a discussion of the background of where the research study emanates from to provide a direction and systematic flow for the research incentive as guided by secondary data. Furthermore, the chapter is inclusive of three theoretical frameworks that have been adopted for creating a meaningful research dissertation, as the theoretical framework provides a mutual understanding and a deeper insight for the researcher and existing body of knowledge within the waste management and urban sustainability fields. Theoretical frameworks are crucial for this research study, as they provide a guideline for developing arguments that correlate with the research study (Sarah, 2022). This chapter has been characterised by the multi-actor environmental governance theory, the integrated solid waste management model, and the urban sustainability theoretical framework.

2.1 Introduction

The world has been revolving through different stages, which has forced humans to adapt to the new way of doing things within society, the economy, and institutional change. It has been proven time and time again that the government alone is not capable of dealing with societal problems, especially if a country is experiencing rapid population growth (KAZEL, 2024). To create a modern society that is governed by a government that delivers adequate service delivery, we need to have collaboration between the public and private sectors, which is beneficial in multiple ways. Therefore, a public-private partnership model, which consists of the government working together with private entities, can result in job creation, successful businesses, and adequate service delivery within the society based on the fact that a public-private partnership model is regarded as a way to finance, build, and operate projects that will deliver a certain service to societies (KAZEL, 2024).

Public-private partnership models are regarded as the new way of effectively dealing with the mismanagement of municipal solid waste within developing countries (Ishawu, 2020). Utilisation of a public-private partnership (PPP) model will result in the provision of service delivery with optimal costs and economic value as infrastructure for waste will be constructed (Ishawu, 2020). Therefore, budget restrictions and decentralisation within municipalities have created an environment for PPP models through the implementation of a systematic process of waste collection, transportation, and disposal (Ishawu, 2020). The rise in population growth

and urbanisation in Brazil led to municipalities entering into PPP agreements for effective management of municipal solid waste for 5 to 35 years according to Brazilian federal law (Marconsina, 2013).

Countries such as Brazil have managed to deal with solid waste management related challenges successfully through the implementation of PPP agreements which has played a critical role towards reduction of waste in sanitary embankments (Marconsin, 2013). PPP agreements in Brazil have played a critical role in reducing illegal dumping and recovering natural environmental sources that have been polluted with waste. Furthermore, PPP contracts in Brazil have also played a critical role towards the development and implementation of energy recovery units within disposal sites (Marconsina, 2013).PPP agreements have provided a more flexible approach towards the financing of solid waste management projects as there's a balanced approach on the allocation of risks (Atkinson, 2024).Moreover PPP models have played a critical role in technological advancement for management of solid waste around the world as countries such as British have managed to construct Surrey Organics Biofuels Facility in Surrey through the Design Build Finance Operate and Maintain PPP contractual agreement (Atkinson, 2024).

In order to enhance sustainable development and effective waste management PPP agreements they are regarded as most suitable model that traditional governments should adopt as the PPP has played a critical role in the development, implementation and maintenance of waste banks in Metro city of Indonesia (Bakti, 2021) .PPP agreements have been effective around the world with regards to modernizing waste management processes in developing countries such as Nairobi (Madinah, 2016). Germany is a leading country with successful management of solid waste through PPP agreements as the city of Berlin is able to effectively categorise waste in terms of their origins which enhances waste sorting and stimulating the circular economy (Madinah, 2016). Waste recovery and natural resource recovery has been the order of the day in the city of Berlin as the private sector plays a critical role in waste collection, disposal, sorting and freeing up the air space in disposal sites through technological advancement and machineries for waste combustion (Madinah, 2016).

Public Private Partnerships have played a critical role towards the management of waste around the world as they have assisted in reducing the waste management burden from the public

sector but nonetheless the PPP agreements are also institutionalised by challenges that hinder the effective management of solid waste in developing countries (Massoud, 2024). Public sectors around the world that are implementing PPP agreements are facing a challenge of not having a clear institutional and regulatory framework for management of solid waste through PPP agreements (Massoud, 2024). According to Leigh, (2016) Private sector guys are regarded as the enemy of the poor due to the structuring of PPP agreements in Nigeria as civilians need to pay for the services provided by the private sector with regards to the collection of solid waste. Furthermore, one of the reasons the private sector is regarded as an enemy of the poor is that it only provides services to affluent communities leaving majority of civilians residing in less affluent and underdeveloped communities with uncollected waste due to lack of affordability (Leigh, 2016).

Effective management of solid waste management in a South African context has been heavily affected by strikes of service delivery which has enhanced environmental degradation and inequality amongst affluent communities and the less fortunate communities (Kalina, 2024). Communities in South Africa that are less fortunate and characterised with low income are heavily affected by the mismanagement of solid waste as strikes have occurred in the EThekweni Municipality with regards to poor service delivery waste management services (Kalina, 2024). Nonetheless multiple strike actions within communities with regards to service delivery issues have hindered the effectiveness of solid waste management practices as communities in South Africa that experience strikes are left with uncollected refuse and garbage as responsible entities for collection of waste are unable to enter communities as they fear for their safety.

Each strike action in South Africa has severe waste management consequences as strikes results in months of recovery for the local municipalities to clear and effectively manage waste (Kalina, 2024). The mandate held by municipalities in South Africa with regards to the provision of waste management service delivery seems to be on a brink of collapse due to poor governance (Makwetu, 2024). Poor provisions of service delivery initiatives in the city of Makhanda South Africa has been an ongoing crisis for almost two decades now and that has led to communities responding through striking activities on the streets of Makhanda (Makwetu, 2024). Strike activities have been of a result of the Makhanda municipality

retreating on waste management service delivery initiatives as municipal funds are reallocated to other service delivery initiatives (Makwetu, 2024).

Implementation of the PPP model in São Bernardo do Campo played a critical role in stimulating the economy and creating jobs for citizens (Marconsina, 2013). Public-private partnership models are roped in to replace the traditional solid waste management strategies being implemented by municipalities, as the PPP models involve the capacitation of experienced and skilled human resources from the private sector to assist the public sector in the management of waste. Moreover, the PPP model has resulted in a more effective management of municipal solid waste as the technical expertise of engineers within the labour force has been capacitated (Butt, 2020). Within a South African context, to achieve Vision 2030 of the National Development Plan and Growing Gauteng Together for 2030, the National Treasury has highlighted the importance of collaboration between the public and private sectors to deliver successful projects that will improve the quality of life's (Initiative, 2019).

2.2. Literature review

The literature review for this research study seeks to form a collective discussion about the foundation of where the research problem, aim, and research objectives emanate from. Therefore, the literature review section is a collective discussion of secondary data from multiple researchers and scholars who have produced valid and reliable data that aligns with the interests of this research study. The presentation of the literature review will be outlined in correlation with the research objectives of the study and will be thoroughly illustrated through sub-themes. Therefore, the chapter will be of outmost importance towards one of the succeeding chapters within the dissertation for data analysis and interpretation of data, as the literature and theoretical frameworks will support the empirical data in order to enhance the validity and reliability of the dissertation.

2.2.1. Forms and conditions of Public-Private-Partnerships in cities

Public-private partnership is regarded as a procurement procedure within the public sector whereby the government appoints a service provider to deliver certain services or goods on a long-term basis and results in the private sector carrying all the risk (Initiative, 2019). In order to tackle the issue of service delivery within communities, the adoption of the public-private

partnership model is very important, as it will result in efficient project delivery for municipal services and will also open the door for the government to have access to the latest technology devices (Quium, 2011). A public-private partnership is regarded to make communities resilient to different societal disasters and environmental concerns that the communities face (Givens, 2013).

A government institution will be able to achieve its desired objectives with regards to service delivery within communities through the public-private partnership model as it provides efficiency, as the government institution won't have to rely solely on its resources and capabilities, as it's known that most government institutions around the world are understaffed and lack resources, as stated by Grants (2013). Municipal solid waste management is regarded as one of the most expensive service delivery duties faced by municipalities around the world, especially with the provision of landfill sites to dump and store waste.

It has been noted by Quan (2023) that to have smart cities in society, there needs to be a collaboration between the public and private sectors, especially in cities that are characterised by urbanisation, as that is one of the contributors towards illegal dumping and large quantities of solid waste. The public-private partnership is a very important aspect in reducing financial burden from the public procurements; hence, Sweeney (2022) emphasises the fact that PPP will improve the connectivity, cohesion and efficiency within the smart cities as the public governments will be better prepared for the future. Furthermore, it has been noted that the partnership between the public sector and the private sector will result in the public sector having access to resources, knowledge, and advanced technology components that can be used to tackle the issue of climate change, as there will be skills transfer between the two sectors (Sweeney, 2022).

Furthermore, it has been noted that the collection of solid waste from households is a very expensive procedure that needs a certain type of transport mode, which is costly; hence, the Cyprus government in the Nicosia district adopted the public-private partnership model for managing waste within their city as they were faced with a landfill site that had to be closed, meaning that they would have to transport waste to another designated landfill site that is outside the Nicosia district (Savvides, 2018). In order to enhance cost-effective garbage management within the city of Nicosia, the government decided to implement the PPP model,

which resulted in the reduction of the costs to transport waste to landfill sites, whereby a private company was appointed to collect all the solid waste within the Nicocia district as the government had no capacity to conduct that duty efficiently (Savvides, 2018).

2.2.1.1. Jointly and Shared Responsibilities

A P-P-P model is designed in a way that the responsibilities of the two parties, which are the private and public sectors, are shared amongst them, whereby in some cases it can be that the duties are carried by another party and the costs of the service are absorbed by the public sector in most cases. Even though many people regard the PPP model to reduce the burden from the public sector, it must also be noted that the PPP model also plays a role in enhancing a fruitful business environment for the private sector, which will result in a stimulated economy. Miraji (2021) states that developing countries do not have the required fiscal budget to deliver services to the community due to macroeconomic instability, which has resulted in funding being limited within the developing countries. Furthermore, it has been highlighted by Miraji (2021) that in the coming years the provision of service delivery within developing countries will be achieved through the PPP model, as it is regarded as the new way of doing things. Within a PPP model, the private sector is required to provide services on behalf of the government, whereby, in relation to municipal solid waste management, the private sector will play a role in collecting MSW from residential areas and also transporting the waste to landfill sites (Miraji, 2021).

Besides the reduction of costs achieved by the PPP model, it is important to note that the PPP model is essential in ensuring that there's environmental protection within the communities and ensuring efficiency of service delivery within the communities (Vin Spoann, 2019). Moreover, the shared responsibilities of the PPP model in a country's economy and society will be beneficial in the long run as it will result in the improvement of the quality of life through the quality of service delivery being provided (Vin Spoann, 2019). Moreover, Miraji (2021) has highlighted the importance of the private sector within the PPP model, which is to assist in investment initiatives and the provisions of transport and the latest technology towards the management of solid waste. Cities within the developing countries are characterised by many problems, whereby one of the problems faced besides unemployment is the issue of insufficient solid waste disposal systems, as stated by Miraji, (2021). Furthermore, a survey conducted by the United Development Program illustrated that managing solid waste

is very expensive, hence the importance of adopting a PPP model, which will result in the sharing of responsibilities since the PPP model consists of the processes of collecting waste, transportation of waste, sorting, recycling, and disposal of waste, which are considered to be costly and time-consuming as the public sector does not have enough capacity and resources to manage all those procedures on their own (Miraji, 2021).

2.2.1.1.1. Financing responsibilities within a PPP for waste management.

One of the most common challenges encountered by the public sector within developing countries is a lack of financial muscle towards the provision of public service delivery projects. Brown (2024) states that to deal with the financial challenges faced by the public sector, a public-private partnership model needs to be adopted to reduce the financial responsibilities of the public sector. Lack of financial muscle faced by developing countries has posed a threat towards the enhancement of sustainable development initiatives in society. Bruno (2019) highlights the importance of incorporating the private sector in enhancing sustainable development in society, as the PPP model will harmonise interests from the public and private sectors.

The financial costs of managing solid waste within cities have been estimated to increase drastically in the coming years, as the United Nations report has indicated that African cities as a whole need 25 billion dollars of financial muscle to manage waste as a whole, because by 2025 the generation of municipal solid waste will increase to 2.2 billion tons. Municipal solid waste has been a burden towards cities around the world, as the financial costs for an effective management of municipal solid waste have been a challenge for the public sector. African cities are in danger of encountering an increase in the quantity of waste being generated within their cities due to the population growth and urbanisation that seeks to happen in the future (Bharadwaj, 2020). The rise of urbanisation and population growth seeks to stimulate the economy and improve living conditions within society, which results in the increase of municipal solid waste generated (Bharadwaj, 2020). Cities in developing countries are having a challenge managing municipal solid waste due to a rise in informal settlements, a lack of financial resources, and poor infrastructure (Bharadwaj, 2020).

Obiora (2024) argues that one of the main reasons why developing countries are faced with the municipal solid waste challenge is due to the lack of financial muscle required to effectively

manage waste. The operational costs of managing municipal solid waste are costly due to the nature of how waste is collected from households, custom-made transportation trucks, and the disposing of the waste at geographical locations that will not cause harm to communities (Obiora, 2024). The United Nations report states that municipal solid waste services consume approximately 20 to 50% of the budgets allocated to municipalities on the African continent.

2.2.1.1.2 Responsibilities of Informal waste collectors

To enhance public health within urban areas, the city of Abidjan has incorporated informal waste collectors as role players to fill the gap within the collection and transportation of waste (Andrianisa, 2016). The introduction of informal waste collectors was initiated in 2007 in the city of Abidjan, which has positively affected the environment of the city as there has been a reduction of waste being disposed of on the streets (Andrianisa, 2016). Developing countries around the world are faced with different socioeconomic challenges such as poverty, unemployment and low-income generation, which has resulted in community members utilising waste as an initiative for income generation to improve the quality of life in their households while protecting the environment (Katusiimeh M. W., 2013). Informal waste collectors are not only characterised by unemployed individuals but also people with low-income generation, and according to Ahn (2020), informal waste collection is mostly done by women, children, and elderly people. Informal waste collectors are known to play a critical role towards the reduction of waste in society as they collect a large share of recyclable waste, which is estimated to be 20 to 50% (Ahn, 2020). Furthermore, it's important to note that informal waste collectors operate in one of the most dangerous and unhygienic environments without any personal protection equipment, which puts their health at risk; hence, Ahn (2020) calls for a need to formalise and legislate informal waste collectors.

In developing countries such as Ghana, which do not have efficient resources for managing municipal solid waste, the role played by informal waste collectors has played a critical role towards the reduction of waste as they serve more than half of the households in Ghana (Amponga, 2024). The rise in urban waste generation, which has affected public health, has made room for the dual waste system between informal waste collectors and formal waste collectors. Therefore, the dual waste system has resulted in 61.5% of households in Ghana relying on informal waste collectors for collection, transportation, and disposing of waste

(Amponga, 2024). Municipal solid waste challenges within cities are caused by poor infrastructure, lack of capacity, lack of resources, and financial muscle needed to manage municipal solid waste. Financial challenges faced by municipalities in cities have led to certain geographical areas in cities being neglected by formal waste collectors, and in Ghana, the informal waste collectors have proven to be able to fill the gap by collecting waste door to door and covering households that are difficult for waste collection trucks to reach (Amponga, 2024).

2.2.1.1.3 Responsibilities for Private Formal waste collectors

Municipalities responsible for the management of cities around the world are not able to keep up with the quantity of waste being generated at their doorstep as their financial and resource muscle do not parallel the increment of waste generation (Amobi, 2017). The city of Ibadan, Nigeria, has implemented the PPP model, which involves the contracting of private waste contractors to manage municipal solid waste being generated within the city as the government was unable to keep up with the waste (Oladeji, 2024). Private waste contractors play a critical role towards the reduction of waste in society, as they are only able to collect waste from approximately 9% of the households in Nigeria (Oladeji, 2024). Furthermore, it's important to note that informal waste collectors contribute significantly a small percentage towards waste collection from sources due to the harsh environmental conditions that they operate under, as municipalities only award them a small duration contract, a limited time schedule, poor implementation of bylaws, and inferior waste collection and transportation tools (Kirama, 2016). Due to the financial costs and resource demand by municipal solid waste countries such as the United States of America and England have given the responsibility of waste management to private companies, as 80% of waste is collected, transported and disposed of by private companies, which has yielded positive results towards enhancing public health and environmental protection (Kirama, 2016).

2.2.1.2. Leases Agreements Between Parties

Kontogianni (2019) emphasises that a PPP model is regarded as an essential mechanism developed in order to become a desired solution instead of just dealing with a service delivery problem. Givens (2013) states that PPP contractual agreements are commonly on a long-term basis between the public and private sectors, whereby there are certain terms and conditions

that govern both parties. Kontogianni (2019) illustrates that during the contractual agreement of the PPP, the public sector tends to be responsible for the transfer of assets, investment capital, environmental awareness programs, social responsibility, and the ability to mobilise political support within the communities. Lease agreements within a PPP agreement provide a direction on the utilisation of an asset between the public and private sector whereby a private sector organisation can build or construct certain goods or services and utilise them for a certain period of time, then the public sector will come in and take over once the lease agreement elapses (ACCOUNTING STANDARDS BOARD, 2017).

The PPP model is characterised by multiple lease agreements that will govern the public and private sectors, whereby a long-term lease agreement is most common in an enhanced user leasing agreement in order to achieve a common goal towards service delivery (Agnieszka, 2024). An enhanced user leasing agreement within a PPP model involves the process of leasing, developing, operating, and building service delivery initiatives. One of the most common lease agreements in the municipal solid waste sector is the ground lease agreement, which is a result of an entity occupying a portion of land only for a long period of time. In the case of effective waste management, the leasing of land for landfill sites is very common as there's a shortage of land for disposing of solid waste (Agnieszka, 2024). Furthermore, Miraji (2021) has highlighted the high operational costs faced by the public sector towards the management of solid waste, as the equipment utilised is expensive and the administration is quite time-consuming; hence, other government departments have the option of the operating lease agreement when they enter into a PPP model. An operating lease agreement is characterised by the leasing of equipment or resources to the other party in order to achieve a certain goal. Moreover, the operating lease agreement is conceptualised by economic benefits and risks of ownership in the case of enhancing effective municipal solid waste. The operating lease agreement will assist government departments in developing countries to cut the costs of buying expensive machinery to collect, transport, dispose of, and recycle solid waste. Agnieszka (2024) illustrated the financial benefits of adopting an operating lease agreement within a PPP initiative, as it is regarded as effective in financing the infrastructure and resources needed to achieve Sustainable Development Goals that are in line with the service delivery of municipal mandates.

2.2.1.2.1. Lease agreements for waste compactor trucks

Municipal solid waste management challenges are caused by inadequate and outdated waste management systems, which make municipalities unable to manage the quantity of waste produced by their inhabitants (Mondal, 2012). The city of Dhaka innovated their waste management system by moving to a waste compactor truck initiative in order to efficiently collect and transport waste as the city had experienced rapid population growth and urbanisation (Mondal, 2012). Municipalities around the world deem the innovation of waste compactor trucks for the collection, transportation, and disposing of solid waste as an expensive task that hurts the public purse, as the city of Dhaka experienced a high quantity of waste generated while they had a shortage of waste compactor trucks (Rahman, 2014). The shortage of waste compactor trucks within the city of Dhaka was resolved through the formulation of lease agreements with private companies that leased their waste compactors and became responsible for the collection, transportation, and disposing of waste (Rahman, 2014). Lease agreements for waste compactor trucks include the duration of the agreement, waste collection points, time frames, and disposal locations.

2.2.1.2.2. Lease agreements in landfill sites

To have an effective waste management system in place, the method used for disposing of waste is of the utmost importance in enhancing public health and protecting the environment, hence the inception of landfill sites for disposing of waste. Han (2016) states that countries such as China, which are characterised by rapid population growth and high consumption rates, developed landfill sites as disposal mechanisms for the betterment of their environment. Municipalities tend to face difficulty in procuring landfill sites that meet the requirements and criteria of the landfill sites, which has resulted in municipalities in developing countries leasing landfill sites from private companies that meet the landfill requirements (Rahmat, 2016). Factors such as distance to groundwater, sensitive ecosystems, land cover, distance to urban and rural areas, land uses, and the type of soil determine whether a proposed landfill site meets the requirements (Rahmat, 2016). Municipalities responsible for cities are having difficulties finding suitable locations within the city's perimeter in constructing landfill sites, which has resulted in the public sector entering into lease agreements with the private sector that owns landfill sites or land that meets all requirements (Rahmat, 2016). Budget limitations faced by developing countries for waste management have resulted in the implementation of the PPP

model in procuring engineered landfill sites that will prevent the pollution of groundwater and the environment (Idowu, 2019).

2.2.1.3 Contractual Agreements for Waste Management Services

A PPP model is characterised by a unique contract between the government and the private sector service providers, which will clearly stipulate the responsibilities, objectives, and main mandates of the agreement. Within a public-private partnership model, there's also a contractual agreement known as the Design-Build-Finance-Operate-Maintain contract (Prieto, 2012). A DBFOM contract within a PPP model will result in a long-term agreement between the private service provider and the government whereby the private service will design, build, finance and operate a service delivery project that meets the mandates of the government. Furthermore, Prieto (2012) states that during a DBFOM contract, the appointed service provider will be responsible for the operations and maintenance of facilities and resources that will be utilised to produce a certain outcome that enhances adequate service delivery. The characteristics of a DBFOM contract will result in cost-cutting measures for governments around the world as they won't be liable for the designing, building, financing-operating and maintaining machines and facilities used to achieve efficient waste management service delivery within communities (Prieto, 2012). Moreover, the DBFOM contract agreement is mostly initialised by the public sector with an intention of allocating the project risks and responsibilities to the appointed private entity, as Prieto (2012) believes that in most cases the public sector does not have the required skills to handle certain service delivery projects that need expertise.

One of the most common issues faced by developing countries is the lack of resources and financial power to enhance service delivery that is in line with Sustainable Developmental Goals; hence, in most cases, they opt for Design-Build-Finance-Operate contract engagement. Reuters (2024) states that the DBFO contract within a PPP model will result in the private sector designing, building, financing, and operating a deliverable that is in line with the government's mandate towards service delivery. While a private service provider will be appointed to handle a project, the government will pay the service provider an agreed-upon financial amount, which will be generated from end users that will be utilising the deliverable framework provided by the private entity (Reuters, 2024). A Design-Build-Finance-Operate PPP contract is regarded as a working mechanism in assisting the public entities and private

entities in making informed decisions and seeking investment initiatives that will enhance sustainable service delivery projects, as stated by Huang Wu (2013).

The PPP model is also characterised by the Build-Transfer-Operate contractual agreement, which involves the process of building a project deliverable, and once it's done, the final product, intellectual property, and personnel will be transferred to the public sector or requester, whereby this is mostly common in the project management industry (Wright, 2024). Furthermore, it has been highlighted by Wright (2024) that the Build Transfer Operate contractual agreement is beneficial for companies and organisations with regards to achieving project deliverables that are outside the core competencies and scope of operations of an organisation. Wright (2024) emphasises that during the build-transfer-operate contractual agreement, the appointed service provider will be responsible for the leasing of required equipment and mechanisms and also facilitating the processes of training and hiring human resources that meet the standards of regulatory compliance within the contract. The Build-Transfer-Operate model is quite different from the DBFOM agreement, as Wright (2024) states that the Build-Transfer-Operate agreement requires the requesting organisation to take ownership of the final deliverable and also maintain it on a continuous basis.

2.2.1.3.1. Contractual agreements for collection of waste from sources

Smart cities around the world are characterised by the evolution of fourth industrial mechanisms, whereby smart cities have found it difficult to move along when it comes to the management of waste in cities (McCurdy, 2021). There has not been an evolution towards the management of waste in cities, regardless of the evolution of technology that is transpiring in cities, as the traditional way of collecting and managing waste is still outdated. There's a schedule and specific date that contracted waste collectors come and collect waste from residential areas, but that hasn't yielded any positive results in effectively managing waste (McCurdy, 2021). Furthermore, the issue of contracted waste collectors is very complex due to issues surrounding the administration and procedures of municipalities around the world, which has had a negative impact on contractual agreements between involved parties (McCurdy, 2021). Local municipal governments around the world have been hit by political instability, economic crisis, and financial crisis, which negatively affected public service delivery for waste management (Plata-Díaz, 2014). Furthermore, it's important to note that the

contracting of private waste collectors comes at a high financial cost and administration complexities, which have resulted in disputes between the public and private sectors, which resulted in mismanagement of solid waste in cities (Plata-Díaz, 2014). Even though there have been contractual disputes between waste contractors and the public sector for the procurement of private waste collectors, Plata-Díaz (2014) still regards their procurement as the best solution to managing the rising quantity of waste in cities. Due to the nature of financial and resource costs encountered during the management of waste, contracting out the waste collection services seems like the best available solution for municipalities in ensuring smart, sustainable cities (Plata-Díaz, 2014).

2.2.1.4. Joint Ventures Consortium

Urban areas within developing countries are characterised by a high level of municipal solid waste, which in turn affects the public health and the environmental segments (Madinah, 2016). To deal with modern problems, there needs to be an implementation of modern solutions towards our social, economic, and environmental problems. Mwengei (2014) states that to deal with modern problems, municipal solid waste should implement a PPP model, which will assist in improving the efficiency and quality of public service delivery within communities. Developing countries around the world are faced with a municipal solid waste problem that has been difficult for the governments to tackle as their countries are faced with rapid population growth, industrialization, and a modern society that influences a high production of municipal solid waste. A joint venture between the private sector and the public sector is very important towards tackling the issue of municipal solid waste within developing countries, as this model will transfer some of the public sector's responsibility to the private sector, as it has been proven around the world that the government finds it difficult to manage solid waste and provide efficient service delivery (Mwengei, 2014). The PPP model will assist the public sector in achieving their service delivery goals and bridging the gap that the public sector faces when it comes to having few resources and expertise in dealing with certain problems that relate to service delivery and the Sustainable Developmental Goals (Mwengei, 2014). The public-private partnership model has proven to be a working mechanism for the underdeveloped countries, whereby countries such as Tanzania were very reluctant to implement the PPP framework in dealing with their municipal solid waste problem (Oteng-Ababio M. , 2010). Furthermore, it has been emphasised that the adoption of the PPP model in Tanzania played a critical role in providing adequate service delivery towards municipal solid waste, as Oteng-

Ababio (2010) states that a PPP model resulted in acquiring resources, risk reduction, and improving service delivery while stimulating the economic sector.

2.2.1.4.1 Collection of recyclable materials as a Joint Venture

The rapid rise in the quantity of waste generated in cities has resulted in a stakeholder approach towards enhancing a cost-effective and environmentally friendly approach in the management of solid waste. The stakeholder approach in the management of municipal solid waste is the participation of community members, private companies, and informal waste collectors, as they have a role to play in the management of waste (Garnett, 2017). The enhancement of a joint venture towards the management of waste within communities came about with the Aarhus Convention, which proposed participation of different role players in decision-making for environmental-related issues (Garnett, 2017). The inclusivity of community members in decision-making processes for managing waste will assist in increasing income generation and quality of life in households as generated waste can be used for recycling (Timm, 2015). Joint ventures with informal waste collectors play a critical role in addressing two of the triple challenges faced by South Africa, which are poverty, inequality, and unemployment. Timm (2015) states that many people earn a living in South Africa through waste recycling. Therefore, the inclusivity of informal waste collectors seeks to mobilise resources and reduce waste at landfill sites (Timm, 2015). Informal waste collectors play a critical role in collecting waste from the poor segments of the population and earning income by participating in the circular economy (Katusiimeh M. W., 2013).

2.2.1.4.2. Sorting of waste as a Joint Venture

The increment in waste generated by cities has resulted in a reduction of economic value for municipalities as the costs to clean and manage waste are substantial (Ferza, 2016). Countries such as India and China, which have experienced rapid population growth and urbanisation, have had difficulties in managing waste generated, which has resulted in informal waste collectors playing a critical role in collecting 90% of the e-waste generated (Sengupta, 2023). Developing countries are unable to handle the influx of waste generated in their cities, which has resulted in the creation of a joint venture between the municipal governments and informal waste collectors as they play a critical role in enhancing the circular economy through recycling (Sengupta, 2023). Informal waste collectors are known as role players that collect waste such

as newspapers, card boxes, glass materials, plastic, and steel cans from households. Sengupta (2023) states that households and business entities prefer to dispose of their waste to informal waste collectors as they are more effective due to their nature of door-to-door collection. Informal waste collectors play a critical role in recycling waste as they perform waste sorting from the source into different categories, which makes it easier for the disposing of waste into the circular economy for recycling purposes (Sengupta, 2023). Formal waste collectors are also involved in the collection of waste through PPP agreements, but their functions have proven not to be effective for the circular economy as their responsibility is to collect waste in bulk, transport, and dispose of it at landfill sites (Ferza, 2016). The role of formal waste collectors has resulted in large quantities of recyclable waste being disposed of in landfill sites, which has resulted in the reduction of air space and less waste material for recycling (Ferza, 2016). Inadequate knowledge on waste sorting and collection by formal waste collectors has had a negative impact on the environment as the influx of disposed waste increases in landfills, which results in contamination of the soil and underground water (Wang, 2020). The sorting of waste is a critical aspect towards effectively managing waste, as the residents play an important role in enhancing this initiative through their human behaviour (Wang, 2020).

2.2.2. Characteristics and indicators of sustainable cities

Developing countries are experiencing one of the most social transformation ideologies of rapid urbanisation, which currently has a great impact on the social, environmental, economic, and biophysical processes found within developing countries (Xuemei Bai, 2016). In the past, there has been a great concern about the sustainability of society and the environment in the coming years, as the United Nations has stated that by 2050, 66% of the world's population will be living in cities (United Nations, World urbanisation prospects: the 2014 revision., 2015). The mismanagement of municipal solid waste within communities has a negative effect on the environment; hence, Bibri (2017) emphasises that sustainability in cities needs to be achieved in a way that it does not undermine the natural and social settings. Previous research studies have discovered that smart cities tend to experience a high rate of municipal solid waste being produced due to their common character of rapid population growth, industrialisation, and modernisation (Bibri S. E., 2017).

To enhance smart cities within a developing country, resources need to be consumed at a high rate due to economic and social activities that will be taking place, and a way on how we can preserve natural resources in cities needs to be found to enhance the sustainability of resources for future generations (Bibri S. E., 2017). The mismanagement of municipal solid waste within cities results in a lot of pollution towards the environmental segments, whereby Bibri (2017) regards that as an activity that undermines the natural settings as it results in ecological degradation in the long run. Sustainable development within cities regarding the management of municipal solid waste is regarded as a process of transformation and strategic approach towards achieving long-term goals, as stated by Bibri S. E. (2017). To enhance sustainability within cities, most town planners and city planners are evolving towards an era of appreciating human capital and healthy, informed, and willing inhabitants, as stated by Ahmed (2019).

2.2.2.1. Urban Economics

One of the most common activities within urban areas is rapid urbanisation, which has an impact on the sustainability and ecosystem of the urban areas. Irene (2023) holds the view that urbanisation contributes to the transformation of the economy and society at large but, in return, tends to affect the natural environment and social system in a negative way; hence, it is regarded as a double sword amongst the anthropogenic factors. Furthermore, Otumawu-Apreku (2020) holds the view that the mismanagement of solid waste within urban communities will result in multidimensional problems within society as the social, economic, and environmental segments are negatively affected by the mismanagement of solid waste. Urban communities are highly characterised by population growth, increased human activities, and changes in consumption patterns, which will result in the increment of municipal solid waste being produced by residents (Otumawu-Apreku, 2020). The anthropogenic factor of modernisation, which tends to enhance the utilisation of advanced technology and economic advancement, affects the urban areas in a negative way as there will be a change in lifestyles and consumption rates that influences the product of solid waste (Otumawu-Apreku, 2020).

The mismanagement of municipal solid waste within urban cities tends to become a burning issue within the Global South cities because pollution within the cities will increase due to the societal and economic setting (Costas, 2023). To enhance sustainability within urban cities, the management of municipal solid waste within urban cities needs to be given much attention

because there's a correlation between the development of urban communities and the environment, health, natural settings, and ecosystem. The 1970s era saw the inception of solid waste collection due to the public health issues that countries around the world experienced; hence, Costas (2023) states that the mismanagement of municipal solid waste within low and middle-income developing countries is a big concern as the ecological segments of those countries tend to be affected as plastic pollution will be on the rise. Furthermore, Costas (2023) highlights the way forward towards enhancing a sustainable urban economy within the cities proximity by advocating for understanding the cities baselines regarding its economy and social setting. Oteng-Ababio (2018) states that one of the reasons developing countries and urban cities tend to experience the negative effects of the mismanagement of municipal solid waste is because most urban cities do not have the required infrastructure capacity to manage and absorb municipal solid waste.

2.2.2.1.1. Effects of urban economies on waste management

There's a significant difference between urban economies and rural economies based on income generation, quality of life, pollution, and waste generation, which have an impact on the environment. Urban economies are characterised by high income generation, which results in high consumption of goods; hence, urban areas are regarded as the highest generators of food waste (Kusumaningtiar, 2023). Due to the nature of economic activities in urban areas, mismanagement of waste in urban areas seems to be a common factor around the world, which results in the reduction of the environment (Kusumaningtiar, 2023). Food waste such as fruits, milk, and vegetables will increase emissions of greenhouse gases to 22%; hence, Kusumaningtiar (2023) suggests that within urban economies, a sustainable production and consumption approach should be implemented to effectively manage waste through the global food supply chain.

2.2.2.2 Natural environment resources conservation

Within Sub-Saharan Africa, urbanisation has increased by 34% amongst the countries since 2024 (Christian, 2017). Since the inception of urbanisation, industrialisation, and modernisation, many developing countries around the world have been characterised by high levels of pollution and mismanagement of municipal solid waste, which has a negative effect on public health and the natural settings within the cities. It's a known fact that rapid

urbanisation within a city will result in population growth and high rates of consumption towards the natural resources due to human activities (Amalia, 2022). In order to stimulate the economy within the urban cities, there need to be large imports of natural resources that will seek to satisfy the needs of the city's population and also assist in making sure that the local production and human activities are enhanced to their full potential (Anderberg, 2012). Mismanagement of municipal solid waste has the potential of affecting the settings of urban cities as it results in pollution, public health, environmental problems, and distribution issues; hence, Anderberg (2012) highlights the importance of having an effective resource flow that covers all segments as they have an interrelation with the sustainability of the global and regional cities.

During urban development initiatives, the consideration of the natural resources is very important, as they play an important role towards the longevity of the urban communities. Yanbing (2023) regards natural resources as the engine behind urban development; hence, it is very crucial to manage and preserve the natural resources and not overconsume them. The sustainable development of cities around the world has been largely affected by the overconsumption of natural resources, as it becomes difficult to maintain and enhance sustainable development within the urban cities as the environmental segments will deteriorate (Yanbing, 2023).

2.2.2.1. Enhancing sustainability in cities through natural environmental resources

The enhancement of sustainability within cities is achieved through the effective management of solid waste to conserve and preserve natural environmental resources. Cities are characterised by a large economic scale and rural-urban migration activities that increase the consumption of natural environmental resources such as land, water reservoirs, and air (Raipurkar, 2020). Reduction of carbon dioxide emissions within cities is a crucial element in dealing with the carbon footprint caused by waste generation (Raipurkar, 2020). The carbon footprint on the natural environmental resources within cities will assist in the fight against climate change and attaining long-term economic expansion (Hong, 2024). Environmental pollution is a new pandemic facing the world and makes it difficult to achieve the 2030 Agenda for Sustainable Development, which primarily seeks to achieve economic, social, and ecological objectives (Hong, 2024).

Cities are in danger of facing natural resource depletion due to industrialisation and population growth, as that has an impact on land occupation and utilisation of natural environmental resources. Inadequate utilisation of natural environmental resources will result in environmental fluctuation and improper utilisation of land within cities, which will result in the rise of climate change as weather patterns will be abnormal (Hong, 2024). Activities such as urbanization, population growth, and industrialisation within urban economies will result in deforestation and depletion of natural environmental resources. The depletion of natural environmental resources due to human activities has resulted in an increase in flooding activities, illegal land invasions, and water scarcity within cities (Hong, 2024).

2.2.2.3. Climate action resilience

The world is currently facing an issue of climate change that is believed to be influenced by the emissions of greenhouse gases that emanate from the high production of municipal solid waste (EPA, Climate Change and Municipal Solid Waste (MSW), 2016). Many scholars and researchers in the past have discovered that many of the developing countries are not able to manage municipal waste, as it has grown to become a problem over the years. To manage municipal solid waste within urban cities, the importance of waste prevention and recycling needs to be realised. To tackle the climate problems being faced by the world, the Climate Change Action Plan emphasises the importance of recycling and source reduction to reduce greenhouse gases (Department of Energy & Environmental Protection, 2020). The rise of the modern economy during the 21st century has really improved the quality of life within communities, but on the other hand, it has also had a negative effect on ecosystems and human health due to the increment of waste production from residential areas (United Nations Environmental Programme, 2024).

