UNIVERSITY OF KWAZULU-NATAL

Sustainable waste management through reverse logistics: A case of selected municipalities in Zimbabwe

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DECLARATION

I, **Benson Ruzive,** declare that:

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ABSTRACT

The study investigated the impact of reverse logistics activities on sustainable solid waste management in selected municipalities in Zimbabwe. Developing countries globally face the challenge of municipal solid waste management and Zimbabwe is among these countries. Five objectives were pursued which were; to establish the perceptions of households/residents on municipal authorities' practices on municipal solid waste management, to determine the practices of households/residents in municipal solid waste management, to examine how residents perception of municipalities towards municipal solid waste management influences the way in which residents manage their municipal solid waste, to ascertain the current state of sustainability and to determine the relationship between reverse logistics of municipal solid waste and sustainability in selected municipalities in Zimbabwe.

Both quantitative and qualitative research approaches were used in the study. These techniques utilised a structured questionnaire and semi-structured interviews to solicit information from 450 households and 7 management workers. To reduce chances of documents getting lost, questionnaires were distributed and collected within a two-week period. SPSS was used to analyse the quantitative data collected from the respondents. Study findings revealed a significant level of disagreement among residents in non-performing areas regarding the quality of services provided in solid waste management. Positive agreement was observed in performing areas regarding the services delivered by municipalities for municipal waste management. The study recommends educating residents about acceptable practices of the management of municipal solid waste. Stakeholders should actively support reverse logistics activities related to municipal solid waste. Furthermore, residents should be encouraged to change their behaviour towards municipal solid waste management by adopting correct solid waste disposal practices, such as separation of different types of municipal solid waste. Lastly, corporate firms should act sustainably by managing end-of-life products through the implementation of reverse logistics practices. Implementing these recommendations can contribute to improving solid waste management practices, enhancing sustainability, and addressing the challenges faced by local government municipalities in Zimbabwe. The study contributes to four SDGs (3,6,11 and 12) by identifying households' perceptions and practices on municipal solid waste management.

Key words: Reverse logistics, municipal solid waste, municipalities, sustainability, sustainable development, household perception and household satisfaction.

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CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

The management of municipal solid waste has become a global challenge that has grown to be a topical issue for researchers and policy makers (Ferronato & Torreta, 2019). The challenge is compounded by the increasingly changing lifestyles of consumers, better medical facilities and better education, and increased demand for food (AlHumid, Haider, AlSaleem, Ainizzi, Shafiquzaman and Sadiq, 2019). Adedara, Taiwo and Bork (2023) point out that there has been a notable increase in the volumes of municipal solid waste generated in Sub-Saharan Africa between the years 2012 and 2016, from 81 million tonnes to 174 million tonnes per year, respectively, with projected growth forecasted to reach 269 million tonnes per year. In contrast, the solid waste collection coverage in the same region was estimated to be 44%, a figure which is far below the rate at which waste is generated (Adedara, Taiwo & Bork, 2023). Online shopping is one example of the lifestyle of consumers that has changed, and this requires packaging of goods to enable safe delivery. As soon as delivery takes place, these packages become part of the municipal solid waste. The problem of the management of solid waste is particularly prevalent in urban areas where food items are predominantly packaged, unlike in rural areas where the majority of the food requirements come from agricultural products that are biodegradable. The increasing urban population, driven by citizens migrating from rural areas searching for employment opportunities and better standards of living (Galarpe, 2017), has exerted pressure on facilities where solid waste is managed. Rural productivity has been brought to a standstill because of people migrating to urban areas where economic growth is taking place, in addition to the push factor of climate change. Historically, rural communities in Zimbabwean relied heavily on activities in the agricultural sector like farming of crops, hunting and cattle breeding (Chitongo & Casadevall, 2019). These agricultural activities were dependent on sufficient rainfall for sustainable yields. The migration of people from rural areas to urban areas results in increased population in urban areas thereby exerting pressure on services that were initially designed to serve fewer people. However, a range of social, economic and environmental changes have compelled those who are still in their prime ages to find other survival strategies.

Consequently, urbanisation has exerted pressure on the management of solid waste in urban areas and given rise to pernicious problems, including disease outbreaks.

Concari, Kok and Martens (2020) observe that recent studies have predominantly concentrated their effort on finding the relationship that may exist between sustainable development and consumption patterns of end-users, resulting in less attention being given to the management of solid waste at household level. The research reported in this thesis investigated whether the implementation of reverse logistics activities for municipal solid waste could enhance how municipal solid waste is managed in developing countries. Selected local municipalities were used in this study as a case study. Reverse logistics for municipal solid waste is surmised as a useful concept for promoting sustainability in waste management. Inadequate disposal of municipal solid waste can lead to various problems, such as the proliferation of communicable diseases like cholera, environmental degradation, and the creation of unhygienic environments. Pena-Montoya, Bouzon, Torre-Lozada and Vidal-Holgiun (2020) contend that reverse logistics of municipal solid waste represents an ideal strategy for fostering sustainability within urban dwelling places of countries that are still in their development stages. Management of municipal solid waste involves households as the end-users of products in supply chains, therefore their perceptions and practices on solid waste management were sought. Additionally, large informal sector that predominates in Zimbabwe (COMESA, February 2023) hinder progress toward the collaboration between municipal authorities and producers of goods. These collaborations could see firms taking back products that have reached their end-of-life to become part of their raw materials in production lines.

