EFFECT OF MUNICIPAL WASTE MANAGEMENT BUDGET ON WASTE MANAGEMENT SERVICE DELIVERY

By

TUMELO ABRAM MANAMELA

DISSERTATION

Submitted in fulfilment of the requirements for the degree of

MASTER OF COMMERCE

In

ACCOUNTING

In the

FACULTY OF MANAGEMENT AND LAW

(School of Accountancy)

At the

UNIVERSITY OF LIMPOPO

SUPERVISOR: PROF. M.B. FAKOYA

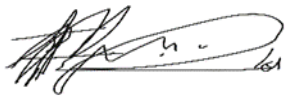
2022

DEDICATION

I dedicate this dissertation to my father Mr SF Manamela, my mother Mr SL Manamela, my sister Mrs MJ Nduru, my uncle Mr OA Diale and my late sister Miss MM Manamela.

DECLARATION

I declare that the **"EFFECT OF MUNICIPAL WASTE MANAGEMENT BUDGET ON WASTE MANAGEMENT SERVICE DELIVERY''** hereby submitted to the University of Limpopo, for the degree of Master of Commerce (Accounting) has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.



22 April 2022

_____ _____

Mr Manamela TA Date

ACKNOWLEDGEMENT

I want to thank the following persons for their respective contributions to this dissertation:

- Firstly, I would thank God for blessing me with the opportunity to complete the study successfully.
- Prof MB Fakoya, my supervisor, for the support, guidance, mentorship and encouragement.
- Prof CC Ngwakwe, for his support, guidance, mentorship, and encouragement.
- My dearest Father and Mother, Mr SF Manamela and Mrs SL Manamela, for their unconditional support, patience, and motivation.
- My sister, Mrs MJ Nduru, for her encouragement and support.
- Mr F Nduru, for his motivation, encouragement and prayers.
- The African Centre for Sustainability Accounting and Management of the University of Limpopo for the support and guidance.
- The Risk and Vulnerability Science Centre of the University of Limpopo for their guidance and support.
- The School of Accountancy of the University of Limpopo for allowing me the opportunity to do this study.
- My friends and colleagues for their support.

ABSTRACT

South Africa has seen an increase in population over the years and that has resulted in the increase in waste which has created problems in waste collection. Waste management service delivery has become one of the essential services provided by local municipalities. It is essential for local municipalities to effectively provide waste management services to the public. Therefore, this study aims to examine the effect of the waste management budget on waste management service delivery. A quantitative research approach is used in the study and secondary data was sourced from local municipalities' websites for 12 years, that is, the reporting period from 2010 - 2021. The study tests the correlation between waste capital expenditure, waste operating expenditure, waste collection revenue, Budget performance and municipal waste management service delivery in selected municipalities in South Africa. Using the Generalised Method of Moment (GMM) the results indicated that there is a significant correlation between municipal waste management service delivery and waste capital expenditure, waste operating expenditure, waste collection revenue and budget performance. The study suggests that local municipalities should increase their municipal waste budget to improve the quality of waste management service delivery.

KEY CONCEPTS

Budget performance; Local municipality; Waste; Waste capital expenditure; Waste collection revenue; Waste management; waste management service delivery; Waste operating expenditure

Table of Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE: GENERAL INTRODUCTION

1.1. INTRODUCTION

This study proposes a way in which local municipalities can be cost-efficient without affecting the quality of the services that they provide. According to Rogge and De Jaeger (2012), municipalities are faced with the challenge of creating a budget without increasing taxpayers' tax burden or reducing the services provided. The costs associated with providing waste management service delivery is mostly dependent on bin collection frequency, transportation routes, transportation mode and the deployment of transfer stations (Aleluia & Ferrao, 2017). Lohri, Camenzind and Zurbrugg (2014) state that to achieve and maintain financial sustainability for all short-term and long-term financial costs, municipalities need to put in place procedures for the regular collection of waste revenue to cover all expenses.

In South Africa, local municipalities have two (2) primary sources of income, a government subsidy and local taxes (monthly fees paid by local residents benefiting from the service delivery). Therefore, local municipalities estimate the expected income to be received to budget their expenditure. De Jaeger and Rogge (2013) indicate that there has been an increase in the number of studies that aim to evaluate and assess the cost efficiency in terms of local municipalities' waste collection service. Other studies show that increasing populations have an impact on municipal solid waste service delivery, which creates constraints because local municipalities need to achieve efficient service delivery with limited funds (Alzamora & Barros, 2020: Bel, Fageda & Mur, 2012). Additionally, Abrate, Erbetta, Fraquelli and Vannoni (2014) found that corruption has a significant effect on service delivery. This means that though the budget may be enough to provide efficient waste service delivery to the public, corruption may likely lead to the inefficient provision of solid waste management service delivery.

There is a global concern about costs and efficiency in waste management (Nanda & Berruti, 2021: Simões & Marques, 2012). A budget that is strictly followed will undoubtedly help in addressing the issue of cost efficiency in waste management. One significant contribution of this study may be the adding to literature and assisting waste

management decision-makers in understanding the influence of waste management budgeting on waste management service delivery.

Pérez-López, Zafra-Gomez and Plata-Diaz (2016) state that there are challenges when evaluating the government service delivery even the service delivery that t=were outsourced to private institutions. Although municipalities offer different kinds of services, the service that is most studied is the service of municipal solid waste and hence this study shall focus on this service. This study will investigate how the municipal waste management budget impacts on waste management service delivery and how this will impact members of the community. This study will not only focus on the overall waste management budget but it will subdivide the waste management budget into different categories. These categories are: capital expenditure, operational expenditure, and municipal revenue.

Although the literature has proven that small municipalities usually achieve cost efficiency, this is because its operations are not as complex as those of large municipalities (Sobotka & Sagan, 2016). Therefore, this study will focus on the local municipalities in South Africa and exclude the District and Metropolitan municipalities in South Africa. This study aims at analyse how the municipal waste management budget on income and expenditure affects solid waste management service delivery and assesses whether the municipal waste management service will be improved.

The above section discussed the introduction of the study and the following sections is the discussion as follows: Section 1.2 presents the research problem. Section 1.3 presents the methodology. Section 1.4 presents the research hypotheses and followed by the objectives of the study in section 1.5. Section 1.6 presents the significance of the study. Section 1.7 presents the definitions of teams and followed by the structure of the study in section 1.8. The last section is summary of the chapter in section 1.9.

1.2. PROBLEM STATEMENT

In recent years, waste service delivery has become one of the essential service delivery which the local municipalities has been providing to the community. Local Municipalities are faced with the challenge of efficiently disposing of waste within their

geographical boundaries. Therefore, the main challenge identified in this study is how local municipalities reconcile the municipal waste budget and the waste management service delivery they provide to the residents within their geographical boundaries. Municipalities have a responsibility for waste collection in the areas they govern and reduce the impact that waste has on the environment (Ebenezer, 2019). With that said, local municipalities in South Africa are faced with the challenge of waste collection within their areas with a constrained municipal waste budget. Therefore, the dilemma that is faced by those charged with governance in local municipalities is how they should budget for capital expenditure, operational expenditure, and collection of waste service-related revenue as waste management services are essential.

Lohri *et al.* (2014) state that municipalities are faced with the challenge of enhancing financial sustainability in their various departments. Therefore, the department of waste management is faced with the challenge of ensuring that the budget allocated to its department is enough to ensure its activities will not cease before the next year's financial period. The fact is that waste services are linked mostly to the municipal budget that is transferred to it. Therefore, this study shall analyse whether the municipal waste budget influences waste collection in local municipalities in South Africa. Furthermore, the pressure of cost efficiency on public services makes the government transfer some of the services to the private sector. Therefore, this causes constraints in the budget. In this study, the impact of public-private partnership on waste management service will not be investigated. According to Ren and Hu (2014), cost recovery is based on the rates on which fees are charged for the services provided; therefore the budget constraints arise from the low fees which are charged, and the services are compromised, and if the fees are too high, this will cause public complaints. The specific research problem of this study is how the waste collection revenue, capital and operational expenditure and budget performance affects the waste service delivery.

1.3. RESEARCH HYPOTHESES

This section presents the hypotheses used to investigate the effect of the municipal waste management budget on waste management service delivery. Each hypothesis accentuates a section in the municipal waste management budget.

H_1: There is no correlation between municipal waste management service delivery and waste capital expenditure in selected South African municipalities

H_2: There is no correlation between municipal waste management service delivery and waste operating expenditure in selected South African municipalities

H_3: There is no correlation between municipal waste management service delivery and waste collection revenue in selected South African municipalities

H_4: There is no relationship between municipal waste management service delivery and budget performance in selected South African municipalities.

1.4. OBJECTIVES OF THE STUDY

The main objective of this study is to add to the body of knowledge found in the literature on the topics of the municipal waste management budget and municipal waste management service delivery. This can be achieved by performing procedures that analyse how the municipal waste management budget is used to improve waste service delivery. The following are the sub-objectives to:

- Examine the correlation between municipal waste management service delivery and waste capital expenditure in selected South African municipalities
- Examine the correlation between municipal waste management service delivery and waste operating expenditure in selected South African municipalities
- Examine the correlation between municipal waste management service delivery and waste collection revenue in selected South African municipalities
- Examine the correlation between municipal waste management service delivery and budget performance in selected South African municipalities.

1.5. SIGNIFICANCE OF THE STUDY

This study is critical because it assesses the cost of efficiency of the disposal of waste and will assess the effect of waste management budget on waste management services delivery of local municipalities. The results of this study will strengthen law enforcement regarding waste management policies, create awareness in the society and assist local municipalities to analyse the impact of waste management service delivery on the preparation of the municipal waste management budget and improve the treatment of waste and how it can be environmentally friendly. Therefore, local municipalities that will apply the recommendations made in this study will be able to understand the effect of the municipal waste budget on waste management service delivery. Additionally, the local municipalities' accounting officers will benefit from the recommendations of this study when budgeting for waste management service delivery. For the researchers, the study will assist researchers in studying the financial implications of waste management that other researchers did not explore. Therefore, the waste management and the institutional theories may be improved, or a new theory may be developed on municipal budgeting for service delivery. The result of this study hope to improve how local municipalities budget for waste collection in the areas they govern.

1.6. DEFINITION OF TERMS

The sustainable solid waste management system is defined as the combination of a management program and the economic, political and environmental, social-cultural and technical components (Sobotka & Sagan, 2016).

Solid waste: solid waste is a known as material that is thrown away that is no longer in use whether by human beings or animals and the abandoned material can be recyclable materials or non-recyclable materials (Lodhia & Hess, 2014).

Budget: A budget is a financial plan which estimates financial data (figures) and how the estimated amounts are to be used. This is accomplished by setting out costs (such as capital expenditure and operational expenditure) of planned activities and how will the income be generated to cover such expenses (Okubena & Imuezerua, 2016).

Local municipality: A local municipality means a municipality that has municipal executive and has the authority to operate within a particular area which may include rural areas or small towns or cities. A local municipality is described as a category Municipality as per the constitution of South Africa (Pasquini, Cowling & Ziervogel, 2013).

1.7. RESEARCH METHODOLOGY

Study research hypotheses have been answered quantitatively through the use of the quantitative methodology. Additionally, this study used panel data analysis to answer the research hypotheses quantitatively. The study population consist of all local municipalities in South Africa. The sample size for this study was 44 local municipalities. The local municipalities were chosen based on a the following predetermined criteria : The number of households serviced, number of household in informal settlements with access to refuse removal, waste management capital expenditure, waste management operating expenditure, waste management revenue, the population of the local municipalities, and municipal classification. In order to get the total number of households, the number of households in formal and informal settlements were added together. The data of the local municipalities was collected from the final annual municipal budget, Housing Development Agency Reports and through STATSA for years (2010-2021). The data is trusted to valid and reliable because it is available from the local municipalities' websites, Housing Development Agency Reports' website and STATSA website for the public use.

1.8. STRUCTURE OF THE STUDY

The study is outlined as follows:

Chapter One

This chapter was used to introduce the study and how the researcher conducted the study. This chapter started with the introduction to the research problem which led to research statement. Followed by the discussion of research hypotheses and research

objectives. Significance of the study was discussed in this chapter and the structure of the study followed.

Chapter Two

This chapter consists of the literature review where theoretical framework was discussed by two theories namely waste management theory and institutional theory. Followed by the overview of municipal waste management and followed by subtopics which analyse the municipal waste management budget and waste management service delivery.

Chapter Three

This chapter presents the research methodology used for this study. Followed by the research method, study population, the sample, sampling methods, sample size, data collection. This chapter also discussed the data analysis procedures, control variables, reliability and validity of the data and the ethical considerations.

Chapter Four

This chapter presents the statistical results and the analysis of this study. Followed by a discussion of the study results based on the four research hypotheses of this study. This chapter concluded with a summary of the chapter.

Chapter Five

This chapter presents of the summary of the research study based on the four research objectives. Followed by the contribution to the body of knowledge made by the researcher to understand the effect of municipal waste management budget on waste management service delivery. Furthermore, this chapter presented the research limitations and the recommendations made by the researcher. This is followed by the conclusion of this study.

1.9. SUMMARY OF THE CHAPTER

This chapter discussed the background of the study, research problem, research hypotheses and objective and the research methodology. The chapter further discussed the significant of the study, the definition of terms and the structure of this study.

The next chapter will discuss the literature review of the study.

CHAPTER TWO: LITERATURE REVIEW

2.1. INTRODUCTION

In chapter one the overall background of the research problem, research problem, the methodology, research hypotheses and objectives, significance of the study and the definitions of terms were presented. Waste management service delivery it is one of the essential services that every local municipality provides to the residents (Aparna, Bhumijaa, El-Latif, Ahemd, Amirtharajan & Praveenkumar, 2022: Hoornweg, Bhada-Tata & Kennedy, 2013). Furthermore, Zaman and Lehmann (2013) state that inadequate waste management service delivery is a sign of local municipalities being inefficient in their operation and their mismanagement of resources. This section will address the issues of waste management by using the combination of waste management theory and institutional theory. It will further assess the effect of expenditure on waste management service delivery, and also assess how the waste collection systems can be improved without increasing the burden on the waste management budget for the municipal waste services.

The layout of the chapter is as follows: In section 2.2 theoretical framework (waste management theory and institutional theory) were discussed; Section 2.3 discussed the overview of municipal waste management; In section 2.4 the effect of capital expenditure on municipal waste service delivery was discussed; Section 2.5 discussed waste management service delivery and operating expenditure; the effect of municipal revenue on waste management service delivery was discussed in section 2.6; In section 2.7 the impact of informal settlement on waste management service delivery was discussed; followed by Recycling in informal settlement section 2.8; Section 2.9 presented the other aspects of budgeting and concluded with section 2.10 which is the summary of the chapter.

2.2. THEORETICAL FRAMEWORK

This section explains the theories which underpin this study. The relevant theories are waste management and institutional theories.

2.2.1. Waste Management Theory

Waste management theory (WMT) is a theory about waste and management, and it is also used to understand how waste can cause harm to human beings' health and to the environment. While many management theories have been applied by many management scholars, for instance, Ajzen's theory of planned behaviour (Bosnjak, Ajzen & Schmidt; Lodhia & Hess, 2014), waste management theory is appropriate for this study. The theory is applied in this study to anticipate how management deals with financial stability in the municipal waste management department and how this could help to reduce the harm caused to society and the environment. Harm to society and the environment is a result of inefficiency in municipal solid waste management. Gaeta-Bernardi and Parente (2016) state that the waste management theory is not viewed with importance because waste management departments (local municipalities) are concerned only about waste collection and disposal, without attention to waste management and its impacts. However, Sije and Ochieng (2013) perceive that waste management theory is used to address the issues and goals set by environmental systems. Local municipalities are institutions that are governed by law and regulations; therefore, waste management theory can be integrated into the laws and regulations that govern local municipalities and departments. Additionally, Hannon and Zaman (2018) point out that waste management theory clarifies the priorities of those charged with waste management and serves as a measure of progress. Waste management theory helps to identify issues that deal with the daily process of waste management services and the limitations in the operations.

2.2.2. Institutional Theory

Levänen and Hukkinen (2013) explain institutional theory as guidelines in the form of accepted structures, rules, norms and routines that are also affected by social behaviour. Additionally, Chen, Tang and Feldmann (2015) indicate that government agencies, laws and regulations and societal pressure would encourage institutions to abide by environmental management practices. Institutional theory is applied in this study to understand the guidelines on how local municipalities assess the influence of waste on the environment and society. Additionally, Hahn and Kühnen (2013) suggest

that institutional theory deals with the issues that institutions encounter because of the impact such issues have on the environment. However, Montiel, Husted and Christmann (2012) assert that institutional theory usually deals with the perception of policymaking and its impact on institutions when making a specific decision.

Furthermore, Suryanto, Haseeb and Hartani (2018) argue that institutional theory has a direct impact on how institutions deal with issues that are on the level of environmental practices. The fact that there are international laws and regulations that deal with waste management and how waste affects the environment automatically affects municipalities and organisations that collect household waste. There is a substantial financial implication for non-compliance with the rules and regulations set by international organisations regarding waste management and how it impacts the environment. The costs of waste collection can be affected by environmental policies that are issued to protect the environment (Falkowska, 2020: Hoornweg *et al.* 2013). As the world population increases, household waste generation is also deemed to increase and might result in local municipalities being unable to collect all waste. Therefore, this might end up being illegally dumped, which affects the environment and causes environmental agencies to legally charge municipalities with environmental negligence.

Scaraboto and Fischer (2012) indicate that scholars have used the institutional theory to understand and examine issues in the organisational discipline, individual actors, and organisations and how they maintain legitimacy and how they apply the guidelines that were set by the institutions. Institutional theory has three essential elements which are: one, the coercive pressures where institutions comply with existing laws and regulations. Secondly, the mimetic pressures that refer to the techniques that were previously used by institutions to respond to the specific situation. Lastly, normative pressures detail the importance of organisations volunteering to migrate to coercive pressures (Jamil, Mohamed, Muhammad & Ali, 2015: Oti-Sarpong, Shojaei, Dakhi, Burgess & Zaki, 2022). In addition, Altayar (2018) states that institutional theory investigates how the organisations are influenced by forces such as governments, professional bodies and the impact on the society. Ervin, Wu, Khanna, Jones, and Wirkkal (2013) concur by stating that institutional theory explains how external

pressures affect the organisation's environmental activities. Most local municipalities are affected by coercive pressures. Ye, Zhao, Prahinski and Li (2013) aver that because of the expectations of society, coercive pressures arose. Therefore, organisations must deal with such pressures. Local municipalities face coercive pressure because community members expect municipalities to deal with the challenge of waste collection and payment for such services. Although, mimetic pressures could also apply as local municipalities have already set a precedence with waste collection that includes households that do not pay for the services.

Jan, Lu and Chou (2012) also state that institutional theory has been used mostly by organisations. Institutional theory has also been used at the individual level as guidelines on rules and regulations to govern the institutions. According to Fernando and Lawrence (2014), institutional theory is also used as a guideline since institutions or organisations respond to pressures from the institutional environment and how the institutional theory adapts to procedures and regulations that are acceptable as an appropriate measure. The theory is applied in this study in order to understand how relevant law and rules, and regulation governing municipalities affect waste management service delivery and municipalities' waste management budget.

2.3. OVERVIEW OF MUNICIPAL WASTE MANAGEMENT

There are elements that have been identified as factors involved in the waste management system. According to Guerrero, Maas and Hogland (2013), the following are critical elements in waste management systems: family size, educational level in the family and monthly income. These all have an impact on the amount of waste each household can produce. Furthermore, Lohri *et al.* (2014) state that according to the World Bank, the increase in population in developing countries has a significant impact on the production of solid waste and that, in turn, influences the waste management budget and they add that the waste management budget could only serve 50% of the population. A large proportion of the municipal budget is used in the waste management department, yet the waste collection service delivery remains inadequate (Chinasho, 2015: Richter, Ng, Karimi, & Li, 2021). According to Zohoori and Ghani (2017), municipalities are responsible for the provision of waste services to

reduce the impact thereof and the greatest challenge of municipalities is to adopt a system that is efficient and effective considering the municipal waste management budget. As budgeting is a tool used to estimate resources required while understanding the uncertainty associated with the services (Huynh, 2022: Parthan, Milke, Wilson & Cocks, 2012), local municipalities' waste management budget are made up of two expenditure categories, namely: budgeted capital expenditure and budgeted operational expenditure. The waste management budget also includes ways in which municipalities will collect revenue (municipal taxes). Therefore, it is likely that those charged with the governance of municipal waste management are burdened with the responsibility of ensuring that the municipal waste management budget covers the total amount of expenditures (operational and capital) and includes the estimated revenue (municipal taxes) to be collected and also indicate the impact it has on waste management service delivery.

2.4. THE EFFECT OF CAPITAL EXPENDITURE ON MUNICIPAL WASTE SERVICE DELIVERY

Capital expenditure includes the costs that create future economic benefit to the organisation such as an investment in vehicles (for collection and transportation), an investment in machinery and equipment, and investment in new projects and infrastructure. It is evident that waste collection services have an impact on the capital expenditure proposed for the service. This is because the higher the waste capital expenditure budget, the more the services are provided to the public more efficiently. There is a trace of evidence proving that most of the time, the budget is enough, but it is used in an inefficient manner (Lohri *et al.* 2014: Tsai, Bui, Tseng, & Wu, 2020). Funds in local municipalities are mismanaged and have caused waste management service delivery to be compromised (Mashamaite, 2014). Additionally, this has resulted in limited investment in possible ways to solve the issue of municipal waste (Zohoori *et al.* 2017). In today's world, the level of waste produced varies from city to city because of the population. Hence the capital expenditure will be different on this basis (Menikpura, Cheewala, Bonnet & Chiemchaisri, 2013: Nepal, Bharadwaj, Karki Nepal, Khadayat, Pervin, Rai and Somanathan, 2022). On the other hand, local municipalities are not the same in size and the policies regarding municipal waste are

set at a national level of government. Therefore, the size of the municipality may directly affect the capital investment of a municipality in waste management, and this will significantly affect the waste management service delivery.

However, according to Sobotka and Sagan (2016), there is no difference between whether the service is provided by a private service provider or is provided by the municipality and the waste capital budget allocated to it because the cost will remain the same. A report about municipalities has indicated that waste management has been affected by the wrong bin collection system, poor planning route, insufficient information on waste collection periods, lack of good infrastructure, the number of waste compactor trucks used for collection of waste. These have an impact on the waste management capital expenditure budget since it is fully used without achieving its purpose because of the constraints (Guerrero *et al.* 2013: Richter, Ng & Pan, 2019). Oteng-Ababio, Arguello and Gabbay (2013) state that the residents in poor urban areas are forced to deal with uncollected waste for weeks and end up burning it or dumping it in unauthorised areas. This may cause local municipalities having to invest in communal containers and locate them in strategic areas where members of the community dump their waste, thus placing a constraint on capital investment. Moreover, the issue of an inadequate waste management infrastructure may prompt the dumping of waste in unauthorised locations or burning that causes air pollution, land pollution and groundwater pollution.

2.4.1. Waste Collection Trucks/Vehicles

Niza, Santos, Costa, Ribeiro and Ferrão (2014) state that waste vehicles and waste compactor trucks are an essential part of waste management service delivery as they are mostly used for waste collection and waste disposal. Local municipalities in South Africa budget substantially for waste vehicles and tractors. According to Alam and Ahmade (2013), developing countries have a huge challenge dealing with the transportation of the ever-increasing solid waste to designated areas. The main cause of this is the lack of waste management vehicles resulting from inefficient waste management budgets. Improper financial management usually leads to inferior service delivery, and in this case, waste management service delivery. Wy, Kim and

Kim (2013) state that waste collection is the most demanding operational problem for local authorities due to the lack of investment in vehicles (tractors) for waste collection. Vehicle cost is one of the direct costs when determining capital expenditure for waste collection (Angouria-Tsorochidou, Teigiserova & Thomsen, 2022: Greco, Allegrini, Lungo, Savellini & Gabellini, 2015). Therefore, it is reasonable for local municipalities to budget for the purchase or leasing and improvements in waste management vehicles. Transportation of waste collected is regarded as an important part of municipal services, and local municipalities usually invest their capital expenditure on waste management vehicles/tractors (Menikpura *et al.* 2013: Sharma & Chandel, 2021). On this basis, South African local municipalities follow the same principles of investing a large amount of their capital expenditure on vehicles that are used for waste collection and waste disposal. Teerioja, Moliis, Kuvaja, Ollikainen, Punkkinen and Mert (2012) declare that door-to-door waste collection requires a substantial investment in vehicles/tractors that are used for solid waste collections and based on the laws and regulations regarding the environment, the waste management vehicles/tractors should be eco-friendly.