As much as urbanisation has transformed the standard of living within communities around the world, it is important to note that it has resulted in the growing quantities of solid waste being produced by residential areas, which have caused a shift within the climate sphere (Sintana, 2012). Global warming has been a burning issue within the United States of America, as Seungtaek (2016) highlights the fact that the USA is currently the country that generates the most waste within the OECD countries. Furthermore, it has been illustrated by Seungtaek (2016) states that the issue of waste management within the USA is a great concern due to the fact their recycling rate is quite low by 26% compared to other OECD countries, which have a

much lower rate of waste production. The management of municipal solid waste is a great concern around the world since there has been an estimation that by 2050 the world will be producing 2.2 billion tonnes of waste on an annual basis. Seungtaek (2016) has raised a great concern about the management of municipal solid waste within urban cities because currently the world is experiencing severe climate changes as the global surface temperature has been estimated to increase by 4.8 C by 2100 and the sea level to increase by 0.82 m because of greenhouse gases caused by municipal solid waste.

2.2.2.3.1 MSW as a contributing factor to climate change

Developing countries are characterised by mismanagement of solid waste within their geographical areas, which has resulted in the rise for illegal dumping of waste and climate change activities as households have resorted to alternative measures for waste reduction. Reyna-Bensusan (2018) states that households in developing countries have implemented the burning of solid waste as a measure to reduce the quantity of waste generated, whereby that has been one of the biggest contributors towards climate change. The uncontrollable burning of solid waste is more common in rural areas, as 92% of households in rural areas within developing countries reduce their waste through burning of waste in their backyards, which has contributed to air pollution (Reyna-Bensusan, 2018). Economic growth within cities is accompanied by high generation of solid waste, which has resulted in the mismanagement of waste and environmental problems as landfills without waste to energy are on the rise and shortage of landfill space for disposing waste is a problem due to depletion of natural environmental resources (Dedinec, 2015). The depletion of natural environmental resources for waste disposal has resulted in illegal dumping on land surfaces and water reservoirs and illegal sand landfills, which do not meet environmental standards (Dedinec, 2015). Mismanagement of municipal solid waste has resulted in environmental degradation and danger to the public health of the population due to its contribution towards the global anthropogenic greenhouse gases generated by MSW (Dedinec, 2015).

2.2.2.4. Inclusivity and quality of life for the people

The South African society is currently characterised by the issue of poor service delivery within multiple sectors, whereby in the last years the government has been finding it difficult to address the burning issues of poverty, unemployment, inequality, and environmental issues,

which are enhanced by the generation of municipal solid waste. Mashamaite (2018) states that the South African government has been having difficulties in improving the quality of life within communities due to a shortage of skills, a lack of administrative capacity, and poor service delivery, which has been the cause of the mismanagement of municipal solid waste. In the past, the public sector, which is also known as the government, was known as the institution that was responsible for managing municipal solid waste within communities, but unfortunately that hasn't been the case due to the rising climate and environmental problems caused by the high generation of municipal solid waste (Mashamaite, 2018).

The high rise of municipal solid waste within the developing countries is influenced by the lack of resources and inadequate mechanisms to be used to collect, transfer, and dispose of garbage (Hartmann, 2018). The failure of the public entities to manage municipal solid waste has realised the importance of implementing the public-private partnership model with regards to enhancing service delivery within the communities. The public-private partnership model has the capacity and ability to achieve the mandate of reducing municipal solid waste within the residential areas, as the model will address the issues of shortage of skills, poor administration, and insufficient mechanisms and resources for enhancing productivity (Hartmann, 2018). In order to enhance inclusivity and the quality of life within communities, it is important for the government to work together with the private sector entities that have expertise in municipal solid waste, and also the inclusivity of informal waste collectors is very important as they collect different kinds of waste in order to recycle them and generate a source of income, which has a critical impact on the quality of life amongst society (Parizeau, 2015).

2.2.2.4.1. Inclusivity of informal waste collectors towards waste management

To enhance the quality of life amongst households and ensure income generation amongst the population in developing countries, citizens have resorted to collecting waste for recycling purposes as an income generation mechanism (Chvatal, 2010). The informal waste collection industry is unregulated and unrecorded based on the income generated by individuals, which has put the health and safety of informal waste collectors at risk (Chvatal, 2010). Informal waste collectors do not only play a pivotal role in managing waste within developing countries; they are critical towards stimulating the economy as they offer financial stability and employment opportunities through their participation in the circular economy (Kala, 2024).

Due to the lack of financial muscles and resources from municipal governments around the world, inclusivity of informal waste collectors is an important aspect that can enhance recycling and reduction of waste within communities (Kala, 2024). Informal waste collectors play a critical role in dealing with challenges and incompetence's faced by municipal governments when it comes to managing waste as informal waste collectors reprocess waste into raw materials. Furthermore, the inclusivity of informal waste collectors is critical, as they are able to reduce the collection and disposal costs of waste in landfill sites, which will reduce greenhouse gas emissions and pollution towards different environmental segments (Kala, 2024).

2.2.2.4.2. Inclusivity of Formal private waste collectors towards waste management

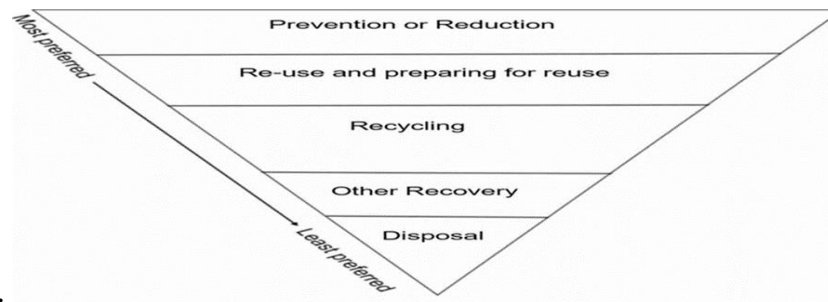
Public sectors responsible for managing solid waste around the world are faced with a lot of obstacles towards their solid waste management strategies due to a lack of resources, financial muscles, and administrative issues. To deal with the obstacles faced by the public sector in managing waste, the inclusivity of formal waste collectors is critical, as they can assist in reducing the financial and responsibility burden of managing waste (Saadeh, 2019). To enhance public health and development within cities, they need the integration of private waste collection companies that are legalised and have operating licenses that are in line with the norms and standards of managing waste through collection, transportation, and disposal (Saadeh, 2019). Looking at the growth of generated waste to 2.2 billion tonnes in 2025, inclusivity of formal private waste collectors is critical as the existing challenges of waste management will be intensified in the next few years (Saadeh, 2019). Furthermore, the inclusivity of formal private waste collectors is of outmost importance, as they will resume the responsibilities and risks of the public sector in the management of waste for a certain period (Afful, 2023). The inclusivity of formal private waste collectors will create a fruitful business environment for waste firms to prosper through joint ventures with big international waste firms through subcontracting of local private waste collectors, and that will increase their capabilities while creating economic and job opportunities (Afful, 2023).

2.2.3. Processes and strategies of solid waste management in the cities

The world is currently experiencing rapid population growth together with multiple anthropogenic factors, while the world is finding it difficult to adapt to the huge mass

generation of municipal solid waste (Senbet, 2023). Developing countries around the world are negatively affected by municipal solid waste within their urban environments; hence, Hussein (2018) states that to deal with municipal solid waste, the solutions to be implemented must be financially sustainable, technically feasible, and environmentally friendly. Mismanagement of municipal solid waste is regarded as a headache for urban communities and cities, as improper disposal of municipal solid waste leads to unsanitary conditions, which later influence pollution (Nathonson, 2022). Municipal solid waste has been a problem since the early 14th century, when a technological approach consisting of watertight garbage cans towards municipal solid waste management was initiated in the late 19th century.

The development and implementation of waste management systems is very important to prevent the contamination of water, air and soil. Kelvin (2023) holds the view that to have effective systems towards the management of solid waste, they need to be an inclusion of all the waste management hierarchy proponents (recycle, reduce, reuse, and disposal). Urban development within developing countries and cities has a challenge of managing solid waste, as there's not enough infrastructure and natural settings to be utilised in order to manage solid waste. Furthermore, Kelvin (2023) states that an implementation of an adequate waste management system will result in reducing the load and baggage faced by landfills and disposal facilities, as there's not enough land within urban areas and cities to perform that kind of activity. In order to have a proper solid waste management system, the management system needs to be designed carefully in accordance with the six stages such as collection, storage, processing/recovery, transportation, and disposal of waste to the designated facilities that have to take place once residents decide to dispose of waste (Collins, 2021). Moreover, it has been noted that an effective management of solid waste will result in the environment and ecosystem being protected as pollution will be reduced as treatment facilities utilise advanced technological mechanisms to treat solid waste while landfill sites utilise leachate to prevent the contamination of groundwater (Nathonson, 2022)



Waste management approach hierarchy (Nyika, 2019)

2.2.3.1. Refuse Collection

The rapid population growth that is happening around the world has resulted in the rapid production of municipal solid waste, as Gertruth (2023) states that on average a human being produces 0.74/kg of municipal solid waste, and on a global scale, the world generates 2.01 billion metric tons of waste. Moreover, it has been noted that the developing countries are also facing problems of inadequate land that will accommodate every human activity, as the biggest contributor towards the mismanagement of municipal solid waste is the issue of urban areas and cities having an issue of insufficient land for waste disposal and treatment sites (Gertruth, 2023). Moreover, the continuous high production of municipal solid waste within residential areas emphasises the importance of developing and implementing suitable waste collection methods that will enhance adequate environmental health (Saba, 2023).

To achieve sustainable developmental goals through the implementation of socio-economic and environmental issues, it is essential for governments to analyse the multiple waste collection strategies for classified treatments (Shuhan, 2023). The importance of implementing adequate waste management strategies that involve the collection and disposal of waste will result in utilising proper waste treatment mechanisms. Shuhan (2023) advocates for the importance of implementing an adequate waste treatment mechanism because it will be easier to classify different waste materials, and that will enhance proper recycling of waste (Shuhan, 2023). Furthermore, it is important to note the fact that the proper collection of waste will not only result in achieving economic goals for waste collectors, but it will also assist in achieving environmental goals within communities (Shuhan, 2023).

2.2.3.1.1. Door to door collection of waste

Recycling is an important aspect towards effective management of solid waste within communities; hence, the European Union Waste Framework has an objective to recycle 55 percent of waste by 2025 (Abeshev, 2023). To effectively recycle waste, there needs to be an effective door-to-door waste collection system in place for enhancing proper sorting of waste before disposal (Abeshev, 2023). Waste recycling will stimulate the circular economy through the door-to-door collection of paper waste, glass waste, plastic waste, and steel metals (Abeshev, 2023). There's a significant difference between the waste generated and the waste separated and collected, as only a few cities around the world collect 30% of their waste separately due to a lack of role players. Effectiveness of the door-to-door collection of waste lies in the hands of informal waste collectors as they sort waste from the source and can reach areas that formal waste collectors cannot reach, especially in overpopulated areas (Ahn, 2020).

2.2.3.1.2. Community Bins as a strategy for collecting waste

Demographic growth and rapid population growth have resulted in large quantities of waste being generated within cities, and due to the nature of economic activities transpiring in the cities, a community bin initiative is crucial in reducing waste (Ferrer, 2019). The door-to-door collection of waste is effective in certain demographic settings, whereby in the Central Business District Demographic Setting that initiative has not been effective as the influx of waste generated and disposed of incorrectly has increased (Ferrer, 2019). Community bins assist in solving the common challenges faced by municipalities as the financial costs encountered in the collection of waste and transportation to different places will be reduced. Furthermore, community bins make it easier to collect waste, as waste compactor trucks will not have to travel to different places to collect waste as they will be a common place for everyone to dispose of their waste (Ferrer, 2019). Community bins are an important strategy towards enhancing an effective waste collection strategy as they reduce the costs and open an environment for the collection of waste to happen daily within cities. The transportation costs will be a bit lower as the distance travelled will be reduced by 20% and routes used by trucks will be 33.2% shorter. Therefore, community bins assist in preventing illegal dumping of waste, overflow of waste, and improper disposal of waste through burning of waste (Ferrer, 2019).

2.2.3.2. Waste Reduction

The mismanagement of municipal solid waste within multiple countries has resulted in pollution activities that have threatened the environmental and public health on a large scale. It is important to note that to prevent pollution from occurring, we need to develop different mechanisms that will seek to tackle the solid waste problem that is faced by developing countries. Changlin (2023) emphasises the importance of implementing waste reduction methods that will seek to tackle the issue of municipal solid waste and reduce pollution stimulated by municipal solid waste. The waste reduction process involves the process of dealing with the issue of municipal solid waste from the source level before it is even disposed of; hence, the waste reduction process involves preventing materials from becoming waste that needs to be disposed of (Lenihan, 2024). The waste reduction process involves the reutilization of objects that can be reused without any issues; hence, waste reduction encourages households to reuse glass and plastic containers and be knowledgeable about the kind of goods you buy and consume, as they have to be reusable and environmentally friendly (Lenihan, 2024).

2.2.3.2.1. Reducing waste through Eco friendly products

Megacities around the world are faced with municipal solid waste problems due to the level of consumption rates of goods and energy inputs, which has resulted in a shortage of waste disposal space (Zhang L., 2024). Waste reduction is an important element towards the recovery of resources to reduce carbon emissions within communities (Zhang L., 2024). Consumption of non-eco-friendly products will have a negative impact on landfills, as there will be a rise in methane emissions as landfills contribute 15% of global anthropogenic methane emissions. To deal with the severe consequences of methane emissions, there needs to be an adoption of eco-friendly products, as the products will prevent waste and boost the circular economy (Zhang L., 2024). Eco-friendly products are also known as green products that have a lower environmental impact as they involve the cutting down of utilising plastic materials for packaging and producing products (Shen, 2024). Businesses and consumers around the world are under pressure to consume and produce products classified as green products to reduce waste and pollution (Nguyen, A consumer definition of eco-friendly packaging, 2020). Firms around the world have attained a competitive advantage through eco-friendly packaging methods to reduce packaging waste being disposed of (Sumrin, 2021). Therefore, the utilisation

of ecofriendly packaging products will reduce the 15-20% of solid packaging waste generated (Sumrin, 2021).

2.2.3.3. Reuse of Waste Material

For the longest of time, municipal solid waste has been regarded as a burning issue around the world that tends to affect the environment and public health. Park (2014) argues the importance of implementing the reuse option to deal with municipal solid waste within communities. Furthermore, it is important to note that civilians need to change how they view waste and adopt transformation solutions in managing waste, such as developing a mindset of reusing a particular unwanted object for something else with an attempt to reduce the quantity of municipal solid waste produced (Park, 2014). Most of the municipal solid waste is characterised by food waste as the majority contributor, as stated by Changlin (2023). Moreover, to successfully reduce municipal solid waste generation, the reusing of food waste needs to be considered as it can have a positive effect on the present and future generations (Pleissner, 2018).

Food waste currently contributes 1.3 billion tonnes of waste globally, hence the necessity to reuse food waste in a chemical complex, as it's quite unsafe to reuse food waste as food again. However, it is important to note that food waste can be put to good use by reusing it and creating raw materials by recycling monomers and the hydrolysis of organic materials, which can have a positive effect on the environment, society, and economy (Pleissner, 2018). Therefore, the reuse of food waste material will assist in curbing pollution and reducing the quantity of municipal solid waste while having a positive effect by enhancing the production of chemical products. The reuse of municipal solid waste is very important, as over the years' research has discovered that municipal solid waste holds secondary rate value. However, it is important to note that the reuse process of municipal solid waste does not come cheap and tends to become more popular for developing countries to implement this method, as over the years the material recovery facilities have become very expensive to construct as they involve a lot of technical expertise (Olukanni, 2018).

2.2.3.3.1. Reutilisation of glass products

The diversification of waste disposal is a result of industrialisation and economic activities within cities; hence, the reutilisation of product materials such as plastic and glass is important in making sure there's no disruptive activities of the ecological structure (Mansour, 2015). To deal with pollution-caused mismanagement of municipal solid waste, they need to enhance the circular economy in transforming waste into a material resource. It has been argued by Mansour (2015) that waste should be classified as a resource material for production of goods at lower costs while protecting the environment and avoiding resource depletion within cities. Plastic products contribute approximately 12–16% of plastic waste produced and disposed of, while glass waste contributes to overflow at landfill sites as glass waste takes hundreds to thousands of years to breakdown (Mansour, 2015). Therefore, reusing glass products is important to prevent the production of toxic substances in landfill sites. The reutilisation of glass products involves the crushing of glass waste into small particles, which will be recycled into new glass products such as glass bottles and jars, and a tonne of natural raw material will be preserved and 2-3% of energy for glass production saved (Silva, 2017). Reutilisation of glass does not only have an impact on reducing carbon dioxide emissions but is also beneficial for firms that produce glass products, as the glass melting time will be reduced and more products will be produced (Silva, 2017).

2.2.3.4. Repurposing waste for manufacturing of goods

Municipal solid waste is characterised by different waste components such as food waste, plastic, paper, glass, and clothing items. Therefore, it is important to note that to deal with the municipal solid waste issue that is affecting the world, they need to repurpose waste materials such as plastic materials (Shenghua W. L., 2021). However, it is important to realise the importance of repurposing plastic waste. Based on a survey that was conducted by the Australian Plastic Recycling Survey, it was discovered that during the period of 2016 and 2017, there was a consumption of plastic waste totalling 3,513,100 tonnes, while only 415,200 tins of plastic waste were recycled (Shuhan, 2023). Plastic waste is waste that should not even be collected and disposed of at landfill sites based on the dangers they possess towards the environment and public health, as plastic waste can produce leachate (Kumagai, 2019). The disposal of plastic materials to landfill sites poses a threat to the drinking water and ecological segments as they have the capacity to produce micro plastics. Therefore, it is important to note

the attempts made by researchers and engineers around repurposing plastic waste through developing wood-plastic composites that can be used for constructing civil infrastructure (Kumagai, 2019).

2.2.3.4.1. Repurposing food waste as a Municipal Solid Waste Management strategy

The quality of life and consumption of goods within cities have resulted in improper waste management practices, as they constitute most of the disposed waste at landfill sites and illegally dumped waste (Lee, 2024). Food waste is one of the biggest contributing factors when it comes to depletion of natural resources, pollution, and shortage of landfill sites together with the public (Lee, 2024). To deal with the issue of food waste within cities, there needs to be a repurposing mechanism implemented by role players responsible for waste management and landfill sites. Repurposing of food waste can be achieved through food waste separation, which will assist in achieving Sustainable Developmental Goals 11 and 12, which advocate for sustainable cities and responsible consumption and production of goods (Lee, 2024). Food waste repurposing is regarded as a waste management strategy as it will result in the production of biobased products and chemicals, which will play a role towards food security, environmental sustainability, and economic growth (Ebikade, 2020). Furthermore, feed stock can be produced through the food waste repurposing strategy, and the agricultural sector will be of great benefit together with companies that produce feed stock as the costs of production will be relatively lower (Narisetty, 2022). Repurposing food waste will eliminate the environmental and health repercussions suffered through landfilling and compositing of food waste. According to the Sustainable Development Goals Agenda 2030 for enhancing a circular economy, repurposing food waste is important in the production of high-value chemicals and bioenergy while ensuring that natural environmental resources are preserved (Narisetty, 2022).

2.2.3.5. Waste Recycling

The increment in the quantity of municipal solid waste produced has really questioned the sustainability of the environment and public health within countries that are finding it difficult to manage municipal solid waste. Therefore, it is important to understand the effects of mismanaging municipal solid waste during economic growth and development of communities, as countries like Malaysia have suffered a great discourse of mismanaging municipal solid waste (Anwar, 2014). The recycling of municipal solid waste is regarded as

one of the best solutions in reducing the quantity of municipal solid waste; hence, Anwar (2014) advocates for the recycling of waste materials as they have the potential of generating income for households and improving the quality of life within developing countries. Furthermore, it is important to note that recycling municipal solid waste will result in reducing municipal solid waste being disposed of at landfill sites (Anwar, 2014). The recycling of municipal solid waste materials such as glass, paper, and aluminium is eco-friendly as it will assist in reducing pollution, as it has been noted by Farzadkiaa (2021) that the manufacturing of recycled materials will result in utilising 17 times less energy compared to manufacturing through raw materials. Moreover, it is also important to realise the fact that recycling of municipal solid waste materials has an economic benefit while preserving the natural resources (Farzadkiaa, 2021).

2.2.3.5.1. On the Go Recycling units

Waste recycling is referred to as a pivotal strategy for environmental and societal challenges experienced through waste generation. The recycling process of waste is inclusive of multiple role players from society, whether formal or informal, to prevent the production of carbon emissions and air space at landfill sites (Taouahria, 2024). Successful waste recycling initiatives are achieved through the access to recycling facilities in communities and the market demand for recyclable waste. Taouahria, (2024) The on-the-go waste recycling initiative involves the sorting of waste by generators, and they dispose the sorted waste into the available on-the-go facilities, which are commonly placed in public areas (Taouahria, 2024). Furthermore, recycling rates increase significantly as it is made accessible to everyone within cities, which assists in preventing littering and illegal dumping of waste as it has done so in the USA and other parts of the world (Mozo-Reyes, 2016). Therefore, on-the-go recycling units reduce generated waste as they have the capability of attracting users during various time frames and societal settings as they are always on the move (Mozo-Reyes, 2016). Commercial institutions play a critical role in enhancing waste recycling programs, as the public sector does not have the capability to carry out all the waste management responsibilities and costs (Andrews, 2013). Recycling units have been provided by commercial institutions that have their branding in public spaces, which provide people with ways to dispose of waste, which is made of paper, glass, card boxes, and plastic, which results in a clean environment (Andrews,

2013). The on-the-go recycling units increase recycling participation amongst citizens as the distance to dispose of recyclable waste predominantly decreases (Andrews, 2013).

2.2.3.5.2. Education awareness programs for waste management in communities

Municipal solid waste management has not been able to achieve the waste reduction and circular economy results due to human behaviour that humans possess with regards to management of waste and taking part in the circular economy (Saladié, 2016). Humans need to consider that mismanagement of municipal solid waste does not only affect the climate but also effects plant health, animal health, water quality, and human health in the long run; hence, it's important to educate citizens about managing waste through recycling and waste sorting (Saladié, 2016). Waste processing educational programs seek to tackle the issue of illegal dumping, littering, and burning of waste to reduce waste in households. The promotion of sorting waste and recycling waste within developing countries is significant as waste will be reduced at landfill sites and there will be recovery of energy (Saladié, 2016). Educational awareness programs seek to enhance behavioural change amongst humans, as they are contributors to environmental problems in the world. Furthermore, awareness programs are regarded as proactive rather than reactive methods for managing waste, as reactive methods include the enforcement of regulations and fines towards people who do not comply. Therefore, a proactive approach makes people aware of the environmental impacts caused by mismanagement of solid waste and also makes citizens informed about different waste products that are recyclable, reusable, and repurpose able (Saladié, 2016).

2.3. Theoretical Framework

It is very important that whenever a research study is being conducted, the study needs to be grounded in its own foundation, which is mostly regarded as the foundation of where the research emanates from. Furthermore, Nhan (2020) regards a theoretical framework as the blueprint for a research dissertation, as it seeks to guide and inform the findings of the research study while defining the epistemologically, philosophically, and methodological approaches being implemented. This research dissertation has been informed by the following theoretical frameworks: multi-actor environmental governance theory, urban sustainability theory, and integrated solid waste management theories to overcome the limitations of the initiated field of study (Nhan, 2020). The utilisation of the triad theoretical frameworks stems from the need to

form an understanding of human behaviour with regards to municipal solid waste management and determining the interactions between the public and private sectors with regards to the management of solid waste within the city of Johannesburg. In order to have a comprehensive understanding of the municipal solid waste situation in the Johannesburg the three theoretical frameworks were implemented in order to examine environmental factors such as municipal solid waste (Siltaloppi, 2017). Therefore the triad theoretical frameworks assisted in making informed decisions with regards to the development of the PPP model for municipal solid waste for sustainable cities as the triad theoretical frameworks managed to provide supporting evidence based practices with regards to waste management and interrelationship between private and public sectors (Siltaloppi, 2017).

2.3.1. Multi-Actor environmental governance theory

The world at large has been characterised by complex environmental problems that require a dynamic leadership style that believes in creating a relationship amongst multiple actors that form part of society, as modern problems require modern solutions (Marc, 2019). Since the adoption of the Sustainable Development Goals by the United Nations General Assembly in 2015, there has been a call for multistakeholder partnerships amongst different countries to enhance climate action through the protection of the environment (SERENA, 2020). Therefore, to achieve sustainable development within communities and deal with modern environmental problems insinuated by pollution through the high generation of municipal solid waste, there needs to be a complex leadership style within government organisations (Marc, 2019). A multi-actor environmental governance approach assists in enhancing transformation mechanisms in applying policies and practices that seek to deliver products and services that are commercially driven in achieving the Sustainable Development Goals by 2030 (SERENA, 2020).

Banerjee (2020) highlights the importance of implementing a multi-stakeholder partnership that is in line with Sustainable Development Goal 17, which promotes the relationship between the public actors and the private actors in tackling moderns such as municipal solid waste. A multi-actor governance mechanism is the inclusivity of the public sector, society at large, the private sector, and the civil society organization. Therefore, the multi-actor governance theory seeks to provide new solutions to the world's greatest challenges, such as pollution and climate change, which are mostly enhanced by municipal solid waste (SERENA, 2020). The collaboration between the private sector and civil society organisations is very essential in

tackling environmental issues, which are deemed to be costly as the partnership seeks to enhance the mobilisation of resources and sharing of responsibilities and risks acquired through a developmental project (SERENA, 2020).

Banerjee (2020) emphasises the importance of having a multi-actor governance mechanism as it results in tackling the voids and problems created by the public sector's inability or unwillingness to achieve certain societal segments that align with the country's developmental vision. Furthermore, research in the past has proven that multi-actor governance results in innovation, opportunities, knowledge sharing, and cost reduction for the public sector. Shakil (2014) holds the view that the public sector on its own won't be able to deal with the scales, facets, and interdependencies that describe environmental problems, hence the need to develop a hybrid of multi-actor environmental governance.

2.3.2. Urban sustainability theory

The rise of urbanisation has been having an impact on the relationship between the environment and society in the past decades. Romero-Lankao (2016) holds the view that in order to understand urban dynamics and its environmental challenges, concepts such as resilience, sustainability, and development should be regarded as concepts to be used in understating the environmental challenges that occur during urbanization. Therefore, it has been realised that to achieve environmental sustainability, there needs to be coherence amongst policies and practice mechanisms that have to be initiated, as stated by Spiliotopoulou (2020). However, it is also important to note that to deal with global socio-ecological problems, urban vulnerabilities and consumption mechanisms need to be given the required attention. Romero-Lankao (2016) holds the view that the rapid population growth around the world has badly affected the ecosystem as it has been degraded by human activities, which hampers the sustainability of urban areas. It's a known fact that urbanisation is on the rise, which has resulted in the development of smart cities around the world, which seek to improve the quality of life amongst communities. Perboli (2020) perceives technology as a panacea for smart cities, whereby all the initiatives implemented are supported and launched by the public sector. Therefore, it is important to note the importance of participative decision-making in enhancing urban sustainability through the systematic phases of environmental management development (Lăzăroiu, 2020). Furthermore, urban sustainable development is a multi-dimensional process

that seeks to make an understanding that there's a relation between the social, economic, and environmental sectors; hence, Marta (2020) states that the introduction of the Sustainable Development Goals towards urban sustainability incorporates the valorisation of cultural resources and the protection of the environment through the participation of all societal actors. Therefore, social cohesion and community participation need to be regarded as important factors towards achieving urban sustainability in smart cities (Marta, 2020).

2.3.3. Integrated Solid Waste Management theory

The world at large has been characterised by greenhouse emissions and pollution, which are a result of the mismanagement of municipal solid waste; hence, Menikpura (2012) emphasises the importance of transforming towards the Integrated Solid Waste Management mechanism in achieving socioeconomic and environmental benefits. Okechukwu (2018) states that the integrated solid waste management theory seeks to develop mechanisms towards managing the quantity of municipal solid waste produced within a certain geographical area. Furthermore, it is also important to realise the fact that local governments around the world play a role in the development and implementation of policies and practices that seek to promote integrated municipal solid waste mechanisms (Menikpura, 2012). Human and economic activities around the world that are a result of urbanisation and industrialisation within smart cities have resulted in municipal solid waste becoming a burning issue for many societies around the world. Moreover, public sector institutions responsible for the management of municipal solid waste have been having difficulties, as research in the past has discovered that municipal solid waste within smart cities is not collected to its full capacity as a fraction of the generated waste gets disposed of (Rao, 2014).

Menikpura (2012) regards integrated municipal solid waste as a systematic approach towards the management of municipal solid waste reduction of pollution through the utilisation of technology. Therefore, it has been noted that the inclusivity of technology in the management of solid waste results in the management of waste streams and the recovery of useful waste materials through recycling, repurposing, and reuse initiatives (Menikpura, 2012). Furthermore, it must be noted that the integrated municipal solid waste seeks to enhance the utilisation of solid waste particles as resources. The importance of the integrated municipal solid waste system promotes the collaboration of the public sector and the communities at

ground level to monitor and collect municipal solid waste, as stated by Nleya (2016). Therefore, integrated municipal solid waste management seeks to solve modern problems associated with municipal solid waste, as the IMSWM system is the combination of the waste collection strategies, treatment, disposal methods, and monitoring of waste streams to enhance environmental sustainability within urban cities (Milan, 2015). The integrated solid waste management systems are informed by three life cycles, namely: stakeholders, technical components, and waste management sustainability. Therefore, the stakeholders cycle seeks to promote the importance of legislation in enhancing sustainable development, while the technical component will enhance waste collection, transportation, and recycling of waste through sorting and recycling initiatives. Finally, the waste management sustainability life cycle will involve multiple groups of people from different sectors, technologies, and processes, as stated by Milan (2015).

2.4. Chapter summary

This chapter was inclusive of the supporting literature from different researchers and scholars that have produced secondary data that aligns with the research problems and research objectives. An overview of the management of municipal solid waste within cities around the world was provided to illustrate the extent of the research problem at hand. To provide a logical flow of arguments for the literature gathered, discussions, and arguments within the chapter, the research objectives were a guideline, as each objective was broken down into at least four themes, which made the data rich. Furthermore, the chapter was inclusive of three theoretical frameworks that provide a direction on where the research emanates in relation to the forms and conditions of PPP agreements, urban sustainability in cities, and strategies being implemented towards the management of municipal solid waste. The literature provided in this chapter managed to illustrate the forms and conditions found within PPP agreements together with the characteristics of urban sustainability within cities. Moreover, the literature also provided an insight into strategies and processes implemented towards municipal solid waste management. The succeeding chapter is an outline of the adopted research methodologies and tools that were used for informing the design, approach, description of the study area, target population, sampling procedure followed, data collection techniques, data analysis procedures, ethical considerations, and limitations that the research dissertation encountered.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

Research designs and methodologies are regarded as the fundamental structure of a research study as they critically provide guidance and instructions that need to be followed to answer the intended research questions and achieve the objectives (Sileyew, 2020). It has been noted by Sileyew (2020) that research design and methodology has assisted in determining the target population, data collection tools, sampling methods, data sources, and the different guidelines and procedures that have been adopted in deriving primary and secondary data for the research study. Sileyew (2020) regards research designs and methodologies as systematic procedures that seek to form an understanding of how research objectives are solved and how the identified research problems are tackled.

This chapter within the research dissertation has provided a systematic procedure that was followed during the adoption and implementation of research designs and methodologies on the collection of primary and secondary data that has managed to tackle the research question and problem. Furthermore, this section has also provided a description of the city of Johannesburg and the exact geographical areas within the city of Joburg, where the study mainly focused main Region D,E and F of the city, which is the Johannesburg Central Business District or inner city and the surrounding regions next to region F. The section also illustrates the target population, which plays a critical role in deriving data from in order to answer the research questions in relation to the gap in knowledge. The target population has been sampled with a sampling tool to minimise and structure the target population with interest to the research area, as it is quite impossible to study the whole population within a community (Sileyew, 2020). Moreover, this section has illustrated the ethical considerations that have been implemented for this study. The research study adopted and implemented the qualitative research method with a mandate to answer the research questions and achieve the intended research objectives.

3.1. Introduction

This research study employed the qualitative research method as a guideline and backbone of the entire research; hence, there was a need to employ the Inductive research design in order to be able to develop a model in relation to the empirical data collected from participants. The inductive research design assisted in describing the solid waste situation in the city of

Johannesburg, whereby the inductive research design also assisted in developing a new theory that informs the development of a public-private partnership model (Raimo, 2014). Furthermore, the Inductive research design adopted systematic methods and procedures that provided guidance for the data collection and data analysis procedures that were followed.

The inductive research design managed to discover and develop a theory after the data analysis process as the sampled participants provided relevant data, which assisted the researcher in identifying the gaps and suitable model for a public-private partnership in managing municipal solid waste effectively (Creswell, 2007). The inductive research design was beneficial for this research study as it provided social processes that people implement towards the management of solid waste. Furthermore, it has been noted by Raimo, (2014) that inductive research design seeks to develop a new theory based on data collected systematically from the key participants. This research design was critical for this research study as it provided the nature of relationships for public-private partnership agreements within the city of Johannesburg towards the management of municipal solid waste.

During the data analysis and findings discussions, it is very important to produce data that is credible and valid in accordance with the research questions and objectives; hence, this research study adopted the inductive research design as it provided guidance during the data collection procedure of in-depth interviews with multiple sampled participants in Region F of the City of Johannesburg Metropolitan Municipality who are involved in the management of solid waste within the city and have an interest in developing models or strategies that enhance effective public-private partnerships (Bhandari., Triangulation in Research | Guide, Types, Examples, 2023).

McCombes (2023) has highlighted that a research design plays a critical role when it comes to the data analysis of a research study as it provides empirical data that is systematic and provides answers for the designed research questions. The inductive research design played a critical role in answering the research questions and achieving the desired research aims and objectives as the inductive research design managed to study the public-private partnership agreements that already exist within the city, and at the end, a new theory that talks about public-private partnerships on solid waste was developed (Siedlecki, 2020). Moreover, this research study also assisted in describing public-private partnership agreements within the city of Joburg,

Region F, and assisted in determining the multiple processes that can be adopted to enhance sustainable cities in relation to the Sustainable Development Goals.

3.2. Research Approach

The specified research study implemented a qualitative research approach, which managed to answer the formulated research questions, aims, and objectives as they were a combination of qualitative elements (George, 2021). The qualitative research design assisted in making this research study credible as different tools and strategies were implemented for collecting data from the sampled participants as it assisted in making sure that there's contextualisation in the conclusion of the research study based on the fact that the qualitative data provided multiple theories in relation to public-private partnership agreements for municipal solid waste management (George, 2021). It has been highlighted by Bhandari (2020) that within the qualitative research method the study was able to study the perceptions and experiences of the key participants, which assisted in getting a deep insight towards the research problem with regards to the collaboration of the public sector and private sector towards solid waste management.

3.3. Research Paradigm

It is believed that in most cases a research structure is informed by its own unique beliefs and assumptions; hence, Ulz (2023) highlights the importance of adopting a specific research paradigm within a research study. A research paradigm is very crucial for a research study, as it plays a role as the foundation for a research study because a paradigm is regarded as a theoretical framework of a certain discipline (Ulz, 2023). The research paradigm plays a critical role in guiding a research process as it provides a philosophical framework that is characterised by a set of beliefs and ideas. The research study implemented the interpretivism research paradigm, which believes that there are multiple realities that are subjective (Nickerson, 2023). Furthermore, the interpretivism paradigm is regarded as a positivist critique for social sciences research. The research paradigm was beneficial for this research study as it is flexible in tackling research problems whereby the perceptions and experiences of the respondents were effective in producing a testable hypothesis at the end, which made the development of a model possible at the end (Nickerson, 2023).

3.4. Description of Study area

The research study was conducted under the largest metropolitan municipality in South Africa based on population size and economy, the City of Johannesburg metropolitan municipality under Region F (COGTA, 2018). The City of Johannesburg Metropolitan municipality consists of a population of 6,198,000 as recorded by Macrotrends (2023), and the metropolitan is regarded as the heartbeat of South Africa's economy, whereby the municipality has two neighbours that are also metropolitan municipalities (City of Ekurhuleni and City of Tshwane metropolitan municipalities). The metropolitan municipality consists of world-class infrastructure that attracts residents on its 1644 square kilometres of land. It has been noted by COGTA (2018) that the city of Johannesburg was started in 1886 when gold was discovered by George Harrison.

The city consists of the oldest township Alexandre and the largest township in South Africa, Soweto, and also 70% of company headquarters are situated within the city of Johannesburg municipality. The report produced by COGTA (2018) has stated that the city of Johannesburg Metropolitan Municipality collects 1.72 million 92.2% of household waste per week, while only 0.6% of the households have their household waste less often removed on a weekly basis. It has been reported that only 0.5% of the population in the city does not have their refuse waste removed on a weekly basis (Oluwatobi, 2021). The municipal solid waste within the city is collected by a state-owned company, Pikitup, and other private entities regarded as service providers. It has been estimated that service providers responsible for solid waste collect approximately 1.6 million metric tonnes of solid waste per year and own four landfill sites, twelve waste management depots, and 33 garden refuse sites (Oluwatobi, 2021).