1.2 Background of the study

Economic development and growth, urbanisation and the continuous increase in population have compounded the challenges presented by municipal solid waste generation globally (Kaza, Yao, Bhada-Tata & Van Woerden, 2018). There is no doubt that the rate of solid waste generation differs from one country to the other, yet developing countries still exhibit more organic content in the total mass of solid waste as compared to developed nations (Kaza et al., 2018). Iyer (2017) points out that the challenge faced in urban areas is that most of the municipal solid waste that is generated ends up in illegal dumping sites, and unsecure landfills. Households are considered generators of solid waste streams and contribute to illegal dumping (Kwakye, Amuah, Ankoma,

Agyemang & Owusu, 2023). Public health is impacted by misplaced municipal solid waste especially in cases where the solid waste is subjected to burning, burying and indiscriminate dumping (Odonkor & Salar, 2021; Rodić & Wilson, 2017). This agrees with Abdissa, Ayalew, Dunay and Illes (2022) who reiterate that dumping, burying and burning of solid waste causes pollution, besides increasing its accumulation. To correct this, municipal authorities are mandated to collect, transport, sort and properly dispose of municipal solid waste, thereby burdening these institutions financially (Mlilo, Marufu-Dzangare, Chigugudhlo & Chitongo, 2021).

Research has established that the way solid waste is disposed of in Zimbabwe poses a potential threat for future disasters such as spreading of diseases, obstruction of drainage systems, and unsightly environments (Munyai & Nunu, 2020; Nedziwe & Murairwa, 2022). The generation of municipal solid waste in developing countries' urban areas has imposed financial pressures on these urban centres' budgets due to the need for increased allocation for waste management (Shabani & Jerie, 2022). Municipalities bear the responsibility of managing solid waste (Dzawanda & Moyo, 2022), yet they face several challenges, including the complexity of the nature of the waste, financial constraints, and system complexity (Baroi, Chowdhury, Roy & Sujauddin, 2020; Jilani & Rashi, 2020). Acquiring land for solid waste disposal has become increasingly difficult due to lack of public cooperation (Nhubu & Muzenda, 2019). Financial limitations hinder how municipal solid waste is collected and transported in many urban areas of developing countries (Mohee & Simelane, 2015). The challenge of illegal dumping of municipal solid waste has been observed in Gweru, a town in Zimbabwe, where residents are dumping municipal solid waste in alleys within the central business district (Dzawanda & Moyo, 2022). The problem of municipal solid waste management in Zimbabwe has been compounded by several challenges, including a lack of knowledge among waste-generating households, municipal authorities' limited knowledge on waste handling, and economic hardships resulting from the dollarization process. The financial constraints have impeded the implementation of planned waste management policies.

The recent Covid-19 pandemic has further exacerbated the problems municipalities face in the management of solid waste (Dzawanda & Moyo, 2022). Authorities implemented measures such as social distancing, sanitizing, and lockdowns to curb the virus spread, which in turn affected the ability of municipal solid waste collection workers to perform their duties (Jribi, Ismail,

Doggui & Debbabi, 2020). Governments in countries like Italy even banned municipal waste collection during the pandemic, encouraging households to resort to composting (Mehran, Raza-Naqvi, Ali Haider, Saeed, Shahbaz & Al-Ansari., 2021). However, such solutions were not environmentally friendly, considering the level of development in those countries (Dzawanda & Moyo, 2022). Zimbabwe was not immune from the solid waste management challenges experienced during the pandemic (Chingwenya & Wadzanai, 2020). Although the Zimbabwean government allowed workers providing essential services to operate, municipal solid waste collection workers were not included on the list of essential workers. Consequently, solid waste accumulated at designated sites and in inappropriate locations. The accumulation of municipal solid waste in the streets of towns in Zimbabwe during the pandemic was observed in Bulawayo, Gweru, Mutare, and Masvingo, exacerbating the existing municipal solid waste management challenges (Dzawanda & Moyo, 2022).

Ferronato and Torretta (2019) highlight that municipal solid waste is a global environmental challenge, and agencies in less developed nations face difficulties in managing waste in municipal areas. Mufume, Zendera, Mutetwa and Musimbo (2016) revealed that solid waste collection by the municipal authority of Sakubva, a suburb in Mutare, was inadequate, leading to residents resorting to traditional unsustainable practices such as burning, burying waste in backyards, and open dumping.

The economic utilisation of solid waste can be enhanced through the implementation of reverse logistics activities, thereby improving solid waste management (Mesjasz-Lech, 2018). Although local governments, specifically municipal councils, have waste management policies, there is a challenge in their effective implementation. Some towns lack regular waste collection days, and in the worst cases, they do not have trucks for the collection and transportation of municipal solid waste. Chitungwiza, Chegutu, and Chinhoyi municipalities in Zimbabwe have resorted to the use of tractors for collecting municipal solid waste (Musademba, Musiyandaka, Muzinda, Nhemachena & Jambwa, 2011), while in Gweru, the use of a tractor is hindered by frequent breakdowns, which can be attributed to poor road conditions and inadequate maintenance of solid waste collection vehicles (Jerie & Tevera, 2014). The main challenge lies in the turnaround time for waste collection in comparison to waste accumulation. This challenge has been exacerbated by economic development and growth, urbanisation, and ever-increasing population (Kaza, et al., 2018).