In South Africa, local municipalities use the door-to-door system. This system is dependent on and constrained by the number of vehicles/tractors for waste collection to be appropriately executed. It is only reasonable that local municipalities invest a large portion of the waste management budget on waste management vehicles/tractors. Although there are other systems that can be used and possibly reduce the cost of investment in waste management vehicles, the main system used is the door-to-door system. According to Chu, Xi, Song and Crampton (2013), local government should invest in waste transportation in order to keep up with the demanding schedule of residential waste collection. Local municipalities in South Africa collect household waste daily in different sections of the community; therefore, most of the local municipalities invest substantially in capital expenditure.

The lack of real-time data on which communal waste bins are to be collected and when has led municipalities to invest in waste collection vehicles for communal waste bins collection without changing their residential waste collection schedule. Das and Bhattacharyya (2015) indicate that there is heavy use of vehicles for waste

management service delivery; therefore, the local government uses a large portion of their waste management capital expenditure budget on vehicles to provide the waste management service delivery. In another twist, most local municipalities lack the necessary funds to invest in new vehicles or to lease waste management vehicles. Therefore, local municipalities substitute their budget for vehicle maintenance with vehicle leasing. A study in Turkey about waste management vehicles that are already in use indicates that not only did local municipalities purchase new vehicles to complement existing vehicles but also replace those nearing their useful life (Demirel, Demirel & Gokcen, 2016).

Local municipalities usually budget for the repair and maintenance of the waste management vehicles and tractors in the short-term and are more likely to replace the waste management vehicles and tractors in the long-term. Local municipalities invest in waste management vehicles and tractors to use them for recycling as part of waste management service delivery (Bain, Xue, Li, Wu, Ma, Okoro & Harder, 2021: Bing, Bloemhof, Ramos, Barbosa-Povoa, Wong, & van der Vorst, 2016). Instead of relying on waste management vehicles to collect recyclable and non-recyclable waste, Rabbani, Farrokhi-asl and Rafiei (2016) suggest that local municipalities should invest in waste management vehicles with multiple compartments for storing specific classes of waste (recyclable and non-recyclable waste). Thus, waste management vehicles should not only be used to collect solid waste but also for recycling. However, most of the local municipalities only use waste vehicles and tractors to collect household waste without the separation of waste. Consequently, South African municipalities are likely to budget for new waste management vehicles that consist of multiple compartments or instead of investing in waste management vehicles that consist of multiple compartments, local municipalities may budget for additional waste management vehicles that are used to collect strictly recyclable waste; and the existing vehicles can collect household waste that is not recyclable. However, waste management vehicles that are effective in the collection of solid waste are sophisticated and expensive and also come with high maintenance which requires substantial funding (Marshall & Farahbakhsh, 2013). Because of the constraints on the waste management budget, local municipalities do not purchase sophisticated and expensive vehicles that have different compartments for waste collections.

A system of using different waste management vehicles/waste compactor trucks for separating recyclable and non-recyclable waste is not rife in South Africa. Since the waste management budget is constrained, local municipalities face the challenge of adopting various waste management collection systems that are more efficient, and that can deal with the increasing solid waste. Moreover, this challenge is exacerbated because most developing countries usually have to import sophisticated waste management vehicles from developed countries that are usually expensive and complicated to maintain (Li, Yu & Gao, 2014; Simic, 2016). Sophisticated waste management vehicles are useful in operation (collection of waste), and South African local municipalities are likely to purchase their waste management vehicles from local suppliers; however this does not make the waste management vehicles less expensive or less complicated to maintain.

Usually, the amount budgeted for waste management capital expenditure is decided upon by councillors, and they are reluctant to spend on waste management vehicles; thus, they prefer to lease waste management vehicles (Godfrey, Scott & Trois, 2013). As a result of the lack of spending on waste management vehicles, waste management service delivery is compromised. Furthermore, Bhor, Morajkar, Gurav, Pangya and Deshpande (2015) state that the lack of spending on waste management vehicles has resulted in inefficient waste management service delivery. Not investing in waste management vehicles results in household waste and solid waste not being collected on time or not collected at all. Hence this has led to the community dumping waste at unauthorised sites or burning it, which results in air pollution. The waste collection process and the expenditure on vehicles should be closely examined to find a solution and achieve efficiency in waste management service delivery (Han & Ponce Cueto, 2015: Taube, Biedenbach, Schmid, Rieck & Behrendt, 2022). Moreover, it was concluded from data collected from municipalities that even the routes used by waste management vehicles in the process of waste collection affect the kind of waste management vehicles municipalities invest in. The local municipality should utilise waste management vehicles efficiently regardless of the amount of investment required for new and updated vehicles.

2.4.2. Waste Management Plants and New technologies

Local municipalities can also consider using waste management capital expenditure to invest in waste management plants as these are more convenient than dumping waste in open spaces. Malinauskaite, Jouhara, Czajazynska, Stanchev, Katsou, Rostkowski, Thorne, Colon, Ponsa, Al-Mansour and Anguilano (2017) point out that waste-to-energy plants are costly. Thus, using more municipal budget on waste management plants which are high in costs than using the municipal budget on dumping areas (landfills) which are less expensive in maintenance costs. Additionally, local municipalities cannot afford to acquire such machinery, whereas private institutions usually do. However, on the other hand, Matsakas, Gao, Jansson, Rova and Christakopoulos (2017) state that converting municipal waste into fuels requires less investment costs than the cost of converting waste-to-energy and the conversion will address the issue of greenhouse gases produced by municipal solid waste. The fact that local municipalities' waste management budget is under constraints and does not cover operational costs and capital expenditure, means that local municipalities usually invest in less financially feasible projects.

However, Beyene, Werkneh and Ambaye (2018) state that there are new plants used for waste-to-energy that have become more affordable, and so local municipalities, and private organisations are considering such as an optional capital investment. According to Kumar, Smith, Fowler, Velis, Kumar, Arya, Rena, Kumar and Cheeseman (2017), the transition to waste-to-energy can be achieved if local municipalities can focus a large sum of their waste management budget towards new technologies (plants) that can efficiently convert waste-to-energy. In addition, data has also indicated that this system of converting waste-to-energy will help local municipalities deal with the issues of dumping its waste at the landfill. It will decrease and minimise the impact waste has on the environment. Moreover, data was collected using a qualitative method to investigate the capital investment made in waste-to-energy plants, whether it reduces waste that is usually dumped in landfills and the impact it has on waste management service delivery. Waste-to-energy plants will not only decrease the impact of waste on the environment but also will also generate an income from the energy being sold, resulting from the conversion of waste-to-energy.

In addition, local municipalities could invest in new ideas that will address issues of waste management service delivery and formulate a system that will plausibly raise revenue directed towards new waste management technological inventions. The fact that research has shown that local municipalities are faced with financial constraints, investment in waste-to-energy can greatly relieve the finances of local municipalities by selling the generated energy to the community. Moreover, the capital investment in waste management plants will subsequently deal with the issue of the landfill as land is a scarce resource and most of the local municipalities use the landfill system to dispose of their solid waste. The landfill waste disposal system requires local municipalities to invest in the maintenance of the land to prevent health issues from affecting the community. Although the required investment for maintenance of land is less than that required for waste management plants, investing in waste-to-energy plants is considered the most reasonable as it also has the potential to generate income for local municipalities (Beyene *et al. 2018*). Waste management plants will generally solve social issues and environmental issues caused by municipal solid waste.

Menikpura, Gheewala and Bonnet (2012) state that in developing countries the cost of landfill consumes the major portion of capital costs/investment. This is because of the increase in human population in developing countries. This can be related to instances where municipalities invest in tracts of land so that they can use them as dumping sites. This is part of their waste management infrastructure expenditure. The land is mostly used for opening dumping. The open dumping landfill system is a practice by most developing countries with unmeasured impact on the environment, polluting groundwater and causing health issues to those near the landfill (Guerrero et al. 2013; Murali, Vijayakumar, Ramesh & Baskaran, 2017: Ramos & Rouboa, 2022). Sudibyo, Majid, Pradana, Budhijanto, Deendarlianto and Budiman (2017) have advised municipalities to invest in technological inventions that will help in disposing of municipal waste.

Notwithstanding this, investment in new waste technologies will require a substantial amount of funding that may put a strain on the municipal waste management budget. Research about technologies used in the smart waste collection system concluded

that local municipalities used a substantial portion of the waste management budget to purchase the waste management inventions to implement smart waste collection system (Gutierrez, Jensen, Henius & Riaz, 2015: Khan, Anjum, Raza, Bazi & Ihtisham, 2022). It serves as conclusive proof that waste management systems that require technology are expensive and local municipalities use a significant amount of their waste management budget to implement such systems. The fact is that municipal waste produces harmful gas; therefore, new ways of waste management should be implemented even though the financial consequences of investing in new technology affects the operation of the whole municipality. Additionally, Bleck and Wettberg (2012) state that because municipal waste produces a harmful substance that affects the environment and causes diseases, local municipalities in developed countries are investing in technologies that reduce the impact of municipal waste. Moreover, Mijac, Androcec and Picek (2017) conducted a study about technology assisting in the improvement of the waste collection and transportation system and concluded that if waste collection vehicles are installed with a navigation system that is connected with waste collection bins which signal when full, it will improve the waste collection and transportation.

Moreover, a proper and maintained infrastructure may likely contribute significantly to waste management service delivery. Due to inadequate waste management infrastructure, which is caused by a lack of funds in Dhaka City, Bangladesh, a significant amount of waste is not collected (Ahsan & Zaman, 2014). In Bolivia, a study conducted by Ferronato, Gorritty Partillo, Guisbert Lizarzu, Torretta, Bezzi and Ragazzi (2018) to assess what the impact of the introduction of a waste treatment plant would have on the reduction of waste and its impact on the environment. Amoo and Fagbenle (2013) indicate that the introduction of plants that convert waste to become energy would reduce the volume of waste that is dumped at landfills and this should automatically reduce the environmental harm caused by waste. Likewise, Yadav and Samadder (2018) reveal that mechanical-biological treatment is more convenient and is a better option than disposing waste at landfills because of the harm waste does; waste is not environmentally friendly. Investment in a plant that can efficiently provide a waste management service might require a substantial amount of funding for South African municipalities to acquire them and operate them.

2.5. WASTE MANAGEMENT SERVICE DELIVERY AND OPERATING EXPENDITURE

Operating expenditure includes costs of waste collection, salaries and wages, repairs and maintenance costs, these expenses are required for day-to-day operations, and it includes depreciation (Hwang & Kim, 2022Lohri *et al.* 2014). Rehan, Knight, Unger and Haas (2014) report that municipalities have been reliant on municipal grants and general sources of income (local waste taxes) to cover operating costs. Others have published the existence of cost differences between the public and private services, and some believe that outsourcing the service reduces the operating costs (Benito, Solana & Moreno, 2014). However, others have concluded that private management comes with a high cost (Zafra-Gómez, López-Hernández, Plata-Díaz & Garrido-Rodríguez, 2016). The operating costs of local municipalities are variable and depend on how large the municipality is and the number of households serviced. Research in Indonesia found that some waste management departments cannot operate to their full capacity because of the lack of funds or limited budget, and this has affected their operations (Sarli, Zakiyya & Soewondo, 2017). It is plausible that having to cope with limited waste management funds may have caused municipalities to provide inferior services resulting in uncollected waste in some areas of the community.

Srivastava, Ismail, Singh and Singh (2015) state that that many local municipalities spend large sum of their municipal budget in waste collection and spending less on maintenance of landfills. According to Sudibyo *et al*. (2017), municipalities have a responsibility to manage waste through the collection and disposal of it to dump sites and after the municipal waste has been dumped to landfills has not been properly managed to reduce the impact on the environment. Hence, Parthan *et al.* (2012) state that the reason why there have been no improvements in solid waste management is because of financial problems that have been encountered by institutions providing the services. Regrettably, most South African local municipalities are not able to properly manage the waste generated in their areas hence they are unable to harness and manage benefits associated with waste collection. The issue of not managing municipal waste finances appropriately may result in inadequate funds to appropriately provide waste management service delivery. Notwithstanding this, it may have

negatively affected the environment because of the community members practising illegal dumping.

Verma and Bhonde (2014) state that the waste collection patterns and the distance between households and landfills have an influence on the operational expenditure related to waste collection. In addition, the researchers obtained geographical information to investigate the distance between households and the dumping area to determine how such information has a direct impact on waste management expenditure. Local municipalities in Kenya usually budget a substantial amount for waste management operational expenditure and the data collected by the researchers indicated that waste operation expenditure had been allocated a significant percentage on the waste management budget (Sumukwo, Kiptui & Cheserek, 2012) and this may apply to local municipalities in SA too. Teixeira, Avelino, Ferreira and Bentes (2014) state that there is no benchmark for the waste management operational expenditure budget, therefore each individual local municipality budgets for waste management at their discretion and a statistical methodology is used to support the waste collection budget. Moreover, Assamoi and Lawryshyn (2012) have indicated that the financial implications of a waste operation vary annually and that is one of the reasons why many local municipalities cannot cover all the waste management operational expenditure in a certain financial period.

Furthermore, a financial analysis was conducted by the researchers to determine the waste management operational costs and the implications thereof (Pinha & Sagawa, 2020: Abdelhamid, 2014). The main reason for local municipalities not being able to adequately budget for the operations of waste management is that it relates to day-to-day operations, and those operations are unpredictable. In addition, local municipalities have a weak labour force and vehicles that are in poor condition further contribute to unpredictable operational waste management expenditure. Data collected for this study indicated that operational cost depends on the condition of labour and vehicles.

Household waste collection is a labour-intensive process; therefore, the labour costs usually comprise a large percentage of the operational expenditure budget (Jacobs,

2015). Moreover, the study by Jacobs (2015) used a quantitative research method to analyse how the labour cost impacts the waste management service delivery and the conclusion indicated that labour cost has a direct impact on waste management service delivery. D'onza, Greco and Allegrini (2016) concur that labour is one of the essential cost drivers in waste management service delivery; the labour cost was identified using a cost accounting method. However, labour cost can be decreased if organisations can generate an income from recyclable waste and thus offset the labour cost with the income (Ezeah, Fazakerley & Robert, 2013: Llorente-Gonzalez & Vence, 2020). Two model scenarios were developed for future decisions regarding the reduction of waste management labour cost and how the income gained from recyclable waste (regarded as a by-product) can be used to offset the labour cost.

Research in India found that after local municipalities invested in new technologies that help reduce the impact waste has on human beings and the environment, municipalities ended up being faced with high operating costs (Joshi & Ahmed, 2016). Although new solutions are needed to solve the increasing waste production, most local municipalities lack funds to invest in new technologies. Furthermore, Demirel *et al.* (2016) state that vehicles fitted with new technological inventions come with high maintenance and operational costs. The municipal waste management budget includes maintenance and operational costs. New technologies' maintenance and operation costs will cause constraints on the waste management budget, and so the costs will have to be budgeted for. Although local municipalities had the potential of gaining revenue from separating recyclable from non-recyclable waste, this will also come with additional operating costs. Da Cruz, Simoes and Marques (2012) also state that recycling comes with additional financial operating costs whether the household waste is collected by a private institution or by local municipalities. Most of the local municipalities have not integrated waste recycling into their waste operation. Therefore, local municipalities can grow their operation, but the problem that has been identified are the constraints on the waste management budget.

2.5.1. Waste Management Education

Research by Lakhan (2014) conducted in Ontario Canada suggests that investment in community campaigns to educate members of the community about the implications of waste will reduce the production of waste. However, in Japan, instead of community campaigns, a budget for municipal waste management service delivery includes a recycling expenditure for municipal solid waste (Kinnaman, Shinkuma & Yamamoto, 2014). Accordingly, Ahsan and Zaman (2014) found that local municipalities in Bangladesh do not allocate funds for educating the public and creating awareness about the impact of waste. Waste management awareness will reduce the generation of waste so that the waste management budget can cover more services than it does now, and waste can also be collected in parts of the communities it was not able to before. Aliu, Adeyemi and Adebayo (2014) indicate that most of the community members when they talk and think about waste management already think about recycling and neglect the collecting and transporting services which absorb a large portion of the municipal budget.

Waste management education should not only focus on the issue of reducing the production of waste. However, it should also address the issues of illegal dumping by community members. The following challenges were identified by most of the local municipalities: (a) the challenges that local municipalities are facing in rural areas is that after placing a communal bin for waste collection, instead of dumping waste inside the communal bin, community members dump waste next to it. The implication of this is that the waste department incurs more in labour costs to the deal with such issue, and the dumped waste affects the health of human beings and also affects the environmental; (b) the capacity of the landfill is continuously deteriorating and resulting from that, local municipalities would not be able to store solid waste due to the required capacity and the increase in waste generation (Laner, Crest, Scharff, Morris & Barlas, 2012). Likewise, the community should be educated on how they can assist the local municipalities in reducing the strains on landfills by reducing the generation of waste. Additionally, the waste management department should also educate the members of the community about the importance of recycling and how it is economical and environmentally friendly.

Oliveira and Duarte (2016) state that for local municipalities to efficiently save costs is when all parties who are involved in waste generation including households are involved in the process of finding a solution to waste management. Moreover, this can be achieved by firstly educating all the parties about the impacts of waste. Bowan, Anzagira and Anzagira (2014) have indicated that waste education will save not only the municipalities' costs but also those of the members of the community as most of the time when the cost of waste collection is high the cost is transferred to the community. Thi, Kumar and Lin (2015) also state that the local municipality may reduce waste collection costs by implementing waste education programs that will improve the waste separation from households and the municipality will only collect, dispose and recycle. Based on the quantitative study and qualitative study conducted by the researchers (Thi *et al.* 2015) indicates that educational programs that are properly implemented assist local municipalities in reducing waste management collection costs as members of the community are involved in the collection system. Therefore, South African local municipalities should implement an educational program that will assist in reducing waste management costs and getting the community members involved in finding solutions to waste management.

Most community members do not attend waste management awareness campaigns, and this results in municipalities increasing the waste collection fees to discourage the creation of waste that requires increased funds to deal with (Zainu, 2019). This is most applicable to local municipalities who use a system that weighs waste before collection, and the system is inappropriate where local municipalities charge a standard price for waste collection service delivery. Therefore, the best alternative is to educate community members about the impact of waste. Although local municipalities are provided with funds to deal with issues of waste, this does not benefit the environment because of illegal waste dumping, which affects the land and the same people who have dumped the waste. Therefore, the lack of information about waste management has a more significant effect on the environment and a social impact on the community than on local municipalities. Like any other institution, local municipalities will adjust their waste management budget to cover the cost of waste education.

Chengula, Lucas and Mzula (2015) declare that that the lack of household involvement in the campaign about waste management awareness delays or causes the members of the community not to pay waste management collection fees. Thus, it causes a constraint on waste management operations because of the increased funds needed to provide adequate service delivery. In South Africa, local municipalities get funding from the National Treasury, and they also collect revenue for the basic services they have provided to the community. Regardless of this, local municipalities continually face financial challenges in providing waste management service delivery. Samah, Manaf, Ahsan, Sulaiman, Agamuthu and D'Silva (2013) explain that waste management campaigns have had a positive effect on revenue collection as the community perception changes. Polanec, Abersek and Glodez (2013) have indicated that waste education must be extended to government workers because they play an essential role in dealing with the issues of the generation of waste.

Nevertheless, Mesjasz-Lech (2014) states that education and awareness are short-term strategies and do not solve the long-term problem that local municipalities have regarding waste management. Short-term solutions might seem like the right fit; however, since most studies found that future waste creation will increase, the short-term solution will be insufficient to solve future waste management problems. Besides, human behaviour cannot be changed by mere campaigns (Desta, Worku & Fetene, 2014). Although waste campaigns might be insufficient, they can, nonetheless, change community perspective on waste handling. Waste management campaigns deal with the disadvantages and the advantages of the production of waste. For example, recycling can be an advantage for households, and the increase in waste collection costs can be a disadvantage.

2.5.2. Waste Collection

Wy *et al.* (2013) identified three waste collection situations. Firstly, household waste collection, which involves the collection of waste at residential homes using waste vehicles from street to street (also known as door-to-door waste collection systems). Secondly, a commercial waste collection where waste is collected from private institutions and businesses. Lastly, industrial or construction waste collection involves

the collection of waste at construction sites and industrial areas. Bleck and Wettberg (2012) contend that waste collection also includes street-sweeping. Then Chu *at al.,* (2013) specify the methods of waste collection for the household to include but not limited to the communal site collection, block collection, curbside collection and door-to-door collection. There are different ways to collect waste but this study focuses on investment in waste collection and how it affects waste management service delivery. Furthermore, an assessment of efficient waste collection systems can be useful to local municipalities.

Solid waste collection costs vary by city, town, community population, and the cost of labour required to collect solid waste and other unforeseen factors that can influence the solid waste collection (Jaunich, Levis, DeCarolis, Gaston, Barlaz, Bartelt-Hunt, Jones, Hauser & Jaikumar, 2016). According to Uson, Ferreira, Vasquez, Bribian and Sastresa (2013), 70% of the municipal solid waste management budget is directed towards solid waste collection and solid waste transportation. Additionally, Bleck and Wettberg (2012) believe that solid waste collection and transportation represent 70% - 80% of the municipal waste management budget. Das and Bhattacharyya (2015) state that waste collection accounts for much of the waste management expenditure in low-income and developing countries. For example, South Africa's waste collection costs represent about 80% - 90%, and 50% - 80% of the waste management budget. Local municipalities in South Africa are likely to use 70% - 80% of the waste management budget on waste collection as this service delivery is an essential element of waste management. According to Aremu (2013), waste collection is an essential element of waste management and is recognised across the globe as a significant measure of waste management service delivery because it constitutes a large portion of the municipal waste management budget. In Dar-es-Salaam, Tanzania, only 40% of waste is collected, and 60% is either burned, buried, recycled by the informal recyclers or dumped illegally by the roadside and yet waste collection service delivery consumes a significant portion of its municipal waste management budget (Senzige, Makinde, Njau & Nkansah-Gyeka, 2014). Scarlat, Motala, Dallemand, Monforti-Ferrario and Mofor (2015) state that in developing countries like South Africa, about 40-70% of waste is collected and the remainder is uncollected. Additionally, Godfrey and Oelofse (2017) indicate that 90% of municipal waste is

collected, recycled and burned, and the remaining 10% is uncollected. This suggests that either the waste management budget allocated to waste collection is not enough even though waste collection consumes a large portion of the budget or the waste management budget is not used effectively to collect all waste produced by the public.

Waste collection is dependent on the availability of labour and transport to collect it from households and transport it to dumping sites. Generally, waste collection and transportation are costly, and this is because waste collection is labour-intensive and the use of multiple vehicles for collection and transportation to processing sites and dumping sites add to the cost (Jaunich *et al.* 2016). Labour and transport are essential elements of waste management service delivery, especially waste pickers and waste dividers. Communal containers or high-volume waste containers are positioned in a strategic point area where community members will dump waste because local municipalities want to reduce both the labour cost and the transportation cost of waste (Gregor, Šomplák & Pavlas, 2017). Hamad, Hanafiah and Abdullah (2017) pointed out that waste collectors should collect waste at a specific time for a specific area. They gave an example about waste collected at a shopping complex and indicated that it should be collected after shops have closed. Labour and transportation of waste are the most relevant tools for waste management; and placing communal containers and scheduling waste collection are also tools to reduce waste collection costs and effectively manage waste. According to Kaushal, Varghese and Chabukdhara (2012), in India, municipalities use communal bins, movable bins and fixed bins (bins built in a particular position). This is because 50% of waste in India is collected manually as residents dump waste by the roadside. Communal and fixed bins usually result in the practice of illegal dumping near the bins resulting in manually collected waste.