The research study was conducted in Region D,E and F of the City of Johannesburg municipality, which is the inner city known as the Central Business District (CBD), also regarded as the financial district of the metropolitan area, as it consists of banking headquarters, fresh produce markets, warehousing and manufacturing poles, and government buildings (COGTA, 2018). The Johannesburg central business district consists of approximately 500 companies together with street vendors who trade different kinds of goods, as the CBD is considered the epicentre of the economy of CoJ. The central business district consists of a latitude of -26.2° or 26° 12' south and the longitude of 28.03333° or 28° 2' to the east.

3.5. Target Population

Whenever a research study is conducted and the time for collecting data arises, there is a need to determine the relevant target population that takes part in the research in order to assist in answering the formulated research questions. It has been noted by multiple researchers that it is quite impossible to study the whole population when collecting data; hence, there has to be a process of identifying the relevant target populations that have a common interest in relation to the research questions and objectives. In accordance with the adopted research methodology, this research study was characterised by informal solid waste collectors, officials from Pikitup SOC, officials from different landfill sites within CoJ, officials from private waste collection companies, officials from the Department of Environment and Infrastructure Development, and also officials from the Johannesburg Metro Police department. The sampled target population was able to provide answers to the research questions as they demonstrated full understanding of the research problem due to the fact that their day-to-day experiences are in relation to municipal solid waste and public-private partnership agreements for enhancing sustainable cities and managing municipal solid waste.

3.6 Sampling Procedure.

To collect accurate data, they need to be a minimisation of the population or key informants that participated within the research study, hence the importance of sampling techniques that need to be implemented to choose a small number of the population since it is quite impossible to study the whole population (Makalela, 2019). Sampling tools are very important for researchers as they assist in saving time and cost during the duration of the research study (Makalela, 2019). Based on the research method that was implemented in this study, which is the qualitative research method, this research study embarked on utilising purposive sampling, which is also regarded as non-random sampling for the qualitative part of the research study (Makalela, 2019). The purposive sampling was beneficial in a sense that it managed to identify relevant key participants as the sample allowed the researcher to use their own judgement on who are the best and suitable candidates to be part of the research study (Nikolopoulou, 2022). Purposive sampling was a great choice for this research study, as the best individuals and events that relate to research questions were identified based on the characteristics and knowledge the participants withheld (Nikolopoulou, 2022). The purposive sampling technique selected participants purposefully, which assisted in getting as much information as possible

that is relevant and aligns with the research questions and objectives. Purposive sampling assisted in identifying and selecting relevant government officials within the city of Joburg who play a critical role in management of municipal solid waste and the fight against illegal dumping and pollution, such as officials from the City of Johannesburg Environmental and Infrastructure Department, the Johannesburg Metro Police Department, and officials from Pikitup. The purposive sampling assisted in choosing participants from the private sector, officials from different landfill sites within the CoJ, officials from Pikitup, and informal waste collectors. Purposive sampling is very key for this research study, as the researcher managed to collect data from people who have experience working with municipal solid waste strategies, illegal dumping, and public-private partnerships. Therefore, the research managed to collect data from 21 participants overall which covered the main role players in the management of municipal solid waste in the city of Johannesburg. Pikitup members played a critical role in determining the suitable people to form part of the data collection process especially for participants who are located in landfill sites. The 21 participants managed to cover the Johannesburg CBD jurisdiction area hence the participants where sampled from region D, region E and region F of the city of Johannesburg as the research projects main focus was the Johannesburg CBD and areas to its close proximity. Furthermore with regards to the focus of the three regions within the city of Johannesburg participants was grouped into three meaning each category of participants had a representative within a specific region in Johannesburg Metropolitan. In order to have an effective identification of the participants within the research project the participants who fully participated within the data collection process will be identified with their own unique code.

3.6.1. Sampling frame

Different types of participants	Number of participants	Codes
City of Johannesburg Environmental and Infrastructure Department	X3	Respondent 13,14 and 15

Johannesburg Metro Police department	X3	Respondent 10,11 and 12
Pikitup	X3	Respondent 1,2 and 3
Officials from private waste companies	X3	Respondent 16,17 and 18
Pikitup GoudKopies Landfill site	X3	Respondent 4,5 and 6
Pikitup Robinson Landfill site	X3	Respondent 7,8 and 9
Informal waste collectors	X3	Respondent 19,20 and 21
Total	21	

3.7 Data collection techniques

As it has been noted, the implemented research method within this research study was the qualitative research method, which resulted in the research study implementing semi-structured interviews in order to derive data for the formulated research questions. The semi-structured interviews were able to inform the selected qualitative research approach as the interviews were conducted face-to-face and online through teams meetings with the sampled population as the participants provided credible and valid data that relates to the research study and provided an effective conclusion at the end, which played a big part in the development of a model. The semi-structured interview questions were characterised by rigorous questions and open-ended interview questions that were asked one-on-one with the participants, which did not limit the

respondents in giving out information as the method was flexible and allowed the participants to provide their perceptions and experiences with relation to the asked research question at that time (Makalela, 2019).

3.8 Data Analysis

Karin (2023) states that data analysis is the process of cleaning and processing raw data collected from participants, whereby data that is relevant to the research study was identified and conceptualised to achieve the research aims and objectives. The collected data from participants was processed through recordings and taking down of notes based on the respondents responses .Data collection recordings were transcribed on Microsoft word as a process of cleaning the data and then later on the data was grouped into multiple themes that formed part of the data presentation and interpretation chapter .The process of cleaning and analysing data assisted in identifying data that is relevant and useful towards the research study; hence, the employment of thematic data analysis throughout the data analysis procedure as this a qualitative study and semi structured interviews were conducted.

This research study implemented the thematic data analysis for the collected qualitative data, whereby the raw data was analysed and grouped into specific themes through words and text and did not include non-numerical statistics. During the data analysis process, the researcher was able to identify common themes, concepts, and ideas that emanated from the key participants that were part of the data collection procedure (Jack, 2019). Thematic analysis assisted this whole research dissertation in outlining common issues alluded to by the key participants who were interviewed, as they played a critical role in developing a model for a public-private partnership on solid waste in order to enhance a sustainable environment within the inner city of Johannesburg Metropolitan Municipality .Thematic data analysis was the best procedure for analysing data in this research dissertation, as it proved to be flexible and avoided biasness during the interpreting and analysis of the raw data (Jack, 2019). It was very important that the researcher employ a thematic data analysis process in order to determine the status of solid waste within the city of Johannesburg and also the existing public-private partnership agreements within the Central Business District of the City of Johannesburg Metropolitan municipality.

During the thematic data analysis process, an inductive approach was implemented in the analysis of the raw data, which involved the correlation of data from interviews with regards to identified existing theoretical frameworks and literature (Jack, 2019). The adoption of the inductive approach assisted in identifying common themes from the analysed data with regards to the implemented theoretical frameworks and literature. The inductive approach made sure that there's a concise meaning during the interpretation of the raw data as it provided a nuanced understanding of the complexity PPP agreements in the management of municipal solid waste (Jack, 2019).

3.9. Ethical Considerations

It is very important to develop a set of principles whenever conducting a research study, as the ethical principles play a critical role in guiding and implementing the research methods systematically to achieve scientific integrity (Bhandari, 2021). Furthermore, Bhandari (2021) states that ethical considerations are very key for research studies as they maintain academic integrity and make sure that the rights of research participants are protected, and their dignity is not stripped off. The research ethics made sure that participants from the target population volunteered and were fully informed about the nature of the research dissertation. This research study is credible as it managed to adhere to all the prescribed ethical conducts of the University of Mpumalanga, including the plagiarism policies, which the researcher adhered to as each source for secondary data is recognised throughout the research dissertation in order to increase the credibility of the data within this paper. During the process of this research study, confidentiality and anonymity of the research participants and organisations they were part of were adhered to, as during the data collection process participants from private waste collection companies were asked to remain anonymous and that their company names must not be named within the study as they fear being misquoted or being blacklisted within the waste management market, which might make it difficult for them to get business from other organisations. Therefore, identities and organisation names of private waste collection companies are to be anonymous due to the fact this research study is only intended for research purposes. For further ethical considerations, permission was asked from the City of Johannesburg, who are the gatekeepers of the study area that has been identified; hence, the research study includes an attachment of the permission letter from the City of Johannesburg, which shows that permission was granted to conduct the research study within the city's proximity. Key participants that took part in this research study were not harmed physically,

emotionally, or psychologically, as the beliefs and cultures that define them were respected cautiously during the data collection process. To enhance the credibility of the research study, interviews were conducted in language that the respondents preferred and fully understood. The South African Protection of Personal Information Act (POPIA) 2013 was enhanced throughout the research project as it seeks to advocate for data privacy law with regards to the collection, utilisation, storing and handling personal information as the researcher adhered to POPIA act. Therefore, the participants were notified that they can feel free to not answer any question they feel uncomfortable or improper and participants were also assured that the collected data was for this research study purpose only and that their recordings are not be shared or distributed to second parties.

3.10 Data control and management (validity and reliability)

Within a research study, there must be proper management of data control to enhance the validity and reliability of the data produced by the research study. Thakur (2020) states that the validity and reliability of data control management tend to differentiate between bad and good research, which assists readers to determine the trustworthiness and quality of the research. The process of data control and management seeks to determine the different tools, techniques, and methodologies adopted within the research study in order to determine the consistency of the methodologies in order to measure something. The validity data control and management assisted in measuring the accuracy of the data collected within the study, whereby in order to determine the reliability within the research study, the effectiveness of the tools and procedures followed within the study need to be analysed.

The validity data control management plays a critical role in analysing and interpreting data, whereby the validity assists in providing a concise on whether or not the data or new knowledge gathered from the respondents relate to the theories and methodologies adopted within the research study. Furthermore, it has been stated by Thakur (2020) that the validity process is incorporated by relevant methodologies, data collection tools, data analysis procedures, and sampling frameworks. As it has been stated above, this research study has adopted the qualitative research method; hence, the validity of this research study is measured through the process of having a skilled moderator who analyses the data collected from respondents in order to curb bias from the researcher.

To determine the reliability of a research study, the results generated from the data collection procedures need to be reproduced once again by another researcher if they were to go on the ground and conduct the same research study, as the aspect is epistemologically counter-intuitive. This research dissertation utilised comprehensive data to determine the reliability of the research study in order to support the validation of the data and data sources and also assist in the presentation of the data.

3.11 Positionality and Reflexivity

A research project tends to be conducted by human being which is the researcher whereby they need to be a reflexivity within a research project in order to provide an awareness with regards to role of the researcher within the research project (Haynes, 2012). Reflexivity is all about explaining different ways in which researcher might affect the research process and outcomes received after the data collection process. The main purpose of reflexivity within a research project is to be self-aware of ones biasness within a research project and critically examine the role of the researcher within the project (Haynes, 2012). The researcher within a research project plays a critical role towards conducting a research project as they are the main role players in the data collection process and data interpretation process whereby in order for a reader to assess the effect of the researcher they needs to be a positionality provided by the researcher (Wilson, 2022). Positionality seeks to identify power dynamics between a research and the research participants by also taking into account how the researchers positionality might have an influence towards the research findings (Wilson, 2022). Moreover, positionality within a research project enhances validity and credibility of the research study and findings by also mitigating any biasness from the researcher. Therefore, with regards to positionality of the research I have detailed my positionality, identity and overview of the reasons to focus on solid waste management for this research project.

I am a young black man who grew up in different cities such as Ekurhuleni and Tshwane but currently residing in the city of Johannesburg, My positionality with regards to the solid waste management in the city of Johannesburg stems back from my honours years when I conducted a research mini dissertation for my honours degree which focused on the vulnerability and adaptability of flood prone settlements and final results of the study had revealed that one of the biggest contributors to flooding activities and making communities vulnerable to floods is the issue of mismanagement pf solid waste in communities. I had discovered that

mismanagement of solid waste results in blockage of storm drainage systems, pollution and climate change which results in abnormal weather conditions.

The reason for me to pursue my Masters dissertation in solid waste management is due to the discovery that there's an interrelationship between flooding activities and management of waste and that waste management shouldn't only be treated as an environmental problem but also as a developmental problem as it tends to be neglected by municipalities where by that view can also bring biasness with regards as I have been exposed to different waste management situations. Another strong reason why I decided to pursue my Masters dissertation in solid waste management in Johannesburg is due the high level of mismanagement of waste that I have experienced through observation within region F of the city of Johannesburg. Based on my observations and knowledge generated through social content with regards to waste management particularly with how they can affect the environment, weather, society and economy I do believe that might bring biasness with regards to the problem of solid waste management.

Setting up data collection appointments and conducting interviews with the research participants I could confidently state that I notified the participants that this is just an academic research project and majority of the participants in the study are male figures especially in the informal waste collectors sector is dominated by male and that has not provided any power dynamics. Moreover, I do believe that they might have been power dynamics between me the researcher and certain participants from government departments as those participants were occupying senior positions in their respective organisations and that might have affected how they respond and participate in the study since I am young and in my mid-twenties and just a student who doesn't occupy any high level of social status and that might have had an impact on my access to information.

I as a researcher played the primary role of formulating the research project from a proposal stage, identifying research participants who are in the solid waste management sector and I also played the primary role of setting up data collection appointments and interviewing the participants one on one. After the collection of data from participants I as the researcher transcribed recordings from data collection, cleaned the data, analysed and interpreted the data within the research project.

3.12 Summary of Chapter

This chapter provided an illustration of the research designs and methodologies that were undertaken within this research study towards the development of data collection procedures and data analysis procedures that were undertaken together with the description of the geographical area of where the study was conducted. Furthermore, the chapter provided concise reasons on why certain research methodologies and techniques were utilised for the suitability of this research dissertation. The chapter provided an insight on how the research objectives and aim for the development of a PPP model were achieved as the dissertation was informed by an inductive research design, which meant that the development of the model is centred around the research findings from the data collected. Furthermore, the chapter highlighted the importance of utilising the qualitative method as the research approach, which resulted in the sampling methods adopted, semi-structured interviews as the data collection strategy, and also the utilisation of the thematic data analysis procedure being followed. Therefore, the chapter also provided a sampling framework of all the participants that participated in this research dissertation, together with the ethical considerations followed and the importance of conducting this research study. The following chapter is the data analysis and interpretation of data generated within the data collection process, which was guided by chapter three, which provided the methodologies and techniques to be deployed. In the following chapter, data analysis and discussions emanate from the raw data derived from participants and are analysed thematically through different main themes and sub-themes that come from the research objectives to create a logical flow. Furthermore, to form a thorough explanation of the empirical data, the following chapter is characterised by image data, which demonstrates arguments and discussions from empirical and secondary data.

CHAPTER FOUR: DATA PRESENTATION AND INTERPRETATION

This chapter provided a detailed data presentation and interpretation with regards to the data generated through the data collection processes by exploring, discovering and developing a hypothesis with regards to the management of solid waste management between the public and private sector. Furthermore, the interpreted empirical data within this chapter is not supported by secondary data and the identified theoretical frameworks. Bhatia (2017) regards data analysis and presentation as a process that draws conclusions from the raw data generated within the research process. Furthermore, it is also important to note that the data analysis process seeks to validate the reliability and validity of data derived within the research process that has the mandate of answering the said research questions and providing a solution for the identified research problem. This research study implemented a qualitative research method whereby the sampled participants were interviewed through semi-structured interviews. Furthermore, it is also important to note that the data derived through semi structured interview processes was analysed through a thematic analysis process. Therefore, it is also important to note that this data analysis and presentation chapter is characterised by visual images that seek to provide a thorough insight into the data being interpreted.

The city of Johannesburg Metropolitan Municipality is a modern city that is highly characterised by industrialisation, modernisation, and rapid population growth, which in return have highly affected the environmental sustainability of the city due to the increment in the municipal solid waste generated. It is also important to note that the city of Johannesburg is characterised by rapid economic growth and human activities that tend to absorb a lot of natural resources, and if there's mismanagement of municipal solid waste within the city, then pollution and climate change is a daily problem. Furthermore, it is also important to note that the municipal solid waste within the city of Johannesburg is managed by the Pikitup SOC, which has collaborated with multiple private entities that have expertise in managing municipal solid waste.

Data for this research study was derived from multiple participants who form part of the public sector, private sector, and informal sector that have an interest in municipal solid waste within the City of Johannesburg Metropolitan Municipality, whereby a total of 21 participants were interviewed. The participation of the officials from the public sector, private sector, and

informal sector was purely voluntary, and participants from private waste management companies are not mentioned with the names of their organisations due to confidentiality and anonymity assurance. Furthermore, the below table gives an insight on how the data is presented in relation to each formulated research objective, whereby the formulated research topics are grouped into their own unique research themes and sub-themes, which are as follows:

Research Questions	Categories	Themes
The forms and conditions of Public-Private-Partnerships in cities	- Responsibilities - Leases - Contracts - Joint Ventures	1. Solid waste management contractual agreements.
Characteristics and indicators of sustainable cities	- Urban Economies - Natural environmental resources - Climate action resilience - Inclusivity and quality of life	2. Municipal solid waste Solid effects towards sustainability in cities.
Processes and strategies of solid waste management in the cities	- Refuse collection - Reduce - Reuse - Repurpose - Recycling	3. Sustainable solid waste management initiatives

Table 4.1: Deductively emerged categories from the empirical data.

The above-formulated themes are characterised by data from the identified participants for this research study, whereby the above-mentioned themes are presented through a narrative discussion and interpretation with regards to the developed research questions. To form an understanding of the public-private partnership agreements being implemented in the city of Johannesburg in managing municipal solid waste that seeks to enhance a sustainable smart city.

4.1 The forms and conditions of public-private partnerships in cities

The partnership between the public and private sectors plays a critical role in reducing the administration and management costs incurred by the government as the private sector can afford better and quality services, which are beneficial towards the process of the implementation of the e-waste management policy .The partnership between the two sectors has been regarded as an investment for the private sector as return on their investment after some time gets received, while on the other hand, the risks and responsibilities are shared amongst the two sectors .Moreover, collaboration between the public and private sectors is defined by the desired outcomes that need to be achieved after completion of the projects, as it involves the issue of budget allocation and payment mechanisms that will be implemented to have a great effect when it comes to the end results of the partnership between the public and private sectors. The public sector has proven not to have the capability to carry out the responsibility of waste management services alone due to the nature of financial costs faced during waste management services. This research project has discovered that PPP agreements are the answer to waste management problems faced by the city of Johannesburg, as the agreements have proven to provide a more satisfying and effective waste management service delivery, even though there are some shortcomings faced within the agreements.

4.1.1. Responsibilities

The public-private partnership is regarded as a contractual agreement between the private sector institution and the public procurements, whereby the responsibilities are shared between the two sectors. Conditions of the Public-Private Partnership entail the private sector to head development projects that are normally headed by the government, whereby during this process the responsibility of the outcome project lies in the hands of the private sector .The responsibility and conditions during the public-private partnership also include the financial responsibilities between the two sectors, whereby the administration, legislation, and management cost responsibilities are shared amongst the two sectors .

4.1.1.1 Types of responsibilities within a PPP for waste management.

The research study has discovered that waste management within the South African context is a neglected service delivery initiative. Moreover, the research study derived data that states that the National Treasury does not allocate enough funds and resources for waste management

services in the country as waste management services are always at the bottom of the barrel when it comes to the funding frameworks for service delivery mandates per financial year. Provision of waste management services within communities is regarded as one of the most expensive service delivery initiatives, as there are a lot of processes that need to be done in order to achieve adequate waste management for communities. Further, it has to be noted that the collection of waste from sources and transportation of waste with specially designed transportation systems is a costly process that needs the collaboration of multiple stakeholders. Through the data derived within this research study, it has been concluded that the disposal of waste to specific areas, such as landfill areas, is a costly process that has been a financial burden for the city of Johannesburg and the three big metros within the Gauteng province. Furthermore, the management of municipal solid waste within the city is not only the responsibility of the public sector but also that of the citizens and business organisations that have an interest in solid waste. Therefore, to manage solid waste effectively within the city of Johannesburg, one of the participants stated that the model used by Rwanda for managing waste should be adopted as the responsibility of waste management for everyone living in the country.

Respondent 1

“Waste management is not supposed to be the responsibility of the government alone but also that of society and civil organisations at large because countries like Rwanda have a model that states that every end of the month everything stops and nobody works and everyone shall come together and clean up the residential areas together with President Paul Kagame .Rwanda takes the issue of waste management and environmental management seriously, as the issue of waste management is not an individual thing but a collective thing.”

The research study has noted that the problem of municipal solid waste and illegal dumping within the city of Johannesburg emanates from the social structure and habits that society carries of not working together to solve a common problem that affects everyone. Furthermore, the study has realised that citizens have a mentality that the responsibility of managing municipal solid waste it's for the public sector only hence most of the time when waste it's not collected or there's littering of waste within the city, citizens put the blame on the government. Therefore, adopting the Rwanda model of making the waste management responsibility for every human and organisation found in Rwanda seeks to implement a multistakeholder

partnership that is in line with Sustainable Development Goal 17, which promotes the relationship between the public actors and the private actors in tackling modern problems such as municipal solid waste.

The research study has noticed that the public sector is not only having PPP for managing municipal solid waste within the city of Johannesburg, but the public sector has entered multiple MOUs (Memorandums of Understanding) partnerships with private companies that have an interest in solid waste management. Participants from the Pikitup SOC hold a view that the inception of MOU partnerships has had a great impact on the Key Performance Indicators that govern the Pikitup SOC, which is the main organisation responsible for managing municipal solid waste. To manage municipal solid waste that is being disposed of at landfill sites, there needs to be a strategy implemented that will reduce the load of waste being disposed of at landfill sites since the majority of landfill sites in the city of Johannesburg are running out of air space. During the course of the research study, interviewed participants from the public sector and private sector stated that they have formed an MOU agreement that looks at the collection of waste from landfill sites.

An official from the PIKITUP SOC has clarified the kind of MOU partnership agreement that they have entered with private companies that specialise in solid waste. The study discovered that the Pikitup SOC has a non-monetary MOU partnership agreement with private companies. Furthermore, the study discovered that the MOU agreement between Pikitup and private companies' entails that the private companies are given the opportunity to come to landfill sites owned by the Pikitup SOC and collect waste from their landfills for free of charge as there's no monetary exchange happening. Officials from the Pikitup SOC have praised the MOU agreement that they have formed with the current private companies, as they believe that this kind of agreement assists in managing solid waste at landfill sites and also seeks to increase the life spans of landfill sites while curbing natural resources such as land used for waste disposal. The MOU agreements between the public and private sectors do not result in environmental benefit only but also result in economic and social benefit, as the MOU has resulted in job creation and development of businesses that focus on recycling and manufacturing as they regard waste as gold.

Respondent 2

“MOU partnership agreements assist us in keeping the environment clean, whereas we give the private entities waste to form a product such as a compost product and sell it. Companies such as CALTERA receive large amounts of waste from us, and they produce manure, which they sell at stores such as builders and other stores.”.

Respondent 3

“We are currently partnering with a lot of private companies that the MOUs that we have signed as manufacturing companies are given access to waste disposed of at landfills, whereby the manufacturers will turn the collected waste into a product that can be sold for agricultural and gardening purposes, and that has been assisting us in reducing waste from our landfills.”.

Respondent 3

“It is important to note that waste is rich in fertilisation nutrients, and farmers, together with farming companies, have requested that we be given waste that they will use to make their soil fertile for growing crops. Once waste is collected from our landfill sites, it gets buried underground on the land to be used for farming purposes to make the soil more fertile.”.

The above-mentioned empirical data is an indication that the city of Johannesburg has entered into different monetary and nonmonetary agreements with private role players for managing waste and reducing the quantity at landfill sites. Proper management of waste, which involves different stakeholders within society, enhances job creation, economic growth, and benefits the agricultural sector at large for fertilisation products. Waste management companies that work together with the public sector have praised the MOU partnership agreements that they have entered with the public sector, as they hold a view that the MOU agreements have assisted their businesses and led to job creation. MOU agreements resulted in the private companies moving towards a recycling mechanism for business strategy. The research study also discovered that the MOU partnership agreements have resulted in the sharing of skills and knowledge between the public sector and private sector without any financial burden. Officials from private companies stated that they have learnt some recycling skills from the PIKITUP SOC, and that has resulted in their organisations being able to turn waste into raw materials for manufacturing

products. The main responsibility within the MOU agreements is that private companies come and collect as much solid waste they desire from the landfill sites for free.

Respondent 16

“Our company specialises in solid waste only, as you know that we also have hazardous waste that is being generated... so our company has an MOU partnership agreement with the Pikitup Soc, which gives us permission to come and collect solid waste at their land fill sites for free of charge at any given time, whereby what we do with that waste is that we put the collected solid waste through a recycling process that will turn the solid waste into raw materials .Within the waste management company, we also have a department that manufactures manure from the solid waste found at landfill sites, and once we produce the manure, we sell it to people who are interested in agricultural activities and also retail stores such as builders and cash build that resell the manure product for us”.

Based on the response from the respondents, it is quite evident that MOU partnership agreements between the public and private sectors do not only benefit the environment but also seek to improve the quality of life within society, as proper management of solid waste results in economic growth, business opportunities, and effective management of municipal solid waste. The existing MOU partnership agreements within Johannesburg assist in conserving and protecting natural environmental resources for manufacturing goods as waste is used as an alternative.

4.1.1.2 Responsibilities between the public sector and informal waste collectors

The management of municipal solid waste involves the collaboration of multiple role players from different walks of life and sectors that have a common objective in adequate management of municipal solid waste. Furthermore, this research study has revealed that the PIKITUP SOC not only has a PPP agreement with formal private companies, but they also have an interest in having an agreement with informal waste collectors. Informal waste collectors are commonly known for collecting waste from disposal bins at every household in a certain geographical area. Moreover, informal waste collectors do their work with the intention of recycling and repurposing waste, as they are very selective of the kind of solid waste they collect from households and residential areas.

During the course of this research study, it was discovered that the Pikitup SOC is moving towards forming multiple partnerships with different role players, such as informal waste collectors, as they have been incorporated within the Pikitup SOC system. Adequate management of municipal solid waste is characterised by different processes, of which one of the most important is sorting at source and recycling of waste, which results in the reduction of the generated waste, which later assists the Pikitup Soc as the waste disposed at landfills gets to be reduced. The research study has discovered that in the past years Pikitup Soc has developed a CO Hops mechanism that seeks to form a partnership with informal waste collectors.

Respondent 3

“We encourage co-hops on a daily basis, whereby we have just appointed hundred and something co-hops, whereby we encourage them and also help them financially in terms of all this circular economy of waste management, and we encourage them all the time, but it’s a difficult job because people are hungry and they want to generate income, so if they don’t benefit financially, then forget.”.

Respondent 5

“We are encouraging informal waste collectors to register and become part of co-hops because to register you just need to group yourself into a group of five, so we are encouraging them to register co-hop. So, after processing the waste materials that they are busy with, we give them that material. We even allocate them some of our garden sites so that they can sort of waste, but the challenge for them is transport again as they need to go and sell that material, which is something that we are working on resolving.”.

Respondent 4

“I know that the department of environmental affairs has that model of assisting the co-ops whereby they support them with machines, but with us, the Pikitup SOC, we just support them with transportation in terms of collection points and not with the transportation to go and sell;

we only do that if they are going to sell within the parameters of the city of Johannesburg, which is where we can assist in terms of transportation.”.

Respondent 13

“Our mandate as the department of environment and infrastructure within the city is to make sure that there’s waste reduction and reduction of climate change activities as they influence the environment. In order to reduce waste within the city we are currently working with Pikitup and we assist them in sorting waste from landfills by providing machines for repurposing waste into different components that can be sold in different markets..... We work together with the informal waste collectors, which are people from different communities who participate in the collection of waste informally, and we give them the opportunity to make extra money by providing machines for waste repurposing, and we also provide them with a market place to trade their produced goods from the repurposing and recycling processes.”

The above-mentioned responses from the sampled participants explain the responsibilities between the Pikitup SOC and the Co Hops, which are known as informal waste collectors. Data derived within the research study states that the responsibility of co-horps is to sort waste at garden sites and other waste facilities, and the responsibility of the Pikitup SOC is to provide the co-horps with transportation, stipend, and giving the co-horps the raw materials generated from recycling processes. Furthermore, towards supporting the cohorps, the department of environment and infrastructure has the responsibility to assist with machines for recycling and repurposing waste for cohorps and provides them with a marketplace for trading within the city parameters.

4.1.1.3 Public-Private Partnership responsibilities for collection of waste.

The participants from the Pikitup SOC and different private companies that have an interest in municipal solid waste have stated that there are public-private partnership agreements between the two sectors towards the management of municipal solid waste within the city of Johannesburg. During the cause of this research study, it was discovered that municipal solid waste management involves multiple sectors that contribute largely to the effective management of municipal solid waste. Municipal solid waste management is characterised by the processing of sorting at source, collection, transportation, disposal, sorting, solid waste

management strategies, and availability of dispersed sites such as landfill sites and garden waste sites, which are financially heavy for the institutions responsible for delivering those mandates. Developing countries such as South Africa are regarded as having difficulties in the management of municipal solid waste in cities due to inadequate financial resources and skills, as one of the respondents from the Pikitup SOC stated:

Respondent 9

“Waste management services are not allocated sufficient budgets as they are always at the bottom of the list of funding for service delivery, whereby that is impacting our infrastructure as we cannot move and get our infrastructure in place as they are sitting with a lot of non-compliances from environmental affairs as they state that we are not complying in terms of legislation because of our old infrastructure, which has never been maintained due to lack of funding and budget, so it’s a big challenge in terms of funding.”.

The integrated solid waste management model seeks to incorporate different stakeholders to solve the solid waste management problems in a well-coordinated fashion, which seeks to promote public-private partnerships within communities. Furthermore, it is important to note that due to rapid population growth within cities, the quantity of waste generation has increased drastically, which has made the public sector unable to manage municipal solid waste through the collection and transportation of solid waste within the city of Johannesburg. Multiple PPP agreements with private entities for sharing responsibilities in collecting and transporting waste have.

Respondent 8

“Currently we have multiple contracts with private waste collection companies whereby we have appointed service providers who provide PIKITUP with plus-minus 200 waste compactor trucks that are collecting waste from the residents. The private companies give us their waste compactor trucks, which we use to collect waste within residential areas. The agreement that we have with private companies is that you avail your truck for waste collection activities, and we pay you monthly.”.

Respondents 16

“Solid waste has been a problem within the city of Johannesburg, and this has not only affected the public sector, but it has also affected the citizens and inhabitants living within the city of Johannesburg area... Our company has been working with the government since its inception, whereby we own a fleet of 22 waste compactor trucks that are operating within the city of Johannesburg and other municipalities outside. Based on the contractual agreement that we have entered with the city of Johannesburg and Pikitup Soc, we send our waste compactor trucks to different communities that fall under the City of Johannesburg area to collect solid waste from households and business areas on a weekly basis, and the Pikitup Soc pays us at the end of the month.”.

Respondent 18

“Our company has been in operation for more than 27 years now, and over the past years we have acquired quite a number of waste compactor trucks that operate in different communities around the country, including the city of Johannesburg, whereby we have been working with the Pikitup SOC for years now, as you know, they are the public sector organisation responsible for the management of municipal solid waste within the city of Johannesburg... Look, we have a partnership agreement with the Pikitup SOC as we assist them in collecting waste from the sources, which are households and business areas, and after the collection of solid waste from the source, we transport the waste with our waste compactor trucks to different landfill sites in the Gauteng province.

Respondent 18

“Our organization is profit-oriented, and for the services we provide, we charge a certain fee, which is payable monthly, quarterly, or annually, as it depends on the contractual agreement we enter. We have an agreement with the government through the Pikitup SOC as we collect and transport waste on their behalf utilizing our own waste compactor trucks, and they pay us monthly.”

Based on the above-mentioned empirical data from the participants it is evident that the city of Johannesburg has different PPP agreements that involve the collection and transportation of waste from source to disposal landfill sites. Furthermore, it has been discovered that the existing PPP agreements are formed in order to resolve the challenges faced by the public sector in the city with regards to the collection and transportation of solid waste as the public sector does not have the required financial muscle to procure their own waste collection machineries. Therefore it has to be noted that the existing PPP agreements for collection waste has contributed positively to the management of solid waste effectively within the city of Johannesburg and has reduced the costs for procuring waste collection machineries as they involve high maintenance costs.

4.1.1.4 Public-Private Partnership responsibilities for landfill sites

Public sector officials that voluntarily participated in this data collection procedure have strongly highlighted the challenge that is facing South Africa towards the management of municipal solid waste, as the biggest issue in South Africa is the issue of not having enough landfill sites and a lack of construction for new landfill sites. Moreover, the participants stated that the national treasurer neglects the waste management sector during the allocation of financial year budgets that seeks to enable service delivery for South African communities. During this research study, it was discovered that it has been more than 80 years since a landfill site was constructed that services the city of Johannesburg Metropolitan Area, even though since 1994 the population of the country and the city of Johannesburg has grown rapidly. The available landfill sites used to dispose of waste within the city of Johannesburg have been affected by a shortage of airspace in the past years and resulted in the closing of a couple of landfill sites without any replacements. Landfill sites are affected by geographical areas and the surroundings within the landfill site, which tend to influence the requirements of a healthy and safe landfill site; hence, it was discovered that within the city of Johannesburg, a landfill site was closed that was privately owned by Waste Group. Furthermore, the city of Johannesburg Municipality does not have enough financial budget allocated for managing waste and constructing landfills, as the costs to construct one Landfill cell amount to R250 million, which does not include maintenance costs. The city has entered into multiple PPP agreements for landfill sites in order to reduce the financial burden faced for waste management as private companies have constructed landfill sites that meet the health and safety regulations. Therefore, the city of Johannesburg municipality has formed an agreement with the private

companies, which gives the Johannesburg municipality the responsibility to dispose of waste at the privately owned landfills while remunerating the private owner monthly as they have constructed the landfill and conduct maintenance on the landfill sites.

Respondent 6

“We have a shortage of natural resources such as land for landfill sites as we are running out of air space for dumping of waste as the landfill sites are running out of space, so it’s becoming very difficult in terms of disposing waste, so it gives the current resources we have a problem as they become overloaded in terms of the covering and combating, so the air space is a main challenge in terms of resources .In order to deal with the shortage of natural resources, we need financial assistance, whereby we need to buy land and develop other cells.”.

Respondent 7

“Most of our landfill sites have reached their maximum capacity and have become full; hence, we are trying to do a rehabilitation, which is to move and reshape the landfill sites, which is more civil engineering and geology activity, and we need through research study the in that field. Since we have a problem of our landfill sites being full, we are busy doing the lining and shaping of the landfill sites to create more airspace, and we need to buy the land next to it or the landfill next to it to develop a new landfill cell.”.

Respondent 9

“The biggest challenge that the big three metros in Gauteng are facing is that there’s a shortage of landfill sites as the existing landfill sites were built in the 1930s, so it’s very bad that the construction and development of new landfill sites is not prioritised .The Treasury does not allocate funding to construct new landfill sites, so what we are doing currently is that we are going to build them in different phases as we do not have the capital in terms of money whereby you can build the landfill that will cost you R250 million as we do not have money .So in terms of waste and service delivery, waste is neglected, and it’s the last thing when they allocate yearly budgets, so I think our politicians do not have much clue on how effective and

important it is to collect waste until we don't come to collect their bins at their residential areas, which is when they realise the importance of Pikitup SOC waste management services.”.

A sampled participant within the study stated that the municipality is facing a problem of having insufficient monthly as they have closed down more than two landfill sites that serviced the city of Johannesburg, and there have not been any plans to replace the landfills that have been shut down due to a lack of financial resources and a lack of understanding by political leaders or people in power when it comes to waste management services .Furthermore, the study revealed that civilians within the City of Johannesburg pay tariffs for the collection of waste on a monthly basis, but the revenue generated by the government is not sufficient to run the whole process of managing solid waste as the construction of new landfill sites is quite expensive due to the compliance procedures with the relevant legislation and acts. The construction of a new landfill site is time-consuming for the public sector within the city of Johannesburg, as it has been estimated that the construction of a new landfill site can take about five years' maximum as there needs to be an independent environmental practitioner appointed to facilitate the whole process.

Respondent 1

“ Construction of a new landfill site is a big problem faced by many municipalities in the country, especially metros, as the process to construct a landfill site is time and financially consuming because in order .To ensure that the new landfill site is complying in terms of the permits that we have been issued with in regards to the environmental legislation .Nema and Environmental Waste Management Act, Environmental Air Pollution, and the Water Act are time-consuming as the process takes years, and we also need to appoint an Independent Environmental Practitioner who will facilitate the whole process, which is a huge financial expenditure that is not spoken about.”.

The research study has discovered that the City of Johannesburg Metropolitan is faced with poor financial muscle needed to enhance service delivery mechanisms for managing municipal solid waste as there's a shortage of landfill sites and lack of financial muscle. Therefore, it must be noted that the problem faced by the city of Johannesburg Metropolitan Municipality is also faced by developing countries around the world, such as India, as they also experience high

population growth and urbanisation. It has been disclosed that the only solution for managing municipal solid waste successfully within the city of Johannesburg is through PPP agreements, as the public sector in local governments does not have the required financial muscle as there are budget cuts ongoing within all government sectors.