Reverse logistics has garnered increasing attention from professionals and academics. Global discussions on topical issues such as the circular economy (CE) have extensively discussed the concept of reverse logistics (Rodriguez-Anton, Rubio-Andrada, Celemin-Pedroche & Alonso-Almeida, 2019). Reverse logistics can facilitate decision-making processes regarding solid waste generated in municipal areas, leading to innovations, economic strategies, and increased competitiveness for companies. The Supply Chain Management Review (2018) emphasises the untapped opportunity for logistics managers to demonstrate innovation and introduce closed-loop logistics. Several benefits of implementing reverse logistics for solid waste in developing countries have been suggested, including improved firm profitability and visibility (Chiou Chen, Cheng & Chung, 2012) and conservation of natural resources (Dias & Braga Jr., 2016).

This study sought to evaluate if reverse logistics practices have an impact on the management of municipal solid waste and decision making in selected local government municipalities. The importance of reverse logistics activities in reducing municipal solid waste and promoting sustainable development is reviewed in the literature.

Appropriate methods of handling municipal solid waste are required before the residue is finally taken to landfills for the final journey of disposal. In Zimbabwe, it is common to find residents littering in cities and towns due to the increase in the number of street vendors and street beggars (Rugoho, 2017). Kaur, Kaur, Routray, Rahimi, Nair and Singh (2021) maintain that municipal solid waste statistics are important in decision-making; for example, understanding the positive correlation between municipal solid waste generated in urban areas and per capita disposable income. Research points out that half of the world's population is estimated to reside in urban areas, placing pressure on urban facilities (Han, Hu & Lin, 2020).

Sustainable development goal number seven (SDG 7) demands appropriate management of natural resources and ecosystems to sustain the population’s food requirements and address environmental, social, and economic needs using less and cleaner energy (FAO, 2021). To achieve these sustainable development goals, governments must put pressure on national and multi-national companies to re-think their processes and responsibilities in manufacturing, taking responsibility for municipal solid waste management and recycling (Huscroft, Hazen, Hall, Skipper & Hanna, 2013).

Reverse logistics (RL) activities have existed for the past three decades and have been essential for management decisions in municipal solid waste, especially in developed countries. Brazil is one country that has used a reverse logistics model called end-of-life producer responsibility that is used for the disposal of pesticide containers (de Oliveira & Luna, 2019). This model can also be applied in developing countries.

The campaign for environmental consciousness has become a growing phenomenon in the modern world and the business arena. Manufacturing firms and countries are persuaded to adopt environmental consciousness movements. Souza and Parente (2020) point out that governments have set sustainable development as one of their objectives, with sound management of municipal solid waste being a top priority. Activities in waste management can be improved by reverse logistics. However, the contribution of reverse logistics to waste management, especially in developing countries, is yet to be fully understood.

Several reverse logistics activities have been discussed in research because of their potential to realise profits, as well as these activities being considered a fundamental part of sustainable development and a circular economy (Julianelli, Caiado, Scavarda & Cruz, 2020). These activities include reuse, repair, remanufacture, recycle and disposal (Banihashemi, Fei & Chen, 2019). However, less has been done to identify the impact of these reverse logistics activities on the management of municipal solid waste and associated decisions, though some studies contend that proper execution and planning of reverse logistics is regarded as an alternative to waste management (Vargas, Alfaro, Karstegl, Fuertes, Gracia, Mar-Ortiz, Sabattin, Duran & Leal, 2021). For example, the circulation of ISO 14000 standards and obligations to adhere to the European Waste Electrical and Electronic Equipment (WEEE) directive might influence a firm's reverse logistics operations (WEEE Directive, 2019). The aims of the WEEE are to prevent the creation of waste electrical and electronic equipment, contribute to the efficient use of resources, encourage retrieval of raw materials from used items, and improve environmental performance. De Paula, de Campos, Pagani, Guarnieri and Kaviani (2019) posit that there is a bond between collaboration and reverse logistics, as well as an inseparable relationship between collaboration and trust. Trust is built over time through recognised interactions between parties involved. The existence of trust among partners in business operations creates a platform for knowledge sharing, especially regarding how to extend the useful life of products (de Paula et al., 2019). Carter and Ellram (in Amole et al., 2018) agree that regulatory measures require firms to move

goods that have reached their end-of-life back into the supply chain to avoid affecting the environment. Companies are beginning to appreciate the benefits of these regulations that are imposed by authorities such as reduced costs of raw materials and reduced energy consumption. These culminate into potential opportunities for increased revenue earnings.

The study included households in the research framework because understanding their perceptions of service delivery from municipalities enabled a better understanding of their (households') practices on municipal solid waste management as they are the primary contributors to the solid waste stream. Understanding the perceptions and practices of households was considered pivotal in the design of effective interventions and policy recommendations whose aim is to improve municipal solid waste management. The assessment of households' perceptions of service delivery from municipal authorities as well as the assessment of households' practices on solid waste reverse logistics activities was deemed fundamental.