Municipal waste management has been problematic for two decades around the world, and waste has been growing at an ever-increasing rate (Io Storto, 2021: Rodrigues, Martinho & Pires, 2016). Therefore, municipalities should implement proper systems for waste collection in order to deal with the ever-increasing waste. Kumar *et al.* (2017) state that the reason municipalities are unable to address the problem of creating a practical waste collection system is because of the insufficient budget. They argue that to apply a proper waste collection system requires time and

money, which are the resources that most of the local municipalities do not have at their disposal. Across the world, local municipalities are using different waste collection systems depending on how they fit the strategic plan of the local municipality (Fernández, Manyà, Mateu & Sole-Mauri, 2014: Zhang, Zhang, Zhao & Xin, 2021). Greco *et al.* (2015) assert that the estimated cost for waste collection is based on the system used. For this reason, local municipalities in Italy use one or two of these waste collection systems; a collection system of waste separation (recyclable waste and non-recyclable waste) and a system that does not require waste separation. In Italy, most local municipalities had implemented a waste separation collection system.

Chi, Dong, Tang, Huang and Ni (2015) in China's Hangzhou State found that local municipalities offer resident bins with different colours in order to collect waste in categories (waste separation) and components (plastic, paper, metal and glass) and, also non-recyclable waste. Consequently, Rabbani *et al.* (2016) found that local municipalities are using waste management vehicles that have different waste compartments to store different classes of waste collected. Different waste compartments are used to store recyclable waste and waste that is recyclable. Following this, most of the local municipalities in developed countries have adopted waste separation (Rathore & Sarmah, 2021: Struk, 2017). This is because the investments made by developed countries reduce the impact of continuously increasing waste. The use of waste vehicles with compartments or supplying residents with more than one waste collection bin for separating waste requires large funds. Owing to the financial constraints that local municipalities are facing it is plausible that this waste collection system is going to be adopted in South African local municipalities. In addition to the use of waste vehicles with a different compartment to store each different class of waste, local municipalities can place a communal bin at a strategic point, with signs indicating which bin is for recyclable waste and which is for non-recyclable waste. Communal waste bins can be used to decrease the required investment for the waste management collection system and the operational cost. This will this solve the problem of incurring a large operational expenditure and the capital expenditure of using different vehicles or using vehicles with different compartments.

Further, communal waste bins may reduce the budgeted operational expenditure for waste management service delivery, as local municipality officials do not have to do the waste separation because community members would be dumping household waste in communal waste bins per category. Abdulai, Hussein, Bevilacqua and Storrings (2015) analysed the communal waste bin collection system and concluded that the communal waste collection systems' operational cost is less compared to other systems. However, the communal bin waste collection system creates a problem where a member of the community dumps waste near the communal container, making it overflow to the ground. Thus, the communal waste collection system cannot be used in isolation; instead, it can be a combination of waste collection systems. For instance, the communal waste collection system can be used in combination with the street sweeping waste management system (Oduro-Kwarteng, Munir, Monney & Keraita, 2015). The use of the communal waste collection system in combination with other collection systems will, however, increase waste management operational expenditure. Yet, this will reduce the impact of household waste on the environment (He & Fu, 2021). Other municipal waste collection systems could be considered. These include pneumatic, door-to-door, kerbside, and block waste collection systems. A decision support system will be discussed further down (section 2.5.2.3) in support of waste collection systems.

2.5.2.1. The pneumatic versus door-to-door waste collection system

Teerioja *et al.* (2012) conducted a study by comparing the pneumatic waste collection system versus the door-to-door waste collection system and determined the economic performance of each system with both systems being used in urban-areas. The pneumatic waste collection system is an automated system where networks of pipes are connected to residential units (household flats) with one central waste bin (communal bin). In evaluating the cost difference between a pneumatic waste collection system and the door-to-door waste collection system, a social life cycle cost method was applied in determining the value of the investment in waste collection systems (Chàfer, Sole-Mauri, Solé, Boer & Cabeza, 2019). Additionally, Nakou, Benardos and Kaliampakos (2014) found that using a pneumatic waste collection system has 40% lower operational costs than a door-to-door waste collection system.

However, the capital investment cost for the pneumatic waste collection system is ten times more than the door-to-door waste collection system.

Sung, Park and Suh (2012) state that most of the local municipalities in South Korea do not use the pneumatic waste collection due to the capital investment required for the system. Among other things, the pneumatic waste collection system, regardless of the high cost of investment, reduces the effect which waste has on the environment (Hidalgo, Martin-Marroquin, Corona & Juaristi, 2018). Therefore, from the point of view of economic performance, the pneumatic waste collection system has the advantage of cost reduction in operational costs and the disadvantage of the high capital investment cost (Fernández, Manyà, Mateu & Sole-Mauri, 2015). In addition, the benefit of the pneumatic waste collection system is the health of the public due to the reduction of emissions that cause diseases (Dixit & Rastogi, 2016).

Besides all the benefits associated with the pneumatic waste collection system, it is a system that is used in residential flats and flats used for office purposes, unlike the door-door waste collection system. The pneumatic waste collection system is likely to be used in developing countries to run smart cities, unlike in South Africa, where the focus is on rural areas. Therefore, based on the two waste collection systems, the door-to-door waste collection system seems appropriate. Moreover, the main advantage of door-to-door waste collection is the assurance that waste is collected in the most remote rural areas in the country.

Door-to-door waste collection and communal bin collection systems are standard in developing countries as other systems are deemed to be too expensive (Abdulai *et al.* 2015: Gudeta, Feyessa, & Kitesa, 2021). Moreover, analytical methods and three scenarios have been analysed to support the system of the door-to-door waste collection system and the efficiency of the system (Amalu & Ajake, 2014). Another system that is usually used and prevalent in waste collection is the public collection point system, where waste bins are placed at a strategic point where members of the community go by in large numbers (Bigum, Petersen, Christensen & Scheutz, 2013). The benefit of the public collection point system is that it requires a low capital investment, and the operational costs are not high, compared to other waste collection

systems (Abd El-Wahab, Eassa, Lotfi, El Masry, Shatat, and Kotkat, 2014). The public collection point system is used only to collect waste from people passing by that point and not used to collect waste from households. Although the public collection point system solves the littering problem, this system cannot be used in isolation to solve the waste management problems.

2.5.2.2. The block waste collection system

According to Huang and Lin (2015), the block waste collection system is a system where the members of the community bring household waste to the collection vehicle. Therefore, the responsibility of waste being delivered to waste management vehicles lies with the members of the community. The block waste collection system depends on the involvement of the community to deal with the waste collection. Moreover, the block waste collection system requires well-maintained road and these roads should lead to collection points/designated station both for waste collectors and the members of the community. Mgimba (2016) has indicated the practices of the block waste collection system are when waste collection vehicle passes block-by-block at waste station areas to collect waste on a predetermined day per section. However, not all waste is collected since most of the community members are unavailable when the waste is collected. Moreover, block waste collection requires a substantial amount of capital expenditure for waste collection vehicles. Although some of the waste is uncollected, the block waste collection system ensures that all the blocks within a municipal waste collection region are collected (Lavigne, Beliën, & Dewil, 2021: Suraj & Sutar, 2015).

Furthermore, the block waste collection system is convenient in rural areas, where there is a lack of good infrastructure for vehicles used for the collection of waste to properly operate. An additional factor why the block waste collection system is convenient for rural areas is that houses are located far apart from each other. However, Popović, Filipović and Božanić (2013) argue that instead of using block waste collection systems and waiting at the designated waste collection stations for waste collection, local municipalities can set up a communal container per block. That will result in waste collection trucks collecting waste containers block-by-block on a

specific day, instead of waiting for the member of the community to take out household waste to the waste collection truck. However, waste collection containers are expensive and local municipalities cannot afford to use the waste containers for the block waste collection system due to constraints on the waste capital budget (Tracy, Park, Plevaka & Bogdanova, 2021). The block waste collection system has similarities with the door-to-door system. The block waste collection system requires the members of the community to take waste to a collection point while the door-to-door waste collection system requires waste vehicles to do the collection at the door. The use of the block waste collection system results in the operational costs being low and medium, unlike other waste systems used for collection. Therefore, the block waste collection system addresses the issue of waste reduction as a member of the community has a sense of responsibility and takes part in solving the issues caused by waste.

Moreover, municipalities using block waste collection have a schedule indicating which block is collected on which day and the community members are made aware of such dates (Mathe & Phiri, 2015). Unlike when the municipality uses waste collection containers, the municipality can collect the waste container as soon as it is filled instead of waiting for a specific day. However, the benefit of having a waste collection schedule is that the community knows about the collection schedule, and that will increase the efficiency in waste collection and will reduce the amount of uncollected waste. Additionally, the block waste collection system will reduce waste that is dumped in an unauthorised area as there would be a central collection point per block per community. Unfortunately, a disadvantage is that waste collection containers get full to the point that the community members dump waste next to the containers. Therefore, the environmental impact can be reduced due to the proper implementation of the block waste collection system. Block waste collection reduces the spread of waste on the streets (Opara, John & Sempewo, 2016). For this reason, local municipalities operating in rural areas can implement the block waste collection system as it is efficient and effective in rural areas.

2.5.2.3. Decision Support system

Mijac *et al.* (2017) proposed a decision support system to address the main problem in waste collection service delivery. This includes situations when waste bins should be collected, and which route should be used when collecting waste bins in a city. A decision support system is used in combination with other waste collection systems, not in isolation. Marshall and Farahbakhsh (2013) state that local municipalities are faced with a challenge of no space for waste collection containers and the roads are narrow and steep (this results in uncollected waste), and there is no system that has been implemented to address the issue of waste collection. Similarly, Schindler and Kishore (2015) found that even private organisations that are tasked with waste collection in Delhi are faced with the same issues of having no space for refuse containers and routes that are narrow, and there is no system in place for an effective way to collect household waste.

Local municipalities in South Africa use a system of collecting waste per section every day in each municipality's jurisdiction. It is likely that South African municipalities do not have a system that deals with a problem about which routes to use while collecting waste because the system used in South Africa is street by street waste collection also known as a kerbside system (Boffardi, De Simone, De Pascale, Ioppolo, & Arbolino, 2021: Du Toit & Wagner, 2018). The other possible reason why local municipalities may not use this system that identifies routes to use is that it might be expensive, and many local municipalities cannot afford it. Kinobe, Bosona, Gebresenbet, Niwagaba and Vinneras (2015) suggest that local municipalities should reduce their operational and capital expenditure in order to invest in new systems. Alternatively, local municipalities should raise revenue from the waste management service delivery to cover the investment needed for new systems used to collect municipal waste in an effective manner. New systems like the decision support system will assist local municipalities to collect waste in a fast and simple way and will also reduce the environmental impact of household waste. According to Hannan, Arebey, Begum and Basri (2012), decision support systems can be used in combination with waste collection containers. The reason for this suggestion is because waste collection containers usually get filled up, and waste is dumped on the side of the waste

collection containers. Therefore, the decision support system will inform local municipalities when the waste collection container is full in real-time. Therefore, South African local municipalities operating in rural areas and using waste collection containers can also implement the decision support system to reduce the impact of household waste.

2.5.2.4. Kerbside waste collection system

A system used for the collection of waste that is usually used by most of the local municipalities in developing countries is the kerbside waste collection system (Kwenda, Lagerwall, Eker, & Van Ruijven, 2021: Mmereki, Baldwin & Li, 2016). Zaman (2014) has showed that the kerbside waste system is also commonly used in industrialised areas and highly developed communities in developed countries. The kerbside waste collection system is a system where members of the community place their recyclable waste and non-recyclable waste in containers and place them outside on a specific day for collection (Mora, Manzini, Gamberi & Cascini, 2014). Local municipalities have adopted the kerbside waste collection system except for waste separation from recyclable and non-recyclable waste. This has resulted in the kerbside waste collection system being used effectively and consequently results in the reduction of waste collection cost. While local municipalities do not incur the operational cost of recycling waste obtained by implementing the kerbside waste collection system (from the separation of waste done by household); they do, however, lose a potential income from waste recycling.

This is supported by Edwards, Burn, Crossin and Othman (2018) when they state that the local municipalities do not incur the operational costs of waste separation while using the kerbside waste collection system. This is because waste is separated by households before it is placed outside for collection. Therefore, the local municipality can fully apply the kerbside system with the additional operational cost of recycling. Conversely, Rigamonti, Ferreira, Grosso and Marques (2015) state that the reason why most local municipalities are not using the kerbside waste collection system is that it requires waste management vehicles with different waste compartments; one to store recyclable waste and the other to store non-recyclable waste. Municipalities

lack the financial capabilities to invest in waste management vehicles that have different waste compartments to implement a kerbside waste collection system. In contrast, Mwanza, Mbohwa and Telukdarie (2018) state that the kerbside system is considered impractical to be used in areas where there is a poor infrastructure. Infrastructure is considered an integral part of the implementation of a waste collection system in a municipality (Tucker & Farrelly, 2016).

Additionally, the kerbside waste collection system is applied correctly in developed areas, unlike in the rural areas where the infrastructure is extremely poor and thus unable to deal with such a waste system. Moreover, for the local municipality to achieve a functional waste management system, studies found that proper infrastructure and recycling facilities for waste collection systems are critical (Nduneseokwu, Qu & Appolloni, 2017). Therefore, local municipalities operating in the rural area are likely to implement a different waste collection system as they cannot meet the financial requirements needed for the use of the kerbside waste collection system. Kranzinger, Schopf, Pomberger and Punesch (2017) state that the kerbside waste collection system provides convenience for those participating in the separation of waste for recycling. Waste separation has become an important issue regarding the reduction of waste and the kerbside waste collection addresses that. South African municipalities do not use a system where waste collected from households is recycled. Gallardo, Prades, Bovea and Collomer (2012) explain that the kerbside waste collection system is used in high population density areas and the collection point is not at the door, but 50-60m from the door on kerbsides. Although, there are places in South Africa with a dense population, the kerbside waste collection system is still not applicable due to the reasons indicated above. The kerbside waste collection system has similarities to door-to-door systems; however, the difference between them is that the kerbside system separates recyclable waste from non-recyclable waste while the door-to-door system does not.

Navghane, Killedar and Rohokale (2016) state that the use of technology in connection with waste bins can increase the likelihood of municipalities saving operation costs as the technology will indicate when the waste bin is full and when to collect it. The world is adapting to new technological inventions. Therefore, local municipalities should

adjust their operation to fit in with the new technologies that are introduced into waste management service delivery. Although the integration of waste collection systems and technology will be costly, the municipalities can recoup the cost through waste collection fees.

2.6. THE EFFECT OF MUNICIPAL REVENUE ON WASTE MANAGEMENT SERVICE DELIVERY

Amfo-Out, Waife, Kwakwa and Akpah-Yeboah (2012) discuss the provision of free waste services. They view this as unsustainable because of outsourcing to private sector participants. However, factors such as household income, household size, household monthly expenditure and education level are significant contributors to the non-payment attitude of the public to solid waste management service delivery. In this vein, Mian, Zeng, Nasry and Al-Hamadani (2017) state that China has devised a system whereby a municipal solid waste management tax is charged at the same rate to all the households regardless of the weight of the waste generated. Similarly, South African local municipalities charge a flat rate depending on the province and the district in which the municipality is located. It is unlikely that charging a waste tax would be feasible in South Africa.

Greenhouse gases such as nitrous oxide or methane can be harvested from landfills by local municipalities and this could be a source of additional income namely as waste-to-energy (Munir, Mohaddespour, Nasr, & Carter, 2021: Owebor, Oko, Diemuodeke & Ogorure, 2019). In Malaysia, local municipalities do not harvest gas from landfills to produce electricity, and this has resulted in municipalities losing an opportunity to raise revenue due to the lack of new technology; therefore, municipalities' revenue is only collected from households (Mohamad & Keng, 2013). In Japan, local municipalities earn some of their income through recycling household waste, and this has reduced waste in landfills and thus reduced the effect of municipal waste on the environment (Kinnaman *et al.* 2014). In Ontario, Canada, municipalities encourage community members to recycle waste that is recyclable instead of municipalities recycling it themselves and hence municipalities lose potential revenue (Lakhan, 2014). The loss of income that could have been obtained from harvesting

gas to produce electricity and recycling household waste could reduce the budgeted amount for waste management service delivery in local municipalities; this might also occur in South African municipalities as they do not harvest gas to produce electricity from municipal waste and recycle the municipal waste that does not produce any gas The loss of potential income may result in inferior waste management service delivery, and it might distort the waste management budget for lack of additional revenue generation. Research has indicated that there is a global increase of waste in areas in which municipalities operate (Nyarai, Wallard, Moses & Ngenzile, 2016). Hence, Ziraba, Haregu and Mberu (2016) state that the increase in municipal waste is about the increase in population which means more waste to recycle and more potential income. Solid waste recycling is not only regarded as a potential source of revenue, but it is also an essential element of municipal solid waste management (Anghinolfi, Paulucci, Robba & Taramasso, 2013). The municipal waste management budget in developing countries only covers about 50% of the population (Lissah, Ayanore, Krugu, Aberese-Ako & Ruiter, 2021: Yang, Fu, Liu & Cheng, 2018). This has presented an opportunity to raise income and increase the capacity of the municipal budget to provide waste management service delivery. Local municipalities could raise cash in the form of recycling, harvesting gas and by doing that they will also reduce the waste that will be dumped at landfills. In the United Kingdom, municipalities separate recyclable waste from waste that cannot be reused and provide households with two bins for specifically recyclable waste; then recyclable waste is collected and revenue is gained to improve waste management service delivery (Bing *et al*. 2016). South African municipalities can also use the same strategy of providing households with two waste bins to collect recyclable waste and recycle and gain revenue and invest it in improving waste management service delivery.

In South Africa, local municipalities offer a certain number of services for free for low-income households (indigent households). This means that there could be a potential loss of income from the services that may have been charged but not reflected in the budgeted revenue for services. According to Obidi and Adeoti (2015), municipalities have the challenge of recovering the cost used in the operation of waste collection. Additionally, Javadi, Moslehi, Yaghoubi, Seirani, Abbasi and Tayyebi (2013) state that waste management is a good business even though it comes at a price. Johari, Alkali,

Ahmed and Mat (2014) advise that municipalities should implement strategies that will reduce operating costs, as currently the waste management budget does not cover the operation of waste management in local municipalities.

2.7. THE IMPACT OF INFORMAL SETTLEMENTS ON WASTE MANAGEMENT SERVICE DELIVERY

Informal settlements consist of community members from the low-income class, and most of the members are unemployed. Therefore, this study aims to assess whether the informal settlement has any impact on the municipal waste management budget and how does this affect waste management service delivery. Communities in informal settlements suffer from abysmal waste management service delivery (Chikowore, 2021: Gutberlet, Kain, Nyakinya, Oloko, Zapata & Zapata-Campos, 2017). This is the case in Brazil and most likely in South Africa too. Most of the residents of informal settlements in South Africa do not pay for waste management services rendered to them. The above study further notes that informal settlement communities contribute a considerable portion of municipal solid waste output with a negative impact on the municipal waste management budget. Campos and Zapata (2014) report that the service provided to informal settlements has an impact on the waste management budget and the fact that there is no revenue generated from providing this service to them causes a strain on waste management service delivery. Such results may apply to the South African context too.

There is a lack of accurate data for how waste from the informal settlements has impacted the waste management service delivery budget and the environment (Mazeka, Sutherland, Buthelezi & Khumalo, 2019). However, Vollmer and Grêt-Regamey (2013) point out that the data that is available and reliable is reveals that there is an increase of residents/population in an informal settlement. Additionally, local municipalities in Ghana predictan increase in residents of informal settlements (Miezah, Obiri-Danso, Kádár, Fei-Baffoe & Mensah, 2015) and this probably applies to informal settlements worldwide. With that said, the estimated increase in residents of informal settlements is usually used to determine the possible increase in waste production. Local municipalities are already struggling with the exiting waste without

adding the waste of informal settlement households. Furthermore, Ravindra, Kaur and Mor (2016) state that the additional waste generated by informal settlements residents usually remains uncollected, resulting in waste being burned, which causes air pollution or illegal dumping. Local municipalities are already facing a challenge of waste management service delivery; therefore, an additional waste management service delivery to informal settlements will increase both the financial and social burden of local municipalities. Moreover, based on their study in East Africa, O'Keefe, Luthi, Tumwebaze and Tobies (2015) state that local municipalities do not collect revenue from informal settlements. Due to this, those who are paying for the basic services of the waste collection are affected by those who do not pay. The impact is the waste that remains uncollected not only in the informal settlements' surrounding areas but also in the residential areas. Therefore, local municipalities, together with the national government, should develop a policy that assesses the ability to pay for services provided for informal settlements although, the residents in the informal settlements are in communities that are struggling financially (Morgner, Ambole, Anditi & Githira, 2020). Local municipalities should develop a waste management policy that caters for informal settlements in the country and ensure that at least the residents pay for service even if it is not the same as others. Instead of the residents of informal settlements paying for the waste management service delivery, local municipalities should apply for a subsidy from the national government to pay for the costs associated with the waste services provided to the informal settlement areas. According to Sibanda, Obange and Awuor (2017), the city of Kisumu, Kenya, has combined modes of services provisions to expand the coverage of waste management service delivery to informal settlements where waste is dumped in pits and burned. As a result of the combination of modes of waste collection services provisions, Kisumu municipality has managed to reduce uncollected waste and waste that was disposed of in pits and burned in informal settlement areas. Therefore, local municipalities in South Africa should implement the same principles by providing a combination of modes of waste collection service.

Oteng-Ababio (2012) states that the informal way of waste collection mostly occurs in the informal settlement areas. According to the data collected, the residents in informal settlements participate more in informal recycling (waste collection) than those in

developed areas. Therefore, the community of an informal settlement participates in solving the issues of waste management by picking up recyclable waste. To this, Suthar, Rayal and Ahada (2016) add that the informal settlement community members are major stakeholders in the reusable/recyclable solid waste materials. Moreover, data indicate that community members in the informal settlements participate in the informal waste trading centre's where they deal with recyclable products. Additionally, recycling rates indicate that 20% - 30% of waste that is recycled is by informal settlement community members (Gutberlet, 2015). Based on the results of these recycling rates, people in informal settlements are involved in solving the issues of waste management. To solve the issues resulting from the generation of waste, all the stakeholders should be involved, and that includes the informal settlement community. Therefore, local municipalities have the responsibility to inform and educate the informal settlement community members about the impact waste has on health and the environment, and about the financial implications it has on both the municipality and the informal settlement community.

Mateu-Sbert, Ricci-Cabello, Villalonga-Olives and Cabesa-lrigoyen (2013) state that visitors (tourists) also cause the increase of waste in municipalities they visit, and it causes constraints on the waste collection budget as they do not pay for the services provided to them in proportion to the waste produced. Not only have those in the informal settlement benefited from free waste management service delivery but also visitors benefit from this service delivery.

2.8. RECYCLING IN INFORMAL COMMUNITY

Gu, Tang, Liu, Li, Fujiwara, Sun, Gu, Yao, Duan, Song, and Jia, (2021) state that for cities to achieve zero waste, recycling plays an essential role. There are two categories of recycling: formal recycling and informal recycling (Rendon, Espluga-Trenc & Verd, 2021). Formal recycling is defined as a legal recycling entity with permission from the government to convert waste materials into new material, while, informal recycling does not require any permission and is usually done by individuals, waste pickers, and scavengers from informal settlements (Wang & Yu, 2021; Guibrunet, 2021). Informal communities are a key role player in the recycling of waste.

Additionally, Dlamini and Simatele (2016) state that in Johannesburg, South Africa informal waste collectors are playing a significant role in waste recycling and collect different types of waste. It is plausible that waste picker in other local municipalities in South Africa play an important roles in waste reduction and waste recycling.

According to Godfrey (2021), Informal waste recyclers contribute 51% of all the recycled paper and packaging waste. With that said, informal communities have benefited from the informal recycling systems and also reduced the impact of waste has on the environment. Informal communities are presented with a unique opportunity to both reduce waste and benefit from recycling. However, Samadikun, Sinttia, Rezagama, Sumiyati, Huboyo, Ramadan, Hadiwidodo and Nabila (2021) state that each informal recycler benefits differ depending on the type of waste they recycle. Therefore, informal communities directly benefit from informal recycling and assist in reducing the environmental impact of waste.

2.9. OTHER ASPECTS OF BUDGETING

The following sub-sections discusses technical, behavioural and environmental aspects of budgeting.

2.9.1. Technical Aspects of Budgeting

The technical aspect of budgeting refers to the technical ability to calculate and prepare budget statements (Oerlemans, 2013). Yukalang, Clarke and Ross (2018) state that the technical aspect used in municipal waste management refers to the technical ability of the municipalities' staff to apply the collecting and transporting process and the reduction techniques that include recycling or reusing waste. For the current study, the Municipal Department of waste management was assessed for their technical ability to prepare a municipal waste management budget and to implement waste management strategies.