4.1.2 Leases

A public-private partnership is regarded as an agreement between the public sector and the private sector whereby the private sector takes over certain projects and responsibilities that were meant for the government with an objective to deliver services within communities. During the public-private partnership agreement, there is a contractual or lease agreement between the public sector and private sector, whereby the duration of the lease agreement between the sectors can be for 3 years to 15 years, depending on the kind of services to be procured, which are in line with the MFMA and MSA. In the duration of the public-private partnership, the private sector leases out land or certain assets to the public-sector entities, whereby the private entity produces a certain service or product for the consumers in the government, which seeks to enhance effective service delivery.

4.1.2.1 Lease agreements for waste compactor trucks

The main point of designing a public-private model is to reduce the wage bill carried by the public sector, as a PPP model is incorporated by funding structure, construction and operation of services to fulfil the mandate of the public sector. It is also important to note that a PPP agreement has a start and end time frame, whereby some of the agreements have lease agreements that guide the agreements if there is an exchange of machinery and resources to be used for delivering a certain service. Therefore, it's important to note that the Pikitup SOC is involved in different PPP agreements with private entities that share the same vision as the Pikitup SOC. The study discovered that Pikitup SOC, which is a public organ, is responsible for the management of municipal solid waste within the City of Johannesburg and does not have sufficient financial muscle to deliver the required services. Furthermore, it is also important to note that management of municipal solid waste is a costly expenditure as it requires a rigorous process and multiple resources and machines to facilitate the collection, disposal, and treatment of the generated municipal solid waste.

The research study discovered that the Pikitup SOC is finding it difficult to manage the generated municipal solid waste within the City of Johannesburg Metropolitan Municipality due to the population size and the socioeconomic activities happening within the city. Moreover, the researcher also discovered that the service delivery initiatives that concern the management of municipal solid waste within South Africa are not allocated enough revenue to deliver the services, as one of the Pikitup SOC participants insinuated that funding for waste services is at the bottom of the barrel within the funding allocation structure provided by the National Treasury, which has affected the city of Johannesburg to a greater extent. Management of Municipal Solid Waste within the City of Johannesburg has been affected by the lack of financial muscle and machinery to be used in managing the generated municipal solid waste, whereby the Pikitup SOC does not have enough fleet of Waste Compactor trucks to collect waste from residential areas. The management of municipal solid waste within the city of Johannesburg has been a challenge for some time now, and that has opened up business for the private sector companies that specialise in municipal solid waste.

Respondent 17

“Our company has been specialising in waste for the past 20 years, and within that time frame the company was able to yield good results as it entered into multiple agreements with different municipalities whereby sometimes, we lease our waste compactor trucks for collection of waste as municipalities do not have the sufficient revenue to buy their own waste compactor trucks.”.

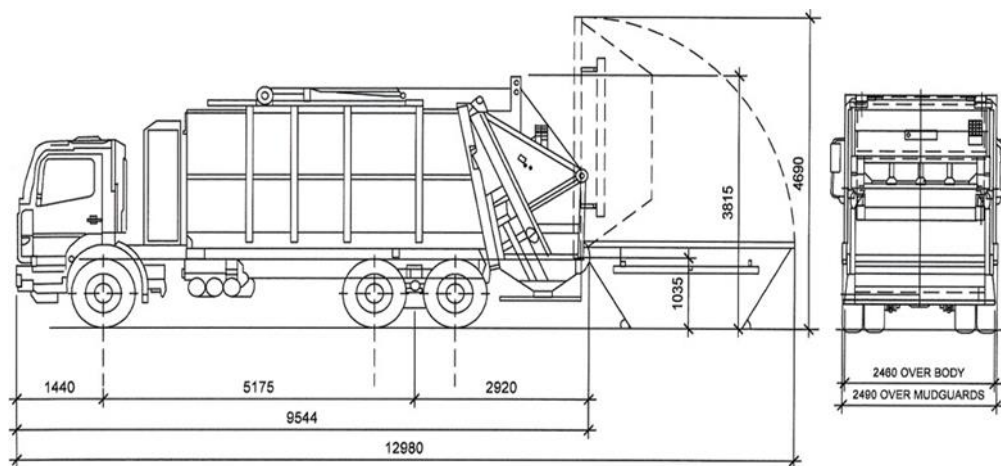
Respondent 2

“The level of waste generated by households and business areas has increased drastically in the past years, whereby we have been having issues when it comes to the collection of municipal solid waste as the Pikitup organisation does not have enough waste compactor trucks to collect waste within the city of Joburg region. Waste compactor trucks do not come cheap, and as a state-owned company, we are not allocated enough revenue to procure the needed waste compactor trucks, which has now led to us working with the private sector guys who own waste compactor trucks. In order to have sufficient service delivery when it comes to the collection of waste from households and residential areas, the Pikitup SOC has entered into multiple agreements with private entities whereby they lease us their waste compactor trucks, which are

used to collect waste within the metro, and we pay them on a monthly basis as per our agreement .Basically, the private companies that we are working with have leased their waste compactor trucks to Pikitup, and they are structured on a three-year lease period.”

Respondent 6

“We don’t use the old skip trucks as waste collection and transportation tools for solid waste within the city for health and safety reasons; hence, now within our integrated waste management plan, it is required that when collecting solid waste and transporting it, you must utilise a waste compactor truck, which doesn’t come cheap as it’s a custom-made truck that is fitted with a lot of machines that carry the 240-litre bins and crush the solid waste into small particles of waste. A waste compactor truck that meets the specifications of the municipality can cost around R1 million and needs to be maintained monthly, and as the municipality, we do not have that luxury as we receive the lowest budget from the Treasury.”



(Pikitup SOC, 2023)

The above annexure is a specification for the waste compactor truck, which is in line with the health and safety requirements of the Pikitup SOC waste collection and transportation services and is equipped with different machines. Therefore, the research study has discovered that the city of Johannesburg has in place lease agreements for waste compactor trucks, which involve the private sector leasing their waste compactor trucks to the municipality for a duration of 3 to 5 years. The waste compactor truck lease agreements are formed as a result of poor financial

muscle by the public sector when it comes to buying the waste compactor trucks, as they have their own specifications for health and safety purposes, which is quite expensive to buy. Furthermore, the issue of maintenance for waste compactor trucks resulted in the PPP agreeing to lease waste compactor trucks as the municipality struggles to maintain a large influx of waste compactor trucks and also looking at the fact that government vehicles do not have insurance.

4.1.2.2 Lease agreements in landfill sites

The city of Johannesburg is characterised by a shortage of natural environmental resources, such as land for constructing landfill cells, which are in line with the National Environment Management Act and the city council's integrated waste management plan. Therefore, that has resulted in a shortage of landfill cells for storage of waste in the north of Johannesburg, as the city does not own any landfill site or suitable land to construct the landfill cell. The construction of landfill sites is a costly procedure and time-consuming for the city of Johannesburg, whereby the city cannot afford to construct new landfill sites without the assistance of the private sector due to low budget allocation, a lack of human resources, and no ownership of suitable land to construct a landfill site. Challenges surrounding the construction of new landfill sites within the city have resulted in the city of Johannesburg entering into PPP agreements with private waste companies and land owners that have ownership of landfill sites and land that meets all the requirements of opening landfill sites. The PPP agreements come in different forms, whereby currently the private companies acquire suitable land, construct the landfill cells that meet the health and safety regulations, install machinery, and conduct maintenance at the landfill sites, while the public sector comes and dispose waste at the privately owned landfill sites. One of the reasons for the public sector within the city of Johannesburg to enter into this kind of PPP agreement is the result that the city does not have any landfill sites in the northern parts of Johannesburg as most of their landfill sites are located in the south of Johannesburg, which is costly for the transportation of waste from the north to the south as the distance is time-consuming and financially costly, and waste from the north creates an influx of waste in

landfill sites found within the south as they are only responsible for servicing the southern parts of Johannesburg.

Respondent 6

“Within the public sector, us people responsible for managing waste are not taken seriously as we are underfunded and we are not provided with sufficient resources to manage municipal solid waste. I believe that people who are in politics do not have a clear understanding of managing municipal solid waste because when we outline and present the costs of setting up a new landfill site, we are not given the proposed budget as we are also always given less. In the past years, me and my team have been working tirelessly to secure new land that is suitable for setting up a new landfill site, but unfortunately the available land within the city of Johannesburg is unavailable or does not meet the requirements for us to set up a landfill site. We have resorted to leasing land from private owners in order for the city to have functional landfill sites, as we have closed down a few landfill sites in the past as they have reached saturation.”

Respondent 8

“Pikitup does not own any landfill sites in the northern parts of Johannesburg, whereby that is a challenge for us because waste generated in the south has nowhere to go as the current landfill sites we have are far away from the north, and transportation of waste from the north to the south, where we have a few landfill sites, is costly when it comes to diesel, truck maintenance, and service providers also charge us an arm and a leg as the distance to be covered is too long; hence, we have formed PPP agreements with private waste companies where we lease landfill sites from them and we pay them on a quarterly basis per each financial year.”

Municipal solid waste has solely been the responsibility of the public sector in the past, but currently that hasn't been unsustainable due to factors such as urbanization, population growth, and the economic growth within local municipalities. Furthermore, the issue of budget cuts faced by the public sector and lack of ownership surrounding land has resulted in the formation of PPP agreements as the public sector leases landfill sites from the private companies in order

to manage waste effectively. The leasing of landfill sites has played a critical role towards creating a healthy business environment for private companies to operate in as they are able to solve some of the issues faced by the public sector pertaining to service delivery.

4.1.3 Contracts

The adoption of the PPPs came about after 1994 for all spheres of government to adopt the model in order to ease the load from the public sector in ensuring that service delivery is not only the responsibility of the public sector. The public-private partnership model is an initiative that the public sector initiates in line with Section 217(1) of the constitution of South Africa, which states, "When an organ of state in the national, provincial, or local sphere of government, or any other institution identified in national legislation, contracts for goods or services, it must do so in accordance with a system that is fair, equitable, transparent, competitive, and cost-effective." Section 217 (1) of the Constitution of South Africa opens room for the PFMA Public Finance Management Act 1 of 1999, which gives the public sector a constitutional obligation to formulate a contractual agreement with the private sector for the delivery of goods or services. PPPs are guided by the PFMA, which plays a pivotal role in mapping out guidelines and instructions for the procurement of goods or services between a public organ and a private entity in order to foster accountability and transparency.

4.1.3.1 Contractual agreements for collection of waste from sources

The research study discovered that the PPP contractual agreement for municipal solid waste within the local or metropolitan municipalities needs to have an integrated development plan and integrated waste management plan in accordance with the National Waste Management Strategy. There has been mismanagement of contractual agreements within the city of Johannesburg for waste management services, as private waste companies have complained that the payment processes utilised by the public sector for contractors are tedious as they struggle to get payments on time due to administration back locks and the PFMA procedures that need to be followed, which has resulted in the private contractors not collecting waste within the city anymore as the contractual obligations from the other party are not met. Furthermore, the contractual arrangements for PPP towards waste management within the city are not met effectively as the issue of political instability and change of power has affected PPP agreements. Some people get conflicted in the management of waste collector contracts

because when a certain political party comes into power, they come and appoint their own waste collector companies that are aligned with their political interests and always find a way to prematurely cancel existing PPP contracts, which has caused a problem for the management of waste within the city. During the course of this study, participants from multiple organisations alluded that there is a big issue of contracts between the private sector companies and the public entities. Participants also argued that the issue of budget cuts within municipalities has created an unstable situation within contractual agreements between the public and private sector, stating that PPP agreements that have been formed to facilitate service delivery have resulted in being chaotic due to the ineffectiveness and mismanagement of PPP contracts due to different challenges that the public sector is facing.

Respondent 3

“The area that we are supposed to service when it comes to municipal solid waste is a very small area but also overpopulated and highly urbanised, which has resulted in the high production of municipal solid waste from residential areas, and that has taken a toll on the public sector when it comes to the collection and transportation of waste from households to landfill sites. The management of municipal solid waste within the city is not prioritised as we have the lowest budget from the Treasury, which has made it difficult to sufficiently collect waste from the inner city as we have a shortage of resources, and now the central business district of the city is smelly and dirty, which now makes us seem as if we are not able to do our work”.

Respondent 4

“Due to a shortage of waste collector trucks, we have outsourced services from private companies, which is in line with the Municipal Systems Act and Municipal Financial Management Act for procurement of goods or services, but now we have a challenge because we can go weeks at some point without the municipal solid waste being collected within the CBD and residential areas due to unresolved issues between our contracted service providers.

We do not have enough money to outsource the collection and transportation of waste, and when the service providers are not paid, they shut down tools, and waste remains uncollected”

Respondent 16

“Working with the government is the most stressful procedure because we, as contracted waste collectors, are not paid on time, and sometimes we could go for months without getting paid, and that affects our production and payment processes of staff and costs incurred by the company .Collection of waste involves the utilisation of diesel for the waste compactor trucks to move around the city, and if we do not get paid on time then we are forced to stop working as workers also need to be paid, insurance needs to be paid, and also monthly instalments for our waste compactor trucks need to be paid or else they will be repossessed.”



Figure 2 : solid waste left uncollected within the city.

The above image is an illustration of the mismanagement of PPP contractual obligations within the City of Johannesburg, which was influenced by factors like political instability, inadequate financial revenue, and mismanagement of PPP contractual agreements. Further, the images above show waste that has been left uncollected by service providers as they are not satisfied with the management of waste within the city of Johannesburg. PPP agreements are formed to solve the challenges faced by the public sector, but due to mismanagement of PPP contractual agreements, waste management services continue to be on the rise as some private contractors complain about how they

are treated and side-lined when there's a change of power within the city council. Therefore, the study found that there are existing PPP contractual agreements for waste management services within the city of Johannesburg that are centred around the collection and transport of waste from sources to landfill sites, but the problem is how the PPP contracts are managed.

4.1.3.2 Contractual agreements for provision of resources

The research study has furthermore discovered that the city of Johannesburg has entered into different contractual agreements, excluding the PPP agreements, whereby the city has signed MOUs (Memoranda of Understanding) with different private companies to assist in the management of municipal waste and machinery equipment. In order to enhance urban sustainability theory within the city of Johannesburg, the city has entered into multiple MOU contractual agreements with private companies to assist in the management of waste within the city, whereby private companies that are in the manufacturing of goods that include plastic, steel, and glass materials are in partnership with Pikiup SOC, and they collect waste from the landfill sites operated by PIKITUP SOC. One of the participants highlighted that:

Respondent 1

“The other partnerships that we have for PPP are the MOU agreements, whereby we work together with private organisations without any exchange of money whatsoever. The agreement within the MOU PPP is that the private companies that specialise in manufacturing and waste will come to our landfill sites and garden sites and take the waste for personal use free of charge. They assist us in keeping the environment clean, whereas we give the private entities waste to form a product such as a compost product and sell it.”.

Respondent 6

“In terms of resources, I can say yes, no, whereby yes, we've got a contact with the service providers who are supplying us with the machines, whereby we are utilising those

machines to manage any waste coming to the landfill sites, so I will tick resources in that part are enough.”.

Towards effective management of waste within the city of Johannesburg, Pikitup SOC has entered into multiple PPP agreements and also MOU agreements that do not have any financial costs towards the public sector. The MOU agreements have resulted in the sharing of skills and machinery with the private companies that specialise in waste management activities, which have also resulted in the stimulation of the economy within the city of Johannesburg as compost products are produced and sold from the waste while keeping the environment clean.

4.1.4 Joint Ventures

Joint ventures between the public and private sectors play a critical role in providing sustainable and efficient management of solid waste within cities, as it has been noted previously that the public has been failing to manage solid waste in communities. Public-Private Partnership agreements are an important model towards tackling solid waste problems within countries and the city of Johannesburg, whereby the costs and responsibilities towards the public sector get reduced if the solid waste management services are not made to be the responsibility of the public sector only. The Public-Private Partnership has been a model implemented by multiple developing countries, such as Botswana, whereby the government did not have the financial muscle and had insufficient resources to manage solid waste within the Lobatse town, which led to the public sector engaging and partnering with the private sector in managing the solid waste within the town. Therefore, joint ventures between different stakeholders and role players in society have played a critical role towards enhancing effective management of municipal solid waste within the city of Johannesburg, as the collection and sorting of waste is performed effectively by different role players.

4.1.4.1 Collection of recyclable materials as a Joint Venture

The integration of multiple societal actors in the collection of waste is of great benefit towards the environment and society at large, as the inclusivity of informal waste collectors results in an effective recycling system that keeps the environment environmentally friendly within Johannesburg. The city of Johannesburg council has a resolution in place with regards to challenges surrounding the shortage of landfill sites for disposing by entering into contractual

joint ventures with private companies that own landfill sites. The city's resolution is that Pikitup SOC collects waste from sources and dispose of the waste at privately owned landfill sites, as the city does not have enough landfill sites to cater for the quantity of waste generated. Data obtained within the research study has highlighted the importance of joint ventures with informal waste collectors as role players for management of municipal solid waste. The study discovered that the city of Johannesburg has a lot of informal waste collectors who participate in the management of municipal solid waste but are not recognised by the municipality even though they are able to collect a large influx of waste that participates within the circular economy. Furthermore, the findings of the study are that informal waste collectors are able to enter and service places that the public sector and private sector cannot reach. Informal waste collectors within Johannesburg go house to house in order to collect waste from sources, which results in the reduction of waste disposed at landfill sites as there's a diversion. Moreover, formal waste collectors are able to collect waste from informal settlements, which are known not to be serviced by the public sector as they do not pay the waste collection tariffs, and that results in the reduction of waste within the informal settlements. Irregular of the role played by informal waste collectors when it comes to management of waste within Johannesburg, it was also disclosed that informal waste collectors are able to earn income from the waste they collect from communities as they sell it to manufacturers and processors, which has had a positive effect on income generation and quality of life within the city of Johannesburg as informal waste collection is also regarded as a career. Therefore, participants in this research study explained the impact of informal waste collectors towards the management of municipal solid waste within the city by stating that:

Respondent 21

"I have been working as an informal waste collector for years now, and I collect waste from "imukhukhu" areas, also known as informal settlements, because I also stay in the informal settlements and no one comes and collects waste from us. Maybe it's because we are poor or something. Since I was not working and I needed to feed my kids, the only solution was to create work for myself, which is collecting waste within my community and other surrounding areas, especially ebalungini (affluent areas), and the money I get has assisted me when it comes to feeding my kids and taking them to school, as the

collected waste we sell to manufacturers, processors, and Pikitup SOC as they have multiple depots within the city.”.

Respondent 2

“We also have multiple landfill sites that are being managed by private companies, which are part of the agreements that we have entered into with those companies, whereby landfill sites such as Chloorkop, owned by EnviroServ, and Mooiplaas, owned by Waste Group. And the agreement that we have with them is that all our Pikitup Depots in the North dump their waste at the privately owned landfill sites as we do not have landfill sites in the North and most of our landfill sites are situated in the South, whereby the privately owned landfill sites charge us a fee on a monthly basis in order to dispose of the collected waste as we do not have enough landfill sites.”.

Respondent 21

“Currently we are in the process of formalising the joint venture we have with community members within the city who are regarded as informal waste collectors, popularly known as (bo radi tlakala, who play a critical role in collecting certain types of waste materials from residential bins that are taken out on a specific day for waste collection. We have people in our communities who have voluntarily decided to collect waste within the community for recycling purposes, whereby they get some financial revenue in exchange of the waste they have collected, and I highly believe that the informal waste collectors greatly assist in reducing the quantity of waste within the city, as already the waste generated is of a high quantity. We have also realised the important role played by informal waste collectors when it comes to keeping our environment clean and reducing the quantity of waste to be disposed of at landfill sites.”.

Respondent 19

“I have been collecting waste for the past ten years after I was retrenched from the company I used to work for, and even though the work that I do, many people in our black communities do not prefer or like it as you deal with waste, but all I can say is that

waste from different households has been carrying my family for years now as I have a wife and kids who depend on the income I generate from the waste I collect. I work from Monday to Friday, as you know that dustbins come out from Monday to Friday, just that days of waste collection vary from place to place, so I travel to different places on a daily basis in order to collect waste. I mainly collect glass materials for recycling purposes, and once the waste has reached the quantity I want, then I will take the waste to glass manufacturing firms for recycling purposes, and they will pay me some money.”



Figure 3: waste collection method used informal waste collectors

Above is an image illustration of informal waste collectors collecting waste from residential bins for recycling purposes and income generation. Therefore, the study discovered that within the city of Johannesburg there are existing joint venture agreements for the management of waste through the collection of recyclable materials conducted by informal waste collectors. The collection of recyclable waste materials by informal waste collectors assists in sorting waste from sources and reducing the disposal of recyclable and reuse able waste material, which the formal waste collectors are failing to do as they just collect waste from residential areas and dispose of it at landfill sites without sorting the waste into different categories for recycling purposes. Multiple researchers that have covered the sphere of informal waste

collectors do support the empirical data generated by this research dissertation, which discovered that within the city of Johannesburg, community members have resorted to becoming waste collectors with no legal obligation in order to deal with the unemployment crisis they face.

4.1.4.2 Sorting of waste as a Joint Venture

Waste management within the city of Johannesburg is managed by the public and private sectors as they collect and dispose of waste to landfill sites, but the issue arising is that there's an influx of waste disposed of in landfill sites, which has resulted in a shortage of air space and the closure of landfill sites due to waste being disposed of without being sorted. To reduce the influx of waste within landfill sites, they need to sort the waste conducted in order to enhance the circular economy and preserve the natural raw materials. Formal waste collectors do not perform waste sorting within the city of Johannesburg, which has had an impact on the environment and climate. The study discovered that the formal waste collectors within Johannesburg are only mandated to collect, transport, and dispose of waste effectively, which creates another problem for Pikitup landfill sites. Findings pertaining to this research study are that Pikitup does not have the financial muscle to conduct waste sorting at their landfill sites; hence, the issues surrounding the reduction of air space in landfill sites are on the rise. To enhance joint ventures within the city of Johannesburg, informal waste collectors are playing a critical role towards waste sorting as they simultaneously sort waste from sources during their collection activities. Informal waste collectors within the city of Johannesburg sort waste into glass products, plastic products, steel products, and card box products, which make it easier for recycling purposes as each waste has its own rates for selling. Due to the impact made by informal waste collectors when it comes to waste sorting and reduction of waste, the Pikitup SCO has realised their importance and the role they can play towards assisting the company when it comes to waste sorting at landfill sites. The Pikitup SOC has started developing an initiative called the COHORPS, which consists of informal waste collectors who perform the duties of waste sorting at the landfill site. Furthermore, it was discovered that the informal

waste collectors sort waste for free at the landfill sites, as they are able to access waste that should be participating in the circular economy but is disposed of at the landfill sites.

Respondent 19

“Once I’m done collecting waste from residential areas in different communities on my spare time and weekends, I sometimes go to the Goudkopies landfill site, which is in the south of Joburg, and I go and sort waste that has been dumped, and once I’m done sorting waste, I am allowed to take the waste and leave with it in order to sell and recycle the waste.”

Respondent 5

“The city currently has an agreement with informal waste collectors, which we refer to as COHORPS, who come and do the sorting of waste before we dispose of waste to the working fields of the landfill sites. We will allow those people to come and sort waste as trucks come and go to dispose waste at the facilities, whereby once the waste is sorted, the material waste that is found to be of value will be taken for processing, and the residual is the one that will be disposed of at the landfill sites and will be compacted and covered. We are really promoting the issue of recycling; hence, we are focusing more on building more recycling facilities within our landfill sites, as informal waste collectors play a critical role in the management of waste.”

Respondent 20

“When we collect waste from households and business areas, we do not just collect any waste; each one of us, as informal waste collectors, looks for waste products that we want to recycle, as some are recycling card boxes, plastic materials, and some glass materials, so it's important that when we collect waste we come with different bags to sort the waste collected into different categories because some of our friends also have an interest in collecting cans and recycling them. To make your job easier as an informal waste collector, you need to learn how to

separate your waste materials when you collect them to make good money.”



Figure 4: Waste sorting done by informal waste collectors

The above images are an illustration of waste sorting conducted by informal waste collectors, as they have separated the waste into glass waste material and cardboard waste material in order to make it easy when recycling. The collection of waste by informal waste collectors is fundamental in achieving Sustainable Development Goal 8, which seeks to promote sustained inclusive and sustainable economic growth, full and productive employment, and decent work for all while addressing the environmental impact. The sorting and collection of waste by informal waste collectors is regarded as a dynamic socioeconomic phenomenon. Participants from the study have alluded that the sorting of waste does play a critical role in income generation for their recycling business and also mitigating the environmental impact faced by municipal solid waste systems. Therefore, the study has determined that there are existing joint ventures towards the sorting of waste between the informal waste collectors and the public sector, which assists in reducing the quantity of waste at landfill sites.

4.2 Characteristics and indicators of sustainable cities

In recent times, the world has been experiencing a lot of transformation within different spheres, which has resulted in the United Nations providing an estimation that by 2050, 66% of the world's population will reside in cities (Bibri S. E., 2017). The transition to cities within

communities around the world seeks to have an impact on the environmental and social susceptibility, as cities are known to consume a large number of resources that result in extensive production of municipal waste that contributes to the environmental problems faced by spheres of government responsible for the management of municipal solid waste. Furthermore, it's important to note that the creation of cities that are sustainable involves having quality structures in place and making sure that there are low to zero carbon emissions. The rise towards the transition to sustainable cities around the world is to enhance human capital development and healthy living standards, taking into consideration the environmental segments in cities.

The city of Johannesburg is highly characterised by economic mobility, infrastructure development, and rapid population growth, which tend to have a negative impact on the sustainability of the city. Due to the fast-growing nature of Johannesburg, there's a common problem amongst them all, which is the issue of municipal solid waste management, which has greatly affected the environment and the climate due to the emission of greenhouse gases and pollution activities produced by solid waste and their improper disposal. The city of Johannesburg is faced with the problem of a high quantity of waste generated within the city due to issues such as rural urban migration of citizens, as people are always on the move to look for better opportunities. Rural urban migration to the city of Johannesburg has enhanced rapid population growth, which resulted in the increment of waste generation every five years as the waste generated has doubled and negatively affected the sustainability of the city. Furthermore, the city of Johannesburg is characterised by high income generation and human activities, which result in high consumption of goods that produce a high quantity of waste, which becomes a burden for the municipality and Pikitup SOC, which are responsible for waste management services, as the collection of waste is a very expensive service to provide, also taking into consideration the provision of landfill sites for waste storage purposes, which produce different toxic gases that affect the climate negatively.

4.2.1 Urban Economies

Cities around the world make up 70% of the greenhouse gas emissions due to the nature of the economic scale of cities which is characterised by rapid population growth. The city of Johannesburg is on the verge of implementing sustainability strategies together with circular economy models in order to enhance sustainability due to the rates of population growth and

urban economy which stimulates the generation of solid waste. Looking at the rapid economic growth and high consumption levels within Johannesburg the research has found that high consumption rates and rapid population growth within Johannesburg have resulted in high quantity of municipal solid waste produced which tends to have a large environmental impact. Due to nature of economies found within the city of Johannesburg a concern has been raised with regards to the sustainability of the city as the formal and informal businesses within the city have contributed to large excessive solid waste, illegal dumping and littering which have resulted in the utilisation of natural environmental resources and pollution activities. Solid waste management has a great effect towards the urban economies within the cities whereby policy makers and administrators within the government scales of a country need to implement different waste management taxes and tariffs that assist in determining the cost and benefits of solid waste management.

4.2.1.1 Effects of urban economies on waste management

The city of Johannesburg is characterised by multiple economies and business sectors that contribute to the GDP of the metropolitan area, which has also influenced the consumption rates and quantity of waste generated. Data derived through the research process conforms the relationship between high population growth, urbanization, and high generation of quantity of waste within cities, as it was discovered that the city of Johannesburg is having a challenge of illegal dumping within the city amongst other waste management problems. Furthermore, the study discovered that the City of Johannesburg is regarded as an economic hub, which has resulted in rural urban migration and a high quantity of waste generation. Rural urban migration within the city of Johannesburg has resulted in the development of multiple informal settlements as the city is also faced with housing problems and a lack of job opportunities that accommodate everyone migrating to the city. Due to the housing problems and lack of job opportunities, citizens have resorted to invading land illegally and constructing informal settlements within the city in order to be closer to the world-class city. Urban economies within the city of Johannesburg involve informal traders, also known as street vendors, who generate a large influx of waste that they do not manage properly within the inner city. Furthermore, informal traders illegally dump waste generated by their businesses, as the study discovered that informal traders do not have designated areas for disposing of waste. The study also found issues pertaining to causes of illegal dumping, as the spatial planning that was executed by the

apartheid government within black communities has influenced illegal dumping activities as proper waste disposal areas are not initiated. Moreover, rapid population growth within Johannesburg and existing housing problems have resulted in the development of back rooms as rental spaces for people within the city, and that has resulted in illegal dumping activities as the existing waste management initiatives are not efficient to manage the quantity of waste generated.

Respondent 7

“Illegal dumping is the second elephant in any other municipality around the world, as the first one is airspace, and the second one is illegal dumping, as illegal dumping is occurring everywhere around the world because of the spatial planning in black communities, whereby most townships and black communities have turned their houses into rental homes as they have built multiple back rooms outside the main house, which has resulted in having tenants and more population without proper implementation of infrastructure for disposal of solid waste and results in people dumping waste in open spaces as the tenants are not given proper disposing bins.”.

Respondent 9

“We need to develop proper structures for informal trades whereby they will be charged a certain fee and their waste will be collected; we cannot allow people to just mushroom everywhere. We need to learn from countries such as Rwanda, as they have strict bylaws as they do not allow people to eat on the streets, as that has assisted them in making the country one of the cleanest cities within the world .Rwanda has a model that states that every end of the month everything stops and nobody works, and everyone shall come together and clean up the residential areas together with President Paul Kagame .Rwanda takes the issue of waste management and environmental management seriously, as the issue of waste management is not an individual thing but a collective thing .We need to keep our environment clean, as nobody will want to invest in a dirty environment whereby the mismanagement of solid waste has resulted in investors running away .People need to realise that waste is gold, and in Gauteng we do not have gold anymore, but we just have a lot of rubbish called solid waste,

and we need to turn the waste generated in the city to gold. We need to treat waste as a resource for raw materials instead of rubbish, as many products can be manufactured through waste.”

Respondents 10

“As the metro police within the city, the biggest challenge besides management of traffic is the issue of dumping that we have to deal with. In the past, the open space within the city would experience a lot of illegal dumping committed by community members, but now, over the years, the issue of illegal dumping has escalated to the inner city, and our roads are currently infiltrated with garbage, which is dumped illegally, and some of the waste is uncollected. My main job is to ensure bylaws within the city that are in line with the City of Johannesburg Metropolitan Municipality Waste Management Bylaws, which were approved by the city council in terms of the Municipal Systems Act of 2000”.

Respondent 11

“I think one of the reasons why the city is experiencing a lot of illegal dumping is due to the fact that we are overpopulated within the city and there are a lot of formal and informal businesses within the city that contribute largely to illegal dumping .Most of the dirty areas that have a large quantity of waste lying around are surrounded by informal traders (street vendors) who don't care about the cleanliness of the environment because most of them just run their businesses and then leave the waste produced behind, which ends up making our roads dirty. The Pikitup guys would come and collect waste on a weekly basis in the city, but there's no change because after a few minutes they would be a new plastic of waste dumped on the same spot that has just been cleaned up.”.

Respondents 3

“In terms of our IDP and SDP ,SDBIB we don't regard illegal dumping as some of our services that we have to render as we have never planned for illegal dumping therefore there's no budget for dealing with illegal dumping as our mandate in terms of the constitution is to collect the waste that is contained in the bin and not the one of bringing a truck and TLB to come and remove illegal dumping waste and clean the streets as those are extra duties and extra costs

for the Pikitup SOC and we have never budgeted to cater for rendering services for illegal dumping as those budget allocations are not there in our MFA and our municipal system so if you see our organisation dealing with illegal waste we are just trying to keep the environment clean as that is not our mandate . Illegal dumping is a big challenge and is affecting us in terms of resources and budgets”.



Figure 5: Illegal dumping caused by urban economies

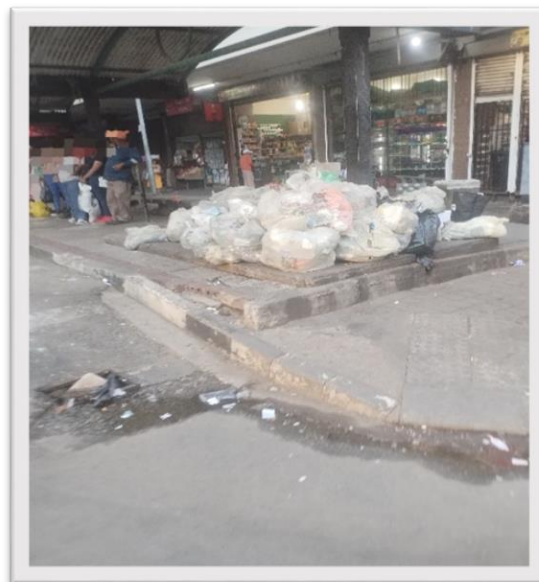


Figure 6: waste generated by businesses

The above data images retrieved during the course of this research study conform with what the participants have alluded to with regards to management of waste and illegal dumping within the city, which is caused by the kind of economic scale and businesses found within the city of Johannesburg. Therefore, it has been discovered that urban economies have contributed to the mismanagement of municipal solid waste and illegal dumping activities, which made it difficult for Pikitup SOC to handle due to the fact that the company is not mandated to conduct illegal dumping services as their constitutional mandate is to collect, transport, and dispose of waste that has been disposed of legally by generators.

4.2.2 Natural environment resources

Every city around the world has its own unique natural resources that have an influence on the economy and social aspects of the country through resource recovery, which produce different materials such as paper, glass, and steel. The city of Johannesburg accounts for approximately 70% of the greenhouse gas emissions that affect the climate on a negative aspect. Due to the characteristics of cities, a lot of natural resources found in the environment tend to be consumed as a result of human activities that involve the utilisation of natural resources. If natural environmental resources are not conserved or preserved, then resource exhaustion occurs, and the environmental segments gets degraded within the city as a result of solid waste disposed of, which releases toxic gases. Once a city overuses its natural resources, the environmental aspects tends to suffer on a long-term basis, and the local ecology of the city becomes negatively affected as there won't be enough natural resources to support urban development.

4.2.2.1 Enhancing sustainability in cities through natural environmental resources

The transition to urban in cities comes at the cost of utilisation of environmental resources within the city's geographic area, and with that said, the research study discovered that there's a high rural-urban migration happening within the city due to economic opportunities. The economic and industrialisation landscape within the city of Johannesburg has resulted in the consumption of resources in a legal and illegal way, whereby the biggest concern faced by the city council is the issue of utilising vacant land resources illegally. Furthermore, it is important to note that the city of Johannesburg has been affected by the issue of illegal land invasion happening around the city, which has resulted in the excessive consumption of natural resources excessively. Currently, the city of Johannesburg has recorded approximately 312

informal settlements within the city's perimeters, which has resulted in mismanagement of natural environmental resources in the COJ. Furthermore, it was discovered that the lack of law enforcement within the country from the national to the local spheres of government has been the biggest contributor towards the damaging of natural resources through large quantities of waste generated within the city. Moreover, it was discovered that illegal immigrants contribute greatly to the mismanagement of solid waste and illegal dumping within the city of Johannesburg as they do not comply with the bylaws surrounding waste management in a South African context, which has resulted in the illegal immigrants disposing waste in the wrong way as they believe it's a way of doing things. Therefore, participants within this research study believe that waste management challenges can be resolved through the enforcement of bylaws and making the issue of waste management everyone's responsibility within the city in order to have a collective approach.

Respondent 7

“The city of Johannesburg is regarded as an economic city, and everyone from different parts of the country and African continent wants to see themselves in the city as they believe that there are greener pastures, and that really has an impact on the environmental resources of the city, as we have to take note that the Gauteng Province is one of the smallest provinces on landscape area while being the most populated province within the country. I highly believe that within the next twenty years there won't be any vacant land within the city of Johannesburg because almost every month we get reports that people have invaded a land somewhere and they have erected shacks, which makes it difficult for us as law enforcers to evict them even though what they are doing is illegal due to the South African constitution, which states that when a person has invaded and occupied a place for more than 24 hours, you cannot evict them from that place without providing alternative accommodation for them”.

Respondent 2

“Most of the people who reside in the industrial settlements have stated that they don't have anywhere to go and that they can't go back to their original homes as there are no opportunities

where they come from, as some come looking for work in the city, and if they do find one, some start businesses as informal traders, which is against the city's bylaws”.