1.3 Overview of sustainability, solid waste management, reverse logistics and sustainable waste management through reverse logistics

In this section of the study, an overview of the key terms is provided, including households' perceptions and practices, sustainability, solid waste management, reverse logistics, and the sustainable management of municipal solid waste through reverse logistics. A thorough literature review was conducted to gather authoritative sources that elucidate these concepts. This overview serves as a foundation for understanding the present condition of the management of municipal solid waste in Zimbabwe and emphasises the importance of investigating this topic further. Previous studies conducted in selected municipalities are highlighted, along with the research gaps they identified. Each key term is subsequently explained in separate paragraphs to ensure clarity and comprehension.

1.3.1 Overview of sustainability

The concept of sustainability has its origins from the Earth Summit of 1992 and has since garnered significant attention for over two decades (Romeo, Lin, Jeffers & DeGaetano, 2014). It encompasses three dimensions, economic, social, and environmental, and emphasises the responsible use of resources without compromising the needs of future generations.

Environmental sustainability has become a prominent topic in current research circles, with corporations encouraged to view sustainability as an opportunity for innovation and competitiveness rather than an additional cost (Romero et al., 2014). Sustainability initiatives are now a priority for companies seeking improved visibility and corporate image. However, research on sustainability has yielded mixed observations. While some studies indicate a positive association between company value and corporate sustainability, others suggest that sustainability reports may not elicit a significant market reaction (Oprean-Stan, Oncioiu, Iuga & Stan, 2020). In the area of municipal solid waste management, several studies have been carried out to establish the performance of municipal food waste management using an approach referred to as life-cycle-assessment (Yeo, Chopra & Zhang, 2019; Slorach, Jeswani, Cuellar-franca & Azapagic, 2019; Oldfield, White & Holden, 2018; Thyberg & Tonjes, 2017). However, few of these studies included the three pillars of sustainability and the involvement of households as stakeholders (Taelman, Tonini, Wandl & Dewulf, 2018). These contrasting findings highlight the need to investigate and uncover new knowledge in this area.

1.3.2 Overview of municipal solid waste management

The literature points out that a suitable definition of municipal solid waste has not been found in the research except with reference to activities in municipal solid waste (MSW), namely, source storage, collection, transportation, treatment and final disposal (Lagerkvist & Dahlem, 2019; Abudulredha, Kot, Khaddar, Jordan & Abudulridha, 2018). Wilson et al. (2015) point out that municipal solid waste management includes legal and regulatory frameworks, strategies, as well as stakeholders involved in assisting effective waste management. The management of solid waste within municipality areas poses a significant challenge for local government authorities (Mesjasz-Lech, 2018). For instance, in Qatar, the increase in migrant workers has contributed to the mounting solid waste problem (Bello, 2016). China also faces a substantial municipal solid waste challenge, with the country being identified as the world's largest producer of solid waste in 2010 (Ma, He, Dan, Chen & Lu, 2018). In Europe, food waste is considered to be the largest part of municipal solid waste with proportions of between 30% and 50% (Treadwell, Bennett & Clark, 2018). The European Parliament and the Council (2018) states that even though the management of municipal solid waste is situation-based, the three pillars of sustainability must be considered. Despite efforts by the government and local authorities, waste management

remains a pressing issue in both urban and rural areas. Rural areas often rely on effective waste management practices such as composting, while cities struggle due to limited space for households to implement similar strategies. The gravity of the municipal solid waste problem is not exclusive to specific countries but is a global concern (Moh & Manaf, 2016).

1.3.3 Overview of reverse logistics

Rodgers and Tibben-Lembke (1999 p.2) define reverse logistics as "The process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal." Unlike forward logistics, reverse logistics comprises distinct characteristics such as lack of visibility and non-uniform product quality. Implementing reverse logistics is not without challenges, as there are barriers associated with the process (Starostka-Patyk, Zawada, Pabian & Abed, 2013). Recently, reverse logistics has gained attention from researchers, policymakers, and organisations due to its potential benefits. However, literature exploring the relationship between reverse logistics of municipal solid waste and sustainability is limited, despite indications of economic and environmental advantages (Banihashemi, Fei & Chen, 2019). Economic benefits of reverse logistics include reduced raw material and disposal costs, while social benefits include addressing customer queries and promoting environmentally responsible behaviour (Rubio & Jimenez-Parra, 2014). This study focuses on proper management of end-of-life products at household level, usually referred to as municipal solid waste, for proper disposal as the last option, but preferably returning, reusing and recycling in the supply chain.

1.3.4 Sustainable solid waste management through reverse logistics

Reverse logistics is a viable approach with a potential to sustainably contribute to solid waste management efforts (Pena-Montoya, Bouzon, Torres-Lozada & Vidal-Holgiun, 2020). The significant threat posed by plastics to marine debris has prompted researchers to seek solutions to this problem. Packaging materials, which often escape formal waste disposal channels at the household level, make up a substantial portion (up to 85%) of aquatic debris (Feil, Coskum & Bosling, 2019). There is a growing concern for conserving and preserving natural endowments, and this observation stems from recognizing the importance of environmental protection (Xu,

Elomri, Pokharel, Zhang, Ming & Liu, 2017). In the context of managing municipal solid waste, involving local communities is crucial as they possess valuable knowledge about their environments and can contribute to finding effective solutions for sustainable development.