Anessi-Pessina, Barbera, Sicilia and Steccolini (2016) state that public sector budgeting has been criticised for its inadequate technical preparation and the inability to seek input on critical resource allocation in the context of Europe. Similarly,

Madzivhandila and Asha (2012) in their South African study state that the financial team that prepares the municipal budget should understand the Integrated Development Plan (IDP) for the budgeted items so that the budget may address all the plans outlined on the IDP. Furthermore, the Municipal budget should address the issues that are outlined on the IDP, and those issues should have development indicators (this refers to indicators that measure the progress of the plan outlined on the IDP) that will indicate the ability of the plan being attainable in the current financial year-end (Mautjana & Mtapuri, 2014). Therefore, the financial teams of local municipalities should continuously receive training to improve their understanding of how the IDP and the development indicators affect the preparation of the municipal budget.

The South African National Treasury introduced the Municipal Standard Chart of Accounts (MSCOA) to promote uniformity across all the municipalities in South Africa and all the municipalities needed to implement it on 01 July 2017 (Marais & Wagner, 2016). The MSCOA is defined as a multi-dimensional recording and reporting system across the segments functions items (liability, revenue, and the expenditure) in the municipality. Therefore, due to the introduction of MSCOA, local municipalities needed to train both financial and non-financial officials on how to apply the principle of MSCOA and also equip the users of MSCOA with the technical ability to apply it (Koekemoer, 2018). In addition, Carstens and Henning (2015) affirm that applying the above will make the accounting officer in the local municipality record a transaction with the assistance of others after being equipped with the technical ability of MSCOA. Based on the points stated above regarding the MSCOA, the local municipalities in South Africa use the principles set out by MSCOA to prepare their annual municipal budget. Therefore, the accounting officer and any other non-financial officer require training to implement the principles of MSCOA so that the reporting of the transaction can be uniform across the state-owned entities (September & Mgadi, 2021). Consistent with that, the budget of the local municipalities is presented in the same format across South African municipalities.

The lack of personnel training and the technical ability to prepare the waste management budget has resulted in waste management projects not being fully

funded by the national government (Desta *et al*. 2014). This was found in AddisAbaba and it is unlikely that it would be different in South Africa.

2.9.2. Behavioural Aspects of Budgeting

Brunzell, Liljeblom and Vaihekoski (2013) declare that the behavioural aspect of budgeting focuses on the abilities of employees to achieve the technical aspect of budgeting and management style, and that behaviour determines the budgeting approach. Hence, according to Raghunandan, Ramgulam and Raghunandan-Mohmmed (2012), the behavioural aspect should be considered in the process of creating a budget. The behavioural aspect of those charged with waste management and those preparing the waste management budget shall therefore be considered for this study.

Chircir and Simiyu (2017) state that a significant part of the budgeting process is the behavioural aspect; this is due to the reliability that is placed on the manager and the employees. The preparation of the budget requires both the participation and commitment of employees and managers, And so to achieve the best outcome in preparing the budget. Local municipalities are service-driven institutions; therefore, the preparation will require the participation and commitment of end-users of the budget (those who will be providing the service delivery). Isaac, Lawal and Okoli (2015) state that there have been several different behavioural aspects to budget preparation across the state-owned entities. Moreover, the negative behavioural aspect of budgeting mostly results from the implementation of new accounting software as municipalities use service providers for accounting software (Hyvönen, Järvinen, Oulasvirta & Pellonen, 2012). Furthermore, Mansor and Tayib (2012) state that the behavioural aspects affect the individual performance of employees in the institutions. Therefore, every employee's behaviour towards the budget can affect the whole team either positively or negatively.

2.9.3. Environmental Aspects of Waste Management

The environmental aspect of the management of waste is affected by poor system controls for waste, and the ability to evaluate the impact waste has on the environment

(Brotosusilo, Utari, Negoro, Firdaus & Velentina, 2022: Guerrero *et al. 2013*). According to Othman, Noor, Abba, Yusuf and Hassan (2013), the environmental aspect should be evaluated for management performance and the alternative of decision-making determined. The environmental aspect of waste management should be critically evaluated and the ability of management in waste management departments to deal with environmental factors of waste assessed. Local municipalities should adequately operate the landfill sites so that they do not cause soil and groundwater contamination (Ferronato, Bezzi, Zortea, Torretta & Ragazzi, 2016). Furthermore, Aderogba and Afelumo (2012) state that the landfill causes litter, a terrible smell, diseases, and fire. Additionally, this can have a negative impact on climate change as waste has an impact on the environment. Local municipalities have a responsibility to properly maintain their landfills and protect the environment from all the damaging effects of waste.

2.10. SUMMARY OF THE CHAPTER

According to the researcher it can be established that no study focuses on evaluating the relationship between waste management service delivery and the municipal waste management budget in South Africa. Many researchers have investigated the impact of waste management service delivery. However, the results from their studies do not focus on how the municipal waste budget affects waste management service delivery. Hence, researchers have concluded that more studies need to be conducted on waste management service delivery (Chinasho, 2015; Park, 2018). Within the theoretical framework, this chapter discussed two theories, namely, waste management and institutional theories. The waste management theory encourages the local municipalities to do their duty by collecting waste and reducing the harm that waste has on human beings' health and the environment. Institutional theory encourages the use of guidelines in the form of rules, norms, and routines that affect local municipalities, society, and the environment.

The chapter also discussed the effect of capital expenditure on municipal waste service delivery. It indicated that investment in capital expenditure has a direct impact on waste collection services that are provided by local municipalities. The chapter also

discussed the effect municipal revenue has on waste collection services and suggested that the revenue collected from the households has a direct effect on the service delivery provided to households. Furthermore, it suggested that the revenue collected by local municipalities is divided into different sources, that is, revenue received from households and revenue received from the national treasury. It also suggested that due to corruption the revenue collected does not cover the capital and the operational expenditure required to provide effective waste management service delivery. Furthermore, the chapter discussed the types of waste collection systems that are used by local municipalities in various countries and the financial implications of those systems.

The next chapter will describe the overall research methodology and the strategy of the study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. INTRODUCTION

The previous chapter present the theoretical frameworks, followed by the discussion overview of municipal waste management, the impact of capital expenditure, operating expenditure, municipal revenue and informal settlement on waste management service delivery and followed by the discussion on the recycling in informal settlement and other aspects of budgeting and concluded with the summary of the chapter. Roberts, (2013) has revealed that a research methodology that is used in literature includes two different structures, a non-structured qualitative analysis and a structured quantitative analysis, and one must choose between the two if not using both. In this study, one of the methods will be used to find out whether the municipal waste management budget that has been allocated to waste management service delivery has been used to provide effective and efficient services. The purpose of this study is thus to investigate the effect of the municipal waste management budget on waste management service delivery. Therefore, the methodology of this study will assist the researcher to achieve the research objectives.

The identified objectives of this study are to:

- Examine the correlation between municipal waste management service delivery and waste capital expenditure in selected South African municipalities
- Examine the correlation between municipal waste management service delivery and waste operating expenditure in selected South African municipalities
- Examine the correlation between municipal waste management service delivery and waste collection revenue in selected South African municipalities
- Examine the correlation between municipal waste management service delivery and budget performance in selected South African municipalities

This chapter discusses the overall methodology used in this study as follows: In Section 3.2, the research method and justification was discussed; Section 3.3 discussed study population and justification; in Section 3.4, the sample, sampling methods and sample size were discussed; Section 3.5, discussed data collection and justification and followed by data analysis and justification in Section 3.6; Section 3.7, discussed control variables; while Section 3.8, model specification; Section 3.9, discussed the reliability and validity of the data; in Section 3.10, ethical considerations were discussed; and the summary of the chapter was discussed in Section 3.11.

3.2. RESEARCH METHOD AND JUSTIFICATION

This study used a quantitative research method to test the research hypotheses. The waste management budget is expressed in amounts and the number of households to which the department of waste management provides the services. The population of each municipality is also expressed in numbers. The reason for this is to discover whether the waste management budget stimulates waste service delivery and whether the waste management budget is enough to cover all households. That the data will be mainly in numbers justifies the decision to use a quantitative approach in this research. Other researchers also support this. Mohamed (2016) used a quantitative method to express the data in percentages and figures to inform decision-making in the issue of domestic waste collection in Samarahan, Malaysia. Regarding financial sustainability, Wilson, Rodic, Cowing, Velis, Whiteman, Scheinberg, Vilches, Masterson, Stretz and Oelz (2015) used the quantitative method effectively for waste management budget data collection, and the affordability of waste collection service delivery and actual values as well as the estimated values were collected from local municipalities. Because the collected data was explicitly in numbers of statistical tests conducted, the study used a quantitative research method. The researcher considered all the advantages and disadvantages of using quantitative research and the method was deemed to be appropriate for this study. Additionally, the researcher concluded, based on the collected data that quantitative research will provide a straightforward statistical analysis to use for this study. Furthermore, Rutberg and Bouikidis (2018) state that quantitative research firstly eliminates bias as the results that are achieved is in numbers. Secondly, the methods provide a broader range of scope in data

collection. Lastly, the data collected using the quantitative research method is reliable and accurate, making the results obtained from the data reliable. Therefore, the researcher considered the quantitative research method to be relevant to this study.

3.3. STUDY POPULATION AND JUSTIFICATION

Addaney and Oppong (2015) had indicated that there is a private-public partnership where municipalities partner with private organisations to solve the problems arising from municipal waste and so this has resulted in local municipalities outsourcing some of their services to the private sector. There are about three sources of data on waste management service delivery. These include local municipalities, private waste organisations, and the publications of the World Bank. The study population included all the local municipalities in South Africa. South Africa consists of nine provinces: Northern Cape province, Eastern Cape province, Free State province, Western Cape province, Kwazulu-Natal province, Mpumalanga province, Gauteng province, Limpopo province and North West province. This population was selected because local municipalities have the most reliable information about waste services and waste expenditure in South Africa (Khale and Worku, 2013), and the number of households to which the services are provided. Metropolitan and district municipalities are excluded from this study. The following are the reasons why metropolitan municipalities were excluded from this study: (a) the municipalities are classified as Category A, (b) these are municipalities that are located in areas with a high population in the country, (c) the municipalities have control of or govern many towns in that particular area, (d) lastly, there are only eight (8) metropolitan municipalities in South Africa (Both & Van Niekerek, 2013). District municipalities were excluded because they govern the border in the local municipalities, they operate.

3.4. THE SAMPLE, SAMPLING METHODS AND SAMPLE SIZE

According to Hamm and Ledford (2017), sampling methods, are classified into two categories, namely, probabilities and non-probabilities. This study used a non-probability sampling method. Acharya, Prakash, Saxena and Nigam (2013) define a non-probability sample as those samples that each member of a population have a greater chance of being selected but the chance is unknown. Non-probability sampling

includes quota, snowball, convenience, and purposive sampling. For this study, quota and purposive sampling will be used. Quota sampling is a technique that is used to choose specific participants that will have the same characteristics of the entire population (Taherdoost, 2016). This study sample consists of local municipalities. Local municipalities were chosen since they are service delivery orientated, unlike the district municipalities. Furthermore, there are 226 local municipalities in South Africa, unlike the only eight metropolitan municipalities and 44 district municipalities. According to Wee, Abas, Chen and Mohamed (2017), the purposive sampling method enables the researcher to specially select the respondents that will be able to provide the information required. Additionally, Cobbinah, Addaney and Agyeman (2017) state that purposive sampling is most efficient when gaining specific information from organisations that has adequate knowledge, experience and interest to the research problem. Therefore, for this study, the local municipalities that were selected are those that had predetermined characteristics. The following are the predetermined characteristics that are set out for a local municipality to be chosen for this study. The number of households serviced, informal settlements' access to refuse removal, waste management capital expenditure, waste management operating expenditure, waste management revenue, population of the local municipalities, and municipal classification. The sampled municipalities met these criteria from 2010 to 2021. This means that the budget of each local municipality should include capital expenditure, operational expenditure and revenue and this should be in all the years under study. The reason why other local municipalities were excluded in this study was due to the unavailability of financial information in some part of the years from 2010 to 2021. Therefore, for this study, 44 local municipalities have met all the predetermined characteristics, and these local municipalities are from all nine provinces in South Africa.

3.5. DATA COLLECTION AND JUSTIFICATION

A researcher has two different methods to use for data collection, namely, primary and secondary data collection. Addeny *et al.* (2015) used the secondary data collection as the information for the study was already gathered by municipalities. Ferronato *et al.* (2018), for example, conducted a study about sustainable development in solid waste

management and also chose to collect secondary data as it was readily available. Therefore, this study used secondary data. The researcher collected data from 44 local municipalities because other local municipalities were merged during the period of this study and the data is from 2010 to 2021 (appendix III). The researcher collected data for the period of twelve (12) years for the 44 local municipalities. The researcher did not collect data from district municipalities as they do not provide waste management services to the public. Furthermore, the researcher did not collect data from metropolitan municipalities and the reason for their exclusion is they are not in the category of municipalities as local municipalities.

In making comparisons among local municipalities about the effect of the waste management budget on waste management service delivery, the selected 44 local municipalities across South Africa were used. For each local municipality the following information was collected: capital expenditure on waste management and operating expenditure on waste management, revenue resulting from waste management, population per municipality, number of households for whom waste management service delivery was provided, number of households in informal settlements and the classification of a municipality. Data was collected by accessing the local municipalities' websites. After that, the process was to access the archived documents of each local municipality and get the final annual municipal budget for the period of study. This was because local municipalities publish their annual municipal budget on their website for public scrutiny. The annual municipal budget is presented in a way that the user of the document will be able to identify each department, the service which is budgeted, and the annual budget for that service. Additionally, on the website of the local municipalities, there is information about the total number of households in their region and the percentage used to calculate the informal settlement's household. This information is provided not only by local municipalities but also on the website of the Housing Development Agency Reports (Agency, 2020). The population of each municipality and its annual growth rate is collected from both the local municipality and the Statistics South Africa (STATSSA) websites. Other researchers can use the data which is collected using the above approach to reach the same conclusions as the researcher in this study. The main reason that the researcher

chose this Local municipalities is because the same data gathered in this study can be gathered by other researchers as it is readily available.

3.6. DATA ANALYSIS AND JUSTIFICATION

According to Hamm and Ledford (2017), data analysis is a process that applies a practical method to evaluate the data that is collected. The data collected was analysed using Panel Data Analysis, and this is because there were two or more variables involved: several households and the budgeted amounts for the period of 12 years from 2010 to 2021 (Capital expenditure, Operational expenditure and Revenue). According to Niazi and Hassan (2016), panel data is a method that is used to analyse two-dimensional data that comprises cross-sectional and time-series data. Panel data analysis is a technique or a system that uses cross-sectional data of time series to predict the economic implications (Bayrakdaroglu, Ege & Yazici, 2013). Similarly, Einav and Levin (2014) indicate that panel data uses economic variables which include multiple units and periods or time frames and also displays a cross-sectional variable and time-series variable. According to Novignon, Olakojo and Nonvignon (2012) panel data analysis considers the importance of time and its effect and also the importance of cross-section. Agrawal (2015) states that panel data analysis uses two or more periods and variables at different levels. The data collected for this study consist of three multiple variables. These are budgeted capital expenditure, operational expenditure, and budgeted revenue; and this study includes different time frames.

3.7. CONTROL VARIABLES

The control variables for this study include population and municipal classification.

The study's regression model:

$$WMSD_{it} = \propto + \beta_1 WCAPEXP_{it} + \beta_2 WOPEXP_{it} + \beta_3 WASTEREV_{it} + \beta_4 INFSETACRR_{it} + \beta_5 POPULATION_{it} + \beta_6 MUNICLASS_{it} + \varepsilon_{it}$$

3.8. MODEL SPECIFICATION

Consider the Ordinary Least Squares (OLS) model specified as:

$$\boldsymbol{log}WMSD_{it} = \propto + \beta_1 logCAPBUG_{it} + \beta_2 logWMOPERA_{it} + \beta_3 logWASTEREV_{it} + \\ + \beta_4 POPULATION_{it} + \varepsilon_{it}$$

Where the total waste management service delivery is $\boldsymbol{log}WMSD_{it}$, $logCAPBUG$ is the log of the capital budget over time, $logWMOPERA$ comprises the operational budget, $logWASTEREV$ denotes waste management revenue. $\beta_1, \beta_2, \beta_3$ and β_4 is the coefficient of the variables mentioned above, respectively, and $\propto$ is the intercept.

However, OLS is biased because there is a probability that the waste management budget is correlated with unobserved effect. In other words, OLS does not account unobserved and time-invariant characteristics. However, it is essential to eliminate individual municipal heterogeneity effects by employing a fixed effect following the study of Cook, Mentink, Bennett, and Burgi, (2007) as:

$$\boldsymbol{log}WMSD_{it} = \propto + \beta_1 logCAPBUG_{it} + \beta_2 logWMOPERA_{it} + \beta_3 logWASTEREV_{it} + \\ + \beta_4 POPULATION_{it} + \varepsilon_{it} \qquad t = 1, 2, 3..T$$

The researcher envisage that there is an unobserved effect such as corruption that is likely to be correlated with the capital budget. It is also assumed that the capital budget is unrelated to the error term. However, the random effect assumed that the unobserved effect is uncorrelated with the capital budget, thus:

$$\boldsymbol{log}WMSD_{it} = \propto + \beta_1 logCAPBUG_{it} + \beta_2 logWMOPERA_{it} + \beta_3 logWASTEREV_{it} + \\ + \beta_4 POPULATION_{it} + \varepsilon_{it}$$

The researcher conducted the Hausman-test for the heterogeneity effect of the unobserved characteristics.

Table 3.1 below present the variables of waste management service delivery.

Table 3. 1: Sources of data

Variables	***Sources of data***
Number of households serviced	*Municipal Department of Waste Management* (from 2010 to 2021), *municipal website, and statistics South Africa*
Informal settlements access to refuse removal	*Housing Development Agency Reports and Local municipalities* (from 2010 to 2021)
Waste management capital expenditure	*Municipal Department of Finance and the municipal website* (from 2010 to 2021)
Waste management operating expenditure	*Municipal Department of Finance and the municipal website* (from 2010 to 2021)
Waste management revenue	*Municipal Department of Finance and the municipal website* (from 2010 to 2021)
The population of the various local municipalities	*Local municipalities, municipal website, and statistics South Africa* (from 2010 to 2021)
Classification of municipalities	*Local municipalities and the municipal website*

Source: Author for data collection

The table above shows a total of seven variables of the study. The number of household in formal settlement and number of household in informal settlement were added together to make up the total number of household.

The following sections discusses the control variables of this study.

3.8.1. Number of Households

The number of households is those households that receive municipal solid waste service delivery. The number of households includes both formal housing and informal housing. The number of households from year 2010 to 2015 was assumed to be the

same without any increase or decrease. However, from year 2016 to 2021, the number of households had fluctuated. This is because Statistic South Africa does its counting (collection of information) after a certain period. Furthermore, Statistics South Africa does not provide any estimates about the change in the number of households for local municipalities. The number of households used in this study for the selected local municipalities was available on each local municipal website and on the website of Statistics South Africa. The number of households collected for this study is for each of the 44 local municipalities.

3.8.2. Informal Settlements Access to Refuse Removal

The number of households in informal settlements that have access to the refuse removal services was collected. For each local municipality, the number of informal households was determined based on a percentage (estimate) provided by both local municipalities and the Housing Development Agency Reports. Therefore, the number of informal settlements was calculated by multiplying the total number of houses by the estimated percentage of informal settlements. The calculation was available for all the local municipalities chosen for this study. Additionally, the Housing Development Agency Reports described the conditions in which informal settlements receive the waste management service delivery.

3.8.3. Waste Management Capital Expenditure

Capital expenditure is the budgeted amount for annual capital investment for solid waste management service delivery for each municipality. Local municipalities publish their annual budget on the website of the institution. The annual municipal budget is prepared in accordance with section 71 of Municipal Finance Management Act (MFMA) requirements. In addition to this, the annual municipal budget should comply with the MSCOA requirements. Notwithstanding this, waste management capital expenditure can be identified in a similar manner in all the selected local municipalities for this study. The annual capital expenditure for 12 years from 2010 to 2021 in the study was obtained from the websites for all the 44 local municipalities. An alternative way of collecting such data was to ask for the information from the local municipal offices.

3.8.4. Waste Management Operating Expenditure

The operating expenditure is the budgeted amount for annual operations for solid waste management service delivery by the municipality. As described under waste management capital expenditure, the budget of waste management operating expenditure should comply with section 71 of MFMA requirements and MSCOA requirements. Therefore, waste management operating expenditure can be identified in the same manner for all the local municipalities across South Africa. For the 44 local municipalities selected for this study, the annual waste management operating expenditure was therefore obtained in a similar manner for 12 years from 2010 to 2021. The information was obtained from the Local municipality website; however, the same information can be obtained by requesting it from the local municipality's offices.

3.8.5. Waste Management Revenue

Waste revenue is the budgeted amount collected from households for solid waste management service delivery. Similar to waste management capital expenditure and waste management operating expenditure, waste management revenue too should comply with section 71 of MFMA requirements and MSCOA requirements. Therefore, waste management revenue was described in the same way in all annual municipal budgets. The information (budgeted revenue) was obtained from the local municipality website; however, the same information can be obtained by requesting it from the local municipality's offices. For this study, the waste management revenue annual budgets were obtained for the 44 local municipalities for the period of 12 years from 2010 to 2021.

3.8.6. The Population of Various Municipalities

The population of the various municipalities is the number of residents in each of the 44 local municipalities. The population number was obtained from each of the local municipalities, and the information is also available from Statistics South Africa. However, each local municipality has a specific population for a specific year, and the others are determined by using the annual growth rate provided by both local municipalities and Statistics South Africa. For this study, the population of a local

municipality for the year 2010 and from 2011 to 2015 was determined using the annual growth rate. For the year 2016, the population figure was obtained from the Statistics South Africa and local municipality websites and from 2017 to 2021 (Lehohla. 2021: Africa, 2021), a new annual growth rate determined the population for a specific local municipality. The population for 2021 is a projection that was obtained using the annual growth rate. This was because Statistics South Africa does not conduct a year to year population count but conducts their counts after a specific length of time and provides a possible estimate for the future growth in populations. Therefore, the population for each local municipality selected for this study was available.

3.8.7. Classification of Municipalities

There are three categories of municipalities in South Africa. Category A includes metropolitan municipalities in South Africa: these are municipalities that control large geographical areas and thus includes most cities in the country. Category B consists of local municipalities: these municipalities control medium and small populated areas. District municipalities fall under Category C, and these municipalities are responsible for the borders and the responsibilities that are not assigned to metropolitan and local municipalities (Both & Van Niekerek, 2013: Africa, 2021). Therefore, for this study, category B has been chosen. The reason for choosing this class of municipalities is because there is a total of two hundred and twenty-two local municipalities in South Africa and the operations of this class of municipalities are the same. Therefore, these municipalities provide the same services to the public in South Africa.

Local municipalities used in this study are either in an urban or rural area. This identification was obtained from each of the local municipalities. The classifications of the municipalities in this study is a dummy variable. Local municipalities in the urban areas are represented by the unit one (1), and those in the rural areas are represented by the unit nought (0).

3.8.8. Municipal Waste Service Delivery

For the study, the municipal waste service delivery investigated is the solid waste management service delivery, excluding sewage waste.

3.9. RELIABILITY AND VALIDITY OF THE DATA

The quantitative research method is a valid method as it was used by Lohri *et al.* (2014) to successfully express financial information about costs and revenue for a financial sustainability study in municipal solid waste management. The method is also reliable as it was used before by Guerrero *et al.* (2013) to successfully assess the challenges of solid waste in developing countries. The purposive sampling method was used by Hamad *et al.* (2017) to select specific respondents to study the performance of residents patterning in the issue of solid waste management in the city of Al-Marj, Libya. Likewise, Siregar and Kustiani (2019) used the purposive sampling method to select respondents who are in project management and those having experience in project management in a study of contractor's perception of the construction-waste management case study in the city of Bandar Lampung. Purposive sampling has been used in more than one research article; therefore, this is evidence that it is reliable and valid. The quota sampling method was used by Owusu-Sekyere, Peprah and Demuyakor (2018) to select the number of households used in exploring the dynamics of e-waste disposal strategies in Tamale, Ghana. Suttipun and Nuttaphon (2014) also used the quota sampling method to select 221 organisations as a sample in a study of corporate social responsibility reporting on websites in Thailand. Hence, the quota sampling method is a proven method of sampling and it is reliable as other researchers in this discipline have previously used it.