Respondent 17

“Our organisation only has a mandate to collect waste within the city of Johannesburg and not deal with illegal dumping, and that has taken a toll on the public purse because we have spent a lot of money towards collecting waste that has been illegally dumped .The city is currently dirty, and we as Pikitup are not responsible for collecting waste from informal settlements as they don’t pay any waste collection tariffs in their areas as they have illegally occupied land, and that has resulted in excessive waste being produced in those informal settlements, which makes people who reside in the informal settlements find alternative ways to dispose of waste, which is through open space land available and through river streams, which creates a new problem environmentally”.

Respondent 8

"Look, the city of Johannesburg attracts a lot of people from all walks of life, whereby many people come here for business and work purposes, so the volume of the population determines the quantity of solid waste being generated. In 2015, when I joined PIKITUP, the population was plus or minus four million, and currently we are on seven million, so the more the population grows, the more the quantity of solid waste is being generated. So the main concern is that they are increasing on a daily basis. In the past ten years, the city was generating plus or minus 1 million tonnes of solid waste per year, and currently the city is generating 1.7 million tonnes of solid waste, but the main factor here is the population because the more the population, the larger the quantity of waste being generated.”.

Respondent 10

“We need to enforce by laws from national level to local government level, whereby we need to start by closing down the borders as the budgets are allocated for South Africans and not for foreigners, and the majority of the illegal foreigners in the city of

Johannesburg do not care about the bylaws in the country, and they don't care about keeping the environment clean because if you can go to their African countries, such as Nigeria, they just dump waste everywhere, and nobody does anything, and one of the dirtiest cities in the world is the city of Lagos in Nigeria, hence the city of Johannesburg looks so dirty today, and we have a problem of illegal dumping .The solution is to enforce the bylaws and increase the penalties for illegal dumping because really we need order because if we cannot continue condoning this thing of people just erecting shacks and tables within the urban areas and the inner city and they just start selling goods.”

Respondent 5

“We need to come up with a solution for informal traders and dedicate a place for them where they will be able to trade because they are also the contributors of illegal dumping, as most of them just run their businesses and sell goods to people without having the proper mechanisms in place that will assist in storing and disposing of solid waste that will be generated .We need to develop proper structures for informal trades whereby they will be charged a certain fee and their waste will be collected; we cannot allow people to just mushroom everywhere. Hence I still emphasise that we need to learn from countries such as Rwanda, as they have strict bylaws” .



Figure 7:Open land dumped with waste illegally

The above image is an illustration of waste being disposed of illegally on the land surfaces, which has the potential to pollute the groundwater and soil. Mismanagement of municipal solid waste within the City of Johannesburg is influenced by multiple issues that human beings create through their day-to-day activities. Erection of informal settlements within the city of Johannesburg has resulted in the excessive consumption of natural environmental resources such as land and rivers, which have been polluted with waste from households and businesses. Urbanisation within the city of Johannesburg has resulted in the degradation of natural assets as the environmental segments are degraded due to waste being dumped illegally on the natural environmental resources. Municipal solid waste largely contributes to the pollution of land and water systems due to the nature of economic growth experienced within the city, which translates to increased generation of municipal solid waste. Moreover, the increment in the quantity of municipal solid waste results in inadequate waste collection services from responsible parties, which later on leaves room for illegal dumping of waste in open spaces and rivers.

4.2.3 Climate action resilience

Cities are the centre of consumption and waste as they exceed the environmental footprint by 10–20, which has a negative effect on the management of solid waste and wastewater treatment. Furthermore, it has been noted that cities around the world are relying on rural areas for the supply of water, food, energy and storage of waste materials, as most cities have exhausted their resources. Climate change degrades the quality of life and environmental segments in the city, which calls for the formulation of adaptation policies in order to enhance sustainability. Solid waste management has been a stumbling block for megacities around the world whereby there are issues with non-existing collection systems of solid waste, which results in illegal dumping, and later on the water reservoirs become contaminated by illegally dumped waste, which has been a result in Johannesburg. The sustainability of the city of Johannesburg is on the brink of collapsing due to solid waste activities contributing largely to climate change as solid waste is not managed properly as there are disparities.

4.2.3.1 MSW as a contributing factor to climate change

The city of Johannesburg is generating a lot of municipal solid waste, which has contributed to climate change activities within the city as it has been discovered that the existing landfill sites

within the city are running out of air space and illegal dumping activities are on the rise. Furthermore, waste disposed at landfill sites within Johannesburg has contributed to climate change as the amount of greenhouse gases generated by solid waste is on the rise. Adequate management of municipal solid waste contributes positively to the enhancement of municipal solid waste, and that hasn't been the case for the city of Johannesburg, as excessive waste is being generated within the city and the responsible parties are struggling to effectively manage the waste. The city of Johannesburg is a major generator of greenhouse gases due to the carbon-intensive economy found within the city and the quantity of solid waste produced by human activities. In an attempt to have climate action resilience within the city, efforts have been made in order to reduce greenhouse gas emissions, as the Pikitup organisation has implemented waste-to energy strategies in their landfill sites in order to generate energy, which plays a significant role in enhancing sustainability within the city and reducing the quantity of waste at landfill sites. The climate action resilience initiative being implemented within Johannesburg seeks to reduce pollution activities towards the soil and groundwater as they reduce solid waste on the land surfaces. Due to the contribution made by municipal solid waste towards climate change, efforts have been made to mitigate climate change by utilising vegetable waste in landfill sites in order to produce methanol gases within Johannesburg. Greenhouse gases within Johannesburg are being prevented through the bio digester process, which results in buses utilising methanol gases instead of diesel fuel, which produces a lot of toxic gases that enhance climate change.

Respondent 4

“We are now moving towards waste to energy as well whereby I’m signing few MOUs as well for waste to energy ,and currently we have a landfill to gas energy initiative but I’m looking more on the expurgation one will take everything in the landfill site which will burn the waste and generate waste and we another one called the bio gas -Bio digester which is your organic vegetable waste which will be digested through that biological process and generate the final product which is methanol or other gases that can be utilised to perform other activities such as for assisting busses in moving instead of using the diesel you can use the final product being produced also working with DBSA in order to achieve this kind of process whereby I had a meeting with them yesterday and it will all be approved”.

The respondents in the study have stated their organisations are still in the process of effectively managing waste while protecting the ecosystem and natural resources through their waste to energy initiatives, which seek to minimise waste generated and stored at landfill sites as the current ones have reached their full capacity. The city of Johannesburg geographical area is characterised by climate change due to the waste management challenges faced by the city as a whole. Landfill sites within the city of Johannesburg have reached their life span, and some privately owned landfill sites have been closed down due to not meeting the requirements set by environmental legislation, the Nema and Environmental Waste Management Act, environmental air pollution, and the Water Act of South Africa. The closing down of privately owned landfill sites due to them being placed at the midstream has resulted in the production of leachates and methane gas that have a negative effect on public health.

Respondent 6

“Another challenge is the problem of leachate and gas, as it will need to be monitored and managed thoroughly because there was one landfill site that was privately owned by a waste management company called Inter Waste Management Company, which was closed in the past years because it was close to the midstream and the gas at the landfill site was effecting the residents of the midstream community as it produced a lot of methane gas. The methane gas, when you inhale it, you will have a bit of a headache, and that can cause you to have a stroke and other diseases, so that is the biggest challenge. Landfill fires, leachates, storm water management, and landfill gases are the main challenges that result in uninvited gases being produced.”.

Respondent 8

“We have a shortage of natural resources such as land for landfill sites as we are running out of air space for dumping of waste as the landfill sites are running out of space, so its becoming very difficult in terms of disposing waste, so it gives the current resources we have a problem as they become overloaded in terms of the covering and combating, so the air space is a main challenge in terms of resources. In order to deal with the shortage of natural resources, we need financial assistance, whereby we need to buy landfill sites.”

The study has discovered that within the city of Johannesburg, municipal solid waste contributes to climate change and other environmental problems due to the toxic gases released by the solid waste. MSW within Johannesburg has resulted in the production of methanol gases, which have risked public health in the city, and as a result, closure of landfill sites privately owned by Interwaste has occurred. In order to reduce gases that enhance climate change, Pikitup SOC calls for the need to develop more landfill cells around Johannesburg in order to reduce the overload faced during combating and covering of waste at landfill sites. Therefore, municipal solid waste is contributing largely to climate change in Johannesburg, as the quantity of waste is too high and there is poor availability of resources to effectively manage waste and enhance sustainability.

4.2.4 Inclusivity and quality of life

Cities have a responsibility to develop and implement policies that enhance urban development by providing initiatives for employment ,quality education and infrastructure within cities .Inclusivity within cities also includes people with disabilities and community members who collect waste during the sustainable development process and inclusion of every role player found in the society regardless of their status in order to come up with measures to make every role player able to access resources and opportunities as highlighted in the Asian Development Bank report .Urbanisation within cities has led to social exclusion and inequality amongst the population found in cities hence inclusivity of everyone living in the society needs to be promoted within cities in order to enhance fairness within the cities society .Inclusivity in cities does not only focus on the social and economic aspects of cities but also incorporates the sanitation within cities .Inclusive sanitation assists in keeping cities clean and safer in order to enhance a healthy environment for all living in it by initiating capacity building programs ,awareness campaigns and capturing best practices for sanitation within cities with an aim to achieve the Sustainable Development Goals.

4.2.4.1 Inclusivity of informal waste collectors towards waste management

Informal waste collectors just need to be formally recognised and integrated within the waste collection systems in order to assist in waste management and reduction of climate change. The waste collectors and recycling system within the city of Johannesburg is inclusive of informal waste collectors who play a critical role in collecting recyclable waste materials from

households and businesses, which assist in the reduction of waste to be disposed of at landfill sites. Moreover, the informal waste collectors in the city of Johannesburg have stated that they collect waste from different households and businesses and then sell the recyclable materials to firms that specialise in the processing of waste materials such as plastic, glass, steel and paper. Based on the impact played by informal waste collectors for waste management, the public sector has emerged in the registration of informal waste collectors to operate in a group of five as they are responsible for the sorting of waste in landfill sites with no remuneration. Within the city of Johannesburg, informal waste collection services conducted by community members have resulted in improving the quality of life in households and ensuring food security. Furthermore, the inclusivity of informal waste collectors needs to be taken seriously in order to protect their health and safety during the collection and transportation of solid waste. Internal waste collectors are operating illegally within Johannesburg, as it is not a formalised sector and does not have any constitutional mandate.

Respondent 20

“I’m self-employed as my work involves the collection of waste from household bins, and we don’t just collect any waste; I specialise in plastic waste and card boxes for recycling. I work Monday to Friday collecting waste, and after the collection of waste from households, I store the collected waste in my yard, where I stay, because in order for me to sell the waste from recycling purposes to the processors and scrap yards, it has to be of a large quantity, as there’s a scale that determines how much you will get paid per the kg brought, such as 1 kg of compressed cans. Is rated at R14 to R20 depending on the processor that you will be trading with.”

Respondent 21

“I collect waste from different houses within the city and also from businesses within the city that store waste for me, and every two days I will come and collect waste such as card boxes and cans that have been generated by the business activities. After the collection of waste from house and business, I sell the cardboard boxes and plastic

bottles to companies such as Mpact and Africa Global Packaging, who later on produce another product with the waste.”.

Respondent 9

"Yes, we do have an interrelation with the informal waste collectors, and we call them the Co Hops, and we encourage Co Hops on a daily basis, whereby we have just appointed hundred and something Co Hops, whereby we encourage them and also help them financially in terms of all this circular economy of waste management, and we encourage them all the time, but it's a difficult job because people are hungry and they want to generate income, so if they don't benefit financially, then forget .Look, truly speaking, recycling does not have a lot of money, and there are a lot of resources required for you to make money, as transportation is the biggest challenge as they need support from us as municipalities in terms of transportation, and it's not easy to help individuals; hence, we are saying that most of the time we are encouraging informal waste collectors to register and become part of co-ops because to register you just need to group yourself into a group of five, so we are encouraging them to register co-ops. So after processing the waste materials that they are busy with, we give them that material. We even allocate them some of our garden sites so that they can sort of waste, but the challenge for them is transport again as they need to go and sell that material. So we've got the transport for collection at the collection points and go and get machinery again to come and bale the material so that it can have more weight, and when you sell the

waste you just bring the bottle individually, the truck will be full, but when you get to the weight bridge and way hill.”.



Figure 8: Informal waste collectors reducing waste from source

The image above is an illustration of how informal waste collectors collect waste and the kind of waste materials they collect from households for recycling purposes in order to generate money. Furthermore, during the course of this research study, it was discovered that the city council responsible for the waste management portfolio is in the process of formalising informal waste collectors into CO-Horps, who need to be provided with permits for waste collections and be provided with waste collection resources, transportation, and recycling machines for turning waste products into goods in order to stimulate the circular economy. In an attempt to enhance an inclusive system for waste management, the Pikitup SOC has made provisions for informal waste collectors to have access to landfill sites and dumping sites in order for them to collect recyclable materials that they can go and sell to processors. Therefore, the study has proven the inclusivity of informal waste collectors within the waste management services in Johannesburg, as they are already assisting the public sector in managing waste and solving the unemployment crisis. Moreover, formal waste collectors have an effect on the management of municipal solid waste and making provisions for a quality of life in households, as citizens can earn an income from the waste generated, and that assists in tackling the issue of unemployment and stimulating the circular economy.

4.2.4.2 Inclusivity of Formal private waste collectors towards waste management

Waste management should be regarded as a collective approach amongst all stakeholders in the community, as the responsibility of keeping our environment does not solely rely on the government but also on private companies, as they have the financial muscles and machinery needed to effectively manage waste. After the realisation that municipal solid waste is a burden for the city of Johannesburg, a PPP approach was implemented for the collection of waste from households, as the trucks and machinery needed to perform that kind of duty are financially costly as the type of waste compactor trucks used to collect and transport waste is costly and need to meet the health and safety regulations as transportation of municipal solid waste is regarded as a hazardous activity. The research study also discovered that due to the rise in municipal solid waste quantity, private waste collector contractors have been roped in to help the municipality deal with the MSW problem. Moreover, it was discovered that the city of Johannesburg municipality does not receive enough budget from the Treasury to conduct its own waste collection and transportation services, as the costs of waste compactor trucks are too high as they have their own specifications; hence, they have appointed private contractors to collect and transport waste for approximately three years. The study discovered that the City of Johannesburg gets most of its revenue for performing waste management public services from the municipal tariffs they charge households and business entities within the city.

Respondent 2

“If you can check in your municipal statement, you will always see a section of waste management that states the amount that you should pay the municipality for waste collection tariffs, whereby the prices differ as in some places they pay R120 or R140; that is the amount that people pay. We also have something called property rates, which assist us in deploying people to come and clean outside residential areas and people's houses, but only properties worth more than R500 000 pay the property rates.”

Respondent 3

“Currently we have multiple contracts with private waste collection companies whereby we have appointed service providers who provide PIKITUP with plus-minus 200 waste compactor

trucks that are collecting waste from the residents. The private companies give us their waste compactor trucks, whereby we utilise them to collect waste within residential areas.”.

Respondent 16

“Currently we have signed a 36-month contract with Pikitup SOC, and our main responsibility is to deploy our waste collector trucks throughout the city of Johannesburg areas to collect and transport waste to dumping sites. Before you become appointed as a waste collector contractor, you need to get a permit from the city council that confirms that your company is complying with the health and safety regulations of collecting and transporting municipal solid waste.”



Figure 9:Waste compactor truck

The image above is an illustration of the waste compactor trucks being utilised by private waste companies in the transportation of waste from residential areas to landfills and dumping sites. The inclusion of formal waste collectors within the city of Johannesburg plays a critical role in reducing waste and enhancing sustainability within the city as an environment for businesses to flourish has been created. Formal waste collectors assist in making sure that the challenges faced by the public sector in procuring waste compactor trucks are reduced as they do not have sufficient revenue. Therefore, inclusivity of formal waste collectors in Johannesburg has been effective in enforcing effective collection and transportation of waste.

4.3 Processes and strategies of solid waste management in the cities

Municipal solid waste has been a burning issue in developing countries and megacities, including the city of Johannesburg, as they do not have an effective system in place that tackles solid waste. In order to come up with an effective waste management system, the development of infrastructure needs to be considered, as it plays a critical role towards the collection, recycling, and transportation systems within the city of Johannesburg. When developing a solid waste management system, the issue of supply chain needs to be taken into consideration, which involves the procurement of tools and machinery to be utilised within solid waste management processes. Moreover, in order to enhance the supply chain towards solid waste systems, the reverse logistics approach needs to be implemented for the responsibility of end-of-life products in order to enhance a friendly environment. The reverse logistics system seeks to provide processes of planning, implementing, and controlling raw materials and finished goods in order to create a cost-effective flow for proper disposal of waste after consumption from sources. In order to enhance effective management of municipal solid waste within the city of Johannesburg, multiple processes and strategies have been deployed by different role players within the city in managing solid waste effectively.

4.3.1 Refuse collection

Solid waste which is non-hazardous and produced by humans within a city need to be collected by different service providers in order to enhance the solid waste management strategy that seeks to prevent illegal dumping and unhealthy environments. Refuse collection can be regarded as a process of collecting and disposing solid waste at designated dumping sites and landfills which can be performed in different ways just like in the city of Johannesburg as there's door to door collection of waste which is a common practice together with community bins for enhancing successful refuse collection services. Solid waste is as a big problem for Johannesburg metropolitan municipality for some time now hence it's important that a systematic process for collecting and disposing of solid waste within the city be developed as the consumption rates are on the rise which have resulted in large quantity of solid waste being produced. Furthermore, it has been noted that in order to develop an effective and efficient system for solid waste management the financial viability, ecological friendliness and technical feasibility must be taken into consideration in the initiation phase which is in line the treasury regulations, PFMA and MFMA,

4.3.1.1 Door to door collection of waste

Within the city of Johannesburg, waste is collected by different stakeholders, such as private carriers, Pikitup trucks, and informal waste collectors who practice the door-to-door mechanism. The city of Johannesburg is on the right track in managing their quantity of waste generated as they have initiated community participation and inclusivity of all role players in the city. Residents within the city of Johannesburg are encouraged to take part in recycling of waste, as participants from the Pikitup Soc regard MSW as the new gold that residents should take part in as it increases income generation for households. Due to the participation of multiple role players in the management of municipal solid waste within the city, different methods are being used to collect and transport waste by informal waste collectors and formal waste collections. Moreover, the study discovered that within the city of Johannesburg, residents are being provided with 240-litre waste bins, which are in line with the health and safety requirements of the integrated solid waste management plan of the city of Johannesburg. The 240-litre waste bins assist during the door-to-door collection of waste conducted by the public and private sectors, as the waste bins are designed to fit the waste collector trucks. In Johannesburg, door-to-door collection of waste involves the citizens placing their waste bins outside their houses in order for the waste to be collected by informal waste collectors first, and later during the day, formal waste collectors come and collect the waste as a bulk form household. The collection of waste from door steps assists in making sure that people do not dispose of their waste illegally, as the door-to-door collection of waste is conducted once a week for households and on a daily basis for the business areas.

Respondent 4

“Our main responsibility as Pikitup is to manage municipal solid waste within the city, whereby we have to provide initiatives for storage of waste in households within the city, and each and every household buys the Pikitup 240-litre bin for R385 which will assist in the collection of waste from households. The 240-litre bins that we provide residents with are in

line with the waste collector trucks that the city is using as per requirements approved by the city council.”.

Respondent 5

“Collection of waste differs per geographical area within Johannesburg, but we service each household once a week as we come and collect waste from their door steps. For households, we collect once a week, and for the businesses in the CBD, we collect the waste each and every day, but the influx of waste is still too high.”.

Respondent 6

"Look, the waste management system is all about the value chain, whereby the value chain is all about residents placing the waste in the bins, and then we schedule at least one day on week that we will send a waste compactor truck that will come and collect, and then they will go and dispose. So the method we are using is that you store, we come and collect and dispose.”



Figure 10: Door to door waste collection

The images above are an illustration of the door-to-door waste collection strategy being implemented within the city and how informal waste collectors collect and transport waste they collect from households, which plays a pivotal role in the reduction and sorting of waste from

sources. The city of Johannesburg is implementing door-to door refuse collection as a strategy to manage solid waste within Johannesburg in order to prevent illegal dumping and littering within the city. Furthermore, it was also discovered that informal waste collectors also participate in the door-to-door refuse collection strategy in Johannesburg, and they assist in reducing the quantity of waste disposed of in landfill sites.

4.3.1.2 Community Bins as a strategy for collecting waste

The city of Johannesburg is characterised by rapid population growth, urbanization, and high consumption rates of goods, which have resulted in the incessant amount of waste generated within the city. The study discovered that within the CBD of the city of Johannesburg there's a big challenge when it comes to managing municipal solid waste as the quantity generated by the CBD is of high quantity and has resulted in the Pikitup SOC constructing and placing community bins for people to come and dispose of their waste which is collected. Implementation of community bins within the City Johannesburg CBD was a result of the overpopulation of citizens in the city's economic hub. The city is characterised by multiple business and economic sectors together with multiple blocks of flats for accommodation purposes, which has made the management of municipal solid waste a bit difficult. Furthermore, it was determined that due to the socioeconomic status of the COJ households, they have resorted to constructing rental rooms for people who have migrated to the city, and that has had a negative effect on the management of waste within the city as it has resulted in illegal dumping of waste. Citizens who are renting backrooms within the city are the highest contributors of illegal dumping and mismanagement of municipal solid waste. Due to the issue of overpopulation, housing infrastructure within the city and the common trend of backroom rentals have resulted in the city placing community bins at accessible locations, but they have not been effective in managing the waste as the constructed community bins are not maintained, which results in them not being effective anymore. Community bins play a critical role within the city of Johannesburg for managing waste effectively, as they provide a fixed location for people to dispose of waste, which reduces the issue of illegal dumping. Furthermore, the community bins assist the informal waste collectors in the collection of waste as the distance travelled for collecting waste gets reduced, and also the private waste collectors also tend to

save when it comes to the costs of diesel and time for collection of waste from different areas as the community bins are a fixed location.

Respondent 7

“illegal dumping is occurring everywhere around the city due to the apartheid spatial planning in black communities whereby most townships and black communities have turned their house into rental homes as they have built multiple back rooms outside the main house which has resulted in having tenants and more population without proper implementation of infrastructure for disposal of solid waste and results in people dumping waste in open spaces as the tenants are not given proper disposing bins hence the municipality has decided that you know what on the open land that is commonly known for illegal dumping we will place community bins which will be collected frequently because construction of new community bins is expensive hence we have also approached the private waste collection companies to donate their old skip containers”

Respondent 12

“Our mandate as the JMPD is to enforce bylaws within the city and also deal with the issue of illegal dumping. The JMPD is a designated unit that deals with illegal dumping offences whereby in many communities within the city, especially townships, there are no community bins on the streets for people to dispose of waste, which has resulted in people disposing of waste illegally within the townships. On a monthly basis, we can arrest about 50 people for illegal dumping if we apprehend them very fast, and we later give them a fine to pay, which is R10,000 as approved by the city council.”.

Respondent 17

“Our company in the past used to use skip trucks for the collection of waste from residential areas, and the city council within their waste management frameworks and requirements for contractors stated that for the collection and transportation of waste from residential areas, waste compactor trucks are the only ones allowed to perform that activity as they meet the health and safety requirements of the waste management framework. So in order to meet the

new requirements for waste collection and transportation, we sold our old trucks and removed the metal skip containers, which we donated and placed in different areas as community bins for proper disposal of waste. Later on, we will come at least twice a week to the location of the community bin and collect the waste, and this initiative also assists in avoiding illegal dumping. The small community bins that are placed on the walkways are not helping in proper disposal of waste, as most of the time when we are supposed to collect waste, we find the waste disposed of on the ground, and I think the cause of that is that most of the small community bins are broken and do not have the capability to carry waste.”

Respondent 8

“In order to manage waste properly within the city of Johannesburg, we as Pikitup have constructed and placed community bins around the city for people to dispose of waste properly and not illegally. For places that are flagged as hotspots for illegal dumping, we have placed big community bins, which are the containers used for skip trucks, as they are big enough and people can dispose of their large quantity of waste.”.

Respondent 18

“The community bins within the city assist in proper disposal of waste, and as a contracted private waste collection company, the community bins assist in saving time and diesel for the trucks as they don’t have to travel long distances to fetch waste from different locations.”.



Figure 11: Big skip community bins



Figure 12: Small constructed community bins

The above images and empirical data are an illustration of the community bins being implemented within the city and also highlight that people within the city try by all means to dispose waste within the community bins. Furthermore, the image data above also demonstrates the lack of maintenance of the constructed community bins, which has resulted in waste being disposed of on the ground in some places within the city. The findings made with regards to the implementation and maintenance of community bins due to lack of financial muscle and resources from the public sector conform to what the integrated solid waste management theoretical framework states with regards to the failure of the public sector in the management of solid waste within developing countries. Community bins within the city of Johannesburg make it easier to perform refuse collection as the waste is stored in one common place and the informal waste collectors are able to access waste easily.

4.3.2 Reduce

Due to the increase of solid waste generated in South Africa and cities, whereby the government does not have the capacity to tackle the problem, waste reduction initiatives need to be enhanced, which in order reduce the quantity of waste to be disposed of at landfill sites. Moreover, a waste reduction strategy is very essential in order to prevent illegal dumping, poor waste collection services, and illegal solid waste management activities that occur in the society within the city of Johannesburg. In an attempt to reduce waste, South Africa has developed the

National Waste Management Strategy, which seeks to prevent waste generation from the sources and also the recycling of solid waste, which is classified as eco-friendly. Furthermore, waste reduction in South Africa is a priority set by the government in order to prevent waste generation and promote sustainability within the society. In order to enhance waste reduction strategies within society, the packaging of manufactured waste should be less so that the produced waste is lower. Based on the nature and quantity of solid waste produced by residents in the city of Johannesburg, informal waste collectors have taken the initiative to perform waste reduction activities in order to generate income while keeping the environment clean.

4.3.2.1 Eco friendly products

Municipal solid waste is regarded as a problem within Johannesburg and also within the landfill sites, as they are occupied with a lot of waste that takes up the airspace and reduces the lifespan of the landfill sites. In order to enhance waste reduction in Johannesburg, a strategy for solid waste management is existing in the city, which is performed by private recycling companies and informal waste collectors as they collect and store eco-friendly products such as card boxes, which get recycled and a new product is created from the card box waste. During the course of the research study, it was discovered that informal waste collectors have made arrangements with some of the informal traders that sell fruits and vegetables that come in multiple boxes, whereby the informal waste collectors on a daily basis collect the card boxes from the informal traders, and that has assisted in reducing the quantity of waste and keeping the environment clean. One of the main reasons for the high quantity of solid waste generated within the city of Johannesburg is the issue of community members not having sufficient knowledge on the importance of waste recycling and consumption of eco-friendly products, which results in an influx of waste that is not eco-friendly. The research study has discovered that the biggest contributors to mismanagement of municipal solid waste in Johannesburg are firms and businesses, as they do not utilise eco-friendly products or do not have mechanisms in place to dispose of the waste produced. One of the biggest concerns and complaints received during the research study from one of the sampled participants is the issue of delivery vans and companies utilising products for packaging and delivery that are not eco-friendly, and once they conclude their delivery, they do not collect their plastic raps, cardboards, and pallets that were used.

Respondent 1

“Manufacturing entities are the ones who are mostly involved in waste distribution, and logistics companies need to take accountability for their actions as they tend to deliver products to households and other residential areas, and they just leave cut boxes and pallets lying around, which has played a role in pollution and illegal dumping .We need to come up with a law that you manufacturer and your logistics company, after delivering your things, need to collect your waste and go and reuse it for other products .Partnerships need to be promoted.”

Respondent 19

“I operate mainly in the CBD, as there are a lot of businesses that are operating, and they have a lot of boxes to throw away as they are used for the packaging of goods such as vegetables, fruits, and clothes that come in bulk .I collect cardboard waste from different retail stores and informal traders that sell vegetables and fruits on the street on a daily basis.”

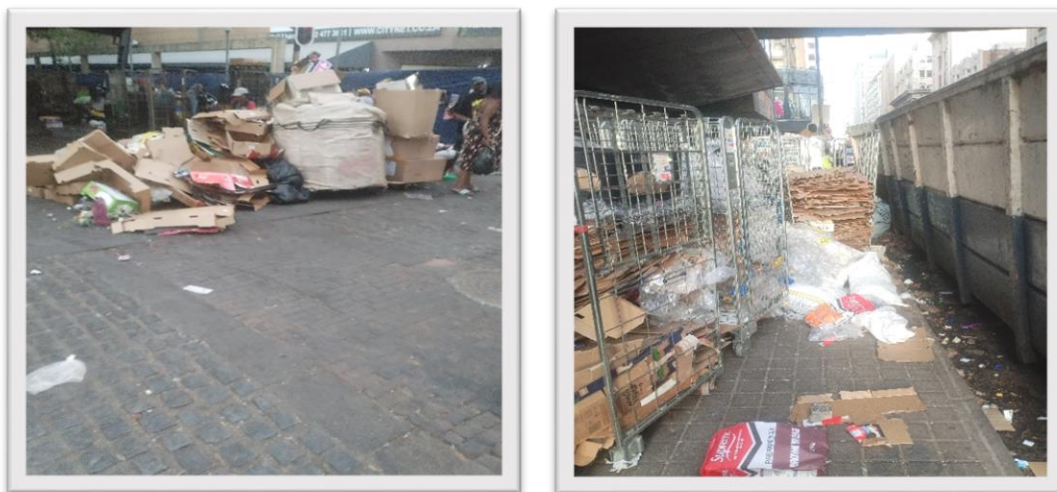


Figure 13: Waste reduction of eco-friendly card box waste

The image above is an illustration of waste reduction performed by informal waste collectors as they manage to collect card boxes from informal traders and businesses around the Johannesburg CBD, whereby the card boxes are used for packing of goods. Furthermore, the collection of eco-friendly products such as card boxes can be used for recycling purposes, which results in waste reduction in landfills and illegal dumping. Therefore, towards enhancing an effective solid waste management strategy through waste reduction, the utilisation and consumption of eco-friendly products are of much importance in order to stimulate the circular economy. Within the city of Johannesburg, waste reduction services are being performed in order to prevent environmentally friendly waste from being disposed of at landfill sites while it can still be used to produce other products and goods while keeping the environment clean.

4.3.3 Reuse

Sorting the collected solid waste into different categories is very important in order to promote a reuse solid waste management strategy, which reduce the production of new materials that later on become solid waste generated from households and businesses. Once solid waste reaches landfills, it becomes difficult to enhance waste reutilization due to the lack of waste sorting performed by formal waste collectors, but whenever informal waste collectors collect solid waste glass components from door-to-door collection of waste, they are able to perform waste sorting and sell the glass waste to manufacturing companies in order to reproduce new glass products. The reuse strategy is very important in reducing the quantity of solid waste produced by human activity, as manufacturers must be regulated to produce new products and materials through recyclable solid waste material .Moreover, the reuse of the solid waste won't only benefit the environment and humans but also benefits the manufacturing firms and companies within the city of Johannesburg, and the circular economy gets to be enhanced while production costs are reduced while preserving natural raw materials.

4.3.3.1 Reutilisation of glass products

The city of Johannesburg has incorporated multiple stakeholders towards the management of waste management as the reutilization of glass waste materials is being practiced within the city. Most of the community members who are not part of the formal waste management structure have stated that due to the issue of unemployment being faced within the whole country, the collection of glass waste has assisted them in avoiding poverty and hunger within

their households, as the informal waste collectors are able to generate an income of around R5000 per month from collecting glass waste material. The collection of glass bottles within the city of Johannesburg is one of the most common waste recycling and reutilization happening within the city. Furthermore, participants have noted that most of the reuse waste strategy is enhanced by informal waste collectors and community members who collect waste on a part-time basis as they assist in reducing waste for the contracted formal waste collectors. Industrial waste collectors are regarded as the middle man when it comes to the waste reuse strategy, as participants have alluded to that they collect glass materials, particularly glass bottles for beverages, which we later on sell to manufacturing companies such as SAB (South African Brewer), Coca-Cola, (Coca Cola) and Consol. Moreover, it was alluded to by one of the participants that the city council must formulate a law that binds all manufacturing companies and logistics companies to practice reuse of the plastic and wood material waste they generate in order to prevent illegal dumping and waste quantity at landfill sites.

Respondent 6

“We need to come up with a law that your manufacturer and you logistic company after delivering your things you need to collect your waste and go and reuse it for other products “

Respondent 20

“I work from Monday to Friday, whereby I collect glass beverage bottles from bins that are taken out by households in different areas. In order for me to make enough money, I need to fill at least three big bags with glass beverage bottles, and in order to do that, I have partnered with taverns and shops that sell alcohol, and I go to those shops on a weekly basis to collect the bottles that have been dumped by their customers, and once I have filled all the bags, I will go to SAB and sell those bottles in exchange for money, as sometimes I will get around R5000 for all the glass waste I have collected.”



Figure 14: Reutilisation of glass products

The above images are an illustration of the practice of waste reuse within the city of Johannesburg by one of the informal waste collectors. Furthermore, the thematic data presented above highlights the importance of waste reuse in society as it can deal with the issues of poverty and unemployment. Reutilisation of glass products within the city of Johannesburg has resulted in the preservation of natural raw materials utilised to produce glass products. Furthermore, reusing glass products is an effective strategy for managing solid waste, as the production of toxic gases and pollution in landfill sites gets reduced as glass waste tends to take a long time to dissolve in the soil. The reutilization of glass waste has resulted in making the production of glass products easier and less financially costly.

4.3.4 Repurposing

It's not every solid waste product and material that should be thrown away or crushed, but some solid waste can be repurposed in a form that the solid waste can be used for another purpose. Formal waste collectors perform their duties of collecting and transporting waste to landfill sites, but the problem has arisen within the city of Johannesburg with regards to the quantity of waste being disposed of at the landfill sites. Solid waste disposed at the landfill sites within the city of Johannesburg has resulted in a reduction of air space with little space available to dispose of waste. Food waste is the largest waste category that takes up space within the landfill sites as it's not recyclable and reusable, unlike other waste materials such as glass, paper, plastic, steel and wood. Therefore, in order to effectively manage waste and reduce the large

quantity of food waste occupying landfill sites a repurposing strategy is being implemented in order to repurpose any solid waste which cannot be recycled, reused and reduced.

4.3.4.1 Repurposing food waste as a Municipal Solid Waste Management strategy

Due to the high quantity of waste being generated within the city of Johannesburg it was discovered that the Pikitup SOC which is responsible for all the waste management issues within the city and also a custodian of all public landfill and garden waste sites are on the verge of transition to a waste to energy initiative in order to reduce the quantity of waste in landfill sites. During the course of the research study it was discovered that the city of Johannesburg is running short of landfill sites for MSW disposal which have resulted in contractual agreements between the public entity and private waste companies that own landfill sites. The city has multiple initiatives towards the management of municipal solid waste such as reuse and recycle but that hasn't been enough in reducing the quantity of waste in the landfill sites which have saturated the air space. Furthermore, it was discovered that majority of the waste in the landfill sites which is not reuse able or recyclable are food waste which can be dealt with by repurposing the food waste in order to free up space at landfill sites. The city of Johannesburg has implemented the waste to energy initiative in their landfill sites whereby private manufacturing companies are given access to waste for free of charge at the landfill sites and some of those manufacturing companies include Caltera which repurpose waste into manure fertilizer which gets sold at multiple retail stores. Officials from the Pikitup SOC have stated they are still on the initiation phase for the repurposing of food waste whereby they looking to turn food waste in landfill sites to energy that be used to produce chemicals and energy for busses instead of utilising diesel which is already contributing to pollution. In order to have an effective repurposing waste within landfill sites the Pikitup SOC has procured technological machineries that assist in implementing the waste to energy and obstruction of gas waste.

Respondent 4

“We are now moving towards waste to energy as well, whereby I’m signing a few MOUs as well for waste to energy, and currently we have a landfill to gas energy initiative, but I’m looking more at the execution. One will take everything in the landfill site, which will burn the waste and generate waste, and we have another one called the biogas digester,

which is your organic vegetable waste, which will be digested through that biological process and generate the final product, which is methanol or other gases that can be utilised to perform other activities, such as for assisting buses in moving. Instead of using the diesel, you can use the final product being produced”.

Respondent 5

“We are now pushing this one of the bio digester process, whereby instead of disposing of that organic waste, it will be diverted to the bio digester process, so some are still in the strategic planning process and not yet implemented as they are still on the pipeline, but the current one that is being pushed is the landfill gas to energy.”.

The city of Johannesburg is moving in the right direction for enhancing solid waste management strategies and processes as the repurposing of food waste within landfill sites seeks to reduce the quantity of disposed waste. Furthermore, it has been discovered that repurposing food waste also reduces climate change activities within the city of Johannesburg while creating different innovative solutions for reducing pollution.

4.3.5 Recycling

Municipal solid waste generation has been a big problem for different communities around the world, which has resulted in public procurements and private entities developing and implementing solid waste management recyclable strategies in order to reduce the quantity of waste generated. Proper planning and successful implementation of recycling methods is vital in dealing with the issue of solid waste within society, as recycling methods are inclusive of a process that sorts solid waste into different categories from source, which easily gets placed within the circular economy. The recycling process is a very critical strategy that can be implemented to reduce solid waste within society, as the recycling method does not allow products to be manufactured or produced with raw materials, but solid waste materials are used to create new products such as glass, paper, wood and steel.