1.4 Scope of the study

This research study focused on evaluating perceptions and practices of residents towards municipal solid waste management services as well as implementing reverse logistics within selected local government authorities in Zimbabwe. The primary responsibility of these municipal authorities is ensuring the proper disposal of municipal solid waste within their respective jurisdictions in order to safeguard the health of residents. However, they face numerous challenges in fulfilling this responsibility. This study explored households' perceptions of services obtained from municipal authorities, and behaviour on municipal solid waste management. A quantitative technique was used to address the first three objectives of the study and the qualitative approach was used to address the last two objectives. The study further explored how the concept of reverse logistics can be utilised to address municipal solid waste challenges and improve the management of municipal solid waste to achieve sustainable development.

1.5 Problem statement of the study

Irrespective of concerted efforts by pressure groups advocating for environmental cleanliness in countries, as advocated in the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), municipal solid waste still poses a significant risk to several nations that are still developing, including Zimbabwe. Hobwana, Ngaza and Mapira (2018) highlight that although the proportion of municipal solid waste generated in Zimbabwe is relatively low, visible efforts to address the problem and reduce waste levels are lacking. Shabani and Jerrie (2022) contend that the handling of municipal solid waste in Zimbabwe may have disastrous consequences for both humanity and the environment. Zikali, Chingoto, Utete and Kanedzimwe (2018) note a noticeable inconsistency in the collection of solid waste between low and high-density suburbs of Zimbabwe. Mafume, Zendera, Mutetwa and Musimbo (2016) point out that municipal towns and cities in Zimbabwe face controversy regarding the way municipal solid

waste is disposed of, with lack of reverse logistics activities such as reuse leading to litter accumulation in various areas.

While developing countries have embraced technology in the process of solid waste disposal, a gap still exists in utilising technology at disposal facilities (Mafume et al., 2016). The Standard (June 24, 2012), as cited by Mutungwe, Tsvere, Munikwa, Dondo and Pedzisai (2014), reported that solid waste dumping in Harare is observed almost everywhere, including rivers, wetlands, roadsides, and woodlands. In Chinhoyi, a city in Mashonaland, Zimbabwe, Mutungwe et al. (2014) found that 40.8% of those who responded agreed to using rubbish pits they dug within their residential stands, 15.5% agreed to using the method of composting as a way treating municipal solid waste, 12.3% simply resorted to throwing litter anywhere, and an alarming 25.9% utilised receptacles and common areas that the government authorities provided in their areas.

There is a notable difference between formal ways of managing municipal solid waste and informal municipal solid waste management. While formal management is organized, has designated dump sites that are easily accessible, and follows municipal regulations, informal management lacks such structure (Mahamba, 2015). Chung (2010) argues that in situations where municipal by-laws are not enforced and where there is lack of technical and financial capacity of municipal authorities, the results are a hindrance to local authorities' operational abilities, leading to residents throwing and dumping municipal solid waste in undesignated sites. This issue of dumping waste in undesignated sites within municipal areas has become a pressing concern (Mahamba, 2015). While much research has focused on understanding the relationships among formal structures, such as types or streams of municipal solid waste, and their levels, less attention has been given to understanding the reasons behind household behaviours in dealing with municipal solid waste. This knowledge gap calls for a better understanding of household behaviours and the attitude of municipal authorities in educating households about waste management.

To address this gap, this study aimed at investigating whether households' perceptions of the services provided by municipal authorities and their satisfaction levels influence their behaviour towards solid waste management. Furthermore, the study investigated whether the

implementation of reverse logistics for municipal solid waste offers solutions to the waste management crisis in Zimbabwe and contributes to achieving sustainability.

1.6 Rationale of the study

This study aimed at contributing to the existing body of knowledge by assessing the perceptions of households on municipal authorities and practices of households towards municipal solid waste, as well as exploring the impact of reverse logistics activities on solid waste management practices in order to attain sustainable development. To the researcher's knowledge, this is the first study in Zimbabwe with a primary focus on examining the influence of residents' perceptions on services obtained from municipalities and residents' practices on solid waste management to achieve sustainable development goals, specifically by leveraging good waste management practices derived from reverse logistics activities.

By investigating the perception of households regarding the attitude of local government authorities towards solid waste reverse logistics for proper municipal solid waste management, this study sought to deliver a comprehensive appreciation of the subject. It aimed at identifying opportunities for improvement and enhancement of municipal solid waste collection strategies.

The findings of this study contribute valuable insights to the existing body of knowledge by shedding light on the relationship between households' perceptions and the attitude of local government authorities towards solid waste management. Furthermore, the study identifies gaps that may guide future research in the areas of solid waste reverse logistics and municipal solid waste for sustainable development.

1.7 Objectives and research questions

The study utilised research objectives and research questions to provide direction and guidance. The combined set of objectives and research questions informed the formulation of the research hypotheses, selecting methods of collecting data, and choosing techniques of analysing data based on suggestions from the literature.