In a study of municipal solid waste collection systems, Laso, García-Herrero, Margallo, Bala, Fullana-i-Palmer, Irabien and Aldaco (2019) source their secondary data from the Thinkstep database for the door-to-door collection system, and this data was readily available. Soni, Roy, Verma and Jain (2019) also collected secondary data from readily available data from governmental, semi-governmental and private publications. Based on the fact that the secondary data collection method was used in other studies, and it was found to be efficient and effective, it means that the secondary data collection method is reliable and valid. The same data obtained in this study can be obtained by others using the same procedure as followed in this study.

3.10. ETHICAL CONSIDERATIONS

This study did not require ethical clearance from the Turfloop Research Ethics Committee (TREC). TREC gives approval for research to be conducted by a person/s employed by the University Limpopo (institution) where the researcher needs to obtain access to confidential information from members of an organisation for a study. The committee ensures that the researcher conducts the research ethically and does not unknowingly cause harm to the participants in obtaining data. According to Hasan (2012), ethical consideration is concerned about the moral principles of human behaviour or the way that they conduct a research activity. This study did not require the researcher to visit local municipalities to request financial information from their offices. As the information used in this study is available on the selected local municipalities' websites. Local municipalities are required by the National Treasury to publish their financial information on their website for public use. Collection of data for this study thus did not require any human contact as the information is available on the website of local municipalities. Furthermore, other people's work has been referenced, and information obtained from other researchers was acknowledged in this study.

3.11. SUMMARY OF THE CHAPTER

This chapter has discussed the research methodology. The researcher adopted the quantitative method for this study which assisted in the analysis and testing of data to determine whether there is any relationship between waste management service delivery and the municipal waste management budget. The sample and population of this study are the 44 local municipalities across South Africa for the period from 2010 to 2021, and the panel analysis was used for local municipalities. The researcher used local municipalities because in South Africa local municipalities are directly responsible for providing waste management service delivery.

The chapter also discussed the control variables of this study which are the financial components that affect the results of the regression model which was used in this study. The data that was used in this study were obtained on the local municipalities' websites. The researcher believes and understands that through the adoption of the

methods mentioned above the research hypotheses were tested and the objectives were achieved.

The next chapter of this study outlines the presentation, interpretation, and results of this study based on the methodology discussed in this chapter.

CHAPTER FOUR: DATA ANALYSIS, INTERPRETATION AND DISCUSSION OF THE RESULTS

4.1. INTRODUCTION

The previous discussed the research methodology used in this study. It explained the research method, study population, sampling and sample size, data collection, data analysis, reliability and validity. This Chapter presents the results of the data analysis, their interpretation and the discussion on them. The results of the analysis are presented in five steps. In the first step, the researcher provided a summary of statistical information about the variables for the study and its observation. This approach allowed the researcher to present the statistical results and provide Histograms and Kernel Density graphs for waste management total service delivery. The second step allowed the researcher to test the effects of the capital budget on service delivery using Ordinary Least Squares, Fixed Effect and Random Effect. The approach allowed the researcher to assess the correlation between service delivery and independent variables (such as the log of the capital budget, the operational budget, and the log of revenue). In the third step, the Hausman test was conducted to test the correlation between unobserved heterogeneous municipal specific and the log of the capital budget. In the fourth step, the Breusch and Pagan Lagrangian multiplier test was conducted. The fifth and final step, allowed the researcher to test the correlation between the waste management budget and service delivery using the Generalised Method of Moment (GMM).

4.2. SUMMARY STATISTICS

Table 4.1 presents the descriptive statistics with 528 being the number of observations. All variables are continuous for the selected 44 municipalities in nine provinces. The scope of the dataset is 12 years (2010 -2021), and there is an increase in the budgets over time. Aside from the population size, all variables took the natural logarithm.

Table 4.1: Descriptive Statistics

Variables	Obs	Mean	Std.Dev.	Min	Max
Capital Budget	528	5127.244	8792.809	0	87071
Operational Budget	528	39175.58	45480.93	40	350000
Revenue Budget	528	41805.33	53639.01	363	353000
Population	528	211000	182000	11673	882000
Informal Settlement	528	10610.14	12658.7	212.918	83761.74
Number of Household	528	59402.85	57448.47	3222	263000

Source: Authors' results of descriptive data from Stata 12 software

The table above shows 528 observations for 12 years for 44 local municipalities in South Africa.

Figure 4.1 shows the histogram and kernel density of the dependent variable. The kernel density estimate describes a smooth curve of the distribution of the total service delivery dataset.

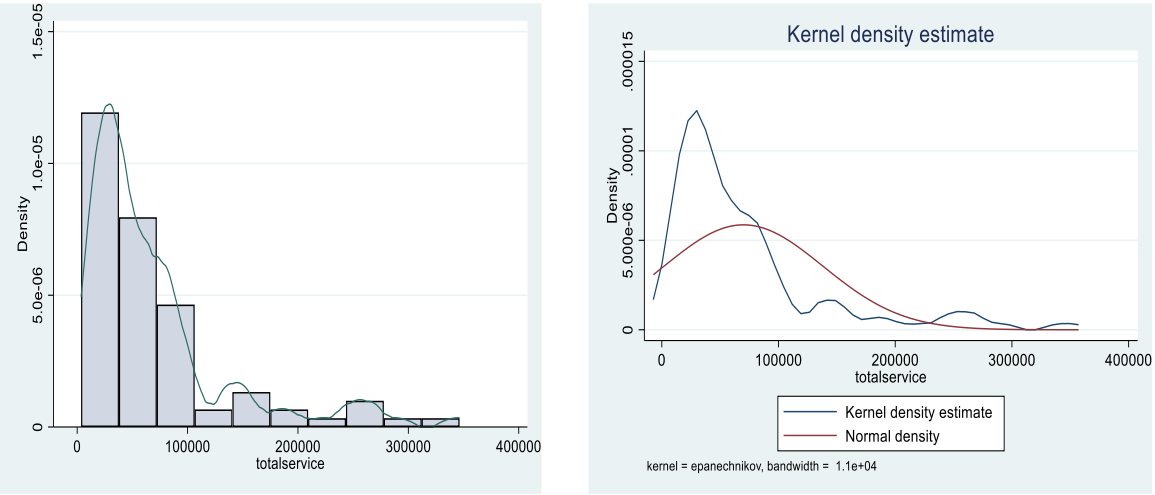


Figure 4. 1: Histogram and Kernel Density graphs for waste management total service delivery

Source: Author's results of the Histogram and Kernel Density graphs from Stata 12 Software

The Kernel density estimate is a technique that is used for the estimation of the probability density that enables users to analyse the probability distribution using the traditional histogram (Kim & Scott, 2012). The Kernel density estimate is used to determine the relationship between the population and waste management service

delivery. In conclusion, the higher the population density the more the waste management service delivery is required. Therefore, there is a positive relationship between the population and waste management service delivery.

4.3. RESULTS

The results of the study's analysis using the OLS, and Fixed and Random Effects are presented in the following paragraphs. According to Changyong, Hongyue, Naiji, Tian, Hua and Ying, (2014), log transformation is used to make the data conform close to the normal distribution and to reduce skewness in the data distribution. When there is a continuous variable(s) in the dataset with high value, the variable(s) are log and it will change the estimation from a unit to a percentage. Table 4.2 below presents the results of the study analysis using the OLS, and Fixed and Random Effects.

Table 4. 2: Effects of Capital budget on service delivery: OLS, Fixed effect and Random Effect

Variables	(1) OLS Total service	(2) Fixed effect Total service	(3) Random effect Total service
Log of Capital budget	589.2	-464.8*	-451.0*
	(584.7)	(272.9)	(273.1)
Log of Operational Budget	-1,817	799.4	638.1
	(1,322)	(710.2)	(704.6)
Log of Revenue	5,594***	1,833**	1,820**
	(1,222)	(806.5)	(786.8)
Population size	0.341***	0.295***	0.329***
	(0.00604)	(0.0208)	(0.0130)
Constant	-44,192***	-14,941**	-20,267***
	(8,393)	(7,601)	(7,716)
Observations	510	510	510
R-squared	0.922	0.390	
Number of municipal		44	44

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The asterisks represent the level of probability (which is the significant level) for each independent variable. The variables without the asterisks are not significant.

Source: Author's results of OLS, Random effect and Random effect from Stata 12 Software

Table 4.2, column 1, presents the results of the effect of the capital budget on waste service delivery using ordinary least squares (OLS). The results shows that a unit increase in the log capital budget increases service delivery by 589.2%. Furthermore, the log of operational budget shows a negative results but it is insignificant. OLS does not account for unobserved heterogeneity in municipal characteristics. There is a possibility that operational budget is correlated with corruption, hence, the negative sign on the log of operational budget. Total revenue and population have a positive and significant relationship with service delivery at a $p<0.01$. When there is an increase in the value of revenue, the total services will increase by 59.4%, all things being equal. This implies that an increase in revenue will improve total services. Also, a unit increase in population will cause an increase in demand of waste service delivery. This implies that an increase in population will put pressure on the waste service delivery. Column 2 and 3 presents the results of the Fixed effect and Random effect. The results show that a unit increase in the log capital reduces service delivery. There is a possibility that capital budget is correlated with corruption, hence, the negative sign on the log of capital budget. The results shows that a unit increase in the log of operational budget increase the service delivery. The log of revenue has a positive and significant relationship with service delivery at a $p<0.05$. When there is an increase in the value of revenue, the total waste service delivery will increase, all things being equal. Also, a unit increase in the population will increase total waste service delivery at a $p<0.01$, all things being equal. Similarly, the population has a positive and significant relationship with waste service delivery. This implies that an increase in population will put pressure on the waste service delivery.

However, the above results are not used to reach conclusion in this research this is because as stated early in chapter 3 OLS is bias and the model selection in the following sections shows that fixed and random effect are inappropriate for this analysis. Hence, the GMM was found suitable for this research and GMM results were used in the discussion of results sections.

Therefore, to know which model and the results to use, the researcher conducted the Hausman test and Breusch and Pagan Lagrangian multiplier test to investigate which

model is appropriate for this study. These test appears in Table 4.3 and Table 4.4 below.

The following paragraph and table 4.3 below shows the results of the Hausman test.

Table 4. 3: Hausman Tests

```
                 ---- Coefficients ----
             |      (b)      |      (B)       |      (b-B)    |  sqrt(diag(V_b-V_B))
             |     fixed     |     random     | Difference    |        S.E.
-------------+---------------|----------------|---------------|--------------------
logCAPITAL~T |   -464.8141   |  -450.9922     |   -13.82188   |            .
logOPERATI~G |    799.4078   |   638.1428     |    161.2649   |     89.45936
  logREVENUE |    1832.728   |   1820.002     |     12.7255   |     177.1491
  POPULATION |    .2949928   |  .3285523      |   -.0335595   |     .0162262
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg
    Test:  Ho:  difference in coefficients not systematic
                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        8.07
                Prob>chi2 =      0.0445   (V_b-V_B is not positive definite)
```

Source: Author's results of the Hausman test from Stata 12 Software

The researcher conducted a Hausman test, which revealed that there is a correlation between unobserved municipal-specific heterogeneity and log of the capital budget. In contrast, the hypothesis that the unobserved heterogeneous municipal specific does

not allow correlation with the log capital budget is rejected. In conclusion, the Random effect model is inappropriate for this study.

Table 4.4 below presents the Breusch and Pagan Lagrangian multiplier test.

Table 4. 4: Breusch and Pagan Lagrangian multiplier test

```
totalservice[munu_n,t] = Xb + u[munu_n] + e[munu_n,t]

Estimated results:

                 |       Var     sd = sqrt(Var)

        ---------+------------------------------

       totalse~e |   4.70e+09       68585.45

               e |   5.96e+07       7720.491

               u |   3.28e+08       18109.56

Test:   Var(u) = 0

                     chibar2(01) = 1881.34

                   Prob > chibar2 =   0.0000
```

Source: Author's results of the Breusch and Pagan Lagrangain multiplier test from Stata 12 Software

Table 4.4 presents the results of the Breusch and Pagan Lagrangian multiplier test. The results reveal that the random effect model is not appropriate for the analysis. The residual is also not correlated with any of the independent variables. The Hausman test shows that the fixed effect model eliminates unobserved individual municipal effect (see Appendix I for the individual-specific municipal effect) in the sample.

OLS is biased because there is a probability that the waste management budget is correlated with unobserved effect. In other words, OLS does not account unobserved and time-invariant characteristics. With that said, the OLS is not appropriate for this

study. Based on the Hausman test and Breusch and Pagan Lagrangian multiplier test the Random and Fixed effect model correlated with the unobserved municipal-specific heterogeneity and unobserved individual municipal effect. Therefore, OLS, Random and Fixed effect model is inappropriate for this study. The GMM estimator removes biasedness that arises from a dynamic endogeneity issue. Therefore, the GMM in Table 4.5 is the appropriate model used to interpret the results. Table 4.5 presents the relationship between the waste management budget and service delivery using the Generalised Method of Moment (GMM).

Table 4. 5: Waste management budget and service delivery: Generalised Method of Moment

Variables	(1) GMM Total service
Lag. Total service	0.967***
	(0.0241)
Log of Operational Budget	168.0
	(482.3)
Log of Capital budget	50.25
	(223.3)
Log of Revenue	339.6
	(464.8)
Population size	0.0146*
	(0.00831)
Constant	-5,343*
	(3,072)
Observations	468
Number of identified municipalities	44
Year dummies	Yes
Wald statistics	60398.51

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Author's results of Generalised Method of Moment from Stata 12 Software

Table 4.5 presents the results indicating that a percentage change in the waste management budget is correlated with a 168.0% increase in waste management

service delivery in the short-run, although it is insignificant on the average, all things being equal. The lagged dependent variable shows that it is statistically significant, while population size has a positive and significant effect on the service delivery at a 0.1% significant level. The GMM estimator removes biasedness that arises from a dynamic endogeneity issue. The study controlled the endogeneity problem is by applying the one-step system GMM estimator. Hence, Hansen statistics show that the researcher has used an appropriate and valid instrument, and the second-order autocorrelation is 0.947.

4.4. DISCUSSION

This study examines the correlation between the municipal waste management budget and service delivery of local municipalities in South Africa. This study used information from 44 local municipalities across South Africa for a period of 12 years (2010-2021). The hypotheses was tested using the panel data analysis. The technique used the Ordinary least squares (OLS), the fixed effect model and the random effect model to accommodate the problem of unobserved heterogeneity in the relationship between the waste management budget and service delivery of local municipalities. The OLS is biased because there is a probability that the waste management budget is correlated with unobserved effect. The decision whether to use the fixed effect model or the random was based on the analysis of the Hausman test. The Hausman test showed a Prob>chi^2 = 0.0445 which is lower than 0.05 resulting in both Fixed and Random Effect being inappropriate for this study. Furthermore, the Breusch and Pagan Lagrangian multiplier test was conducted to prove further that the random effect is not appropriate for the analysis, and the residual value does not correlate with any of the independent variables. The GMM estimator was used to remove biasedness that arises from a dynamic endogeneity issue, and the Hansen statistics show that the study has used an appropriate valid instrument, and the second-order autocorrelation is 0.947.

4.4.1. H_1: Municipal Waste Management Service Delivery and Waste Capital Expenditure in Selected South African Municipalities

The first research hypothesis of this study states that there is no correlation between municipal waste management service delivery and waste capital expenditure in selected South African municipalities. The research model selection indicates that OLS, Random and Fixed effect model is not appropriate for this study. Therefore, for this study the appropriate model used to analyse the research results is the GMM. From the GMM in Table 4.5, there is a significant correlation between municipal waste management service delivery and waste capital expenditure, where a change in waste capital expenditure results in a 50.25% increase in waste management service delivery. The results suggest that waste capital expenditure does influence the municipal waste management service delivery that is provided by local municipalities. The finding of this study is similar to that of Greco *et al.* (2015) who focused on the factors that influence waste collection costs, and found that waste capital expenditure changes because of the volume of refuse waste that needs to be collected. Furthermore, it indicates that the growing waste production would increase and strengthen the capital expenditure for municipalities and leads to the conclusion that there is a relationship between the waste collection service delivery and capital expenditure.

The study by Bhor *et al*. (2015) examines the relationship between the implementation of the smart waste collection system and the efficiency in waste collection service delivery. Their results indicate that there is a positive relationship between the implementation of technological inventions in assisting with efficient and waste collection service delivery. Their results further show that the capital expenditure on technology has implications on waste management and thus has a positive relationship with waste collection service delivery. The results of this study presented in Table 4.5, therefore reject the hypothesis that there is no relationship between municipal waste management service delivery and waste capital expenditure in selected South African municipalities. Hence the alternative is rejected, and the null hypothesis is accepted.

4.4.2. H_2: Municipal Waste Management Service Delivery and Waste Operating Expenditure in Selected South African Municipalities

The second research hypothesis of this study states that there is no correlation between municipal waste management service delivery and waste operating expenditure in selected South African municipalities. The OLS, Random effect and Fixed effect model is inappropriate for this study and the GMM was regarded as appropriate. From the GMM, there is a positive correlation between municipal waste management service delivery and waste operating expenditure, where a change in waste operating expenditure results in a 168% improvement in waste management service delivery. The result suggests that the waste operating expenditure does have a significant impact on the quality of municipal waste management service delivery. The results of this study are similar to that of D'Onza *et al.* (2016) who focused on the full cost accounting in the analysis of separated waste collection efficiency. Furthermore, the researcher indicates that there is additional cost associated with separating recyclable waste from non-recyclable waste and the cost associated with the separation increases as more waste is separated. Furthermore, the same study concluded that the waste collection per ton increases when the waste is not separated, that is, undifferentiated. Their results have revealed that there is a positive relationship between waste operating expenditure and municipal waste management service delivery, which means that an increase in municipal waste management service delivery increases wastes operating expenditure. Moreover, the results of this study are similar and consistent with those of Bleck and Wettberg (2012) who focused on waste collection in developing countries. They concluded that waste collection has a major impact on the waste operating expenditure. Furthermore, the change in waste collected in tonnes has an influence on the change in waste operating expenditure.

The study by Kaushal *et al.* (2012), which examined municipal solid waste management and the economic implications, found that the waste management cost is increasing due to the increase of waste generated. Waste management expenditure varies in accordance with the level of waste regardless of the level of service delivery that is provided. The results depicted in table 4.5, therefore, do not support the hypothesis that there is no relationship between municipal waste management service

delivery and waste operating expenditure in selected South African municipalities. Hence the alternative is rejected, and the null hypothesis is accepted.

4.4.3. H_3: Municipal Waste Management Service Delivery and Waste Collection Revenue in Selected South African Municipalities

The third research hypothesis of this study states that there is no correlation between municipal waste management service delivery and waste collection revenue in selected South African municipalities. The GMM model was used in this study, because the OLS, Random and Fixed effect model is inappropriate for this study. The results of this study, when having used the GMM, suggest that there is a positive relationship between municipal waste management service delivery and waste collection revenue. A change in waste management service delivery results in a 339.6% increase in the waste collection revenue. The results suggest that municipal waste management service delivery has a direct link to municipalities' waste collection revenue.

The results of this study differ from those of Amfo-out *et al.* (2012) who focused on the willingness of the residents of a semi-rural municipality in Ghana to pay for solid waste collection. Their results indicate that waste collection revenue depends on the willingness of residents to pay and the waste collection system used, and this is at the significance level of five percent. However, the results are inconsistent with those of Ziraba *et al.* (2016) who focused on the potential impact of poor solid waste management in developing countries and concluded that many local municipalities have lost revenue because they do not recycle waste to increase revenue and further compromise the service delivery and this at the significance level of 5%. Furthermore, the results of this study differ from those of Johari *et al.* (2014) who analysed the financial plans to meet the waste management expenditure. They concluded that most of the revenue was from government grants for waste management projects, instead of from the collection from households. The results of this study as shown in table 4.5 above, therefore, reject the hypothesis that there is no relationship between municipal waste management service delivery and waste collection revenue in selected South

African municipalities. Hence the alternative is rejected, and the null hypothesis is accepted.

4.4.4 H_4: Municipal Waste Management Service Delivery and Budget Performance in Selected South African Municipalities

The fourth research hypothesis of this study states that there is no relationship between municipal waste management service delivery and budget performance in selected South African municipalities. The OLS, Fixed, and the Random effect model are not appropriate for the analysis of budget performance related to waste management service delivery. Consequently, this study used the GMM to test the correlation between waste management service delivery and budget performance. The subsequent GMM results indicate a positive and significant relationship between service delivery and waste management budget by a *p*-value of 0.967. The results suggest that municipal waste management service delivery has a direct link to municipal waste management budget performance.

The results of this study are similar to of those of Hidalgo *et al.* (2018) who scrutinised the sustainable vacuum waste collection systems in areas of difficult access. They concluded that the system used for waste collection has a direct impact on the waste management budget. However, the results are inconsistent with those of Mashamaite (2014) who focused on the service delivery challenges faced by local municipalities, and concluded that service delivery is compromised due to mismanagement of funds, thus resulting in budget targets not being met. However, these results concur with those of Zohoori *et al.* (2017) who studied waste management challenges and problems in low-income and developing countries. They concluded that due to the increased generation of waste a burden is imposed on the budget. The resulting high expenses are associated with waste generation. Therefore, budget targets are not achieved due to the low-income homes in the municipality's area. The results, therefore, reject the study hypothesis that there is no relationship between municipal waste management service delivery and budget performance. Hence, the alternate hypothesis is rejected, and the null hypothesis is accepted.

4.5. SUMMARY OF THE CHAPTER

This chapter presents the interpretation, presentation and results of this study using statistical analysis to test the research hypotheses and achieve the objectives of this study. The study revealed the relationship between waste management service delivery and the municipal waste management budget using the GMM. Given the above results, it can be concluded that the municipal waste management budget has a direct influence on waste management service delivery. Moreover, the 44 local municipalities used in this study are the ones that have the most reliable information and that were not merged between 2010 and 2021.

In next chapter of this study, the research discusses the summary, conclusion and the recommendations of this study based on the research findings.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

The previous chapter discussed the methodology used in this study. It explains the research method, study population, sampling method and sample size, data collection, data analysis, reliability and validity of the data. This chapter discusses the summary of results on the research objectives. It also presents recommendations and conclusions. The previous chapter presented and discussed the results of this study. Furthermore, the chapter provided the interpretation of the results. In this chapter, section 5.2 will discuss the summary of results, section 5.3 will discuss the contribution that this study makes to the current body of knowledge, while section 5.4 will discuss the research limitations of this study, and finally, section 5.5 outlines the recommendations based on the study results.

The following sections discusses the summary of results on research objectives.

5.2. SUMMARY OF RESULTS ON RESEARCH OBJECTIVES

The main objective of this study was to determine the effect of the municipal waste management budget on waste management service delivery. The previous chapter presented the research results of the study relating to the research hypotheses. Therefore, this section presents a discussion of the results pertaining to the research objectives of this study.

5.2.1. Summary of Results on Research Objective 1

To examine the correlation between municipal waste management service delivery and waste capital expenditure in selected South African municipalities.

The research results regarding research objective one (1) indicate that waste capital expenditure directly affects the quality of waste management service delivery. The data analysis shows a 50.25% significance in accordance with the GMM. The results suggest that the more local municipalities' budget and spent funds on waste capital expenditure, the more there will be a significant improvement in municipal waste

management service delivery. The research results have important implications for future budgeting and management expenditure and for the influence it has on municipal waste management service delivery. The results of this study are similar to those of Menikpura *et al.* (2012). Furthermore, the results are in line with those of Bhor *et al.* (2015). Therefore, the research results of this study support the research objective since the analysis has indicated the correlation between municipal waste management service delivery and waste capital expenditure (in the context of the selected local municipalities' data used in this study).

5.2.2. Summary of Results on Research Objective 2

To examine the correlation between municipal waste management service delivery and waste operating expenditure in selected South African municipalities.