4.3.5.1 On the Go Recycling units

Municipal solid waste reduction has been one of the objectives that the city of Johannesburg and Pikitup SOC seeks to achieve over the years in order to reduce the emissions of greenhouse gases and environmental dangers. One of the most common strategies for reducing and managing solid waste is recycling waste, which involves the manufacturing of new products with recyclable waste. In order to enhance recycling activities within Johannesburg, the public and private sectors are implementing different recycling initiatives, such as placing recycling units in public spaces, in order to make it easier for the public to dispose of waste properly. The on-the go recycling mechanism seeks to capture large quantities of recyclable solid waste from sources, and that has resulted in the creation of jobs and stimulating the economy while conserving the environment. In an effort to deal with municipal solid waste challenges within the city of Johannesburg, the private and public sector companies have alluded that they have placed on-the-go recycling machines in places that have a lot of traffic in order to reduce waste disposal at landfill sites. Private companies that specialise in manufacturing of product materials such as paper, glass, and steel have designed their own specific on-the-go recycling machines, which they placed in shopping centres and office parks within the city of Johannesburg, which have yielded positive results. Furthermore, it was discovered that the Pikitup SOC, which is the public entity, has also developed and placed their own on-the-go recycling machines in various locations within the city of Johannesburg in an attempt to reduce solid waste and promote a healthy, sustainable environment. Furthermore, it was noted during the research study that the municipality has partnered with corporations and businesses in the implementation of the on-the-go recycling tools.

Respondent 3

“We are an organisation that seeks to promote recycling of waste within our communities, and most of the people that participate in the recycling of waste are informal waste collectors as they generate money through recycling, and also private manufacturing companies and corporate companies that have a corporate social responsibility have greatly assisted in purchasing and placing the on-the-go recycling machines, as we do not have enough budget to procure those resources and machines for

on-the-go recycling machines, but we do have a few of the on-the-go machines that assist in collecting recyclable waste, which we give for free to manufacturers.”.



Figure 15: Recycling unit in a public area



Figure 16: On the Go Recycling units

The above image data is an illustration of the on-the-go recycling machines, also known as Pikitup Recycle Units, which play a critical role in enhancing an effective recycling

environment within the city while contributing largely to the circular economy within the city of Johannesburg. Moreover, private companies are playing their role in enhancing recycling activities within the city of Johannesburg, as shown by a demonstration of recycling units being placed in a shopping centre in order to reduce littering and stimulate the circular economy. Therefore, recycling units are playing a critical role towards solid waste managers as they are able to sort waste from source.

4.3.5.2 Education awareness programs

Recycling as a way of waste reduction and income generation initiative while keeping the environment clean is less taken seriously within communities, especially black racial communities. The study discovered that educational awareness programs in relation to recycling and waste management have been unsuccessful with regards to educating citizens. It is important to note that the municipal solid waste challenges faced by the public sector are due to human activities, and human beings are the only ones who can help solve this problem. Education awareness programs have been implemented around the city of Johannesburg, but they are not taken seriously by black communities, unlike the affluent white dominant areas, which do attend and take part in the environmental education awareness programs with regards to recycling. There is a distinctive difference between township areas and affluent suburban areas in how they receive the educational programs. Factors such as income level and education level play a critical role in how people from townships and affluent areas accept the education awareness programs. Furthermore, it was discovered that issues such as unemployment, poverty, and lack of housing infrastructure have been a contributing factor towards the reduction of community members in black-populated areas (townships), as they always tell the Pikitup SOC officials state that the education awareness programs do not do any good for communities or assist in solving their socioeconomic problems.

Respondent 5

“Look, I’ve seen a lot of people doing this thing of education awareness and campaigns for recycling, reusing, and repurposing of solid waste, but it’s been happening, and I don’t think it’s a good model because the biggest problem that enhances pollution and mismanagement of solid waste is human behaviour. Remember, if we do not deal with

the behaviour of our residents, it is where the problem emanates from, so it becomes difficult to educate people about that because one will say, "Let's do the study first and check the market, while the market is very important, and you cannot compare Midrand with Alex and say you want to set up the recycling facility in Alex. In Midrand yes you will have a successful campaign and you will collect a lot of cans because people are buying cool drinks in big numbers and in terms of education and income level its different because when you talk to them they will say look every recyclable material that you generate please put it in one place we will come and collect the material outside your gate and in Alex the social dimension is quite different because in Alex if you tell a person to recycle waste material he or she will not take you seriously as they are faced with a lot of socioeconomic challenges and all they want is food ,water and shelter so this model of educational campaigns and awareness needs to be revised on how they will approach people situated in poor communities and faced with a lot of socioeconomic problems

Respondent 9

“Recycling activities must be enhanced in developed areas, and the underdeveloped areas must be occupied with activities that will improve their quality of life because people who are situated in underdeveloped communities dispose of waste in rivers and other water reservoirs, and if you try to tell them about the importance of recycling and safekeeping the environment, they will insult you as that is the last thing they think of. As they want electricity, water, and houses.”.

Respondent 11

“Our organisation, JMPD, forms as one of the stakeholders that works together with Pikitup SOC, which is owned by the city of Johannesburg. During our stakeholder engagements, we attend the waste management awareness campaigns in different communities, and we, as JMPD, need to inform the community members about the bylaws and what happens to people who are found to be dumping waste illegally within the city, as our department has a specialised unit that deals with illegal dumping since it has been a problem. When we go to township and have the campaigns, people do not want to attend and listen to what we have to say, as they will tell you that they already have a lot of problems and that us law enforcement officers are useless and not doing our work.”.

The issue of inequality within society needs to be taken into consideration, as the data collected within this research study has stated that one of the issues that contribute to waste management challenges is the issue of different socioeconomic statuses. Public sector and private sector are having difficulties in promoting recycling activities and waste management initiatives in the townships and communities characterised by multiple socioeconomic problems. Furthermore, the city of Johannesburg does not have successful educational awareness programs for managing solid waste, as there is a lack of community participation that motivates the community members have an interest in participation in the educational programs, which makes it difficult to enhance recycling activities within the city of Johannesburg communities.

4.4. Chapter Summary

This chapter had an objective to explore the nature of PPP agreements with regards to municipal solid waste management in Johannesburg by gaining a better understanding about the nature of PPP contracts for waste management, strategies for solid waste management and characteristics of a sustainable city. The data was derived through one-on-one semi-structured interviews based on the formulated data collected tools, which emerge from the research objectives. Data analysis within this chapter conducted a thematic process whereby during the data cleaning process the data was grouped into different main themes and subthemes in order to have a logical and systematic flow of data. The data that was included in this chapter is data that is regarded to be relevant for the research problem, and as the study had multiple participants from different sectors, if there was data that was similar amongst the participants, a conclusion was formed. The above-mentioned chapter is characterised by different themes that emanate from the data analysis process that was employed in describing the forms and conditions of PPP agreements in cities for waste management, whereby the chapter discovered that the city of Johannesburg has multiple PPP agreements in place for waste management services, and the forms and concessions are governed by the constitution, NEWMA, Treasury and the Municipal Systems Act. Moreover, characteristics of sustainable cities and whether or not the city of Johannesburg is a sustainable city have been explained, whereby the study discovered that the city of Johannesburg is not sustainable based on the nature of the urban economies, natural environmental resources, climate action resilience, and the inclusivity and quality of life within the city .Moreover, the chapter also provided data that explains and illustrates the processes and strategies being implemented within the city of Johannesburg for municipal solid waste management, which resulted in discovering that the city of Johannesburg

is implementing multiple waste management strategies that focus on refuse collection, waste reduction, waste reuse, waste repurposing, and recycling activities. Therefore, in relation to the processes and strategies being implemented for waste management, it was discovered that there is a lack of community participation in waste management initiatives, and the community members are not responsive to the processes and strategies being implemented due to multiple factors such as lack of finance, lack of machinery, lack of support from the national government, poor administration, and political instability. The following chapter provides a discussion of the empirical data, which is demonstrated systematically through the three research objectives, and the developed PPP model for waste management in cities, which is the research aim that has been achieved.

CHAPTER FIVE: DISCUSSION OF FINDINGS

5.1 Introduction

The above-mentioned chapter within this research dissertation focuses on the data analysis of the raw data derived through semi-structured interviews with the sampled participants. The data analysis was presented in accordance with the formulated research objectives, and for a deeper insight and enhancing a thematic data analysis approach, the data collected was also present under main themes and sub-themes that provided a thorough insight on issues pertaining to public-private partnership agreements, characteristics of sustainable cities, and processes and strategies for managing solid waste in cities. This chapter is a discussion of the analysed data that was collected from sampled participants, which also involves the inclusion of the theoretical frameworks and literature to support the findings. This chapter is very important as it has outlined what the research has found on the ground compared to what is already known with regards to the research problems, as this will be an insight generated by the researcher after the analysis of data. Furthermore, the chapter will also provide the developed model that emanates from the research findings.

The research dissertation had a mandate to achieve four objectives to provide mechanisms for addressing the research problem. This section is an illustration of how the research objectives were achieved through the empirical data, which correlates with the literature and adopted theoretical frameworks. The first objective of the research dissertation was to determine the forms and conditions of existing public-private partnership agreements within the city of Johannesburg Metropolitan Municipality; the second objective seeks to describe the characteristics and indicators of a sustainable city; the third objective seeks to evaluate the processes and strategies employed in order to manage municipal solid waste within cities; and the last objective was to develop a model for public-private partnership towards effective waste management that is inclusive of all role players within a society.

5.2 PPP solid waste management contractual agreements

The study unveiled that the city of Johannesburg Metropolitan Municipality is one of the three big metropolitan municipalities in the Gauteng province and also considered the number one municipality that has a large economic hub. Furthermore, the city is characterised by rapid

population growth, economic growth, urbanisation, and industrialisation, which has resulted in an increase in rural to urban migration as people believe that they can redeem themselves and improve their quality of life. Based on the socioeconomic characteristics found within the city of Johannesburg, it was revealed that there's a high generation of municipal solid waste due to the rise in consumption rates. Therefore, municipal solid waste has become a burden and a new pandemic faced by the municipal government as the costs for effective management of municipal solid waste are unmanageable for the public sector, which has resulted in illegal dumping, littering, and uncontrollable solid waste on the pathways. The issue of population growth and urbanisation within cities has resulted in the Gauteng province being the highest generator of waste by 42% in 2010, while on the other hand it was recorded that in 2013, the Gauteng province generated a total of 3.02 million tonnes of waste per annum, which saw the city of Johannesburg generate a total of 1 492 000 tonnes of waste (Bonolo, 2016).

5.2.1 Challenges faced by the city Johannesburg with regards to management of solid waste

The empirical evidence of the study shows that due to the nature of the population, quality of life, consumption rates, and municipal solid waste generated, the City of Johannesburg council voted for the establishment of the Pikitup SOC, which will focus on waste management services within the city. The city of Johannesburg is the only local government municipality that has an established state-owned company for waste management service delivery in South Africa due to the large quantity of municipal solid waste generated. The Pikitup SOC is capacitated with skilled human resource and waste management machines and disposal sites as the SOC owns four landfill sites, twelve waste management depots, and 33 garden refuse sites, but that has proved not to be enough in dealing with waste management challenges. Furthermore, it has been noted that sustainable development initiatives that occur in cities are informed by multiple development goals that need to be achieved in order to improve the quality of life on a social, economic, political and environmental level. Sustainable cities are regarded as a multiple process that is rolled out by public programs and private entities with renewed concerns for the planet as multiple initiatives are implemented in order to enhance low to zero carbon emissions, whereby one of the most important objectives of sustainable cities is human capital development, as stated by Sodiq (2019).

The Pikitup SOC has been facing difficulties in the management of municipal solid waste within the city of Johannesburg, as the participants alluded that the municipality is not allocated sufficient revenue to carry out the waste management services, as they regard waste management services as the most underfunded public service delivery provision. Waste management has been a challenge for the Pikitup SOC as the city does not have enough waste compactor trucks for the collection and transportation of municipal solid waste. Furthermore, the city also has a challenge in the disposal of municipal solid waste, as the city is facing a shortage of landfill sites for disposing waste due to the fact that the city has not constructed any new landfill sites in the past 20 years due to the high financial costs faced for the construction of landfill sites as there are health and safety standards that need to be met. Moreover, the city is also faced with the issue of landfill sites that are closed down as they have reached their airspace capacity and do not meet the health, safety, and waste management regulations anymore. Closure of landfill sites that have reached their airspace within the city of Johannesburg is also regarded as a costly expenditure for the municipality, as the closed landfill sites need to be maintained to prevent trespassing of citizens to the closed sites and mitigation of pollution activities. Multiple researchers have stretched the issue of collaboration between the public and private sector when it comes to the development of municipal solid waste management systems (Javier, 2016). Furthermore, it has been noted by Sweeney (2022) that the PPP model will result in long-term financial sustainability for development projects that will be implemented in the city.

5.2.2 Responsibilities within PPP agreements

The study has revealed that responsibilities within the PPP agreements do not accommodate community members, as the researcher found that management of solid waste is currently regarded as the responsibility of the government and private waste contractors. Therefore, society as a whole needs to be included within PPP arrangements in order to share the responsibilities, as countries like Rwanda are regarded to be the cleanest country in the world based on their approach utilised in managing waste, as the responsibility is placed on every citizen within the country, and they work as a collective to collect, transport, dispose waste, and contribute to the circular economy. Banerjee (2020) highlights the importance of implementing a multi stakeholder partnership that involves all spheres of society and is in line with Sustainable Development Goal 17, which promotes the relationship between the public actors and the private actors in tackling modern problems such as municipal solid waste.

The study also shown that the Pikitup SOC has PPP agreements that do not involve financial remuneration, which are also known as MOUs (memoranda of understanding). Pikitup SOC has entered into different MOU agreements with multiple private waste companies whereby their responsibility is to come and collect waste for reproduction of compost products such as manure for free of charge. Furthermore, the MOU agreement is playing a significant role in reducing waste within landfill sites and increasing their lifespans as private companies such as CALTERA collect a large quantity of waste from Pikitup landfill sites .MOU agreements have a critical role in stimulating the circular economy as recycling, repurposing, and reusing of waste gets promoted and does not have an impact on the environment only but will create job opportunities, income initiatives, and stimulate the economy. Marshall (2013) holds the view that the integrated solid waste management theory will provide safer and cleaner cities and better business opportunities while enhancing economic growth in the cities. Furthermore, the integrated solid waste management theory is incorporated by multiple policies and technologies that will enhance effective waste management within cities as it will promote different waste management mechanisms, such as recycling of waste (Marshall, 2013).

Towards an effective waste management strategy, the Pikitup SOC has developed PPP agreements with the informal waste collectors to register as CO Horps, and their responsibility will be sorting of waste at landfill sites and garden waste sites. After the sorting of waste, the Co Horps will be given some of the waste for them to manufacture new products that they will also sell within marketplaces. It is the responsibility of Pikitup SOC to provide transportation for their movements, and the responsibility of the Department of Environmental Affairs is to provide the CO Horps with machines that manufacture roducts from disposed waste. To enhance sustainability of the environment and waste management, the Integrated Solid Waste Management theory seeks to provide multiple sustainable approaches that are inclusive of segregation, transfer of waste, sorting, treatment, recovery, and the disposal of waste in an integrated manner (UNEP, 2020). During the PPP model, the formulation and implementation of policies and project plans lie in the hands of the public and private sectors, whereby there will be engagements that will outline the fine details of the desired objectives of the project that the private sector will invest heavily in. The public-private partnership can be regarded as a systematic and strategic procurement when it comes to delivering sustainable development initiatives that cover the aspects of social, economic, and environmental sectors (Miraji, 2021).

5.2.3 Leasing of services within PPP agreements for solid waste management

The waste management challenges faced by the city of Johannesburg are mainly caused by a lack financial muscle and resources, as in the past years the public sector has been faced with budget cuts. Lack of financial muscle and resources within the public sector resulted in the formulation of public-private partnerships with private waste collection companies .The research study has found that the Pikitup SOC has PPP agreements with private companies for the collection of waste within the city .Furthermore, the PPP agreements involve shared responsibilities between the public sector and private sector, as it was stated by one of the participants that within the PPP agreements, the private sector is given the responsibility to collect waste from residential areas and also transport the waste to disposal sites. The responsibilities carried out by the private sector are that they provide their waste compactor trucks to the municipality, which will collect and transport waste, and the municipality will remunerate them financially. Therefore, the research found that the municipality has PPP agreements that involve the procurement of over 200 waste compactor trucks from private companies. The above data derived during this research study relates to the arguments made by Savvides (2018), as the researcher states that the collection of solid waste from households is a very expensive procedure that needs a certain type of transport mode, which is costly. The Cyprus government in the Nicocia district adopted the public-private partnership model for managing waste within their city as they were faced with a problem of the collection and transportation of waste as the dumping sites and landfill sites were very far from the sources that generate waste (Savvides, 2018). Furthermore, the above data provided by officials from the public and private sectors is in line with the employed multi-actor environmental governance theory, as Newell (2012) states that the theory advocates for a PPP model in dealing with municipal solid waste problems as the traditional governments have been failing to tackle global environmental problems such as illegal dumping and high generation of municipal solid waste.

The research study revealed that the city of Johannesburg has not constructed any new landfill sites for the past 80 years, which has had a negative effect on the availability of landfill sites for the disposal of waste. Landfill sites that were constructed in the past 80 years are reaching their lifespan as the airspace gets saturated, which has resulted in the Pikitup SOC entering into PPP agreements with private companies that own their own landfill sites. The city has resorted to leasing landfill sites from private companies that construct and obtain licensing of the

landfills with their own money, while the public sector has the responsibility of disposing of waste in the private landfills and paying the private custodian of the landfills an agreed-upon financial amount. Moreover, multiple researchers, scholars, and this research study found that solid waste management has been a big problem for developing states around the world. Marshall (2013) notes that the integrated solid waste management theory is a widely adopted paradigm by developing countries to manage solid waste within their cities. It has been a known case that governments in developing countries are not able to manage the solid waste generated by their cities population as the resources they have are limited (Marshall, 2013).

The private waste companies have the responsibility of constructing, licensing, procuring machinery, and maintaining the landfill sites. The reason for this PPP agreement is based on the problem of lack of financial revenue faced by the city of Johannesburg to construct new landfill sites, as one of the participants stated that the construction of a new landfill site amounts to R250 million. The findings deduced within this research have proved the claims made by Matinise (2020) that most municipalities around the world have a lower monetary budget for the management of solid waste than is needed, even though there's a problem of rapid population growth in the world that has influenced the high generation of solid waste, which calls for the provision of landfill sites. Poor access to natural resources such as land for construction of landfill sites has been a stumbling block towards the management of solid waste, as the public sector does not have the capabilities to provide that kind of service due to a lack of revenue and resources (Matinise, 2020).

Due to the high increment of municipal solid waste being generated within the city of Johannesburg, it has been revealed that the Pikitup SOC is facing a problem with the availability of waste compactor trucks, as there's a huge shortage of waste compactor trucks. The Pikitup SOC owns a fleet of waste compactor trucks, but it is not sufficient to manage waste. The shortage of waste compactor trucks has resulted in the Pikitup SOC entering into multiple PPP agreements with private waste collector companies that lease their waste compactor trucks for a period of three years, and the municipality will remunerate them financially based on the agreement at hand. The city has leased over 200 waste compactor trucks from different private companies. Furthermore, findings were made that the National Treasury does not allocate enough funding for waste management services as they do not regard the management of waste as a priority for service delivery. The Multi-Actor

Environmental Governance theory emphasises the collaboration of multiple sectors in order to enhance effective and sustainable environmental policies and strategies that will reduce the burden on the public sector, as engagements and participation initiatives need to be promoted between businesses, civil society, and local governments (Newell, 2012). To enhance cost-effective garbage management within the city of Nicocia, the government decided to implement the PPP model, which resulted in the reduction of the costs to transport waste to landfill sites, whereby a private company was appointed to collect all the solid waste within the Nicocia district as the government had no capacity to conduct that duty efficiently (Savvides, 2018). The development of a PPP model is essential towards the management of solid waste in communities, as the collection of waste from sources of generation is the biggest financial cost faced by mandated institutions, as the transportation of municipal solid waste takes a large portion of the financial budget allocated for the management of solid waste, as stated by CSIR and the Department of Environmental Affairs (Matinise, 2020).

5.2.4 Contract nature in PPP agreements for managing solid waste

The study findings have revealed that the Pikitup SOC is also entering into PPP agreements with private landowners for the construction of new landfill sites as one of the most important health and safety requirements for landfills is that they must not be located next to households or human activities. Kansanga, (2020) states that Geographical areas which are referred to as cities and are characterised by urban development tend to experience urbanisation and growth of the population which later influences the management of waste which will result in cities having a problem of scarcity of land use for landfill sites hence the recommendation to utilise peri urban spaces. Due to rapid population growth and urbanisation within the city of Johannesburg the municipality has faced a challenge to acquire suitable land for construction of new landfill sites which have resulted in the Pikitup SOC entering into lease agreements with private landowners who have the suitable land that meets all the requirements of constructing a new landfill site as issue of location and the type of soil must be considered. Municipal Solid Waste has solely been the responsibility of the public sector in the past but currently that hasn't been unsustainable due to factors such as urbanisation, population growth and the economic growth within local municipalities. Madiba, (2023) highlights that the public sector has been faced with financial, resources and land use challenges for managing waste which has resulted in the public service being unsustainable. Moreover, Madiba, (2023) argues that challenges in the management of municipal solid waste emanate from the budget cuts,

corruption and lack of political will within the municipalities which has resulted in some municipalities optioning to implement the Public-Private Partnership model for a sustainable municipal solid waste public service. Osazee, (2021) regards Landfill sites as the most popular mechanism for managing municipal solid waste. Furthermore it is important to note that the design of landfill sites is categorised into three spheres which is the landfill for inert waste, for non-hazardous waste and for hazardous waste as stated by (Osazee, 2021). The construction of landfill sites it's a tedious process which is costly as there a lot of regulations and standards that need to be met for a landfill site to operate and also when the air space has been saturated as the closed landfill sites need to maintained and monitored.

Public-private partnership agreements have different contractual agreements for sharing of responsibilities, resources, and remuneration benefits. The study found that within the city of Johannesburg there's an issue of effective contractual agreements as the Pikitup SOC faces challenges in payment of service providers responsible for collection and transportation of waste. Ineffective management of PPP contractual arrangements is due to the issue of budget cuts faced by the public sector and political instability, which hit the municipality after the 2016 local government elections. Therefore, mismanagement of contractual agreements arise within the municipality as service provides so get paid late due to administration and technical issues whereby this has resulted in the private waste collectors refusing to collect waste, and that has resulted in illegal dumping, littering, and mismanagement of municipal solid waste within the city of Johannesburg. Eberhard (2018) conforms with the findings by stating that PPP contracts are not managed properly due to different administration and technical factors faced by municipalities in South Africa. Furthermore, Mashwama (2018) also states that the current PPP agreements in South Africa are not flexible, and there is a lack of resources dedicated to fostering PPP projects, which just creates instability when it comes to service delivery, as the issue of change in political leadership in spheres of government tends to have a negative effect on the progress of PPPs.

Provision of resource machines at landfill sites has been regarded as a process that does not have any difficulties due to the PPP contractual agreements that Pikitup SOC has entered with private companies who provide machines to Pikitup-owned landfill sites for the effective management of waste at landfill sites for compositing, covering, and sorting of waste. Furthermore, there are also MOU contractual agreements between Pikitup and private

companies that produce products that have plastic, steel, and glass materials, whereby the private companies are given the permission to come and collect that waste for free of charge at the landfill sites for remanufacturing of products and packaging materials. The urban sustainability framework assists in measuring and assigning the longevity of sustainable development initiatives planned out by the city. As a result of urbanisation and population growth in cities in the 21st century, many cities around the world are faced with the challenges of depletion of natural resources, reduction of biodiversity, climate change, and the disposal of waste. Sustainable cities have a mandate to make sure that their environment is friendly towards its inhabitants (GPSC, 2018). The urban sustainability framework seeks to provide long-term solutions for cities on how they can deal with their social, economic, and environmental challenges that result from urbanisation and how the future generation can also avoid the challenges caused by human activities and make sure that the environment is sustainable (GPSC, 2018). To enhance urban sustainability theory within the city of Johannesburg, the city has entered into multiple MOU contractual agreements with private companies to assist in the management of waste within the city, whereby private companies that are in the manufacturing of goods that include plastic, steel, and glass materials are in partnership with Pikitup SOC and they collect waste from the landfill.

5.2.5 Joint Ventures through PPP on solid waste management

The study revealed that Pikitup SOC has developed joint ventures through PPP agreements with private companies that own landfill sites in order to manage waste in the northern region of Johannesburg. The joint venture assists Pikitup with disposing of generated waste at the landfill sites as the municipality does not own any landfill sites in the northern region, which has resulted in the development of PPP joint venture agreements in order to reduce the costs of transporting collected waste from the northern region to the southern region as the majority of landfill sites owned by Pikitup are located within the southern region. Informal waste collectors are part of joint ventures for the collection of recyclable waste from households and landfill sites, as they have been given permission to sort and retrieve recyclable waste, which results in a reduction of waste from households and landfill sites. Mesharch (2013) states that informal waste collectors play a pivotal role in tackling the issue of unemployment in developing countries, which now substantiates the empirical data derived during the research process. Furthermore, Mwanza (2019) argues that the recovery of waste from residential and business areas relies on informal waste collectors, as they keep the communities clean and have a

positive impact on the production of productive resources for goods, which backs up the urban sustainability theory that has been adopted for this research study. Therefore, the inclusivity of informal waste collectors as role players in the management of municipal solid waste is essential, as it seeks to reduce the financial costs of waste collection faced by municipalities while providing income generation to the less fortunate (Mwanza, 2019).

The city of Johannesburg has developed joint ventures with the informal waste collectors for waste sorting services at the landfill sites in order to enhance the circular economy and reduce the quantity of waste at landfill sites. Furthermore, the joint venture for waste sorting is regarded as the CoHorps initiative, which groups the informal waste collectors into groups of five and they will sort the waste at landfill sites. The collection of waste by informal waste collectors is fundamental in achieving Sustainable Development Goal 8, which seeks to promote sustained inclusive and sustainable economic growth, full and productive employment, and decent work for all while addressing the environmental impact (Makhele, 2023). The sorting and collection of waste by informal waste collectors is regarded as a dynamic socioeconomic phenomenon. Participants from the study have alluded that the sorting of waste does play a critical role in income generation for their recycling business and also mitigating the environmental impact faced by municipal solid waste systems (Botello-Álvarez, 2018). The integrated solid waste management theoretical framework seeks to enhance sustainability of the environment and waste management as it provides multiple sustainable approaches that are inclusive of segregation, transfer of waste, sorting, treatment, recovery, and disposal of waste in an integrated manner (UNEP, 2020).

5.3 Municipal solid waste management effects towards sustainability

The research study has revealed that the city of Johannesburg is infiltrated by rural-urban migration due to the nature of the urban economy found within the city, as the city of Johannesburg is the biggest municipality in South Africa and the largest contributor to the Gauteng province GDP due to economic activities in the city. The large economic scale and population growth within the city have had an effect on the management of municipal solid waste, as consumption rates are high and waste generated is on the rise. Due to the nature of economic activities that involve formal and informal economies within the city, illegal dumping has been on the rise and is regarded as unmanageable, as the study revealed that the

municipality does not get allocated funds for dealing with illegal dumping, and currently they have spent millions in removing illegally dumped waste. Linwei Du (2021) states that cities around the world are not exempted from the issues surrounding waste management, like illegal dumping, due to the nature of the economic and social development experienced in those urban areas. The issue of illegal dumping and mismanagement of waste within the city of Johannesburg is in relation to arguments made by RAMLI (2014) when it comes to the association of rapid population growth, economic growth, industrialisation, and urbanisation within a geographical area as the quality of life increases and consumption of goods also increases, which have a negative effect on the public sector.

5.3.1 Urban economies

The city of Johannesburg is experiencing rural-urban migration in the city, which has resulted in the development of backrooms for rental purposes, and that has contributed to waste management problems as there are not waste disposal facilities provided to people residing in backroom rentals, and they end up disposing of waste on land surfaces. The Urban Resilience theoretical framework adopted in this research study supports the empirical data revealed as it states that urbanisation is an opportunity that will improve the living standards of humans within the society while on the other hand having severe consequences for the environment as the quantity of waste produced will increase with insufficient land to be utilised for disposing of waste, which results in illegal dumping and environmental disasters (GPSC, 2018).

Furthermore, a finding was made that informal traders do not follow the city's bylaws as they run their businesses in the city, and the waste that they generate is not disposed of correctly, as one of the participants stated that law enforcement is for informal traders, and illegal dumping is not enforced effectively as most of the illegal dumping is caused by informal traders. Looking at the rapid economic growth and high-income levels within cities research has proven that high income rates within cities result in the high quantity of municipal solid waste produced, which tends to have a large environmental impact (Tsui, 2021). Due to the nature of economies found within urban areas, a concern has been raised by Tsui (2021) that cities around the world contribute 50% to the produced global waste while utilising 60–70% of natural resources globally.

5.3.2 Natural environmental resources

The study has made revelations in relation to the sustainability of natural environmental resources in the city of Johannesburg as the city is faced with depletion of vacant land due to the rise in informal settlements, as one of the participants alluded that in the next 20 years there won't be any vacant land in the city. Furthermore, illegal invasion of land in the city has a negative effect on the water quality and air in the city due to illegal dumping happening within rivers and dams. Pollution of natural environmental resources is on the rise in the city, and that has raised questions with regards to the sustainability of natural environmental resources found in the city. The municipality does not collect waste generated by informal settlements as they are not legal communities and do not pay any waste collection tariffs, which results in them disposing waste illegally on the available natural environmental resources. Municipal solid waste has largely contributed to pollution of land and water systems due to the nature of economic growth experienced within the city, which translates to increased generation of municipal solid waste (Institute of Natural Resources, 2020). Moreover, the increment in the quantity of municipal solid waste results in inadequate waste collection services from responsible parties, which later leaves room for illegal dumping of waste in open spaces and rivers (Institute of Natural Resources, 2020) holds. The Urban Sustainability theoretical framework states that once the initiatives of the city governance and planning fail, then there will be socioeconomic inequality, informal settlements, and the degradation of natural ecosystems, which will influence global climate change (GPSC, 2018).

Illegal immigrants have largely contributed to the rise in informal traders, informal settlements, and illegal dumping due to cultural discrepancies and a lack of knowledge of South African laws in terms of managing waste, trading, and human settlements as they come to the city and want to impose their way of doing things from the countries they originate from. Therefore, illegal immigrants have contributed largely to the depletion of natural environmental resources and waste management problems within the city of Johannesburg. One of the participants made a call for the strengthening of our porous borders and enforcement of laws, as budgets allocated for service delivery are meant for South Africans and legal immigrants. The Institute of Natural Resources (2020) holds a view that urbanisation within the city of Johannesburg has resulted in the degradation of natural assets as the environmental segments are degraded.

5.3.3 Climate action resilience

The urban sustainability for the city of Johannesburg is not guaranteed soon as the city generates an influx of waste, which has contributed largely to the abnormal weather patterns and climate change within the city as the waste generated contributes to pollution of the climate and emission of greenhouse gases due to the carbon-intensive economy within the city. The natural environmental resources within cities have been negatively affected by the increase of municipal solid waste generation as municipalities around the world face the issue of land shortages for disposal and storage of waste and environmental damage caused by illegal dumping activities, which results in the loss of recyclable waste materials (Kurniawan, 2024). To deal with the effects of climate change caused by emissions of greenhouse gases, the city is currently implementing waste to energy initiatives, landfill gas to energy, and gas to bio digester, which involve a biological process of turning waste into bio products and generating methanol gas and other energy that can be used for buses instead of utilising diesel. Therefore, the processes of turning waste into energy and bio products have an impact on the reduction of greenhouse gases and waste reduction in landfill sites. The urban sustainability theoretical framework has a goal to conserve and protect ecosystems and natural resources within the cities. Furthermore, the urban sustainability theoretical framework has an outcome dimension that it needs to achieve within the cities, which is the effective management of solid waste within cities through minimisation of waste generation and environmental impacts. (GPSC, 2018)

The study found that the closing down of landfill sites that have reached their lifespan and do not meet the requirements has contributed to the problem of climate change within the city as the landfill sites that are not operating release leachates and methane gases, which also affect the health of the public negatively. The multi-actor environmental theoretical framework states that environmental management is a big concern for the world. Climate change has been raised in multiple conferences in which the issue of waste management in relation to greenhouse emissions has been highlighted (Simelane, 2017). The multi-actor environmental theoretical framework states that management of solid waste in countries is carried out by the traditional governments, and multiple researchers have come out and stated that the traditional governments do not have sufficient resources to produce effective and sustainable waste management practices (Simelane, 2017). The adopted multi-actor environmental theoretical framework for this research study provides a way forward for how challenges relating to the

management of municipal solid waste can be tackled, as the research study has explained that the public sector within the city of Johannesburg does not have sufficient resources to produce effective waste management, which calls for a PPP initiative.

5.3.4 Inclusivity and quality of life

The research study has found that to enhance urban sustainability within smart cities, they need to create job creation initiatives and activities that will stimulate the economy in order to improve the quality of life. Furthermore, waste management is a pandemic within the city but has played a role in increasing the quality of life and enhancing inclusivity of informal waste collectors within the waste management frameworks. Municipal solid waste has contributed to the increase of quality of life in multiple households, as some of the participants' regard waste generated as their source of income through their participation in circular economies. Waste has contributed positively to food security, income generation, quality of life, dealing with unemployment, and reducing waste within the city, as inclusivity of informal waste collectors is important in tackling social, economic, and environmental problems faced. The multi-actor environmental governance theoretical framework states that environmental issues are multifaceted and know no boundaries; hence, Simelane (2017) highlights the importance of public-private partnerships and the inclusion of international organisations and private actors in dealing with issues related to waste management and the environment. The multi-actor environmental governance theory seeks to provide benefits such as sharing of resources, responsibilities, and costs and formulation of international agreements and treaties with multiple members of state, as noted by Simelane (2017). Inclusivity of informal waste collectors would also assist in reducing climate pollution and environmental damage caused by treatment approaches implemented for unauthorised recyclable processes as they open burn and use strong acid corrosion for processing recyclable material sold by informal waste collectors (Wei, 2021).

To enhance sustainability within economies found in cities, they need the inclusivity of private waste management companies, as the responsibility of managing waste needs to be collectively approached. Furthermore, the study revealed that the inclusivity of private waste management companies assists in creating a healthy business environment and creating job opportunities within the private sector through PPP agreements. Inclusivity of formal private waste management companies tackles the three triple challenges of poverty, unemployment, and

inequality between white racial people and black people, as it affords them the opportunity to enter the business sector and stimulate the economy. A finding was made within this research that inclusivity of private waste management companies results in job creation for waste compactor truck drivers, collectors, administrators, and engineers. The inclusivity of private waste collector companies is in line with the statement made by Quan (2023) that to have smart cities in society, there needs to be a collaboration between the public and private sectors, especially in cities that are characterised by urbanisation, as that is one of the contributors towards illegal dumping and large quantities of solid waste. The Multi Actor Environmental Governance theoretical framework emphasises the collaboration of multiple sectors to enhance effective and sustainable environmental policies and strategies that will reduce the burden on the public sector, as engagements and participation initiatives need to be promoted between businesses, civil society, and local governments.

5.4 Existing solid waste management strategies

The research study has found that there are existing processes and strategies implemented to manage waste in the city, whereby for the collection of waste, the city is characterised by a door-to-door collection strategy and a community bin strategy for the collection of municipal solid waste. Furthermore, during the research process, the empirical data collected has led to the finding that there's poor maintenance of community bins, as some have broken down and vandalised, which now defeats the purpose of the community bins. The door-to-door collection strategy is performed by formal and informal waste collectors, whereby the formal waste collectors go to households with waste compactor trucks and collect waste, then transport and dispose of the waste at the destination, which is landfill sites. In an effort to reduce the financial implications faced by municipalities around in the management of municipal solid waste, the door-to-door waste collection mechanism has been a popular mechanism in the effective management of municipality solid waste in Italy (Botti, 2020). Informal waste collectors also contribute to the management of municipal solid waste as they collect waste from bins found on the doorsteps/gates of households, and the difference with them is that they use trollies and big bags to collect and transport the waste to processors. Informal waste collectors choose the specific waste they want to collect from bins, as some collect plastic materials, glass materials, and paper for recycling purposes, which means they do not take the waste to landfills but to different processors and manufacturing companies for recycling purposes. (Laurieri, 2020)

states that in order to have an effective circular economy within a city, there need to be different role players, such as informal waste collectors that will collect waste from households on a door-to-door method, as they can assist in the sorting of waste from sources, which makes the process of a circular economy effective (Botti, 2020). Furthermore, the collection of waste by formal waste collectors in Johannesburg assists in reducing waste and keeping the environment clean, while the collection of informal waste collectors assists in stimulating the circular economy and waste reduction. Door-to-door waste collection enhances waste recovery through sorting of waste from the source. Therefore, Teerioja (2012) states that the door-to-door collection of MSW seeks to enhance waste recovery through household source separation.