1.7.1 Objectives of the study

Primarily, the study sought to explore the impact of reverse logistics activities on solid waste management so as to achieve improved sustainability.

The secondary objectives of this study were:

a) To establish the perceptions of households/residents on municipal authorities' practices on the management of municipal solid waste in selected municipalities in Zimbabwe.

b) To determine the practices of residents/households on the management of municipal solid waste in selected municipalities in Zimbabwe.

c) To determine whether the attitude and behaviour of municipalities towards municipal solid waste management, as perceived by the residents, influences the way in which residents manage their municipal solid waste.

d) To ascertain the state of sustainability in selected local government municipalities in Zimbabwe.

e) To determine if there is a relationship between reverse logistics of municipal solid waste and sustainability in local government municipalities in Zimbabwe.

1.7.2 Research questions underpinning the study

The following research questions were used in the study to inform the research objectives.

a) What are the perceptions of households/residents on municipal authorities' practices on the management of municipal solid waste in selected municipalities in Zimbabwe?

b) What are the practices of residents/households on the management of municipal solid waste in selected municipalities in Zimbabwe?

c) Do the attitude and behaviour of the municipality towards waste management, as perceived by the residents, influence the way in which the residents carry out their waste management?

d) What is the state of sustainability in the selected municipalities in Zimbabwe?

e) Is there a relationship between reverse logistics of municipal solid waste and sustainability in selected local government authorities in Zimbabwe?

1.8 Hypotheses

The study proposed the following hypotheses:

H_1: The perceptions and practices of the municipalities by households on municipal solid waste management have a positive effect on the way households practice reverse logistics of solid waste.

H_2: The residents' satisfaction with the municipalities' municipal solid waste management has a positive effect on the way residents dispose of solid waste.

1.9 Research synopsis

The following paragraphs provide a synopsis of how the study was designed, the approaches that were used and the sample sizes. This was important to guide how the study was carried out, to come up with meaningful and credible results.

1.9.1 The design of the research

The research study was designed as a case study to explore the perceptions and behaviour of households on the services they get from local government authorities that might influence the way these households treat solid waste management and reverse logistics activities for attaining sustainable development. The case study design was chosen for its ability to thoroughly examine evidence and provide generalisations whose limits are acceptable. Case studies are predominantly used in research to provide solutions to existing problems and investigate phenomena in situations where there is a lack of lucidity about the distinctions between the problem and truth. The case study approach involved empirical inquiry and relied on multiple sources of evidence.

1.9.2 Approaches to the research

The research study used a mixed research method, combining both qualitative and quantitative techniques to achieve the desired results. Quantitative research methods were used to provide what Patton (2015) calls numerical estimations and answer questions about the frequencies, magnitude, and impact of the phenomenon. Qualitative research methods (Barrett & Twycross, 2018) were used to explore decision-making processes and gain a comprehensive understanding

of intervention strategies. The qualitative approach allowed for the collection of rich and meaningful data, while the quantitative approach was used to test hypotheses. Through using a qualitative methodology, researchers can gather facts about the thoughts and feelings of participants, thereby gaining a better understanding of the experiences of the participants of the phenomenon under study (Sutton and Austin, 2015; Barrett & Twycross, 2018).

1.9.3 Sample size

A total of 450 households were included in the study, and a structured questionnaire was distributed to collect data on their perceptions and attitudes towards sustainable municipal solid waste management. The sample size was determined using the Yamane sample formula, taking into account the population of 22,105 households. The study used the quantitative technique to address the first three objectives of the study. Qualitative data were collected from seven local government authority employees through interviews. The qualitative sample size of seven was considered sufficient as the responses reached theoretical saturation, meaning that no new information or themes were emerging. The qualitative technique was used in the study to answer research questions on sustainability and reverse logistics activities in municipalities. Three municipalities were selected, including one performing well and two struggling with sustainable solid waste management.

1.10 Expected contribution of the study to the body of knowledge

The study contributes to the objectives of Sustainable Development Goal (SDG) number 11, which focuses on promoting sustainable cities, inclusive and sustainable urbanisation, and reduction of adverse environmental effect on cities. The research aimed at establishing if the perceptions of households towards services they get from municipalities contribute to their (households) practices on solid waste management and practices of reverse logistics for sustainable development in urban areas of Zimbabwe, a developing country in the Southern African region. By reviewing the literature and highlighting innovative approaches from other nations, the study promotes knowledge about the relationships among reverse logistics, municipal solid waste, and sustainability. This knowledge can inform policymakers and stakeholders and improve practices related to municipal solid waste management.

1.11 Limitations of the study

- The respondents who participated in the questionnaire and interviews were purposively selected, so the results cannot be generalised to all local government municipalities in Zimbabwe. The research did not provide an equal chance for all participants to be selected, as the surveyed sample was taken from selected municipalities.
- Participant bias could not be ruled out in the study as residents could have provided responses that they felt were socially desirable contrary to their real perceptions and behaviour regarding the management of solid waste. In some instances, bias may have been factored in the responses based on each individual's or group's experiences with local government authorities, such as clash of goals, which could influence the overall perceptions. Some responses might be based on what respondents perceive as morally correct in the management of solid waste but not what they really would be doing. The perceptions and attitudes of households cannot be exhaustively captured by the selected variables, leaving behind other variables like socio-economic and cultural values that might be associated with sound management of solid waste.
- The study took a cross-sectional survey, which might have limited the quality of data collected as the perceptions and behaviours of residents are likely to change over time, unlike longitudinal studies that have the capacity to capture these changes.