The results on research objective two (2) show that waste operating expenditure has a significant impact on the quality of waste management service delivery that local municipalities provide to the public, and the data analysis shows a 168.0% significance, according to GMM. This is highly significant. The research results show that waste operating expenditure is improving the waste management service delivery provided by local municipalities. The research results on this research objective are consistent with those of Bleck and Wettberg (2012). Moreover, D'Onza *et al.* (2016) had a similar finding where waste collection cost per ton had an important influence on municipal waste management service delivery. Therefore, the research results support the research objective since the analysis has proven that there is a correlation between municipal waste management service delivery and waste operating expenditure (in the context of the data used in this study).

5.2.3. Summary of Results on Research Objective 3

To examine the correlation between municipal waste management service delivery and waste collection revenue in selected South African municipalities.

The results of this study on objective three (3), which examined the correlation between municipal waste management service delivery and waste collection revenue

in selected South African municipalities, shows that the waste management service delivery provided to the public/households has a significant influence on the revenue collected by local municipalities as the data analysis shows a 339.6% significance based on the GMM. The results indicate that municipal waste management service delivery has a direct impact on the waste revenue collected by local municipalities. The results of this study differ from those of Amfo-out *et al.* (2012), as their results indicate that the revenue collected from waste management service delivery depends on the willingness to pay rather than on the service delivery provided. However, Johari *et al*. (2014) had a positive finding, namely, the waste revenue collected, and government grants have led to quality waste management service delivery. Therefore, the third research objective has been achieved as the data analysis has proven that there is a correlation between municipal waste management service delivery and the revenue collected from the households for the service delivery (in the context of the data used in this study).

5.2.4. Summary of Results on Research Objective 4

To examine the correlation between municipal waste management service delivery and budget performance in selected South African municipalities.

The results on research objective four (4) indicate that municipal waste management service delivery has an impact on the municipal budget performance, and the data analysis shows a *p*-value of 0.967 which is highly significant according to the GMM. This indicates that municipal waste management service delivery influences how the local municipalities' budgets perform. The finding is supported by Zohoori *et al.* (2017). Furthermore, the results on the research objective is consistent with those of Hidalgo *et al.* (2018). However, Mashamaite (2014) differed on where budget performance was affected by the mismanagement of funds. Therefore, the research objective has been achieved as the research analysis has proven that there is a correlation between waste management service delivery and budget performance (in the context of the data used in this study).

5.3. CONTRIBUTION TO THE BODY OF KNOWLEDGE

The study contributes to the understanding of how waste management service delivery affects the budgeting of municipal waste management. To the knowledge of the researcher, no research in waste management in South Africa has been conducted specifically on the municipal waste budget. In addition, according to the researcher this study is the first to use the unique data that include the six independent variables waste capital expenditure, waste operating expenditure, waste collection revenue, number of households, and informal settlements having access to waste services in South Africa. This study suggests applying a new model when researching how waste management service delivery is affected by municipal waste management.

The correlation between municipal waste management service delivery and the municipal waste budget in South African can be represented as follows for future research:

$$WMSD_{it} = \propto + \beta_1 WCAPEXP_{it} + \beta_2 WOPEXP_{it} + \beta_3 WASTEREV_{it} + \beta_4 INFSETACRR_{it} + \beta_5 POPULATION_{it} + \beta_6 MUNICLASS_{it} + \varepsilon_{it}$$

The model can be used by future researchers to investigate whether the results of this study can be replicated or be contrary to other countries. Additionally, this model can be used to advance this topic by investigating private and public organisations offering waste management services in South Africa.

5.4. RESEARCH LIMITATIONS

The study's limitations may be attributed in part to the sampling of data from only 44 local municipalities in South Africa and drawing data for a specific 12-year period ending in the 2021 financial reporting period. During this period local municipalities were faced with the problem of providing quality service delivery with limited resources. Moreover, other local municipalities have been merged (refer to Appendix III) with other local municipalities to form new local municipalities, therefore, those were excluded from the study due to insufficient data from 2010 to 2021. The study did not use data from metropolitan and district municipalities. It is yet to be researched

whether both metropolitan and district municipalities' budgets have any effect on the waste management service.

5.5. RECOMMENDATIONS

Based on the research results of this study and the limitations of the study, the researcher makes the following recommendations.

5.5.1. Industry and Economy

The researcher recommends that local municipalities increase their municipal waste expenditure as it will improve the waste management service delivery. For example, employing more waste pickers/collectors might lead to a better waste service delivery. Furthermore, local municipalities should improve their revenue collection as it finances the municipal waste expenditure. There is an indication that local municipalities could exploit the possible revenue generated from recycling. The researcher recommends that local municipalities in South Africa start recycling and generate revenue accordingly. Furthermore, the recycling of recyclable waste will create jobs which will reduce the unemployment rate. The researcher recommends that all merged local municipalities should also consolidate their financial information prior to the merger. Studies have shown that there is a direct connection between the increase in waste generation and the increase in population. Therefore, local municipalities should consider such factors when they prepare municipal waste management budgets.

The study provides insight regarding waste operating expenditure, waste capital expenditure, waste collection revenue, and budget performance that will assist in furthering academic research regarding municipal waste management service delivery. The results of this study may encourage the management of local municipalities to strategically align their municipal budget to service delivery as it will reduce the impact waste management service delivery has on society and the environment. Furthermore, the results of this study could assist policymakers of waste management policy to factor in the financial implication of waste management service delivery.

5.5.2. Future Research

In this study, only the effect of waste service delivery on the municipal budget has been evaluated but there are other essential services that local municipalities provide. In further research, other types of municipal service delivery may be investigated on which the municipal budget may have an impact. Examples of these could be: wastewater management service delivery, water management service delivery, and electricity management service delivery. In addition, further research is recommended to look at the effect of waste management services provided by private organisations on their waste management budget. The reason is that this study focused only on local municipalities while private organisations also offer waste management services. In a similar vein, it is recommended that future research should also look into the metropolitan municipalities in South Africa. Future researcher may investigate the positive effect of informal recycler on waste service delivery. Furthermore, the future researcher may also investigate the municipal budget per district municipality.

Future studies can be conducted using different variables such as wastewater management service delivery and water management service delivery. Furthermore, a longer time period can be used for future studies as this study only used 12 years of data. Additionally, upcoming researchers can use more than 44 local municipalities for collection. Future research can use mixed-method approaches as this study used a quantitative approach only. Future research may also opt to investigate the effect of waste management budget on the public partnership between local municipalities and private organisations.

5.6 CONCLUSIONS

The goal of this study was to analyse the effect of municipal waste management service delivery on the municipal waste budget. Therefore, the objectives of this study were: to examine the correlation between municipal waste management service delivery and waste capital expenditure in selected South African municipalities; to examine the correlation between municipal waste management service delivery and waste operating expenditure in selected South African municipalities; to examine the correlation between municipal waste management service delivery and waste

collection revenue in selected South African municipality and to examine the correlation between municipal waste management service delivery and budget performance in selected South African municipalities. Within the sampled 44 local municipalities there is a significant correlation in waste capital expenditure and municipal waste management service delivery where 50.25% GMM. Additionally, within the sampled 44 local municipalities, the results revealed that there is a correlation of 168.0% between waste operating expenditure and waste management service delivery using GMM. Similarly, within the sampled 44 local municipalities, it is evident that there is a correlation between waste collection revenue and waste management service delivery where at 339.6% using the GMM. Within the sampled 44 local municipalities, there is a significant correlation between municipal budget performance and waste management service delivery where there is a *p*-value of 0.967 for GMM. Therefore, the results of this study have achieved the objectives set by the researcher by discussing literature together with the waste management theory, institutional theory and the analysis of this study.

Although there are some similarities between of the previous research studies and this one, relating to the municipal waste expenditure there are differences. Municipal waste expenditure is important in order for local municipalities to provide quality waste collection services. Therefore, the researcher recommends that local municipalities increase their municipal waste expenditure as it will improve the waste management service delivery and improve the waste collection revenue, as it is evident that there is a significant correlation. However, the study was conducted in local municipalities in South Africa, therefore the results might be different when using private organisations or metropolitan municipalities when sampling. Based on the results of this study, the researcher concludes that within the sample of local municipalities examined, there is enough evidence to conclude that the municipal waste management budget affects the waste management service delivery.

References

Abrate, G., Erbetta, F., Fraquelli, G. & Vannoni, D. 2014. The cost of corruption in the Italian solid waste industry. *Industrial and Corporate Change*, *24(2),* pp.439-465.

Abd El-Wahab, E.W., Eassa, S.M., Lotfi, S.E., El Masry, S.A., Shatat, H.Z. & Kotkat, A.M. 2014. Adverse health problems among municipality workers in Alexandria (Egypt). *International journal of preventive medicine*, *5*(5), pp.545.

Abdelhamid, M.S. 2014. Assessment of different construction and demolition waste management approaches. *HBRC Journal*, *10*(3), pp.317-326.

Abdulai, H., Hussein, R., Bevilacqua, E. & Storrings, M. 2015. GIS Based mapping and analysis of municipal solid waste collection system in Wa, Ghana. *Journal of Geographic Information System*, *7*(02), pp.85.

Acharya, A.S., Prakash, A., Saxena, P & Nigam, A. 2013. Sampling: Why and how of it. *Indian Journal of Medical Specialties*, *4*(2) pp.330-333.

Addaney, M. & Oppong, R.A. 2015. Critical issues of municipal solid waste management in Ghana. *Journal of Energy and Natural Resource Management*, *2*(1), pp.30-36.

Aderogba, K.A. & Afelumo, B.A. 2012. Waste dumps and their management in Lagos metropolis. *International Journal of Learning and Development*, *2*(2), pp.1-16.

Agrawal, G. 2015. Foreign direct investment and economic growth in BRICS economies: A panel data analysis. *Journal of Economics, Business and Management*, *3*(4), pp.421-424.

Ahsan, T. & Zaman, A.U. 2014. Household Waste Management in High-Rise Residential Building in Dhaka, Bangladesh: Users' Perspective. *International Journal of Waste Resources*, *4*(1), pp.1-7.

Alam, P. & Ahmade, K. 2013. Impact of solid waste on health and the environment. *International Journal of Sustainable Development and Green Economics*, *2*(1), pp.165-168.

Aleluia, J. & Ferrão, P. 2017. Assessing the costs of municipal solid waste treatment technologies in developing Asian countries. *Waste Management*, *69*, pp.592-608.

Aliu, I.R., Adeyemi, O.E. & Adebayo, A. 2014. Municipal household solid waste collection strategies in an African megacity: analysis of public private partnership performance in Lagos. *Waste Management & Research*, *32*(9), pp.67-78.

Altayar, M.S. 2018. Motivations for open data adoption: An institutional theory perspective. *Government Information Quarterly*, *35*(4), pp.633-643.

Alzamora, B.R. & Barros, R.T.D.V. 2020. Review of municipal waste management charging methods in different countries. *Waste Management, 115*, pp.47-55.

Anessi-Pessina, E., Barbera, C., Sicilia, M. & Steccolini, I. 2016. Public sector budgeting: a European review of accounting and public management journals. *Accounting, Auditing & Accountability Journal*, *29*(3), pp.491-519.

Anghinolfi, D., Paolucci, M., Robba, M. & Taramasso, A.C. 2013. A dynamic optimization model for solid waste recycling. *Waste management*, *33*(2), pp.287-296.

Angouria-Tsorochidou, E., Teigiserova, D.A. & Thomsen, M. 2022. Environmental and economic assessment of decentralized bioenergy and biorefinery networks treating urban biowaste. *Resources, Conservation and Recycling, 176*, p.105898.

Amalu, T.E. & Ajake, A.O. 2014. Appraisal of solid waste management practices in Enugu city, Nigeria. *Journal of Environment and Earth Science*, *4*(1), pp.97-105.

Amfo-Out, R., Waife, E.D., Kwakwa, P.A. & Akpah-Yeboah, S. 2012. Willingness to pay for solid waste collection in semi-rural Ghana: A Logit estimation. *ZENITH International Journal of Multidisciplinary Research*, *2*(7), pp.40-49.

Amoo, O.M. & Fagbenle, R.L. 2013. Renewable municipal solid waste pathways for energy generation and sustainable development in the Nigerian context. *International Journal of Energy and Environmental Engineering*, *4*(1), p.42.

Aremu, A.S., 2013. In-town tour optimization of conventional mode for municipal solid waste collection. *Nigerian Journal of Technology*, *32*(3), pp.443-449.

Assamoi, B. & Lawryshyn, Y. 2012. The environmental comparison of landfilling vs. incineration of MSW accounting for waste diversion. *Waste Management*, *32*(5), pp.1019-1030.

Bayrakdaroglu, A., Ege, I. & Yazici, N. 2013. A panel data analysis of capital structure determinants: empirical results from Turkish capital market. *International Journal of Economics and Finance*, *5*(4), pp.131-140.

Bel, G., Fageda, X. & Mur, M. 2012. Does cooperation reduce service delivery costs? Evidence from residential solid waste services. *Journal of Public Administration Research and Theory*, *24*(1), pp.85-107.

Benito, B., Solana, J. & Moreno, M.R. 2014. Explaining efficiency in municipal services providers. *Journal of Productivity Analysis*, *42*(3), pp.225-239.

Beyene, H.D., Werkneh, A.A. & Ambaye, T.G. 2018. Current updates on waste to energy (WtE) technologies: a review. *Renewable Energy Focus*, *24*, pp.1-11.

Bleck, D. & Wettberg, W. 2012. Waste collection in developing countries–Tackling occupational safety and health hazards at their source. *Waste management*, *32*(11), pp.2009-2017.

Brunzell, T., Liljeblom, E. & Vaihekoski, M. 2013. Determinants of capital budgeting methods and hurdle rates in Nordic firms. *Accounting & Finance*, *53*(1), pp.85-110.

Bigum, M., Petersen, C., Christensen, T.H. & Scheutz, C. 2013. WEEE and portable batteries in residual household waste: Quantification and characterisation of misplaced waste. *Waste Management*, *33*(11), pp.2372-2380.

Bing, X., Bloemhof, J.M., Ramos, T.R.P., Barbosa-Povoa, A.P., Wong, C.Y. & van der Vorst, J.G. 2016. Research challenges in municipal solid waste logistics management. *Waste management*, *48*, pp.584-592.

Bhor, V., Morajkar, P., Gurav, M., Pandya, D. & Deshpande, A. 2015. Smart garbage management system. International Journal of Engineering Research & Technology, 4(3), p.2000.

Boffardi, R., De Simone, L., De Pascale, A., Ioppolo, G. & Arbolino, R. 2021. Best-compromise solutions for waste management: Decision support system for policymaking. *Waste Management*, *121*, pp.441-451.

Bolaane, B. & Isaac, E. 2015. Privatisation of solid waste collection services: Lessons from Gaborone. *Waste Management*, *40*, pp.14-21.

Botha, D. & Van Niekerk, D. 2013. Views from the Frontline: A critical assessment of local risk governance in South Africa. Jàmbá: *Journal of Disaster Risk Studies, 5(2),* pp.1-10.

Bosnjak, M., Ajzen, I. & Schmidt, P. 2020. The theory of planned behavior: Selected recent advances and applications. *Europe's Journal of Psychology*, 16(3), p.352.

Bowan, P.A., Anzagira, L.F.A.C.A. & Anzagira, C.A. 2014. Solid Waste Disposal in Ghana: A Study of The WA Municipality. *Journal of Environment and Earth Science*, *4*(4), pp.10-16.

Brotosusilo, A., Utari, D., Negoro, H.A., Firdaus, A. & Velentina, R.A. 2022. Community empowerment of waste management in the urban environment: More attention on waste issues through formal and informal educations. *Global Journal of Environmental Science and Management, 8(2),* pp.1-16.

Carstens, A. & Henning, C. 2015. mSCOA-what does it mean for you?. *IMFO: Official Journal of the Institute of Municipal Finance Officers*, *16*(2), p.32.

Campos, M.J.Z. & Zapata, P. 2014. The travel of global ideas of waste management. The case of Managua and its informal settlements. *Habitat International*, *41*, pp.41-49.

Chàfer, M., Sole-Mauri, F., Solé, A., Boer, D. & Cabeza, L.F. 2019. Life cycle assessment (LCA) of a pneumatic municipal waste collection system compared to traditional truck collection. Sensitivity study of the influence of the energy source. *Journal of cleaner production*, *231*, pp.1122-1135.

Changyong, F. E. N. G., Hongyue, W. A. N. G., Naiji, L. U., Tian, C. H. E. N., Hua, H. E., & Ying, L. U. (2014). Log-transformation and its implications for data analysis. *Shanghai archives of psychiatry, 26(2)*, pp105.

Chen, L., Tang, O. & Feldmann, A. 2015. Applying GRI reports for the investigation of environmental management practices and company performance in Sweden, China and India. *Journal of Cleaner Production*, *98*, pp.36-46.

Chengula, A., Lucas, B.K. & Mzula, A. 2015. Assessing the awareness, knowledge, attitude and practice of the community towards solid waste disposal and identifying the threats and extent of bacteria in the solid waste disposal sites in Morogoro Municipality in Tanzania. *Journal of Biology, Agriculture and Healthcare*, *5*(3), pp54-65.

Chi, Y., Dong, J., Tang, Y., Huang, Q. & Ni, M. 2015. Life cycle assessment of municipal solid waste source-separated collection and integrated waste management systems in Hangzhou, China. *Journal of Material Cycles and Waste Management*, *17*(4), pp.695-706.

Chikowore, N. 2021. Factors influencing household waste management practices in Zimbabwe. *Journal of Material Cycles and Waste Management, 23(1),* pp.386-393.

Chircir, C.P.K. & Simiyu, C.R.S. 2017. Influence of budgetary control system on financial performance of ALMASI Beverages Group Limited, Kakamega, Kenya. *Management*, *8*(18), pp.51-64.

Chinasho, A. 2015. Review on community based municipal solid waste management and its implication for climate change mitigation. *American journal of scientific and industrial research*, *6*(3), pp.41-46.

Chu, Z., Xi, B., Song, Y. & Crampton, E. 2013. Taking out the trash: Household preferences over municipal solid waste collection in Harbin, China. *Habitat International*, *40*, pp.194-200.

Cook, N.B., Mentink, R.L., Bennett, T.B. & Burgi, K. 2007. The effect of heat stress and lameness on time budgets of lactating dairy cows. *Journal of dairy science*, *90*(4), pp.1674-1682.

Cobbinah, P.B., Addaney, M. & Agyeman, K.O. 2017. Locating the role of urbanites in solid waste management in Ghana. *Environmental Development*, *24*, pp.9-21.

Da Cruz, N.F., Simões, P. & Marques, R.C. 2012. Economic cost recovery in the recycling of packaging waste: the case of Portugal. *Journal of Cleaner Production*, *37*, pp.8-18.

Das, S. & Bhattacharyya, B.K. 2015. Optimization of municipal solid waste collection and transportation routes. *Waste Management*, *43*, pp.9-18.

D'Onza, G., Greco, G. & Allegrini, M. 2016. Full cost accounting in the analysis of separated waste collection efficiency: A methodological proposal. *Journal of environmental management*, *167*, pp.59-65.

De Jaeger, S. & Rogge, N. 2013. Waste pricing policies and cost-efficiency in municipal waste services: the case of Flanders. *Waste Management & Research, 31*(7), pp. 751-758.

Demirel, E., Demirel, N. & Gökçen, H. 2016. A mixed integer linear programming model to optimize reverse logistics activities of end-of-life vehicles in Turkey. *Journal of Cleaner Production*, *112*, pp.2101-2113.

Desta, H., Worku, H. & Fetene, A. 2014. Assessment of the contemporary municipal solid waste management in urban environment: The case of Addis Ababa, Ethiopia. *Journal Environmental Science and Technology*, *7*, pp.107-122.

Dixit, S. & Rastogi, D. 2016. Underground Automated Vacuum Waste Collection System for Gwalior City (A Case Study). *International Journal of Engineering Technology, Management and Applied Sciences*, *4*(5), pp.36-40.

Dlamini, S.Q. & Simatele, D. 2016. Unrecognized informal solid waste recycling in an emerging African megacity: A study of Johannesburg, South Africa. *WIT Transactions on Ecology and the Environment: Johannesburg, South Africa, 202,* pp.13-25.

Du Toit, J. & Wagner, C. 2018. The Effect of a Weekly Comingled Kerbside Collection Service on Household Recycling in a Gated Community in Pretoria, South Africa. *Sustainability*, *10*(4), pp.1207.

Ebenezer, O. 2019. Aesthetics Application in Solid Waste Management as a Means of Optimising Environmental Sustainability in Urbanizing Third-World Environments. *International Journal of Engineering and Manufacturing*, *9*(4), pp.15.

Edwards, J., Burn, S., Crossin, E. & Othman, M. 2018. Life cycle costing of municipal food waste management systems: The effect of environmental externalities and transfer costs using local government case studies. *Resources, Conservation and Recycling*, *138*, pp.118-129.

Einav, L. & Levin, J. 2014. The data revolution and economic analysis. *Innovation Policy and the Economy*, *14*(1), pp.1-24.

Ervin, D., Wu, J., Khanna, M., Jones, C. & Wirkkala, T. 2013. Motivations and barriers to corporate environmental management. *Business Strategy and the Environment*, *22*(6), pp.390-409.

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

Falkowska, A. 2020. The impact of environmental policy on location patterns in the waste management industry. *Economia Politica, 37(1),* pp.167-195.

Fernández, C., Manyà, F., Mateu, C. & Sole-Mauri, F. 2014. Modeling energy consumption in automated vacuum waste collection systems. *Environmental modelling & software*, *56*, pp.63-73.

Fernández, C., Manyà, F., Mateu, C. & Sole-Mauri, F. 2015. Approximate dynamic programming for automated vacuum waste collection systems. *Environmental Modelling & Software*, *67*, pp.128-137.

Fernando, S. & Lawrence, S. 2014. A theoretical framework for CSR practices: integrating legitimacy theory, stakeholder theory and institutional theory. *Journal of Theoretical Accounting Research*, *10*(1), pp.149-178.

Ferronato, N., Bezzi, M., Zortea, M., Torretta, V. & Ragazzi, M. 2016. An interdisciplinary approach for introducing sustainable integrated solid waste management system in developing countries: The case of La Paz (Bolivia). *Procedia Environmental Science Engineering and Management*, *3*, pp.71-81.

Ferronato, N., Gorritty Portillo, M.A., Guisbert Lizarazu, E.G., Torretta, V., Bezzi, M. & Ragazzi, M. 2018. The municipal solid waste management of La Paz (Bolivia): Challenges and opportunities for a sustainable development. *Waste Management & Research*, *36*(3), pp.288-299.

Gaeta-Bernardi, A. & Parente, V. 2016. Organic municipal solid waste (MSW) as feedstock for biodiesel production: A financial feasibility analysis. *Renewable energy*, *86*, pp.1422-1432.

Godfrey, L. 2021. Quantifying economic activity in the informal recycling sector in South Africa. *South African Journal of Science, 117(9-10)*, pp.138-144.

Gallardo, A., Prades, M., Bovea, M.D. & Colomer, F.J. 2012. Separate Collection Systems for Urban Waste (UW). *Management of Organic Waste, 7*, pp.115-132.

Godfrey, L. & Oelofse, S. 2017. Historical review of waste management and recycling in South Africa. *Resources*, *6*(4), pp.57.

Godfrey, L., Scott, D. & Trois, C. 2013. Caught between the global economy and local bureaucracy: the barriers to good waste management practice in South Africa. *Waste Management & Research*, *31*(3), pp.295-305.

Government of South Africa. 2021. Local government, Government of South Africa, viewed 12 January 2022, <https://www.gov.za/about-government/government-system/local-government>.

Greco, G., Allegrini, M., Del Lungo, C., Savellini, P.G. & Gabellini, L. 2015. Drivers of solid waste collection costs. Empirical evidence from Italy. *Journal of Cleaner Production*, *106*, pp.364-371.

Gregor, J., Šomplák, R. & Pavlas, M. 2017. Transportation cost as an integral part of supply chain optimisation in the field of waste management. *Chemical Engineering Transactions*, *56*, pp.1927-1932.

Gu, B., Tang, X., Liu, L., Li, Y., Fujiwara, T., Sun, H., Gu, A., Yao, Y., Duan, R., Song, J. & Jia, R. 2021. The recyclable waste recycling potential towards zero waste cities-A comparison of three cities in China. *Journal of Cleaner Production, 295*, p.126358.

Gudeta, B.G., Feyessa, F.F. & Kitesa, W.M. 2021. Household Generated Solid Waste Collection System Management Using Arcgis: a Case of Jimma Town, Southwestern Ethiopia. *The Journal of Solid Waste Technology and Management, 47(2),* pp.317-323.