To reduce illegal dumping and littering within the city of Johannesburg, the study has shown and explained that community bins have been constructed and placed in different public spaces, which gives citizens a directive to dispose of their waste properly without making the environment dirty. The community bins also assist informal traders within the city in disposing of their waste properly instead of leaving it lying around. Moreover, the community bin strategy is implemented by the public and private sectors as places like malls, parks, walkways and vacant land have the small and big community bins that are collected on a daily basis, and that has played a positive role in reducing waste management problems as the transportation and collection costs of waste become reduced as the distance covered by waste compactor trucks gets reduced as they travel short distances collecting a large quantity of waste. The findings made with regards to the implementation and maintenance of community bins due to lack of financial muscle and resources from the public sector conform to what the integrated solid waste management theoretical framework states with regards to the failure of the public sector in the management of solid waste within developing countries. The integrated solid waste management theory holds the view that there needs to be engagement and participation between the public sector, private sector, rag pickers, and different service providers (Marshall, 2013). The integrated solid waste management model seeks to incorporate different stakeholders to solve the solid waste management problems in a well-coordinated fashion, which seeks to promote public-private partnerships within communities (Marshall, 2013). The innovation of community bins seeks to provide an initiative for households and business areas on where they can dispose of their waste without effecting the environment and risking public health (Laurieri, 2020).

5.4.1 Reduce

The study revealed that to reduce waste in a proactive manner, there's still a lot of gaps within the city of Johannesburg, as the participants alluded that the biggest contributors of illegal dumping and littering are firms and private companies that deliver goods as they dispose of their packaging and cover waste recklessly. Furthermore, delivery vans and companies utilising products for packaging and delivery that are not eco-friendly contribute to environmental problems. Once they conclude their delivery, they do not collect their plastic raps, card boxes, and pallets that were used to hold, secure, and cover their products. Therefore, the study has shown that there's a lack of eco-friendly products being utilised in the city, which makes the environment and waste management unsustainable. To create sustainable cities around the world, the Urban Sustainability theoretical framework seeks to promote waste reduction to curb illegal dumping and disposal of waste in landfills (GPSC, 2018). Utilisation of eco-friendly products will assist in reducing landfill costs, as biodegradable products will reduce the amount of waste in landfill sites (AsiaPack, 2024). Therefore, the utilisation of eco-friendly products by retailers, businesses, and consumers is important in tackling the waste management issues faced by the city of Johannesburg, as they have alluded to the fact that the city is battling with air pollution at their landfill sites due to large quantities of waste being disposed of. Nguyen (2020) states that eco-friendly products enhance sustainable development within cities that are characterised by urbanisation and rapid population growth. The eco-friendly packaging method, also known as green packaging, plays a pivotal role in waste prevention and ensuring that there is environmental sustainability within communities (Rajesh, 2021).

5.4.2 Reuse

Through the data that was derived through semi-structured interviews, it was revealed that within the city of Johannesburg there's successful implementation of waste reuse initiatives as the quantity of glass waste gets reduced effectively from the sources through the participation of informal waste collectors. Glass waste products are collected from the source by informal waste collectors, and they trade the waste glass for financial gains with glass manufacturing companies such as CONSOL, SAB, Coca-Cola and Mpact, whereby that assists in stimulating the circular economy and income generation, as one of the participants stated that they are able to generate around R5000 on a monthly basis from glass waste. Therefore, the reuse of glass keeps the environment clean, there is less pollution, and the scale of production costs will be

reduced for manufacturing companies. The adopted integrated solid waste management theoretical framework through the post-normal science school of thought seeks to look at the policy frameworks, risk strategies, and environmental plans with relation to the management of solid waste (Simelane, 2017). The integrated solid waste management theoretical framework states that governments in developing countries are faced with inadequacy of integrated solid waste management as the municipalities were faced with poor planning and disorganisation within the waste management departments of the municipalities as they were poor systematic thinkers (Turan, 2009). To have an effective circular economy in place, the reutilization of glass products and glass packaging will be of great benefit. Morseletto (2020) regards the circular economy as an economic model that reduces waste and retains the value of waste through the reutilization of waste. Liu (2019) states the reutilization of glass waste results in environmental and economic benefits and solves the waste management challenges experienced by cities around the world as the consumption of the natural ingredient will have conservative benefits. The waste reuse strategy will have a positive effect on resource efficiency and promotion of green production activities that will achieve the sustainable developmental goals (Bui, 2022).

5.4.3 Repurposing

The study found that there are repurposing initiatives are being implemented in the city of Johannesburg, especially in landfill sites, by the Pikitup SOC, which has contributed to the reduction of waste in landfill sites and increasing the lifespan for landfill sites. Pikitup SOC has implemented the repurposing of food waste initiative to reduce the waste that is not recyclable and reusable. Therefore, food waste is repurposed into manure fertiliser, which is sold in multiple retail stores. The study also made further findings that Pikitup SOC is still in the process of repurposing food waste into energy that will be used for vehicles. Organic food waste is also being repurposed through the bio digestive process to produce chemicals and bio products. Paritosh (2017) states that there is a relationship between population growth and the accumulation of food waste in landfill sites, which will result in a shortage of land for landfill sites and cause severe environmental problems. The repurposing of food waste through the standards management practices is critical towards food waste reduction in dumping sites (Paritosh, 2017). Further, Paritosh (2017) advocates the repurposing of food waste as it will assist in dealing with food security issues and stimulating economies around the world as the food waste can be turned into livestock feed and produce biogas to generate electricity and fuel

vehicles. The repurposing of food waste into energy is in line with the Urban Sustainability theoretical framework in relation to effectively managing waste to reduce environmental impacts while implementing sustainable measures for energy production that will support all spheres of the economy within the city. The GPSC (2018) furthermore holds a view that the urban sustainable framework seeks to guide cities on how they can incorporate integrated approaches in pursuing urban sustainability that will measure the cities performance.

5.4.4 Recycling

To reduce the quantity of waste collected and disposed of the study found that there are recycling methods that are being implemented by the public and private sector companies within the city. To enhance effective recycling activities, Pikitup SOC has implemented the On the Go Recycling units, which get transported around the city for the collection of recyclable waste such as glass, paper, plastic, and steel. Private companies have placed recycling units in public spaces such as malls, schools, and corporate environments so that people can have access to recycling facilities that assist in the sorting of waste from source; therefore, the recycling of waste within the city of Johannesburg is done collectively by private companies, the public sector, and informal waste collectors, and that has resulted in the growth of the circular economy within the city. The findings conform with the urban sustainability theoretical framework with regards to providing efficient collection, treatment, and disposal of municipal solid waste from the city. To create sustainable cities around the world, the Urban Sustainability Framework seeks to promote recycling to curb illegal dumping and disposal of waste in landfills (GPSC, 2018). The partnership between the public sector and private sector with regards to the implementation of the on-the-go recycling units within public spaces is in line with the Multi-Actor Environment Governance theoretical framework, which advocates for collaboration of different stakeholders from the private sector towards the management of municipal solid waste. Furthermore, the multi-actor environmental governance theoretical framework seeks to tackle the issue faced by the public sector with regards to a lack of financial muscle towards managing municipal solid waste by advocating for public-private partnership models in sharing of resources and responsibilities and reducing the burden on the public sector. The reduction of solid waste within landfill sites should be dealt with from public areas, which are characterised by moving traffic through the on-the-go recycling machinery that gets placed at different public areas, and community members will come dispose of waste into their categories (Mozo-Reyes, 2016). Moreover, the incorporation of the on-the-go recycling

machinery is an important tool to use in enhancing recycling of waste, as Mozo-Reyes (2016) states that the on-the-go recycling machinery is effective in capturing recyclable waste materials from the sources and reducing the quantity of solid waste being disposed.

The issues surrounding illegal dumping and littering within society are regarded as human behaviour that needs to be changed through educational awareness programs; hence, the study made the finding that currently the Pikitup SOC is implementing educational awareness programs with a specific focus on waste management and the environment. It has been revealed that awareness programs are effective in the affluent areas, which are characterised by high-income households, high educational levels, and a high standard of living, as they seem to respond positively to the educational awareness programs. Furthermore, it was explained that in places that are regarded as townships, informal settlements, and less affluent areas, educational awareness programs are not effective, as the population in those areas does not participate in the programs as they regard them as useless and won't bring any change to their lives. It was revealed that less affluent areas such as Alexandre township reject the educational awareness programs as they feel like they have bigger socioeconomic programs, as they always inform coordinators from Pikitup SOC and private companies that they need food, jobs, and houses instead of educational programs that do not increase their standard of living. Saladié (2016) states that multiple socioeconomic factors have an impact on human behaviour with regards to the management of waste within their communities. Education about waste management is critical when it comes to tackling environmental problems and public health issues. Furthermore, Saladié (2016) emphasises the participation of different stakeholders within the community in promoting education awareness campaigns to make society aware and not enforce bylaw regulations. Saladié (2016) conforms to what the research study has found with regards to consumption patterns within society being influenced by different demographic issues, socioeconomic issues, and environmental factors that define citizens. Zaina (2012) states that most human beings within society have adopted a negative habit of not caring for the environment and proper management of the waste they generate. To deal with the issue of negative human behaviour with regards to illegal dumping and mismanagement of solid waste, there needs to be education awareness programs with a specific focus on waste management and recycling of solid waste (Zaina, 2012).

5.5. Proposed model for Public-Private Partnership for solid waste management

The undertaken research study aimed at developing a model for public-private partnership towards managing municipal solid waste within cities. For the research aim to be achieved, the study investigated the existing public-private partnership agreements for solid waste within the city of Johannesburg together with the characteristics of urban sustainability within the city. Furthermore, in the development of the PPP model, the study also had a glimpse of the process and strategies being implemented in the city for the management of solid waste.

The research study has managed to achieve its intended aim of developing a PPP model for solid waste management within smart cities. Therefore, the development of the PPP model within the research study was informed by the empirical data collected from sampled participants, as it assisted in identifying gaps within PPP agreements and waste management strategies. Based on the empirical data generated within this research study, a model has been developed and was centred around issues emanating from the empirical data, such as community participation, formalisation of informal waste collectors, and the circular economy, as they can play a critical role towards waste management, preserving the environment, and enhancing social and economic development. The PPP model that has been developed is an integration of the public sector, private sector, community members, and informal waste collectors, as they need to be an integration and collaboration of the role players towards an effective waste management strategy as the existing waste management strategies and public-private partnerships are not informed by community participation, formalising informal waste collectors and enhancing the circular economy.

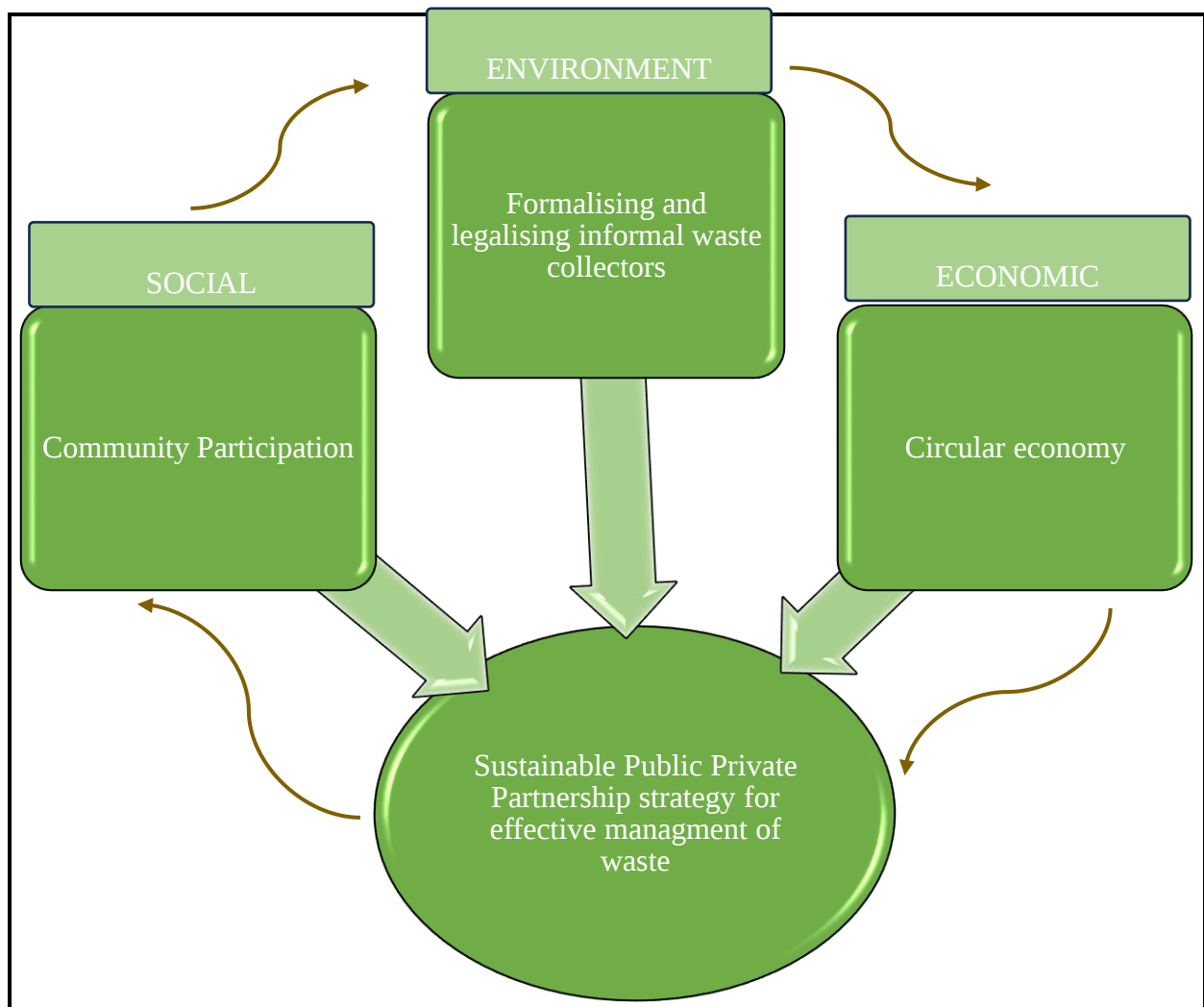
Waste management has been a problem within cities around the world, particularly the city of Johannesburg, based on the nature of the economic scale, urbanisation, and rapid population growth that is happening within the city. Furthermore, the city of Johannesburg has implemented multiple waste management strategies that are inclusive of the public-private partnership agreements. Moreover, regardless of the implementation of the PPP agreements for waste management in the city, waste is still regarded as the biggest problem that the city is facing due to multiple problems such as poor financial muscle, lack of resources, and lack of partnerships with different role players found within the society. It is also important to note that the management of waste does not solely lie with the public and private waste management

companies that are contracted but, most importantly, lies with the generators of waste. Waste management regulations and policies are reactive measures put for the management of waste, as they do not solely tackle the factors that enhance ineffective waste management within the city. Therefore, the developed model seeks to stretch the existing public-private partnership models to a larger scope in order for them to be more proactive in dealing with waste management problems through utilising community participation as a driver for a more effective management of waste from sources and formalising informal waste collectors in order to have an effective circular economy that can be used as a tool for economic growth, social development, environmental protection, and waste minimisation within cities. The proposed model, which emanates from the data collected within this dissertation, seeks to enhance a broader PPP agreement model by including community participation, formalising and legalising informal waste collectors, and circular economy.

5.5.1 Method used to develop the model

The development of the public-private partnership model is methodologically informed by an inductive research design, as the study utilised a qualitative research approach. The model emanates from the derived empirical data collected systematically within the research process; hence, the model is grounded with the research findings and data analysed (Raimo, 2014). Furthermore, the utilisation of the inductive research design involved the utilisation of the empirical data from the field in order to develop the model, which is centred around community participation, circular economy, and the formalisation of informal waste collectors. During the development of the model, the views and perceptions provided by participants are taken into consideration and inform the entire model instead of utilising an existing theory (Raimo, 2014). Therefore, utilisation of inductive research design assisted the researcher in being informed about the existing public-private partnership agreements, processes followed, and existing waste management processes within the city of Johannesburg. The model has been presented theoretically and with a process flow chart that is grounded in the empirical data to form an interrelationship between community participation, formalising informal waste collectors, and enhancing the circular economy towards effective management of solid waste through public-private partnerships, which enhanced the sustainable development dimensions of social, environmental, and economic.

Figure 16: A Model for Public-Private Partnership for sustainable solid waste management



Source: Own Invention

5.5.2. Community Participation

The dissertation found that the city of Johannesburg is characterised by multiple problems within the management of solid waste PPP agreements, as one of the findings was that the city of Johannesburg is not inclusive of the community members who are the end users of waste service delivery initiatives. Community participation plays a pivotal role towards the management of waste and the environment as a whole; hence, one of the recommendations within the research is that there must be an enhancement of community participation initiatives

within the city .Furthermore, in the city of Johannesburg, during the planning phase and processes of developing waste management structures, the community is not consulted or informed about the strategies to be implemented for managing waste within the communities, as the community members do not have a sense of ownership and accountability as the social support was reduced, hence there's ineffective waste management strategies within the city. Therefore, the adopted multi-actor environmental governance model supports the proposed model, as Newell (2012) emphasises the collaboration of multiple sectors in order to enhance effective and sustainable environmental policies and strategies that will reduce the burden on the public sector, as engagements and participation initiatives need to be promoted between businesses, civil society, and local governments.

Community participation initiatives are enhanced through the Integrated Development Planning process that occurs within municipalities on a five-year basis in order to systematically plan service delivery initiatives. It is important to note that within the city of Johannesburg, waste management services are not incorporated within the IDP of the city, which makes it difficult for the enhancement of community participation whenever developing a waste management strategy. Therefore, the implementation of community participation initiatives will assist the city of Johannesburg in getting social support from community members who are responsible for the waste generated and that their inclusivity will make them have a sense of importance and responsibility towards protecting the environment and managing waste effectively, as states Zhang (2020), that community participation will change the perception that community members hold when it comes to managing solid waste and effectively participating in environmental projects.

The city of Johannesburg has formed multiple PPP agreements for waste management, but the PPP agreements are not inclusive of the community members when it comes to the management of waste within the city hence the promotion of community participation initiatives are of outmost importance towards enhancing inclusivity of community members towards the waste management frameworks. Zhang, (2020) states that the promotion of community participation initiatives involves the community members being part of the decision-making process when it comes to process and strategies to be used for managing waste. Therefore, the promotion of community participation initiatives within the PPP agreements will reduce the challenges and burdens faced by the public and private sector as

the model advocates for a collaborative working arrangement between the public sector, private sector and community members as they are the source of waste generated.

Community participation has the potential to solve environmental-related problems in developing countries as it involves the important role players, which are the perpetrators of the environmental-related problems (Zhang Y., 2020). Furthermore, community participation initiatives will provide an informative approach towards the management of waste and dealing with environmental challenges experienced as the consumption of eco-friendly products will be promoted during community participation activities. Consumption of eco-friendly products will be promoted and enhanced through community participation initiatives, as community members will be more educated about eco-friendly products or green products that they must consume, which will assist in the reduction of waste materials that are not eco-friendly. Furthermore, the consumption of eco-friendly products has a positive effect on waste management and reducing environmental problems such as pollution of plastic and non-eco-friendly products.

The community participation initiative will not only result in the consumption of eco-friendly products but will also result in the participation of community members in the green economy. Moreover, since the community members will get a better understanding of waste management and a sense of belonging and importance as they are included throughout the management of waste by the public and private sector, educational awareness programs conducted by relevant stakeholders will be accepted in communities, especially the less affluent, or rather the township areas, which has not been the case so far within the city of Johannesburg. To have successful educational awareness programs centred around waste management, community participation should be regarded as an important tool to provide a paradigm shift within community members. Shukor, (2011) states that community participation is a tool to successfully managing waste within communities, as community members will be informed on how to sort waste and perform recycling activities. Community participation will result in community members cleaning after themselves and disposing waste in the right manner while protecting the environment from harmful gases (Shukor, 2011).

Community participation will also result in the sorting of waste from source as citizens will be more informed about waste management and preserving resources, and that will result in the

stimulation of the green economy, and manufacturers of products will be the biggest winners. Therefore, the inclusivity of community members within the waste management structures will result in community ownership of waste management services, which will reduce the burden faced by the public sectors, and a health completion will be created for the private sector, which participates within waste management services, as issues of incompetence, poor service, and corruption will be reduced as community participation provides an environment for service providers to be held accountable. Shukor, (2011) supports the assertion of community participation in solid waste management services by stating that a sense of responsibility for managing waste will be developed, which will enhance efficiency and continuity of solid waste management service delivery initiatives.

5.5.3 Formalising and legalising informal waste collectors

Once the community members have a full understanding of managing waste and they have a sense of ownership for waste management services, the second step that should be taken is the issue of formalising or legalising informal waste collectors within cities. The dissertation revealed issues and challenges surrounding the informal waste collectors, as there's no legal framework that governs them, and they are regarded as informal waste collectors as they are not legally operating within the South African policies. Furthermore, it was also revealed that informal waste collectors' health and safety are not priorities, even though they play a critical role towards the management of waste and reducing waste within communities as they are able to enter places that the formal waste collectors can't enter. Aparcana, (2017) states that informal waste collectors reduce environmental pollution, and the quantity of solid waste disposed at landfill sites as they can collect waste from the sources. Furthermore, the informal waste collection industry needs to be formalised and legalised within the low and middle-income countries by improving the working conditions to make the industry more appealing to community members to regard informal waste collection as an alternative for them to generate income (Aparcana, 2017).

Informal waste collectors have been critical in the management of waste within informal settlements, as the formal waste collectors from the private and public sectors do not service those areas as they are not paying waste tariffs. Moreover, the informal waste collection sector has been active in reducing waste within informal settlements, which has assisted in keeping

the environment clean and preserving environmental segments. Moreover, the urban sustainability theoretical framework that has been adopted for this research study conforms with the formalisation of informal waste collectors as they have an outcome dimension that needs to be achieved within the cities, which is the effective management of solid waste through minimisation of waste generation and environmental impacts (GPSC, 2018). The solid waste management outcome dimension within the urban sustainability theoretical framework seeks to provide efficient collection, treatment and disposal of municipal solid waste from the city (GPSC, 2018).

To have an effective PPP model for waste management, informal waste collectors need to be formalised and legalised within the South African context to have a broader scope for PPP agreements, and they should not just end between the public and private waste collectors. Formalising and legalising informal waste collectors will result in the booming of the circular economy, poverty reduction, and reduction of unemployment rates, as the study has found that informal waste collection is a way of living and income generation for multiple households within the city of Johannesburg. Moreover, Chu (2024) argues that formalising informal waste collectors will not only result in waste reduction but will enhance their integration within the waste recycling system, whereby they can coexist with the formal waste collectors, as solid waste management services should be regarded as a collective approach.

As the first step of the model will be to enhance community participation for waste management projects, then the formalisation and legalisation of informal waste collectors will result in the recruitment of more informal waste collectors who will play a critical role in stimulating the circular economy and income generation. The formalisation of informal waste collectors will result in empowering initiatives and ensuring that there is a network for growth and sustainable economic ventures (Mvuyane, 2018). Formalisation and legalisation of informal waste collectors will make the sector more attractive and appealing for community members, and they will see the need to participate in waste collection services, and the myth within less affluent or black communities regarding informal waste collectors that it's done by mentally unstable people and less educated people will be destroyed. Therefore, the model suggestions are supported by Aparcana (2017), who believes that informal waste collection results in increased recycling activities that have a positive effect on the environment and economic growth.

The formalisation and legalisation of informal waste collectors needs to be carried by the public sector within the local municipality levels whereby they need to be a development of a policy and framework that will guide the operations of informal waste collectors starting from their health and safety, reimbursement initiatives, recycling tariffs and operating environments. Mvuyane, (2018) supports the empirical suggestions with regards to the model for PPP that formalisation of informal waste collection will enhance a sustainable job creation sector through the circular economy. Furthermore, this initiative will result in the recognition of informal waste collectors as they will be provided with permits and operation licences which will result in making the initiative more popular amongst citizens and will be a force to be recognised within the waste management sector for private waste companies as they will be integrated within the PPP agreements.

The formalisation and legalisation of informal waste collectors will reduce the financial burden faced by the public sector in developing countries towards the management of waste, as the community members will be skilled and informed to manage waste effectively and as a tool for income generation. Looking at the triple challenges of poverty, unemployment, and inequality, formalisation of informal waste collectors can be utilised as a tool to tackle the triple challenges and migrate the South African waste management sector to an effective circular economy sector and waste to energy sector. Furthermore, Chu, (2024) states that formalisation of informal waste collectors through regulations and legislation will result in more employment opportunities and economic growth within cities as the informal waste collectors are able to perform the recycling and reuse solid waste management strategies effectively. Therefore, to have an effective waste management plan through the PPP agreements, the model proposes the legalisation and inclusivity of informal waste collectors within the waste management frameworks and PPP agreements.

5.5.4 Circular economy

The developed PPP model for waste management in cities for this dissertation is centred around three components that emanate from the data collected on the field, and the third component of the model is the prioritisation of the circular economy. Through the formalisation and legalisation of informal waste collectors, the circular economy will benefit a lot and result in growth as there will be more role players from the public sector, private sector, and

communities who will be partaking in waste management services. Based on the findings of the study, the city of Johannesburg is still in the process of fully implementing a circular economy, as there's not enough role players to partake as a lot of waste that can partake in the circular economy ends up at landfill sites. Therefore, the importance of community participation as the driver for formalisation of informal waste collectors and the circular economy was realised because data from the field has stated that there's no community participation initiative being done within communities for the planning of waste management services. The only way to have an effective circular economy is through community participation and formalisation of informal waste collectors to participate within the circular economy, as the formalisation will result in waste collection being a professional full-time job, which is already for some citizens (Skånberg, 2015).

The public and private sector are already playing a critical role towards the management of waste within communities but the biggest issue which was revealed within the empirical data was that they collect waste ,transport and dispose the waste at landfill sites which takes up a lot of air space and data from the field has stated that a lot of waste occupying landfill sites its waste which should be used for recycling ,reuse and repurposing purposes hence the landfill sites are open to the public for sorting of waste disposed in landfill sites .Therefore proper implementation of community participation initiatives and formalisation of informal waste collectors will reduce the waste disposed at landfill sites as the waste will be diverted from sources to the processors and manufactures which will reduce the time and costs for sorting waste at landfill sites (Ashijya, 2021).

The circular economy will increase the lifespan of landfill sites and air space required, whereby that will also result in a reduction of pollution and emissions of greenhouse gases. Once the PPP agreements are centred around the circular economy, private sector businesses will be booming, especially for manufacturers and processors, as the time for manufacturing will be reduced and the costs acquired for manufacturing goods through raw natural resources will be reduced while preserving the natural environmental resources. The integrated solid waste management theory is in line with the arguments made pertaining to the circular economy within the proposed model by stating that safer and cleaner cities and better business opportunities and economic growth will be enhanced through the implementation of the circular economy, which is high on community participation and formalisation of the informal

waste collectors (Marshall, 2013). Furthermore, the integrated solid waste management theory is incorporated by multiple policies and technologies that will enhance effective waste management within cities by implementing the circular economy as an initiative for reducing waste disposed and greenhouse gases produced by solid waste (Marshall, 2013). The developed model for this research dissertation seeks to advocate for the inclusion and legalisation of informal waste collectors, the public sector, and manufacturing and processing companies from the public and private sectors instead of just having PPP agreements centred around the collection of waste. PPP agreements should be entered into with private and public processors and manufacturers, as that will have an impact on the development of the circular economy, which will in turn enhance economic development within cities while waste is managed effectively (Skånberg, 2015).

The circular economy will be instrumental towards job creation within cities, which will include unskilled labourers, as there will be skills transfer between the private sector, public sector, and community members in the management of waste (Vikas, 2019). Circular economy is informed by the reuse and repurposing of waste, which are instrumental towards job creation in cities. As the empirical data has alluded, the city of Johannesburg is still in the initiation phase of implementing the circular economy, whereby co-horps are used to sort waste at landfill sites and remanufacture the waste into different products that are later sold at marketplaces. Furthermore, through the recycling of waste, jobs will be created for waste pickers and collectors, and within the private sector, jobs will also be created for administrators, receivers, processors, engineers, and waste technologies, who are all involved throughout the processing and remanufacturing of waste into new products that are eco-friendly (Lahane, 2021).

The circular economy will also result in economic growth within cities and increase the standard of living as the ICT, textile sector, packaging sector, electronic manufacturing sector, and renewable energy sector seek to benefit a lot from the circular economy due to the utilisation of municipal solid waste in producing energy for electrical purposes (Bressanelli, 2020). Within the city of Johannesburg, the waste to energy initiative is being implemented, but data from the field has stated that the waste to energy initiative for renewable energy isn't growing at a fast pace due to a lack of resources, funding, and support; hence, community participation should be regarded as a driver for enhancing the circular economy, as support will

emerge from community members and different stakeholders within the society. The circular economy will also result in the production of biogas products through the processing of organic materials found in landfill sites, which is part of the initiatives being implemented by the city of Johannesburg, but due to a lack of role players to participate in the process, the production of biogas products has been slow. Moreover, the reuse of organic waste materials within the circular economy will also result in job creation, income generation, and food security in cities as manure for sustainable agricultural purposes will be produced (Masullo, 2017).

5.6 Chapter Summary

The above-mentioned chapter is a discussion of findings that emanate from the empirical data generated during the research study, whereby the discussion of findings is divided into three research objectives that were formulated together with the aim of the dissertation. Discussion of findings is a glimpse of the main concerning issues that were revealed by the researcher during the data collection process, whereby the findings discussed are drawn from the data analysis and presentation of the data chapter, which is also informed by literature and theoretical frameworks. The chapter was able to provide critical findings with relation to the forms and conditions of PPP agreements found within the city of Johannesburg towards waste management and provided a thorough discussion on whether the city of Johannesburg is urban sustainable. Moreover, the chapter provided a logical flow of discussion on the processes and strategies being implemented towards waste management within the city of Johannesburg. Therefore, the research study has managed to achieve its intended aim by developing a model for public-private partnerships towards the management of waste within cities as guided by the empirical data generated within the research study. The succeeding chapter within the dissertation is the last and final chapter, which provides the conclusion of the research dissertation together with the recommendations that are derived and guided by the empirical data generated. Recommendations in the succeeding chapter are presented in connection with the research objectives and later followed with the conclusions of the research dissertation.

CHAPTER SIX: SUMMARY FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

6.1. Introduction

This chapter is comprised of a conclusion of the research dissertation on whether the research aims and objectives were achieved, as recommendations are also provided in order provide possible measures that can address the research problem, identified gaps, and future research recommendations are also be outlined. Furthermore, the chapter is inclusive of the research findings, which are connected to the research objectives, as the main purpose of the research dissertation was to develop a model for PPP agreements for waste management services within cities. Moreover, the above-mentioned chapter consists of the research aim together with the research findings; hence, this chapter provides an overview of the above chapter.

6.2. Accomplishment of the Research Aim and Objectives

The following findings are discussions of what the research dissertation discovered on the filed during the data collection process in relation to the formulated research questions with regards to the management of municipal solid waste within the city of Johannesburg and the existing PPP agreements. Therefore, the findings are interconnected with the research objectives to form a logical and systematic flow of the findings.

6.2.1. Forms and conditions of Public-Private partnerships in cities.

- The research study has revealed that the responsibility of waste management within the city of Johannesburg is solely the responsibility of the public sector and the contracted private waste collection companies and does not include the community members as role players towards waste management activities. Moreover, the study revealed that to deal with waste management problems within the city, community participation needs to be enhanced in communities, just like in Rwanda, as community members take responsibility for the waste generated and clean up the spaces.
- To enhance the key performance indicators within the city of Johannesburg, the public sector has entered into multiple MOU agreements with private companies who are given the responsibility to come and collect waste from landfill sites for the reproduction of manure and agricultural products for fertilisation. Therefore, the

responsibility given to the private sector assists in the reduction of waste at landfill sites, which prevents the shortage of air space.

- Mou agreements for waste management services within the city of Johannesburg have played a critical role towards job creation and creating more business opportunities within the recycling sector as manufacturing companies are given free access to waste disposed at landfill sites which they can use for manufacturing and recycling purposes.
- During the course of this research study, it was discovered that the Pikitup SOC is moving towards forming multiple partnerships with different role players, such as informal waste collectors, as they have been incorporated within the Pikitup SOC system, which is known as the co-horps, whereby they have recruited more than 100 informal waste collectors to come and sort waste at the landfill sites and garden sites.
- The study has also revealed that in order to share the responsibility of waste management within the city of Johannesburg, the development of the environment and infrastructure is assisting the co-horps in providing them with machines to recycle waste and repurpose waste into products that can be sold.
- In order to stimulate the economy within the city of Johannesburg, the municipality is assisting the registered co-horps in providing them with a trading space around the city where the co-horps can sell their products, which they have created from the waste.
- The responsibility of waste management within the city of Johannesburg is not only carried by Pikitup SOC but also other government departments, such as the department of environment and infrastructure, which assists Pikitup in sorting waste at landfill sites as their main mandate is to reduce waste and mitigate climate change within the city.
- Waste management services are neglected within the city of Johannesburg and not treated as a priority, as it was discovered that waste management services are receiving the lowest budget allocations from the Treasury, which makes them ineffective in managing waste. Moreover, it was also discovered that political leaders who are in government and occupying senior management posts do not have a full understanding of managing waste, and the importance of treating waste management as a priority due to the effects it has on the economy, society, and environment.
- Waste management services within the city are faced with a lot of non-compliance issues from the Department of Environment, as the public sector is having difficulties maintaining their waste management infrastructure as there's a lack of funding, which

has resulted in landfill infrastructure being poor and that results in illegal dumping and pollution.

- The public sector has a responsibility to manage waste within the city, but it has been difficult to manage waste effectively as the city of Johannesburg has experienced a lot of population growth in the past ten years, which has increased the quantity of waste generated.
- PPP agreements have been formulated within the city of Johannesburg for the collection of waste and transportation of waste as the public sector has procured more than 200 waste compactor trucks from the private sector companies as the public sector does not have enough waste compactor trucks as they are very expensive to buy and maintain. Moreover, the private waste collection companies are paid on a monthly basis and are required to collect waste from Monday to Friday in different areas within the city.
- There's a shortage of land for constructing landfill sites within the city of Johannesburg due to population growth and urbanisation within the city. Furthermore, it was also discovered that the city of Johannesburg does not have the required financial muscle to construct new landfill sites, whereby the existing landfill sites were constructed in the late 1930s, and as a result, two landfill sites have closed down in the previous years due to a shortage of landfill spaces. It has been impossible to construct new landfill sites within the city as the cost to construct a new landfill site is more than R250 million, which the city does not have.
- In order to deal with the shortage of land for landfill sites, the city of Johannesburg has entered into PPP agreements with the private companies that own land and landfill sites, whereby the city utilises privately owned landfill sites for disposing waste. Moreover, the public sector pays the private companies that have leased their landfill sites to the public sector. Therefore, the city of Johannesburg utilises privately owned landfill sites for disposing waste outside the city's perimeters, as the city of Johannesburg also disposes of waste in Chloorkop, which falls under Ekurhuleni.
- There's a need of financial resources in order to procure land for the municipality so that new landfill sites and cells can be developed within the city as the current cells are experiencing overloading during waste combating and covering, which has a negative effect on the environmental resources.

- Another huge financial burden faced by the public sector towards the management of waste within the city is that an independent environmental practitioner needs to be appointed for the facilitation of acquiring a permit license for landfill sites, which takes a couple of years, and that creates a problem for the availability of landfill sites to use for disposing waste as they have to comply with NEMA, the Environmental Waste Management Act, Environmental Air Pollution, and the Water Act.
- PPP agreements within the city of Johannesburg are characterised by long and short-term lease agreements, as lease agreements for waste compactor trucks run for 36 months, while lease agreements for landfill sites, which are constructed and maintained by the private companies, run for more than 10 years depending on the availability of air space in the landfill sites.
- There's mismanagement of contractual agreements for PPPs within the city of Johannesburg, which has resulted in waste being uncollected within the city and piling up on the walkways of the CBD. Moreover, the mismanagement of contractual agreements within existing PPP agreements is that the public sector tends to delay in payment of private contractors, which results in them stopping to work as the collection and transportation of waste is a very costly expenditure.
- Private waste collection companies have regarded working with the public sector as the most stressful procedure due to the political instability within the city, as contracted private waste collectors can work for months without being paid, especially if there's a change in political power within the municipality, which results in payment delays and contracts being cancelled prematurely due to political affiliations.
- Due to a shortage of landfill sites within the city of Johannesburg, the city has entered into PPP agreements with companies such as Enviro Serve, which owns the Chloorkop landfill sites, and Waste Group, which owns the Mooiplaas landfill site. The reason for this PPP agreement is that Pikitup SOC has most of their landfill sites in the south of Johannesburg, and the northern side does not even have a single landfill site owned by Pikitup. Therefore, Pikitup depots in the north of Johannesburg dispose their waste in those landfill sites, which are located outside the city of Johannesburg perimeters, and Pikitup pays the private companies a monthly fee.
- The study discovered that the city of Johannesburg has informal waste collectors who play a critical role in waste reduction and waste sorting from sources; they collect waste from households and business areas. Therefore, the city of Johannesburg is still

assessing how they incorporate the informal waste collectors into waste management plans and frameworks.