1.12 Overview of theses on related research

There is a considerable body of scholarship that aids understanding of the intricate interplay between reverse logistics, solid waste management, and sustainability. Table 1.1 presents a summary of relevant studies that have explored the relationships between reverse logistics of municipal solid waste and sustainability. Kinobe, Gebresenbet, Niwagaba and Vinneras (2015) carried out a study focusing on developing countries to investigate the relationship between reverse logistics and waste management. The study elucidated the evolution of logistics and the establishment of concepts such as closed-loop logistics (reverse logistics), emphasising its connection with solid waste management. Bing (2014) linked reverse logistics to sustainability in the context of appropriate disposal of household plastic waste. The study proposed the use of recycled plastic waste as a raw material in plastic manufacturing, highlighting its cost-saving

benefits compared to fresh raw materials. The study also analysed sustainable processes in the reverse logistics of household plastic waste, from collection to treatment, and suggested designs for regional and global levels of reverse logistics of solid waste. Kumar (2020) highlighted the impact of plastic waste on the environment within operations of local and central authorities, emphasising the need for social responsibility among plastic manufacturers and users. The study identified three approaches to plastic waste management: mechanical recycling, energy recycling, and landfilling. The Ellen MacArthur Foundation (2017) stated in The World Economic Forum Report in Davos that the reverse logistics of plastics as solid waste is proposed, citing economic benefits as one dimension of sustainability that is projected to increase from 14% to 70%. Lingaitiene, Burinskiene and Davidaviciene (2022) examined the components of municipal solid waste and their association with reverse logistics processes. The research aimed at understanding the behaviour of municipal solid waste components in relation to recycling rates.

Table 1.1: An Overview of Related Research

Year	**Name of Author(s)**	**Title of Article**	**Institution**
2023	Irowarisima I.	Investigating solid waste management in developing countries using Nigeria as a case study.	Abertay University
2023	Molloy E.	Waste not, want not: planning for consumer goods reuse in municipal waste management strategies.	Toronto Metropolitan University
2023	Ainooson O.	Rapid urbanisation and its impact on municipal solid waste management in the greater Accra Region of Ghana.	Auburn University
2023	Hosseini D.B.	Environmental and economic assessment of municipal solid waste management scenarios in NSW, Australia.	Macquarie University
2022	Lundumen D.	Willingness to pay for improving solid waste management through Taka Ajira Project. A case of Kigamboni Municipal.	The Open University of Tanzania

2022	Sibanda E.	Developing a people centred framework for solid waste management in informal settlements within Tshwane and Johannesburg Metropolitan Municipalities.	University of Venda
2022	Adeyoola A.A.	Towards integrated solid waste management in Nigerian cities.	Northumbria University, Newcastle
2022	Mukuma R.	Spatial analysis of the link between solid waste and floods in Kalikiliki and Kanyama ward settlements in the city of Lusaka, Zambia.	University of Zimbabwe
2021	Ussi H.K.	Local community participation in solid waste management in Urban West Region, Zanzibar.	Open University of Tanzania
2021	Mubanga K.H.	Sustainable household practices for environmental sustainability in informal settlements. Insights from Kanyama Ward 10, Lusaka, Zambia.	Journal of Environment and Ecology Vol. 21(1) pp. 1-24.
2020	Van Lier S.	Optimising solid waste management in semi-public spaces. A case of the Efteling Theme Park.	Delft University of Technology
2020	Sharma S.K.	Using reverse logistics for better solid waste management in India-plastic waste. Plastic Waste; Towards a Sustainable Environment and Business.	Towards a Sustainable Environment and Business Conference ICOI2020. Ghaziabad IIIT Allahabad, Indian Institute of Information Technology - Allahabad
2020	Pena-Montoya C., Bouzon M.,	Assessment of maturity of reverse logistics as a strategy to sustainable solid waste	Waste Management and Research. Vol. 38

	Torres-Lozada P. and Vifal-Holguin C.D.	management.	(1) Supplement pp. 65-76.
2020	Alamerew Y.A.	Circular economy and reverse logistics: An end-of-life decision making assistant. (PhD Thesis)	Grenoble Alpes University
2019	Feil A., Coskum E., and Bosling M.	Improvement of the recycling of plastics in lightweight packaging treatment plants by a process control concept.	Waste Management and Research. Vol. 37 pp. 120-126
2019	Pham T.	Reverse logistics in plastic supply chain in Vietnam. (Bachelor's Degree)	JAMK University of Applied Sciences
2018	Mesjasz-Lech A.	Reverse logistics of municipal solid waste-Towards zero waste cities.	Transportation Research Procedia Vol. 39 pp. 320-332.

Table 1.1 gives a summary of previous studies that offer insights and innovative strategies to address the pressing challenges posed by municipal solid waste, inspiring policymakers, researchers, and stakeholders to collaborate towards effective and sustainable waste management practices.