Guibrunet, L. 2021. The interplay of tacit and explicit knowledge in the informal economy: the atypical case of a recycling family business in Mexico City. *International Development Planning Review*, 43(1), pp.13-31.

Guerrero, L., Maas, G. & Hogland, W. 2013. Solid waste management challenges for cities in developing countries. *Waste Management, 33*(1), pp. 220-232.

Gutberlet, J. 2015. Cooperative urban mining in Brazil: Collective practices in selective household waste collection and recycling. *Waste Management*, *45*, pp.22-31.

Gutberlet, J., Kain, J.H., Nyakinya, B., Oloko, M., Zapata, P. & Zapata Campos, M.J. 2017. Bridging weak links of solid waste management in informal settlements. *The Journal of Environment & Development*, *26*(1), pp.106-131.

Gutierrez, J.M., Jensen, M., Henius, M. & Riaz, T. 2015. Smart waste collection system based on location intelligence. *Procedia Computer Science*, *61*, pp.120-127.

Hahn, R. & Kühnen, M. 2013. Determinants of sustainability reporting: a review of results, trends, theory, and opportunities in an expanding field of research. *Journal of cleaner production*, *59*, pp.5-21.

Hamad, J.R.J., Hanafiah, M.M. & Abdullah, S. 2017. Problems and current practices of solid waste management in the city of Almarj. *Journal CleanWAS*, *1*(1), pp.01-05.

Hamm, K. & Ledford, J. 2017. On bases of cardinal functions and their role in approximate sampling methods. *International Conference on Sampling Theory and Applications, 3*, pp. 203-206.

Han, H. & Ponce Cueto, E. 2015. Waste collection vehicle routing problem: literature review. *PROMET-Traffic & Transportation*, *27*(4), pp.345-358.

Hannan, M.A., Arebey, M., Begum, R.A. & Basri, H. 2012. An automated solid waste bin level detection system using a gray level aura matrix. *Waste management*, *32*(12), pp.2229-2238.

Hannon, J. & Zaman, A.U. 2018. Exploring the phenomenon of zero waste and future cities. *Urban Science*, *2*(3), pp.90.

Hasan, Z. 2013. Corporate governance in Islamic financial institutions: An ethical perspective. *Prime Journals of Business Administration and Management, 2*(1), pp. 405-411.

He, C. & Fu, Y. 2021. Why does waste separation policy vary across different Chinese cities? A configurational analysis of the pilot scheme. *Journal of Cleaner Production*, *283*, p.124613.

Hidalgo, D., Martín-Marroquín, J.M., Corona, F. & Juaristi, J.L. 2018. Sustainable vacuum waste collection systems in areas of difficult access. *Tunnelling and Underground Space Technology*, *81*, pp.221-227.

Huang, S.H. & Lin, P.C. 2015. Vehicle routing–scheduling for municipal waste collection system under the "Keep Trash off the Ground" policy. *Omega*, *55*, pp.24-37.

Huynh, Q. 2022. Factors influential to the acceptance of managerial accounting tools in Tra Vinh's small and medium enterprises. *Accounting, 8(1),* pp.75-80.

Hoornweg, D., Bhada-Tata, P. & Kennedy, C. 2013. Environment: Waste production must peak this century. *Nature News*, *502*(7473), pp.615.

Housing Development Agency. 2020. Research reports, Housing Development Agency, viewed 24 June 2020, <http://thehda.co.za/index.php/multimedia/research>.

Hwang, H. & Kim, H. 2022. Demand risk transfer and government's cost efficiency: Focusing on Korean waste treatment PPP cases. *Waste Management, 137,* pp.31-38.

Hyvönen, T., Järvinen, J., Oulasvirta, L. & Pellinen, J. 2012. Contracting out municipal accounting: the role of institutional entrepreneurship. *Accounting, Auditing & Accountability Journal*, *25*(6), pp. 944-963

lo Storto, C. 2021. Effectiveness-efficiency nexus in municipal solid waste management: *A non-parametric evidence-based study. Ecological Indicators, 131,* p.108185.

Isaac, L., Lawal, M. & Okoli, T. 2015. A systematic review of budgeting and budgetary control in government owned organizations. *Research Journal of Finance and Accounting*, *6*(6), pp.1-11.

Jacobs, T.J. 2015. Waste heat recovery potential of advanced internal combustion engine technologies. *Journal of Energy Resources Technology*, *137*(4), pp.14

Jan, P.T., Lu, H.P. & Chou, T.C. 2012. The adoption of e-learning: an institutional theory perspective. *Turkish Online Journal of Educational Technology-TOJET*, *11*(3), pp.326-343.

Jamil, C.Z.M., Mohamed, R., Muhammad, F. & Ali, A. 2015. Environmental management accounting practices in small medium manufacturing firms. *Procedia-Social and Behavioral Sciences*, *172*, pp.619-626.

Jaunich, M.K., Levis, J.W., DeCarolis, J.F., Gaston, E.V., Barlaz, M.A., Bartelt-Hunt, S.L., Jones, E.G., Hauser, L. & Jaikumar, R. 2016. Characterization of municipal solid waste collection operations. *Resources, Conservation and Recycling*, *114*, pp.92-102.

Javadi, M., Moslehi, S., Yaghoubi, M., Seirani, F., Abbasi, M. & Tayyebi, Z. 2013. Waste minimization: A survey in Iranian public and private hospitals. *International Journal of Hospital Research*, *2*(1), pp.25-30.

Johari, A., Alkali, H., Hashim, H., Ahmed, S.I. & Mat, R. 2014. Municipal solid waste management and potential revenue from recycling in Malaysia. *Modern Applied Science*, *8*(4), pp.37.

Joshi, R. & Ahmed, S. 2016. Status and challenges of municipal solid waste management in India: A review. *Cogent Environmental Science*, *2*(1), pp.1139434.

Kaushal, R.K., Varghese, G.K. & Chabukdhara, M. 2012. Municipal solid waste management in India-current state and future challenges: a review. *International Journal of Engineering Science and Technology*, *4*(4), pp.1473-1489.

Khale, S. & Worku, Z. 2013. Factors that affect municipal service delivery in Gauteng and North West Provinces of South Africa. *African journal of science, technology, innovation and development, 5(1)*, pp.61-70.

Khan, S., Anjum, R., Raza, S.T., Bazai, N.A. & Ihtisham, M. 2022. Technologies for municipal solid waste management: Current status, challenges, and future perspectives. *Chemosphere, 288,* p.132403.

Kim, J. & Scott, C.D. 2012. Robust kernel density estimation. *The Journal of Machine Learning Research*, *13*(1), pp.2529-2565.

Kinobe, J.R., Bosona, T., Gebresenbet, G., Niwagaba, C.B. & Vinnerås, B. 2015. Optimization of waste collection and disposal in Kampala city. *Habitat International*, *49*, pp.126-137.

Kinnaman, T.C., Shinkuma, T. & Yamamoto, M. 2014. The socially optimal recycling rate: evidence from Japan. *Journal of Environmental Economics and Management*, *68*(1), pp.54-70.

Koekemoer, S. 2018. mSCOA-The Journey. *CIGFARO Journal (Chartered Institute of Government Finance Audit and Risk Officers)*, *18*, pp.8-10.

Kranzinger, L., Schopf, K., Pomberger, R. & Punesch, E. 2017. Case study: Is the 'catch-all-plastics bin'useful in unlocking the hidden resource potential in the residual waste collection system?. *Waste Management & Research*, *35*(2), pp.155-162.

Kularatne, R.K. 2015. Case study on municipal solid waste management in Vavuniya township: practices, issues and viable management options. *Journal of Material Cycles and Waste Management*, *17*(1), pp.51-62.

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

Kumiega, A. & Van Vliet, B.E. 2012. Automated finance: The assumptions and behavioral aspects of algorithmic trading. *Journal of Behavioral Finance, 13*(1), pp.51-55.

Kwenda, P.R., Lagerwall, G., Eker, S. & Van Ruijven, B. 2021. A mini-review on household solid waste management systems in low-income developing countries: A case study of urban Harare City, Zimbabwe. *Waste Management & Research,* p.0734242X21991645.

Lakhan, C. 2014. Exploring the relationship between municipal promotion and education investments and recycling rate performance in Ontario, Canada. *Resources, Conservation and Recycling*, *92*, pp.222-229.

Laner, D., Crest, M., Scharff, H., Morris, J.W. & Barlaz, M.A. 2012. A review of approaches for the long-term management of municipal solid waste landfills. *Waste management*, *32*(3), pp.498-512.

Laso, J., García-Herrero, I., Margallo, M., Bala, A., Fullana-i-Palmer, P., Irabien, A. & Aldaco, R. 2019. LCA-Based Comparison of Two Organic Fraction Municipal Solid Waste Collection Systems in Historical Centres in Spain. *Energies*, *12*(7), pp.1407.

Lavigne, C., Beliën, J. & Dewil, R. 2021. An exact routing optimization and simulation model for bio-waste collection in the Brussels Capital Region. *Expert Systems with Applications,* p.115392.

Lehohla. 2021. Census 2021, Statistics South Africa, viewed 12 January 2022, <http://www.statssa.gov.za/?page_id=3839>.

Levänen, J.O. & Hukkinen, J.I. 2013. A methodology for facilitating the feedback between mental models and institutional change in industrial ecosystem governance: A waste management case-study from northern Finland. *Ecological Economics*, *87*, pp.15-23.

Li, J., Yu, K. & Gao, P. 2014. Recycling and pollution control of the End of Life Vehicles in China. *Journal of Material Cycles and Waste Management*, *16*(1), pp.31-38.

Lissah, S.Y., Ayanore, M.A., Krugu, J.K., Aberese-Ako, M. & Ruiter, R.A. 2021. Managing urban solid waste in Ghana: Perspectives and experiences of municipal

waste company managers and supervisors in an urban municipality. *Public Library of Science one, 16(3),* p.e0248392.

Llorente-González, L.J. & Vence, X. 2020. How labour-intensive is the circular economy? A policy-orientated structural analysis of the repair, reuse and recycling activities in the European Union. Resources, *Conservation and Recycling, 162*, p.105033.

Lodhia, S. & Hess, N. 2014. Sustainability accounting and reporting in the mining industry: current literature and directions for future research. *Journal of Cleaner Production*, *84*, pp.43-50.

Lohri, C.R., Camenzind, E.J. & Zurbrügg, C. 2014. Financial sustainability in municipal solid waste management–Costs and revenues in Bahir Dar, Ethiopia. *Waste Management*, *34*(2), pp.542-552.

Madzivhandila, T.S. & Asha, A.A. 2012. Integrated development planning process and service delivery challenges for South Africa's local municipalities. *Journal of Public Administration*, *47*(1), pp.369-378.

Mansor, M. & Tayib, M. 2012. Tax administration performance management: Towards an integrated and open system approach. *International Journal of Trade, Economics and Finance*, *3*(2), pp.132.

Marais, A. & Wagner, J.J. 2016. Sol Plaatje's mSCOA journey-a reflection. *CIGFARO Journal (Chartered Institute of Government Finance Audit and Risk Officers)*, *17*(1), pp.14-16.

Marshall, R.E. & Farahbakhsh, K. 2013. Systems approaches to integrated solid waste management in developing countries. *Waste management*, *33*(4), pp.988-1003.

Malinauskaite, J., Jouhara, H., Czajczyńska, D., Stanchev, P., Katsou, E., Rostkowski, P., Thorne, R.J., Colon, J., Ponsá, S., Al-Mansour, F. & Anguilano, L. 2017. Municipal solid waste management and waste-to-energy in the context of a circular economy and energy recycling in Europe. *Energy*, *141*, pp.2013-2044.

Mashamaite, K. 2014. Public service delivery protests in a democratic South Africa: A dilemma for local municipalities. *Mediterranean Journal of Social Sciences*, *5*(25), pp.231.

Mateu-Sbert, J., Ricci-Cabello, I., Villalonga-Olives, E. & Cabeza-Irigoyen, E. 2013. The impact of tourism on municipal solid waste generation: The case of Menorca Island (Spain). *Waste management*, *33*(12), pp.2589-2593.

Matsakas, L., Gao, Q., Jansson, S., Rova, U. & Christakopoulos, P. 2017. Green conversion of municipal solid wastes into fuels and chemicals. *Electronic Journal of Biotechnology*, *26*, pp.69-83.

Mathe, M. & Phiri, A. 2015. Management of Municipal Solid Waste in Gwanda Town. *International Journal of Scientific and Engineering Research*, *6*(6), pp.1555-1568

Mautjana, H.M. & Mtapuri, O. 2014. Integrated development plans without development indicators: Results from Capricorn District Municipalities in South Africa. *Mediterranean Journal of Social Sciences*, *5*(8), pp.474-474.

Mazeka, B., Sutherland, C., Buthelezi, S. & Khumalo, D. 2019. Community-based mapping methodology for climate change adaptation: A case study of Quarry Road West informal settlement, Durban, South Africa. In *The Geography of Climate Change Adaptation in Urban Africa, 10*, pp. 57-88.

Menikpura, S.N.M., Gheewala, SH & Bonnet, S. 2012. Sustainability assessment of municipal solid waste management in Sri Lanka: problems and prospects. *Journal of Material Cycles and Waste Management*, *14*(3), pp.181-192.

Menikpura, S.N.M., Gheewala, S.H., Bonnet, S. & Chiemchaisri, C. 2013. Evaluation of the effect of recycling on sustainability of municipal solid waste management in Thailand. *Waste and Biomass Valorization*, *4*(2), pp.237-257.

Mesjasz-Lech, A. 2014. Municipal waste management in context of sustainable urban development. *Procedia-Social and Behavioral Sciences*, *151*, pp.244-256.

Mgimba, C. 2016. People's Awareness and Practice on Technologies for Sustainable Solid Waste Management in Mbeya City, Tanzania. *Imperial Journal of Interdisciplinary Research,* 2(5), pp.1380-1386.

Mian, M.M., Zeng, X., Nasry, A.A.N.B. & Al-Hamadani, S.M. 2017. Municipal solid waste management in China: a comparative analysis. *Journal of Material Cycles and Waste Management*, *19*(3), pp.1127-1135.

Miezah, K., Obiri-Danso, K., Kádár, Z., Fei-Baffoe, B. & Mensah, M.Y. 2015. Municipal solid waste characterization and quantification as a measure towards effective waste management in Ghana. *Waste management*, *46*, pp.15-27.

Mijac, M., Androcec, D. & Picek, R. 2017. Smart city services driven by IoT: A systematic review. *Journal of Economic and Social Development*, *4*(2), pp.40-50.

Mmereki, D., Baldwin, A. & Li, B. 2016. A comparative analysis of solid waste management in developed, developing and lesser developed countries. *Environmental Technology Reviews*, *5*(1), pp.120-141.

Montiel, I., Husted, B.W. & Christmann, P. 2012. Using private management standard certification to reduce information asymmetries in corrupt environments. *Strategic Management Journal*, *33*(9), pp.1103-1113.

Mora, C., Manzini, R., Gamberi, M. & Cascini, A. 2014. Environmental and economic assessment for the optimal configuration of a sustainable solid waste collection system: a 'kerbside'case study. *Production planning & control*, *25*(9), pp.737-761.

Morgner, C., Ambole, A., Anditi, C. & Githira, D. 2020, December. Exploring the dynamics of social networks in urban informal settlements: the case of Mathare Valley, Kenya. In *Urban Forum*, *31(4),* pp. 489-512.

Mohamad, Z.F. & Keng, J. 2013. Opportunities and Challenges in Sustainable Waste Management Transition in Malaysia: A multi-level socio-technical perspective. *In Globelics Seminar on Low Carbon Development*, *2013*, pp.4-5

Mohamed, S.H. 2016. The Study of Domestic Waste Collection at Samarahan, Sarawak, Malaysia. *Asian Business Research*, *1*(1), pp.27.

Murali, U., Vijayakumar, C., Ramesh, M. & Baskaran, M. 2017. An overview of hazardous waste management in India. *International Journal of Engineering and Management Research*, *7*(4), pp.355-368.

Muma, B.O., Nyaoga, R.B., Matwere, R.B. & Nyambega, E. 2014. Green supply chain management and environmental performance among tea processing firms in Kericho County-Kenya. *International Journal of Economics, Finance and Management Sciences*, *2*(5), pp.270-276.

Munir, M.T. Mohaddespour, A. Nasr, A.T. & Carter, S. 2021. Municipal solid waste-to-energy processing for a circular economy in New Zealand. *Renewable and Sustainable Energy Reviews,* 145, p.111080.

Mwanza, B.G., Mbohwa, C. & Telukdarie, A. 2018. The Influence of Waste Collection Systems on Resource Recovery: A Review. *Procedia Manufacturing*, *21*, pp.846-853.

Nakou, D., Benardos, A. & Kaliampakos, D. 2014. Assessing the financial and environmental performance of underground automated vacuum waste collection systems. *Tunnelling and underground space technology*, *41*, pp.263-271.

Nanda, S. & Berruti, F. 2021. Municipal solid waste management and landfilling technologies: a review. *Environmental Chemistry Letters, 19(2),* pp.1433-1456.

Navghane, S.S., Killedar, M.S. & Rohokale, V.M. 2016. IoT based smart garbage and waste collection bin. *International Journal of Advanced Research in Electronics and Communication Engineering*, *5*(5), pp.1576-1578.

Nduneseokwu, C.K., Qu, Y. & Appolloni, A. 2017. Factors influencing consumers' intentions to participate in a formal e-waste collection system: A case study of Onitsha, Nigeria. *Sustainability*, *9*(6), pp.881.

Nepal, M., Bharadwaj, B., Karki Nepal, A., Khadayat, M.S., Pervin, I.A., Rai, R.K. and Somanathan, E., 2022. Making urban waste management and drainage sustainable in Nepal. In *Climate Change and Community Resilience* pp. 325-338.

Niazi, A. & Hassan, H. 2016. Trust and economic performance: Evidence from cross-country panel data analysis. *Review of International Business and Strategy*, *26*(3), pp. 371-391.

Niza, S., Santos, E., Costa, I., Ribeiro, P. & Ferrão, P. 2014. Extended producer responsibility policy in Portugal: a strategy towards improving waste management performance. *Journal of cleaner production*, *64*, pp.277-287.

Nogueira, S. & Jorge, S. 2016. Explanatory factors for the use of the financial report in decision-making: Evidence from Local Government in Portugal. *Revista de Contabilidad, 19*(2), pp. 216-226.

Novignon, J., Olakojo, S.A. & Nonvignon, J. 2012. The effects of public and private health care expenditure on health status in sub-Saharan Africa: new evidence from panel data analysis. *Health Economics Review*, *2*(1), pp.22.

Nyarai, M.P., Willard, Z., Moses, M. & Ngenzile, M. 2016. Challenges of solid waste management in Zimbabwe: a case study of Sakubva high density suburb. *Journal of Environment and Waste Management*, *3*(2), pp.142-155.

Obidi, A.B. & Adeoti, A.I. 2015. Preference for improved solid waste management attributes among urban poor and non-poor households' in Delta-State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology,5*(1), pp.46-56.

Oduro-Kwarteng, S., Munir, S., Monney, I. & Keraita, B. 2015. The potential, impacts, and challenges of pay-as-you-throw for municipal solid waste services in Ghana. *Journal of Environmental and Occupational Health*, *4*(2), pp.84-91.

Oerlemans, J. 2013. A note on the water budget of temperate glaciers. *The Cryosphere*, *7*(5), pp.1557-1564.

O'Keefe, M., Lüthi, C., Tumwebaze, I.K. & Tobias, R. 2015. Opportunities and limits to market-driven sanitation services: Evidence from urban informal settlements in East Africa. *Environment and Urbanization*, *27*(2), pp.421-440.

Okubena, O. & Imuezerua, E. 2016. An Evaluation of Budget Allocation and Expenditure Patterns of Sedibeng District Municipality on Service Delivery. *International Journal of Global Business*, *9*(2), pp.72.

Oliveira, M. & Duarte, E. 2016. Integrated approach to winery waste: waste generation and data consolidation. *Frontiers of Environmental Science & Engineering*, *10*(1), pp.168-176.

Omair, A. 2015. Selecting the appropriate study design for your research: Descriptive study designs. *Journal of Health Specialties*, *3*(3), pp.153.

Onn, A. & Woodley, A. 2014. A discourse analysis on how the sustainability agenda is defined within the mining industry. *Journal of Cleaner Production, 84*, pp. 116-127.

Opara, J.A., John, A.K. & Sempewo, J. 2016. Environmental health efficiency and urbanisation: The case solid waste management in Bor municipality of South Sudan. *International Journal of Bioinformatics and Biological Science*, *4*(1), pp.19-33.

Oteng-Ababio, M., Arguello, J.E.M. & Gabbay, O. 2013. Solid waste management in African cities: Sorting the facts from the fads in Accra, Ghana. *Habitat International*, *39*, pp.96-104.

Oteng-Ababio, M. 2012. The role of the informal sector in solid waste management in the GAMA, Ghana: Challenges and opportunities. *Tijdschrift voor economische en sociale geografie*, *103*(4), pp.412-425.

Othman, S.N., Noor, Z.Z., Abba, A.H., Yusuf, R.O. & Hassan, M.A.A. 2013. Review on life cycle assessment of integrated solid waste management in some Asian countries. *Journal of Cleaner Production*, *41*, pp.251-262.

Oti-Sarpong, K., Shojaei, R.S., Dakhli, Z., Burgess, G. & Zaki, M. 2022. How countries achieve greater use of offsite manufacturing to build new housing: Identifying typologies through institutional theory. *Sustainable Cities and Society, 76,* p.103403

Owebor, K., Oko, C.O.C., Diemuodeke, E.O. & Ogorure, O.J. 2019. Thermo-environmental and economic analysis of an integrated municipal waste-to-energy solid oxide fuel cell, gas-, steam-, organic fluid-and absorption refrigeration cycle thermal power plants. *Applied energy*, *239*, pp.1385-1401.

Owusu-Sekyere, E., Peprah, K. & Demuyakor, R.M. 2018. Exploring the Dynamics of E-waste Disposal Strategies in Tamale, Ghana. *Ghana Journal of Development Studies*, *15*(2), pp.168-192.

Park, S. 2018. Factors influencing the citizen cost burden in managing the volume-based waste fee system in South Korea. *Waste management*, *82*, pp.285-291.

Parthan, S.R., Milke, M.W., Wilson, D.C. & Cocks, J.H. 2012. Cost function analysis for solid waste management: a developing country experience. *Waste management & research*, *30*(5), pp.485-491.

Pasquini, L., Cowling, R.M. & Ziervogel, G. 2013. Facing the heat: Barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa. *Habitat International*, *40*, pp.225-232.

Pérez-López, G., Prior, D., Zafra-Gómez, J.L. & Plata-Díaz, A.M. 2016. Cost efficiency in municipal solid waste service delivery. Alternative management forms in relation to local population size. *European Journal of Operational Research*, *255*(2), pp.583-592.

Pinha, A.C.H. & Sagawa, J.K. 2020. A system dynamics modelling approach for municipal solid waste management and financial analysis. *Journal of Cleaner Production*, *269*, p.122350.

Polanec, B., Aberšek, B. & Glodež, S. 2013. Informal education and awareness of the public in the field of waste management. *Procedia-Social and Behavioral Sciences*, *83*, pp.107-111.

Popović, F.J., Filipović, J.V. & Božanić, V.N. 2013. Paradigm shift needed: Municipal solid waste management in Belgrade, Serbia. *Hemijska industrija*, *67*(3), pp.547-557.

Rabbani, M., Farrokhi-asl, H. & Rafiei, H. 2016. A hybrid genetic algorithm for waste collection problem by heterogeneous fleet of vehicles with multiple separated compartments. *Journal of Intelligent & Fuzzy Systems*, *30*(3), pp.1817-1830.

Raghunandan, M., Ramgulam, N. & Raghunandan-Mohammed, K. 2012. Examining the behavioural aspects of budgeting with particular emphasis on public sector/service budgets. *International Journal of Business and Social Science*, *3*(14), pp.110-117.

Ramos, A. & Rouboa, A. 2022. Life cycle thinking of plasma gasification as a waste-to-energy tool: Review on environmental, economic and social aspects. *Renewable and Sustainable Energy Reviews, 153,* p.111762.

Rathore, P. & Sarmah, S.P. 2021. Investigation of factors influencing source separation intention towards municipal solid waste among urban residents of India. *Resources, Conservation and Recycling, 164,* p.105164.