- Informal waste collectors have a responsibility to collect specific waste, such as plastic, glass, and steel can waste, from residential areas for participating in the circular economy, as some regard that as their income generation initiative, which has been carrying their families for years now. Informal waste collectors operate from Monday to Friday as they travel to different places within the city to collect and are able to reach places that the formal waste collectors cannot reach, as the informal waste collectors also collect waste from informal settlements that are not serviced by the municipality due to them not paying waste tariffs and municipality bills.

6.2.2. The Characteristics and indicators of sustainable cities.

- The research study discovered that the city of Johannesburg is not sustainable because of the economic scale found within the city, which generates a lot of waste that is illegally dumped within the walkways and corners. The environmental segments of the city of Johannesburg are not sustainable, as illegal dumping is regarded as a pandemic.
- Due to rapid population growth and economic scale within the city of Johannesburg, apartheid spatial planning within black communities has resulted in a high quantity of waste generated and illegal dumping within the city, as many people who migrate to Johannesburg end up renting backrooms within the black communities, which do not have proper infrastructure for disposing of waste as tenants are not given proper disposing bins.
- Informal traders within the city have contributed largely to the waste management problems faced by the municipality as they do not have infrastructure to dispose of the waste generated by their businesses, as some sell food and clothing within the city, which produce packaging waste and waste generated by their customers, which ends up being disposed of in the wrong manner. Therefore, it was discovered that bylaws need to be reinforced for informal traders, whereby they should be charged a certain amount for the collection and transportation of waste generated by their business activities, which they leave lying around, making the city dirty.
- It was also discovered that municipal solid waste has affected the investment rates within the city of Johannesburg, as the city is currently characterised by a high quantity

of waste dumped and littering around the city, which has made the city unattractive for investors. Therefore, waste should be regarded as the new gold within the city, as there's a lot of money that can be generated from waste as it can be treated as a raw material for the reproduction of products.

- Illegal dumping activities are not regarded as the key performance areas for the municipality, as their key performance area is to collect waste from formal households and residential areas. Furthermore, illegal dumping has affected the municipalities budget and resources as they have to be redirected to collecting waste, which is illegal dumping, and they need to hire TLBs to collect the illegally dumped waste, and that has resulted in the city of Johannesburg losing millions for dealing with illegal dumping.
- Natural environmental resources such as land and rivers are being depleted and deteriorated by human activities as the city is facing an issue of informal settlements that are mushrooming within the city. The city has more than 300 informal settlements that have depleted and deteriorated land space within the city. Moreover, informal settlements have depleted natural water resources such as rivers and dams as people dispose of their waste on open land and nearby rivers, which have affected the ecosystem negatively.
- Lack of law enforcement within the country from the national to local spheres of government has been the biggest contributor towards the damaging of natural resources through large quantities of waste generated within the city. Moreover, it was discovered that illegal immigrants contribute greatly to the mismanagement of solid waste and illegal dumping within the city of Johannesburg as they do not comply with the bylaws surrounding waste management in a South African context, which has resulted in the illegal immigrants disposing waste in the wrong way as they believe it's a way of doing things. Therefore, in order to deal with illegal dumping penalties, they need to be stricter and higher, as they affect the environment and ecosystem negatively.
- The population of the city has grown from 4 million to 8 million today, and the quantity of waste has also increased from 1 million tonnes of waste per year to 2.2 million tonnes of waste per year generated. In order to have control of the population growth, the borders need to be managed properly, and illegal immigrants need to be deported, as the waste management services are meant for South Africans and legal immigrants who pay municipal tariffs.

- Due to the high quantity of waste generated by municipal solid waste within cities, the sustainability aspect has been threatened, hence the city of Johannesburg, in order to manage climate change, the waste to energy initiative is currently being implemented in order to reduce emissions of greenhouse gases and leachates. The waste to energy initiative seeks to produce methanol gases and gases that can be used as energy for buses to move around. Moreover, the waste-to-energy initiative also involves the biogas digester process that involves the utilisation of vegetable waste through the biological process.
- The study also discovered that landfill sites around the city tend to produce leachate gas, enhancing climate change, which has resulted in the municipality closing down a privately owned landfill site owned by an Interwaste management company as the landfill site was close to the midstream and residential areas, which affected community members as they were inhaling the gases produced by the landfill site. Once the methane and leachate gases are inhaled by humans, they tend to experience headaches, strokes, and other diseases. Furthermore, municipal solid waste also enhances climate change, as in the past landfill sites have experienced fires and pollution of the groundwater, which is not good for the environment.
- During the course of the research study, it was discovered that municipal solid waste is used as a strategy to improve the quality of life amongst community members, as informal waste collectors have stated that they collect plastic waste, cardboard and glass bottles from Monday to Friday and they sell the waste in bulk to processors, and the informal waste collectors are able to make around R5000 per month as processors and scrap yards pay around R15 to R20 per kg of waste brought.

6.2.3 Processes and strategies of solid waste management in cities.

- The research study discovered that the city of Johannesburg has implemented the door-to-door collection of waste from residential areas, whereby households place their 240-litre bins outside of their homestead on a specific day once a week for the waste collectors to come and collect waste .Furthermore, within the door-to-door collection of waste, the public and private sectors are the formal waste collectors who collect all the waste from the bins, while informal waste collectors within the city of Johannesburg

specifically choose the waste they are interested in collecting based on one's specialisation.

- As a strategy to manage waste effectively and reduce illegal dumping within the city of Johannesburg, the city has placed small and large community bins within the walkways for citizens to dispose of their waste instead of littering and illegally dumping waste. The community bins are placed in areas that experience a lot of traffic and human activities that produce waste. The public and private sectors are both playing their roles in availing community bins, whereby private companies have donated their skip containers that are placed within the city for citizens to dispose of the waste. Furthermore, it was discovered that the waste from community bins is collected at least three times a week, which reduces the financial costs and time for waste collectors as they don't have to travel long distances collecting waste as the community bins have a fixed location.
- Logistics and delivery companies have contributed largely to the waste management problems within the city of Johannesburg as delivery companies transport goods covered with card boxes, forms, and pallets for safety measures, but when they are done delivering the goods, they just leave the card boxes, plastics, foams, and pallets lying around in public.
- Municipal solid waste within the city is managed through the reduce strategy, which involves the utilisation of eco-friendly products for packaging and transportation of goods .It has been discovered that waste reduction is enhanced through the collection of eco-friendly products such as card boxes from retail stores .Furthermore, it was discovered that the informal waste collectors play a critical role in reducing waste as they collect the majority of card box materials from informal traders and retail stores that sell vegetables, fruits and clothing items that come packaged in boxes and foam plastic.
- Effective management of waste within the city of Johannesburg is enhanced through the participation of informal waste collectors, who can collect reusable waste materials from households. It has been discovered that within the city, if Johannesburg informal waste collectors collect glass material waste, mainly beverage bottles, for reusing them through the circular economy, which are sold to SAB, Coca-Cola, and other manufacturing companies.

- The city of Johannesburg is in the process of repurposing food waste disposed of in landfill sites as they take up a lot of air space; hence, the city is repurposing food waste into agricultural manure for farming purposes, as Pikitup SOC has partnered with multiple private companies that produce farming fertilizers. Pikitup SOC has also implemented the gasification process of repurposing waste and bio digesting organic waste found from food waste.
- Furthermore, the city of Johannesburg has implemented the On the Go recycling units for enhancing and promoting recycling activities to reduce waste disposed at landfill sites. However, the city of Johannesburg has also tried to have educational awareness campaigns that focus on waste management activities within communities, but they have not yielded positive results as the people in the less affluent or township areas are reluctant to take part in the campaigns as they state that waste management activities are the least of their problems as they are already characterised by a lot of socioeconomic problems.

6.3 Recommendations

Based on the data collected during fieldwork and from the secondary data in relation to Public-Private Partnerships, sustainability in cities and solid waste management process being implemented recommendations have been generated. This section is a provision of recommendations for policy, practice and future research towards tackling the waste management issues in the city of Johannesburg

6.3.1. Recommendations of policy

- Due to the responsibilities being undertaken by informal waste collectors, it is of outmost importance that policy be developed at the national government level, which covers the aspect of health and safety. The policy should be centred on health and safety requirements for informal waste collectors for when they go and collect waste from households and landfill sites as they inhale a lot of gases that cause headaches, diarrhoea, and other illnesses. Furthermore, the policy should also look at the provision of personal protective equipment's such gloves for handling waste and masks, amongst others, when handling waste.

- The municipality should formulate and enforce a policy for a collective approach to managing waste within the city by making it compulsory for citizens to participate in street sweeping and collection of waste around their residential areas in order to keep the environment clean, just like Rwanda does .The policy should make it mandatory for citizens to at least participate in waste management programs at least once a week for at least an hour, which can assist in reducing waste and making citizens aware of the importance of managing waste and keeping the environment clean, in order to enhance change within human behaviour. The policy will also assist in changing the behaviour of illegal dumping and littering of waste as citizens will know that they have to come and clean up later on, and the policy will also assist the municipality in reducing waste management costs as it is already underfunded.
- A remuneration policy for informal waste collectors should be developed in order to have fixed and fair remuneration rates for the waste they collect and sell to manufacturing companies and processors for recycling, reusing, and repurposing .The policy will make sure that informal waste collectors get compensated accordingly to what they deserve, and the department of environmental affairs should come on board for this policy and make sure that informal waste collectors are not exploited for their services .Furthermore, this policy will also encourage citizens to participate within the circular economy by sorting waste, collecting waste, and selling it for recycling purposes, as citizens will be assured by the policy that they will be compensated fairly. This recommendation comes because of complaints received from participants, as they alluded that they do not get fairly compensated by some of the processors and manufacturing companies who buy waste from them as their rates change from time to time.
- A policy must be developed that will investigate the management of PPP agreements by protecting the agreements from political instability, as the political activities within the city play a huge role in determining the future of the PPP agreements. Some of the private companies within the study have alluded to the fact that the coalition government and constant change of power also affect payments for the services they provide .The policy will prevent cancellation of PPP agreements prematurely on the basis that there's political differences amongst stakeholders because when there's a change of power, some political parties want to only work with people who align with their interests and that possess as a threat to the success of PPP agreements. The policy

should prohibit political interference in the formulation of PPP agreements and management of PPP contracts.

- The development of the Integrated Development Planning for the City of Johannesburg Metropolitan Municipality should be revised and start including service delivery for waste management services. It has been highlighted by one of the Pikitup SOC officials that waste management services are not taken seriously by the government, and they are not incorporated within the IPD document of the city; hence, it is even more difficult to enhance community participation and receive sufficient funding for waste management services.
- A policy should be developed and initiated for dealing with illegal dumping within the city of Johannesburg, whereby there should be harsher punishments issued to perpetrators of illegal dumping and littering within the city as they contribute to environmental degradation and pollution. In most cases, when a person is arrested for illegally dumping waste, they are given a fine of a certain amount, which makes it difficult to hold people accountable. Illegal dumping should be regarded as a serious criminal act towards the environment and ecosystem as it kills the environment and societal hemisphere; hence, this policy is important for the protection of non-living things. It has been proposed that people who are caught for illegal dumping should be given a jail sentence and community service as their actions of attempted murder as they kill the environment, non-living things, and natural resources.
- Illegal dumping and waste generation contributed by informal traders should be dealt with as a matter of urgency as they contribute largely to the littering and large quantity of waste generated within the city. A policy should be developed that is in line with the process of issuing out trading permits for informal traders that will force them to clean after their waste and keep their trading perimeters clean, and if they don't comply, their trading permits should be revoked. This policy will ensure that informal traders also play their role in waste reduction and keeping the city clean, as they are regarded as one of the biggest contributors of waste and illegal dumping within the Johannesburg CBD, so stricter measures need to be put in place.
- Immigration laws should be reviewed within the South African context since illegal immigrants also play a pivotal role in illegal dumping and littering, as there's an issue of cultural norms and beliefs in the way of doing things from where they come from and South Africa. It's very important to review the immigration laws when it comes to

the issue of illegal immigrants, as they contribute to land evasions, and our constitution protects them as it states that once a person, whether a South African or an illegal immigrant, invades a place for more than 24 hours, that particular person must be provided with alternative accommodation, and that has resulted in the increment of informal settlements within the city of Johannesburg. Land invasion should be treated as a serious offence towards the government, citizens, and the environment.

- A policy should be formulated and implemented for the formalisation of informal waste collectors, as they play a critical role in waste minimisation and the circular economy. Currently, informal waste collectors do not have a policy or legislation that governs them, which makes them illegal. Therefore, a policy that will provide constitutional obligations for informal waste collectors is of outmost importance, as this initiative is an income generation initiative for different households within the city. The policy will also create an environment for more people to participate in the circular economy and green economy, and that will result in waste reduction.
- To enhance waste reduction within society, a policy should be implemented for private companies and delivery companies for the utilisation of eco-friendly products for packaging purposes and safe keeping of their products when transporting them. Eco-friendly products contribute largely to pollution, greenhouse emissions, and climate change, and the empirical data and secondary data have stated that delivery companies and firms contribute largely to this problem. Therefore, the implementation of this policy is of outmost importance, as companies, firms, and consumers will be forced to consume eco-friendly products.

6.3.2. Recommendations of practice

- It is recommended that waste management services must be prioritised and taken seriously by senior management or decision makers within the government sector. Waste management services must be allocated more financial budget and be treated as a priority towards sustainable development within the country hence the National, Provincial and Local governments need to work together, and the National treasury needs to conduct a feasibility study to determine the impact and level of solid waste generated before allocating a budget for waste management services to Municipalities.

- The Pikitup SOC needs to form partnerships with private manufacturing companies and processors to effectively promote recycling, reuse and repurposing of waste as they can be given an opportunity to have more access to waste at landfills and garden sites which will assist in reducing production costs for companies.
- Small community bins need to be maintained regularly so that they can be effective for the disposal of solid waste as the study discovered that within the city of Johannesburg community bins in different places are not maintained and the infrastructure has deteriorated which makes it unappealing to citizens to dispose waste correctly as people end up dumping the waste on the walkways.
- The collection schedules of waste from households and businesses needs to be revised whereby instead of collecting waste once a week the waste can be collected at least two times a week in areas that have been identified to be generating high quantity of waste and illegal dumping.
- Furthermore, it is recommended that more big community bins need to be placed within the CBD of Johannesburg which will make it easier for informal traders and business to dispose their waste effectively as the small community bins structure is not effective as they get full very fast so more community bins at public spaces such as taxi ranks need to be placed as they experience a lot of waste generated.
- Waste management services need to be incorporated within the IDP of the municipality which will outline a five-year plan on how waste will be managed within the city. Furthermore, community participation for waste management services needs to be prioritised so that the community can be aware that management of waste is also their responsibility and the waste projects within their communities are for their wellbeing. The community participation recommendation will result in social cohesion towards the management of waste in communities and that will reduce the burden carried by the public sector.
- As it has been recommended that community participation will play a critical role in enhancing an effective waste management strategy within communities. Furthermore, it is also recommend that community participation initiatives will assist in promoting educational awareness programs for waste management in townships and less privileged communities as one of the findings of the study it's that townships and less privileged communities do not receive the educational awareness programs very well as they reject them and that is due to the fact that community members do not feel like

they own the projects .Community participation will endure that community members are part of the decision making process which will make them to want to tackle part within the educational programs and take part within the circular economy.

- It is recommended that informal waste collectors need to be legalised and included within the waste management framework and be treated as private role players towards waste management. This recommendation will assist in attracting more people from the community to participate in the collection of waste for recycling purposes. There needs to be more financial and resource investment towards the waste to energy initiatives at landfill sites, as they will assist in reducing the quantity of waste landfill sites and generating energy.
- There needs to be an overview of the marketing of waste management specifically towards informal waste collectors, as a new marketing strategy needs to be developed that will provide a paradigm shift to citizens that waste collection is the new gold and can deal with issues such as poverty and unemployment .A development of a new marketing strategy for waste collection by community members will remove the mindset from people that waste collection is done by drug addicts or people who are not mentally.
- It is also recommended that the South African government adopt the circular economy as a new way of managing waste, creating jobs, and reducing poverty while conserving the natural environmental resources. The national government needs to support local municipalities in setting up structures and resources for the implementation of a circular economy within their municipalities, as this initiative will solve many social, economic, and environmental problems.

6.3.3. Recommendations for future research

- The data collected within this research study has noted that PPP agreements within the city of Johannesburg tend to be negatively affected by political instability, which creates a problem for managing waste effectively .Therefore, it is recommended that a research be conducted about the effects and impacts of political instability within national departments, provincial departments, and local governments with regards to service delivery and management of PPP agreements as the South is moving into a new political landscape of government of national unity, government of provincial unity,

and coalition governments at local municipalities, which started in 2016 within the city of Johannesburg Metropolitan Municipality.

- Thorough research needs to be done on the impact of illegal immigrants towards waste management in major cities, as there's a lot of cultural differences and norms between their original countries and where they originate from, as some illegal immigrants don't see any problem with dumping waste just anywhere on the ground. This research recommendation will assist in determining the role they play towards the problem of illegal dumping and littering but will also assist in assessing their role towards infrastructure deterioration, land invasions, and high jacking of buildings within the city of Johannesburg.
- For future research, it is recommended that a study be done on how technology can be incorporated towards the management of municipal solid waste. Furthermore, a research study needs to be conducted on the impact that the circular economy has on waste reduction and cost reduction for the public sector when it comes to waste management services.

6.4. Conclusions

The research study has managed to generate relevant and credible data for the formulation of a Public Private Partnership model in waste management for sustainable cities as an inductive research design was implemented as one of the research methods played a significant role in the development of a model instead of utilising existing theories. The findings within this research project made it possible to make findings with relation to the Public Private Partnership forms and conditions being implemented within the city of Johannesburg and whether or not if they effective in managing municipal solid waste. Furthermore, data findings managed to determine the characteristics of urban sustainability within the city of Johannesburg and also processes and strategies being implemented in the management of municipal solid waste have been discovered and the public sector together with the private sector is playing a pivotal role in implementing waste management processes.

This research study has revealed that there are PPP agreements found within the city of Johannesburg Metropolitan Municipality as the researcher found that waste management services are under the Pikitup SOC which has entered into multiple PPP agreements with the private sector towards enhancing an effective waste management system. Furthermore, it was

discovered that PPP agreements are constituted by the Municipal Systems Act and the Municipal Finance Management Act which makes provision for the procurement of private services. Public Private Partnership agreements in the city has assisted in the collection, transportation and disposing of waste as private companies have leased their waste compactor trucks and landfill sites which play a pivotal role in the waste management. The PPP agreements also provide a business environment that makes it possible for businesses to flourish which results in job creation and economic growth.

The research study has raised concerns with regards to the sustainability of the city of Johannesburg in relation to its economy, natural environmental resources, climate change reduction, and quality of life. Based on the derived data within this research study, the city of Johannesburg is deteriorating at a fast pace due to economic activities, urbanisation, industrialisation, and rapid population growth, which have resulted in an increase in the quantity of waste generated. Therefore, the sustainability of the city is at risk due to administration, technical, political instability, and availability of finance challenges faced by the municipal government when it comes to the management of waste within the city. The research study managed to determine the waste management strategies and processes being implemented within the city of Johannesburg, whereby a finding was made that the city of Johannesburg has in place waste collection strategies, recycling strategies, repurposing of waste, reuse of waste, and waste reduction mechanisms that involve private companies and informal waste collectors, which later on results in the stimulation of the circular economy.

Interesting findings, which formed a foundation for the development of a PPP model for waste management in the city of Johannesburg. Data collected from this research study assisted in identifying the gaps within the waste management sector, the development of PPP agreements, and a collective approach that should be implemented towards managing waste and reducing the burden faced by the municipal government. Therefore, the PPP model that has been developed within this research is centred around the inclusivity of informal waste collectors and their formalisation together with the promotion of community participation initiatives in accordance with waste management for the stimulation of the circular economy. The circular economy will result in waste reduction while creating income generation initiatives for communities and reducing the consumption of resources while preventing environmental damage and climate change.

6.5. Limitations of the study

The limitations that emanate from this research dissertation are that the research was conducted within the city of Johannesburg, region D, E and F, and perceptions and experiences of other cities within Gauteng or around the world were not included, which makes the research findings solely for the city of Johannesburg and does not mean that other cities are facing the same problem. Furthermore, the research experienced limitations when it comes to participant's recruitment, as some informal waste collectors were reluctant to participate in the data collection process as they thought I was a law enforcement official who's in the process of investigating them, even though I had explained multiple times that the research was for school purposes. The research study is characterised by private waste companies that have entered PPP agreements, and the private waste management companies requested that the names of their companies and organisations not be mentioned within the research dissertation for confidentiality and anonymity purposes. The request from private waste management companies comes from the fact that private waste management companies do not want to give out information, which might jeopardise their working relationship with the public sector, which might result in them being blacklisted. During the data collection process, the study also faced limitations when it came to interviewing participants from private companies and government departments, as the initial sampling framework had suggested that in each and every organisation at least three people would be interviewed, but that wasn't the case as organisations could only provide one representative from a senior management position to partake in the data collection process due to a shortage of human resources and time constraints; hence, the researcher only managed to interview at least one participant from each of the three private companies. Data was collected from participants who are located and operated within region D Region E and region F of the city of Johannesburg and when I had reached the third person of each of the five categories of the sampling frame they were a repetition of opinions, behaviour and experiences with regards to the management of solid waste management and that did not provide any new information.

6.6. Chapter Summary

The above chapter was the last chapter of the dissertation and is conceptualised by the conclusions of the research study on how the research dissertation was conducted and how the research questions were answered. The chapter illustrated that the research objectives of the research dissertation were achieved, and the aim of the dissertation, which is to develop a model, was successfully achieved as the implementation of an inductive research design, empirical data, and secondary data played a critical role in developing the model for waste management in cities. Furthermore, chapters are also characterised with recommendations from the researcher based on the research study findings and are explained systematically in correlation with the research objectives. The possible recommendations that were developed in the chapter seek to address the gap within the forms and conditions of PPP agreements for waste management services in cities, together with the recommendations that can be implemented for enhancing sustainability within the city of Johannesburg. Moreover, the chapter provided recommendations for enhancing a more effective waste management strategy and processes to be implemented. Therefore, this was the final chapter, which illustrates that the intended research objectives and aim were achieved and possible solutions for the research problem at hand have been provided.

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Annexure A: Ethical Clearance

Faculty Research Ethics Committee

FREC-UMP



Ref: UMP/Khoza/11/2023

Date: 20 November 2023

Thabang Khoza (201964899)
School of Development Studies

RE: APPROVAL FOR ETHICAL CLEARANCE FOR THE STUDY:

***A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities:
The Case of the City of Johannesburg Metropolitan*** Reference is made to the above heading.

The Chairperson, on behalf of the Faculty Research Ethics Committee (Faculty of Economics, Development and Business Sciences) UMP, approved the ethical clearance of the above-mentioned study. Any alteration/s to the approved research protocol i.e., Questionnaire/Interviews Schedule, Informed Consent form, Title of the Project, Location of the Study, Research Approach, and Methods must be reviewed and approved through the amendment/ modification prior to its implementation.

PLEASE NOTE: Research data should be stored securely in the school/division for a period of 5 years.

The Ethical Clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter, Recertification must be applied for on an annual basis.



Prof. Ogujiuba Kanayo

Chairperson: FREC,

Faculty of Economics, Development and Business
Sciences University of Mpumalanga

Annexure B: Consent Form

A Consent Form for Participation in the Study.

I agree to participate in a research project conducted by Thabang Khoza who is a Master of Development Studies candidate at the University of Mpumalanga.

This participation form serves as permission that I am giving to the researcher regarding my full participation in this research.

The participation form also acknowledges the following aspects:

1. I have adequate information about the research topic, and I understand the study.
2. I understand that my participation is based on voluntary participation. Therefore, the role that I will play in the study has been clearly outlined to me and I understand the role.
3. I am fully aware that since my participation is voluntary and there is no force used on me to participate in the study. I can withdraw at any stage of the researcher when I no longer feel comfortable sharing any information.
4. I understand that during the data collection process, the researcher will take written notes and use a tape recorder to record our conversation for the purpose of the study. I give the researcher full permission to take written notes and I am aware that I can choose to not be recorded by the researcher.
5. I am aware that my anonymity, privacy and confidentiality will be respected in this study. Therefore, the researcher will only share information that I have fully agreed upon for the need of the study.

.....

Participants signature

Date:

.....

Researcher signature

Date:

Annexure C: Gate Keepers Letter



a world class African city

City of Johannesburg

Department of Corporate & Office of the Group Head: Group Human Capital Management Shared Services

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05 December 2023

Thabang Khoza

Student No: 201964899

Master of Development Studies

University of Mpumalanga

Ref: Permission to conduct research study

This letter serves to acknowledge receiving the letter requesting permission to conduct research in the City of Johannesburg under the title: **“A MODEL FOR PUBLIC-PRIVATE-PARTNERSHIP ON SOLID WASTE MANAGEMENT TOWARDS SUSTAINABLE CITIES: THE CASE OF THE CITY OF**

JOHANNESBURG METROPOLITAN”. I am aware that the study entails the collection of information from the City, city officials and participants from communities through semi-structured interviews, questionnaires, observation participation and other fora of the city.

The research study is promoted by the City of Johannesburg because it helps both students and practitioners to gain an understanding of the sociology of the City, as it evolves and contributes towards the building of developmental local government.

I, Tersia Johanna Groenewald, as delegated authority of the City of Johannesburg Municipality (the City), hereby give permission to the primary researcher, Thabang Khoza, the following:

To collect and publish information about the City is publically not available, for the research project titled:

“A MODEL FOR PUBLIC-PRIVATE-PARTNERSHIP ON SOLID WASTE MANAGEMENT TOWARDS SUSTAINABLE CITIES: THE CASE OF THE CITY OF JOHANNESBURG METROPOLITAN”.

- This authorisation is based on mutual understanding that the City’s name can be revealed in her/his project; and
- The researcher contacts the relevant department for arrangements pertaining to the research; and
- The information provided by the employees or any other means (such as company’s archived documents or reports) of the City is purely for academic purposes and cannot be used for any other purpose.

Please note that on completion of the study, a copy of the research report should be submitted to the City of Johannesburg in honour of your commitment.

I urge you to present this letter of permission whenever you come across officials and participants in the research study. I thank you for choosing the City of Johannesburg to conduct the study.

Kind Regards



Ntombozuko Lufungo (on behalf of Tersia Groenewald)
Acting Manager: Human Resource Development
Tel: (011) 407- 6064
Email: NtombozukoL@joburg.org.za

Annexure D: Interview guideline for key participants

Research interview schedule

For Landfill site officials

Master of Development Studies Research Dissertation

Research Dissertation Title: **A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan.**

1. Which role do you occupy?
2. How long have you been occupying the specified role?
3. How long has the landfill site being operating and what is the lifespan of the site?
4. Is the landfill site located in an urban, rural or semi urban area?
5. What is your opinion when it comes solid waste?
6. What is the flow of solid waste within the landfill site?
7. Are there any technological equipment's you have in your sites that assists in managing solid waste?
8. How is waste collected from residential areas?
9. What are the processes you have in place that enhances?
 - Recycling
 - Repurpose
 - Reuse
 - Waste reduction
10. On a daily basis what is the quantity of solid waste you receive?
11. Do informal waste collectors come and dispose waste here
12. Are there any private companies that you have partnered with when it comes to solid waste
 - Recycling
 - Repurpose
 - Reuse
 - Waste reduction
13. What methods do you have in place in order to reduce waste within the site?

14. If waste reaches its fully capacity, what do you do?
15. Which service providers come and dispose waste?
16. Do you have enough resources to make sure that the operation of the site is effective?
17. What are the challenges you experience within the site?
18. What do you think should be done in order to reduce the solid waste problem faced by the city ?

: Interview guideline for key participants

Research interview schedule

For City of Johannesburg Metropolitan Police Department officials

Master of Development Studies Research Dissertation

Research Dissertation Title: **A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan.**

The data and information that will be provided by the key participants will only be utilized for this research study or academic purpose only. Please note that you are not forced to participate as this is voluntary participation. Below are the interview questions:

1. What role do you occupy?
2. How long have you been occupying the specified role?
3. What role does your organization play in managing municipal solid waste and dumping within the CoJ?
4. What is your opinion about solid waste in the CoJ?
5. Are there any policies that you have in our department that specifically deals with solid waste?
6. What is the flow of solid waste within the city?
7. How frequent do citizens dump waste in the city?
8. In your own opinion what do you think makes citizens to end dumping waste illegally?
9. Are you satisfied with municipal solid waste management strategies implemented within the city?
10. Has municipal solid waste and illegal dumping affected the road infrastructures in the CoJ?
11. Do you think there enough garbage bins placed within the city for people to dispose waste?
12. How does illegal dumping of solid waste affect your job when you're on the field?
13. What kind of municipal solid waste bylaws do you implement in the city?
14. Are there any programs or campaigns that you conduct in order to alert the citizens about bylaws that they must follow for disposing of waste?

15. Who do you think are the most polluters in the city?
16. What are the challenges you experience when enforcing law and order towards citizens when it comes to solid waste?
17. What do you think should be done in order to reduce illegal dumping?

: Interview guideline for key participants

Research interview schedule

For City of Johannesburg Environmental and Infrastructure Department officials

Master of Development Studies Research Dissertation

Research Dissertation Title: **A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan.**

The data and information that will be provided by the key participants will only be utilized for this research study or academic purpose only. Please note that you are not forced to participate as this is voluntary participation. Below are the interview questions:

1. Which position do occupy in this institution?
2. How long have you been in the position?
3. What is your opinion about solid waste within the CoJ ?
4. Which specific role does your organisation play as a stakeholder when it comes to municipal solid waste?
5. What is your opinion when it comes to people dumping waste in open fields and its impacts towards the environment?
6. Are you satisfied with the way solid waste is managed in the city?
7. Do you think the implemented municipal solid waste management strategies are effective in the city?
8. Is there any partnership between your organisation and other government organisations, SOC and private institutions when it comes to management of solid waste?
9. Is climate change one of the problems faced by the city?
10. What are the effects of solid waste towards the environment in general?

11. Are there any environmental awareness campaigns that you conduct in communities in order to enhance safe and healthy environments?
12. Has the department constructed or implemented any infrastructure that seeks to tackle municipal solid waste?
13. What kind of infrastructure does the city have that will enhance solid waste collection, recycling and transportation systems within the city?
14. What kind of measures has the department implemented in order to promote recycling, reuse and reduce of solid waste produced?
15. systematic process for collecting and disposing of solid waste
16. Does municipal solid waste play a role in pollution and environmental issues faced by the city?
17. Does the city have enough environmental segments to have a sustainable and urban city?
18. What kind of challenges do you face when it comes to municipal solid waste in the city ?
19. What methods can you recommend in order to have an eco-friendly environment that is free from pollution and dumping of solid waste?

: Interview guideline for key participants

Research interview schedule

For Pikitup SOC officials

Master of Development Studies Research Dissertation

Research Dissertation Title: **A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan.**

The data and information that will be provided by the key participants will only be utilized for this research study or academic purpose only. Please note that you are not forced to participate as this is voluntary participation. Below are the interview questions:

1. Which position do you occupy?
2. How long have you been in the Pikitup organisation?
3. What is the main responsibility of your organisation?
4. Does the organisation have any partnership agreements with other organisation in relation to solid waste? If so please specify
 - Duration of partnership
 - Responsibilities
 - Leases
5. Is there any Public-Private Partnership that the organisation is involved in?
6. What kind of methods do you use to collect solid waste within the CoJ?
7. How is solid waste transported in the city?
8. What is the flow of municipal solid waste within the CoJ?
9. Are the available resources sufficient for managing solid waste within the CoJ?
10. Do you have any interrelation with informal waste collectors?
11. What kind of refuse collection methods do you have in place?
12. Do you have any systematic process for collecting and disposing of solid waste ?

13. How do you enhance recycling, reuse and repurposing of solid waste?
14. Where is solid waste disposed after it has been collected from residential areas ?
15. How many landfills and dumping sites do you have in place which are in full operation?
16. What is the life span of the landfills and dumping sites?
17. Who manages and takes responsibility of the landfills and dumping sites?
18. What kind of challenges do you experience at the landfills and dumping sites?
19. What kind of methods have you implemented to reduce solid waste within the city?
20. Is there any programmes that the organisations implements in order to promote a green environment?
21. How frequently is waste collected from households and other residential areas?
22. What kind of tools do households and other residential areas use to store solid waste ?
23. What kind of municipal solid waste infrastructure is available within the city waste storage?
24. How much are the municipal solid waste taxes and tariffs and how does it work?
25. Are there any illegal dumping activities that occur in the city? If so please specify what influences those activities?
26. How is waste processed after being collected from different points in the CoJ?
27. What are the challenges that you experience when it comes to management of solid waste within the CoJ?
28. What do you think should be done to reduce the large quantity of solid waste produce by CoJ citizens?

: Interview guideline for key participants

Research interview schedule

For Informal waste collectors

Master of Development Studies Research Dissertation

Research Dissertation Title: **A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan.**

The data and information that will be provided by the key participants will only be utilized for this research study or academic purpose only. Please note that you are not forced to participate as this is voluntary participation. Below are the interview questions:

1. How long have you been a waste collector?
2. What are the requirements of being a waste collector?
3. What has influenced you to become a waste collector?
4. What impact does it have towards your life?
5. When collecting waste is the specific waste materials that you collect?
6. What is your opinion about solid waste in the municipality?
7. What methods do you use to collect waste?
8. Is there any waste collection method that you can propose for the future?
9. Do you collect waste in one area or multiple areas? If so please specify
10. Is there any partnership between you and the municipality towards managing solid waste?
11. After collecting waste from residential areas where do you take the waste to?
12. Do you get any remuneration for collecting waste and bringing it to designated areas?
13. What is the average quantity of waste you collect on a daily basis?
14. On average how much revenue do you generate from waste collection?
15. What kinds of solid waste materials are essential for recycling?

16. What kinds of challenges do you experience when recycling waste?
17. Any recommendations you would like to make for managing solid waste?

: Interview guideline for key participants

Research interview schedule

For Private Formal waste management collectors

Master of Development Studies Research Dissertation

Research Dissertation Title: **A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan**

The data and information that will be provided by the key participants will only be utilized for this research study or academic purpose only. Please note that you are not forced to participate as this is voluntary participation. Below are the interview questions:

1. What role does your organisation play when it comes to solid waste management in the city?
2. How long have you been in operation?
3. What is the process of being a formal waste collector?
4. Are you involved in any public-private partnership?
5. If so what responsibilities do you have in agreement?
6. Does your organisation have any partnership agreement with the municipal government?
7. What kind of processes do you use to manage solid waste?
 - Recycle methods
 - Reuse methods
 - Repurpose methods
8. If so, what kind of partnership agreement does it have?
 - What is the duration of the agreement?
 - Does your organisation receive any type of assistance from the government?
9. What does your organisation specialise in on a daily basis?
10. What is your opinion when it comes to solid waste in Johannesburg Municipality?
11. What type of methods do you use to collect waste?
12. What type of methods do you use to dispose waste?

13. How can the quantity of solid waste be reduced in the municipality?
14. What kind of processes have you developed and implemented to manage solid waste?
15. What are the challenges that you encounter when it comes to solid waste?
16. What can you recommend in order to have an effective and efficient solid waste management in the municipality?

Annexure E: Similarities report

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"Municipal Solid Waste Management in Asia and the Pacific Islands", Springer Science and Business Media LLC, 2014

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Annexure F: Language editing certificate



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TO WHOM IT MAY CONCERN

LETTER OF CONFIRMATION OF PROOFREADING AND EDITING SERVICES RENDERED TO MR THABANG KHOZA WITH STUDENT NUMBER 201964899 FROM THE UNIVERSITY OF MPUMALANGA

This letter serves to confirm that proofreading and editing services were rendered to Mr Thabang Khoza on his research project titled "A Model for Public-Private-Partnership on Solid Waste Management towards Sustainable Cities: The Case of the City of Johannesburg Metropolitan", a research paper submitted in fulfillment of the requirements for the degree in Master of Development Studies at the University of Mpumalanga.

At Research Rescuers, we pride ourselves in providing exceptional proofreading and editing services to postgraduate students in the pursuit of their research dissertation journey. As such, this letter serves to confirm the rendering of such services to the student and confirm that the research project has been proofread according to the highest standards in alignment with acceptable academic writing guidelines. We therefore recommend that the research paper is grammatically coherent and has been edited to eliminate language and grammatical errors.

For any inquires relating to the above, please feel free to contact Mr Evens Masemola who was delighted with the task of editing and proofreading the research paper.

Yours sincerely,

Mr Evens Masemola

Director

SEM Resolutions Pty (Ltd) (trading as Research Rescuers)

Date: 21/11/2024