Ravindra, K., Kaur, K. & Mor, S. 2016. Occupational exposure to the municipal solid waste workers in Chandigarh, India. *Waste Management & Research*, *34*(11), pp.1192-1195.

Rehan, R., Knight, M.A., Unger, A.J. & Haas, C.T. 2014. Financially sustainable management strategies for urban wastewater collection infrastructure–development of a system dynamics model. *Tunnelling and Underground Space Technology*, *39*, pp.116-129.

Ren, X. & Hu, S. 2014. Cost recovery of municipal solid waste management in small cities of inland China. *Waste Management & Research, 32*(4), pp. 340-347.

Richter, A., Ng, K.T.W., Karimi, N. & Li, R.Y.M. 2021. An iterative tessellation-based analytical approach to the design and planning of waste management regions. *Computers, Environment and Urban Systems*, *88*, p.101652.

Richter, A., Ng, K.T. & Pan, C. 2018. Effects of percent operating expenditure on Canadian non-hazardous waste diversion. *Sustainable Cities and Society*, *38*, pp.420-428.

Rigamonti, L., Ferreira, S., Grosso, M. & Marques, R.C. 2015. Economic-financial analysis of the Italian packaging waste management system from a local authority's perspective. *Journal of Cleaner Production*, *87*, pp.533-541.

Roberts, T. 2013. Understanding the research methodology of interpretative phenomenological analysis. *British Journal of Midwifery, 21*(3), pp. 215-218.

Rodrigues, S., Martinho, G. & Pires, A. 2016. Waste collection systems. Part A: a taxonomy. *Journal of Cleaner Production*, *113*, pp.374-387.

Rogge, N. & De Jaeger, S. 2012. measuring and explaining the cost efficiency of municipal solid waste collection and proceesing services. *Omega, 41*(4), pp. 635-665.

Rutberg, S. & Bouikidis, C.D. 2018. Focusing on the fundamentals: A simplistic differentiation between qualitative and quantitative research. *Nephrology Nursing Journal*, *45*(2), pp.209-213.

Samadikun, B.P., Sinttia, D.A.B., Rezagama, A., Sumiyati, S., Huboyo, H.S., Ramadan, B.S., Hadiwidodo, M. & Nabila, F. 2021. The economic potential of paper waste recycling activities on the informal sector in Grobogan District a case study: Purwodadi Sub-district. *In IOP Conference Series: Earth and Environmental Science, 623(1),* pp.012077.

Sarli, P.W., Zakiyya, N.M. & Soewondo, P. 2017. Correlation Between Visual Improvement and Behavior Change of Municipal Solid Waste Management in Jodipan and Ksatrian Village, Indonesia. *IPTEK Journal of Proceedings Series*, *3*(6), pp.544-550.

Samah, M.A.A., Manaf, L.A., Ahsan, A., Sulaiman, W.N.A., Agamuthu, P. & D'Silva, J.L. 2013. Household Solid Waste Composition in Balakong City, Malaysia: Trend and Management. *Polish Journal of Environmental Studies*, *22*(6), pp.1807-1816

Scaraboto, D. & Fischer, E. 2012. Frustrated fatshionistas: An institutional theory perspective on consumer quests for greater choice in mainstream markets. *Journal of Consumer Research*, *39*(6), pp.1234-1257.

Scarlat, N., Motola, V., Dallemand, J.F., Monforti-Ferrario, F. & Mofor, L. 2015. Evaluation of energy potential of municipal solid waste from African urban areas. *Renewable and Sustainable Energy Reviews*, *50*, pp.1269-1286.

Schindler, S. & Kishore, B. 2015. Why Delhi cannot plan its 'new towns': The case of solid waste management in Noida. *Geoforum*, *60*, pp.33-42.

Senzige, J.P., Makinde, D.O., Njau, K.N. & Nkansah-Gyeke, Y. 2014. Factors influencing solid waste generation and composition in urban areas of Tanzania: The case of Dar-es-Salaam. *American Journal of Environmental Protection*, *3*(4), pp.172-178.

Sentime, K. 2014. The impact of legislative framework governing waste management and collection in South Africa. *African Geographical Review*, *33*(1), pp.81-93.

September, N. & Mgadi, M. 2020. SALGA supports Gauteng and Western Cape Municipalities on the role that has to be played by Political Leadership while executing their oversight responsibilities. *Chartered Institute of Government Finance Audit and Risk Officers, 21(1),* pp.10-11.

Sharma, B.K. & Chandel, M.K. 2021. Life cycle cost analysis of municipal solid waste management scenarios for Mumbai, India*. Waste Management, 124*, pp.293-302.

Sibanda, L.K., Obange, N. & Awuor, F.O. 2017, December. Challenges of solid waste management in Kisumu, Kenya. In *Urban Forum*, *28*(4), pp. 387-402.

Sim, N.M., Wilson, D.C., Velis, C.A. & Smith, S.R. 2013. Waste management and recycling in the former Soviet Union: the City of Bishkek, Kyrgyz Republic (Kyrgyzstan). *Waste Management & Research, 31*(10), pp.106-125.

Simões, P. & Marques, R.C. 2012. On the economic performance of the waste sector. A literature review. *Journal of Environmental Management*, *106*, pp.40-47.

Simic, V. 2016. Interval-parameter chance-constraint programming model for end-of-life vehicles management under rigorous environmental regulations. *Waste Management*, *52*, pp.180-192.

Siregar, A.M. & Kustiani, I. 2019, March. Contractors' perception on construction waste management case study in the City of Bandar Lampung. In *IOP Conference Series: Earth and Environmental Science, 245*(1), pp. 012035.

Sije, A. & Ochieng, P.A. 2013. Cell phone disposal and strategic evaluation of electronic waste management in Kenya, a case of mobile Phone dealers in Kisumu County. *European Journal of Business and Innovation Research*, *1*(4), pp.1-8.

Sobotka, A. & Sagan, J. 2016. Cost-saving Environmental Activities on Construction Site–Cost Efficiency of Waste Management: Case Study. *Procedia Engineering, 161*, pp. 388-393.

Soni, A., Patil, D. & Argade, K. 2016. Municipal Solid Waste Management. *Procedia Environmental Sciences*, *35*, pp.119-126.

Soni, U., Roy, A., Verma, A. & Jain, V. 2019. Forecasting municipal solid waste generation using artificial intelligence models—a case study in India. *SN Applied Sciences*, *1*(2), pp.162.

Srivastava, V., Ismail, S.A., Singh, P. & Singh, R.P. 2015. Urban solid waste management in the developing world with emphasis on India: challenges and opportunities. *Reviews in Environmental Science and Bio/Technology*, *14*(2), pp.317-337.

Struk, M. 2017. Distance and incentives matter: The separation of recyclable municipal waste. *Resources, conservation and recycling*, *122*, pp.155-162.

Sudibyo, H., Majid, A.I., Pradana, Y.S., Budhijanto, W. & Budiman, A. 2017. technological evaluation of municipal solid waste management system in Indonesia. *Energy Procedia*, *105*, pp.263-269.

Suraj, A. & Sutar, S.M.G. 2015. Solid Waste Management in Rural Areas Emerging Towards Growth Centre Through GIS SystemMahalung, Solapur. *International Journal of Science and Research*, *47*, pp.475-478.

Suryanto, T., Haseeb, M. & Hartani, N.H. 2018. The correlates of developing green supply chain management practices: Firms level analysis in Malaysia. *International Journal of Supply Chain Management*, *7*(5), p.316.

Sumukwo, J., Kiptui, M. & Cheserek, G.J. 2012. Economic valuation of improved solid waste management in Eldoret Municipality. *Journal of Emerging Trends in Economics and Management Sciences*, *3*(6), pp.962-970.

Sung, S.K., Park, J.G. & Suh, S.H. 2012. A Study on the optimal design of confluent pipe for waste collection piping system. *Korean Journal of Air-Conditioning and Refrigeration Engineering*, *24*(5), pp.428-432.

Suthar, S., Rayal, P. & Ahada, C.P. 2016. Role of different stakeholders in trading of reusable/recyclable urban solid waste materials: A case study. *Sustainable cities and society*, *22*, pp.104-115.

Suttipun, M. & Nuttaphon, C. 2014. Corporate social responsibility reporting on websites in Thailand. *Kasetsart Journal-Natural Science*, *35*(3), pp.536-549.

Taherdoost, H. 2016. Sampling methods in research methodology; how to choose a sampling technique for research. *How to Choose a Sampling Technique for Research, 5(*2), pp. 18-27

Teerioja, N., Moliis, K., Kuvaja, E., Ollikainen, M., Punkkinen, H. & Merta, E. 2012. Pneumatic vs. door-to-door waste collection systems in existing urban areas: a comparison of economic performance. *Waste Management*, *32*(10), pp.1782-1791.

Taube, L., Biedenbach, F., Schmid, F., Rieck, J. & Behrendt, F. 2022. Economic benefits through system integration of electric waste collection vehicles: Case study of grid-beneficial charging and discharging strategies. *International Journal of Electrical Power & Energy Systems, 136*, p.107282.

Teixeira, C.A., Avelino, C., Ferreira, F. & Bentes, I. 2014. Statistical analysis in MSW collection performance assessment. *Waste management*, *34*(9), pp.1584-1594.

Thi, N.B.D., Kumar, G. & Lin, C.Y. 2015. An overview of food waste management in developing countries: Current status and future perspective. *Journal of environmental management*, *157*, pp.220-229.

Tracy, C.L. Park, S. Plevaka, M. & Bogdanova, E. 2021. Opportunities for US-Russian collaboration on the safe disposal of nuclear waste. *Bulletin of the Atomic Scientists, 77(3),* pp.146-152.

Tsai, F.M., Bui, T.D., Tseng, M.L. & Wu, K.J. 2020. A causal municipal solid waste management model for sustainable cities in Vietnam under uncertainty: A comparison. *Resources, Conservation and Recycling, 154,* p.104599.

Tucker, C.A. & Farrelly, T. 2016. Household food waste: the implications of consumer choice in food from purchase to disposal. *Local Environment*, *21*(6), pp.682-706.

Usón, A.A., Ferreira, G., Vásquez, D.Z., Bribián, I.Z. & Sastresa, E.L. 2013. Environmental-benefit analysis of two urban waste collection systems. *Science of The Total Environment*, *463*, pp.72-77.

Verma, A. & Bhonde, B.K. 2014. Optimisation of municipal solid waste management of Indore City using GIS. *International Journal on Emerging Technologies*, *5*(1), pp.194.

Vollmer, D. & Grêt-Regamey, A. 2013. Rivers as municipal infrastructure: Demand for environmental services in informal settlements along an Indonesian river. *Global Environmental Change*, *23*(6), pp.1542-1555.

Wang, S. & Yu, J. 2021. Evaluating the electric vehicle popularization trend in China after 2020 and its challenges in the recycling industry. *Waste Management & Research, 39(6)*, pp.818-827.

Wee, S.T., Abas, M.A., Chen, G.K. & Mohamed, S. 2017. October. The constraints of good governance practice in national solid waste management policy (NSWMP) implementation: A case study of Malaysia. In *AIP Conference Proceedings*,*1891*(1), pp. 020127.

Wilson, D.C., Rodic, L., Cowing, M.J., Velis, C.A., Whiteman, A.D., Scheinberg, A., Vilches, R., Masterson, D., Stretz, J. & Oelz, B. 2015. 'Wasteaware'benchmark indicators for integrated sustainable waste management in cities. *Waste Management*, *35*, pp.329-342.

Whitney, K., Bradley, J.M., Baugh, D.E. & Chesterman Jr, W.C. 2015. Systems theory as a foundation for governance of complex systems. *International Journal of System of Systems Engineering*, *6*(1-2), pp.15-32.

Wy, J., Kim, B.I. & Kim, S. 2013. The rollon–rolloff waste collection vehicle routing problem with time windows. *European Journal of Operational Research*, *224*(3), pp.466-476.

Yadav, P. & Samadder, S.R. 2018. Environmental impact assessment of municipal solid waste management options using life cycle assessment: a case study. *Environmental Science and Pollution Research*, *25*(1), pp.838-854.

Yang, Q., Fu, L., Liu, X. & Cheng, M. 2018. Evaluating the Efficiency of Municipal Solid Waste Management in China. *International Journal of Environmental Research and Public Health*, *15*(11), pp.2448.

Ye, F., Zhao, X., Prahinski, C. & Li, Y. 2013. The impact of institutional pressures, top managers' posture and reverse logistics on performance—Evidence from China. *International Journal of Production Economics*, *143*(1), pp.132-143.

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

Zafra-Gómez, J., López-Hernández, A., Plata-Díaz, A. & Garrido-Rodríguez, J. 2016. Financial and political factors motivating the privatisation of municipal water services. *Local Government Studies, 42*(2), pp. 287-308.

Zainu, Z.A. 2019. Development of Policy and Regulations for Hazardous Waste Management in Malaysia. *Journal of Science, Technology and Innovation Policy*, *5*(2), pp.34-42

Zaman, A.U. 2014. Measuring waste management performance using the 'Zero Waste Index': the case of Adelaide, Australia. *Journal of Cleaner Production*, *66*, pp.407-419.

Zaman, A.U. & Lehmann, S. 2013. The zero waste index: a performance measurement tool for waste management systems in a 'zero waste city'. *Journal of Cleaner Production*, *50*, pp.123-132.

Zhang, S., Zhang, J., Zhao, Z. & Xin, C. 2021. Robust Optimization of Municipal Solid Waste Collection and Transportation with Uncertain Waste Output: A Case Study. *Journal of Systems Science and Systems Engineering,* pp.1-22.

Ziraba, A.K., Haregu, T.N. & Mberu, B. 2016. A review and framework for understanding the potential impact of poor solid waste management on health in developing countries. *Archives of Public Health*, *74*(1), pp.55.

Zohoori, M. & Ghani, A. 2017. Municipal Solid Waste Management Challenges and Problems for Cities in Low-Income and Developing Countries. *International Journal of Science and Engineering Applications*, *6,* pp39-48.

Appendix I: Analysis of study variables in the Nine Provinces in South Africa (1 to 9)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Totalservice	totalservice	totalservice	Totalservice	totalservice	totalservice	totalservice	totalservice	totalservice
logCAPITALBUDGET	-57.78	-152.4	-1,935	-386.0	-889.1	2,287	-278.1	-569.8	1,032
	(166.8)	(488.8)	(1,546)	(379.9)	(590.8)	(4,520)	(318.7)	(2,602)	(701.6)
logOPERATIONBUDG	424.7	476.2	3,246	-1,367	-635.1	-25,281	1,485	-10,948	4,495**
	(331.8)	(1,131)	(5,465)	(1,087)	(1,589)	(37,861)	(1,027)	(8,726)	(2,215)
logREVENUE	-160.3	3,822***	22,481***	3,285***	883.9	18,238	-335.9	-535.5	2,396
	(407.7)	(985.8)	(6,261)	(573.3)	(2,272)	(37,334)	(1,023)	(5,060)	(1,724)
POPULATION	0.358***	0.323***	0.299***	0.215***	0.308***	0.452***	0.288***	0.537***	0.191***
	(0.0107)	(0.0193)	(0.0122)	(0.00812)	(0.00887)	(0.0407)	(0.00919)	(0.0347)	(0.0159)
Constant	-4,024	-34,341***	-242,279***	-5,671	242.0	20,394	-7,470	86,718	-63,909***
	(3,611)	(9,975)	(37,895)	(7,419)	(9,232)	(95,714)	(7,309)	(64,989)	(18,705)
Observations	61	36	54	72	72	24	71	48	72
R-squared	0.963	0.969	0.986	0.971	0.985	0.927	0.978	0.949	0.895

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1 Provide a link to the numbering of the provinces. Province 1 = ; Province 2 = ;

Appendix II: Dynamic panel-data estimation, one-step system GMM

```
Dynamic panel-data estimation, one-step system GMM

------------------------------------------------------------------------------

Group variable: munu_n                  Number of obs      =       468

Time variable : year                    Number of groups   =        44

Number of instruments = 96              Obs per group: min =         7

Wald chi2(5)          =  60398.51                      avg =     10.64

Prob > chi2           =    0.000                       max =        11

------------------------------------------------------------------------------

    totalservice |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]

-----------------+------------------------------------------------------------

    totalservice |

             L1. |   .9673785   .0240718    40.19   0.000     .9201987    1.014558

logOPERATIONBUDG |   168.0167   482.3227     0.35   0.728    -777.3183    1113.352

logCAPITALBUDGET |   50.24729   223.2529     0.23   0.822    -387.3203    487.8149

      logREVENUE |   339.6066   464.7549     0.73   0.465    -571.2962    1250.509

      POPULATION |   .0145654   .0083138     1.75   0.080    -.0017294    .0308603

           _cons |  -5342.815   3072.177    -1.74   0.082    -11364.17    678.5411

------------------------------------------------------------------------------

Instruments for first differences equation

  Standard

    D.(logOPERATIONBUDG logCAPITALBUDGET logREVENUE POPULATION)
```

```
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(1/11).(L.totalservice logOPERATIONBUDG)
Instruments for levels equation
  Standard
    logOPERATIONBUDG logCAPITALBUDGET logREVENUE POPULATION
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.(L.totalservice logOPERATIONBUDG)
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -5.88  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.07  Pr > z =  0.947
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(90)   = 316.96  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)


Difference-in-Sargan tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Sargan test excluding group:     chi2(78)   = 272.96  Prob > chi2 =  0.000
    Difference (null H = exogenous): chi2(12)   =  44.00  Prob > chi2 =  0.000
  iv(logOPERATIONBUDG logCAPITALBUDGET logREVENUE POPULATION)
    Sargan test excluding group:     chi2(86)   = 311.12  Prob > chi2 =  0.000
    Difference (null H = exogenous): chi2(4)    =   5.84  Prob > chi2 =  0.211
```

Appendix III: These local municipalities were merged between 2010 and 2021

Name	Province	Dissolved	New name/ Newly formed
Camdeboo Local Municipality	Eastern Cape	3 August 2016	Merged to create Dr Beyers Naudé Local Municipality
Ikwezi Local Municipality	Eastern Cape	3 August 2016	
Baviaans Local Municipality	Eastern Cape	3 August 2016	
Nkonkobe Local Municipality	Eastern Cape	3 August 2016	Merged to create Raymond Mhlaba Local Municipality
Nxuba Local Municipality	Eastern Cape	3 August 2016	
Tsolwana Local Municipality	Eastern Cape	3 August 2016	Merged to create Enoch Mgijima Local Municipality
Inkwanca Local Municipality	Eastern Cape	3 August 2016	
Lukhanji Local Municipality	Eastern Cape	3 August 2016	
Maletswai Local Municipality	Eastern Cape	3 August 2016	Merged to create Walter Sisulu Local Municipality
Gariep Local Municipality	Eastern Cape	3 August 2016	
Motheo District Municipality	Free State	18 May 2011	Part became Mangaung Metropolitan Municipality, other parts annexed by Xhariep and Thabo Mofutsanyana District Municipalities Annexed by Mangaung Metropolitan Municipality
Naledi Local Municipality	Free State	3 August 2016	
Metsweding District Municipality	Gauteng	18 May 2011	Annexed by City of Tshwane Metropolitan Municipality
Nokeng tsa Taemane Local Municipality	Gauteng	18 May 2011	
Kungwini Local Municipality	Gauteng	18 May 2011	
Randfontein Local Municipality	Gauteng	3 August 2016	Merged to create Rand West City Local Municipality
Westonaria Local Municipality	Gauteng	3 August 2016	
Ezinqoleni Local Municipality	KwaZulu-Natal	3 August 2016	

Hibiscus Coast Local Municipality	KwaZulu-Natal	3 August 2016	Merged to create Ray Nkonyeni Local Municipality
Vulamehlo Local Municipality	KwaZulu-Natal	3 August 2016	Annexed by eThekwini Metropolitan Municipality and Umdoni Local Municipality
Emnambithi/Ladysmith Local Municipality	KwaZulu-Natal	3 August 2016	Merged to create Alfred Duma Local Municipality
Indaka Local Municipality	KwaZulu-Natal	3 August 2016	
Umtshezi Local Municipality	KwaZulu-Natal	3 August 2016	Merged to create Inkosi Langalibalele Local Municipality
Imbabazane Local Municipality	KwaZulu-Natal	3 August 2016	
Big 5 False Bay Local Municipality	KwaZulu-Natal	3 August 2016	Merged to create Big Five Hlabisa Local Municipality
Hlabisa Local Municipality	KwaZulu-Natal	3 August 2016	
Ntambanana Local Municipality	KwaZulu-Natal	3 August 2016	Annexed by Mthonjaneni, uMfolozi and uMhlathuze Local Municipalities
Ingwe Local Municipality	KwaZulu-Natal	3 August 2016	Merged to create Dr Nkosazana Dlamini-Zuma Local Municipality
Kwa Sani Local Municipality	KwaZulu-Natal	3 August 2016	
Mutale Local Municipality	Limpopo	3 August 2016	Annexed by Musina and Thulamela Local Municipalities
Aganang Local Municipality	Limpopo	3 August 2016	Annexed by Blouberg, Molemole and Polokwane Local Municipalities
Mookgopong Local Municipality	Limpopo	3 August 2016	Merged to create Modimolle/Mookgopong Local Municipality
Modimolle Local Municipality	Limpopo	3 August 2016	
Fetakgomo Local Municipality	Limpopo	3 August 2016	Merged to create Fetakgomo/Greater Tubatse Local Municipality
Greater Tubatse Local Municipality	Limpopo	3 August 2016	
Umjindi Local Municipality	Mpumalanga	3 August 2016	Annexed by Mbombela Local Municipality
Kagisano Local Municipality	Northwest	18 May 2011	

Molopo Local Municipality	Northwest	18 May 2011	Merged to create Kagisano-Molopo Local Municipality
Ventersdorp Local Municipality	Northwest	3 August 2016	Merged to create Ventersdorp/Tlokwe Local Municipality
Tlokwe Local Municipality	Northwest	3 August 2016	
Mier Local Municipality	Northern Cape	3 August 2016	Merged to create Dawid Kruiper Local Municipality
Khara Hais Local Municipality	Northern Cape	3 August 2016	

Source: http://thehda.co.za/index.php/multimedia/research

University of Limpopo
Faculty of Management and Law
OFFICE OF THE EXECUTIVE DEAN
Private Bag X1106, Sovenga, 0727, South Africa
Tel:(015) 268 2558, Fax: (015) 268 2873, Email: frikkie.ponelis@ul.ac.za

30 August 2019

Manamela T.A (201312626) MCOM
SCHOOL OF ACCOUNTANCY
MASTER OF COMMERCE (Accounting)

Dear Manamela T.A,

FACULTY APPROVAL OF PROPOSAL

I have pleasure in informing you that your Masters proposal served at the Faculty Higher Degrees Committee meeting on **26 June 2019** and your tittle was approved as follows.

"Effect of Municipal Waste Management Budget on Waste Management Service Delivery".

Note the following: The study

Ethical Clearance	Tick One
Requires no ethical clearance Proceed with the study	✓
Requires ethical clearance (Human) (TREC) (apply online) Proceed with the study only after receipt of ethical clearance certificate	
Requires ethical clearance (Animal) (AREC) Proceed with the study only after receipt of ethical clearance certificate	

30/08/19

Prof MP Sebola
Chairperson: Faculty Higher Degree Committee

CC: Supervisor and Research Manager, Prof MB Fakoya and Prof M.S Tayob, Acting Director of School of Accountancy.

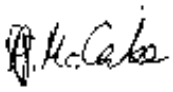
RMC LANGUAGE PRACTITIONER
117 OOSTVALLEI VILLAGE
657 COLEY STREET
GARSFONTEIN
PRETORIA 0081

TO WHOM IT MAY CONCERN

This is to certify that I have proofread and edited the master's dissertation (MCom) entitled **Effect of Municipal Waste Management Budget on Waste Management Service Delivery** by Tumelo Abram Manamela.

I applied Microsoft Office Word track changes to the document and have suggested certain changes and corrections to language usage and style which I trust will be effected to make it suitable for examination.

signed:



Date:
27 July 2021

Dr RV McCabe
MA in Applied Linguistics (NWU)
MPPS - Masters in Public Policy Studies (UP)
PhD in English Language Studies (NWU)

- CELLPHONE: 0827730282
- EMAIL: rvmccabe@oostvallei.co.za