1.13 Outline of the study

Chapter one: Introduction and background to the study

Chapter one serves as an introduction to the study, establishing its foundational elements. The chapter covered the background of the study, an overview of solid waste reverse logistics, overview of the management of solid waste and sustainability, scope of the study, rationale for the study, statement of the problem, research objectives and research questions, hypothesis, research synopsis, expected contributions of the study, limitations of the study, an overview of the theses on related research, and an outline of the study.

Chapter two: An overview of solid waste management

Continuing from the foundation laid in chapter one, chapter two presents a comprehensive overview of solid waste management. It provides an overview of waste management in Zimbabwe followed by providing an overview of municipalities, their sizes, locations, compositions and responsibilities.

Chapter three: Overview of sustainability, reverse logistics and sustainable solid waste management through reverse logistics

Chapter three offers a detailed overview of sustainability, reverse logistics, and waste management through reverse logistics. It focuses on reverse logistics practices, drivers, processes, solid waste management practices, and sustainable reverse logistics activities for municipal solid waste.

Chapter four: Research design and methodology

Chapter four delves into the research design and methodology employed in the study. It clarifies key terms such as research design and research and discusses the research objectives, hypothesis, reliability and validity of the study. The chapter also outlines the methodological approaches adopted, data collection methods, data assessment, and data analysis.

Chapter 5: Analysis and discussion of the quantitative findings

Chapter five analyses and discusses the quantitative results of the study. It begins by presenting the response rate and providing an overview of data processing procedures. The results are then examined based on the hypotheses formulated to guide and direct the study, leading to a conclusive summary.

Chapter six: Analysis and discussion of qualitative findings

Chapter six focuses on the presentation, analysis and discussion of the qualitative data. The qualitative method employed in the research aimed at addressing research objectives numbers four and five. The chapter covers the qualitative process, including open coding, axial coding, and selective coding.

Chapter seven: Summary, recommendations, caveats and suggestions for future research

In this concluding chapter, a summary of the findings is provided, followed by recommendations based on the results. The research objectives, which explored the perceptions and behaviours of households on the services they get from local government authorities on the management of municipal solid waste, the level of satisfaction of these services to the residents, the behaviour of residents on solid waste revere logistics activities, the impact of reverse logistics on the management of municipal solid waste (external), the impact of solid waste management on sustainability, and the impact of reverse logistics on sustainability are addressed. Additionally, suggestions for future research are offered, highlighting areas that require further investigation.

1.11 Chapter summary

This chapter serves as a comprehensive introduction to the study, providing essential background information and setting the stage for further exploration. It commenced with a brief history of the study. It was followed by an exploration of the background of the study, wherein the challenges in the management of municipal solid waste were observed as being predominantly influenced by population growth in urban dwellings. The statement of the problem identified the nature of the issue and its significance, and outlined the study's aim to propose a solution. Subsequently, the research objectives and a list of hypotheses were provided. The significance of the study, research methodology, and limitations of the research were also addressed. The next chapter provides an overview of study variables, namely solid waste reverse logistics activities, and municipal solid waste management and sustainability, thereby facilitating a comprehensive understanding of the core concepts and their interrelationships.

CHAPTER TWO

AN OVERVIEW OF SOLID WASTE MANAGEMENT

2.1 Introduction

In the preceding chapter, a comprehensive understanding of the research background was presented, focusing on the problems that accompany the management of municipal solid waste in urban areas. The study variables, namely sustainability, solid waste management, and reverse logistics, were briefly introduced to provide context. Additionally, the chapter addressed the scope of the study, statement of the problem, rationale of the study, objectives of the study and research questions, hypotheses, the methodology that was adopted in the study, and the anticipated contributions to the existing body of knowledge.

Moving forward, this chapter aims to delve deeper into the topic by providing an overview of municipal solid waste management. Specifically, it explores the management of solid waste within the context of Zimbabwe and conducts a literature review. The inclusion of a literature review is essential as it establishes the foundation of sustainable practices and concepts in the management of municipal solid waste.

2.2 Global overview of solid waste management

There has been a noticeable increase in the population of urban dwellers to as much as 529 million people over the last 50 years – 13% of the global population (Yao & Liu, 2022). Research indicates that industrialisation, technological development, economic growth and development, improved medication and better education have led to rapid population growth (Heidari, Yazdaparast & Jabbarzadeh, 2019; Henyo, Buor & Odame, 2019; AlHumid et al., 2019; Lagerkvist & Dahlen, 2019). Yao and Liu (2022) state that this growth has adverse effects on transportation services by causing congestion, accelerates the transmission of diseases in those densely populated areas, and causes environmental problems such as pollution from household solid waste generation. Currently, the global population of approximately 8.1 billion people generates 1300 million tonnes of solid waste annually, with projections estimating an increase to approximately 2200 million tonnes per year by 2025 (Ram, Kumar & Rani, 2019). A significant growth in greenhouse gas (GHG) emissions can be attributed to landfilling of municipal solid waste, a practice that is common in developing countries (Temireyera,

Zhunussova, Aidabulov, Venetus, Sarbassor & Shah, 2022). Todorov and Dimov (2022) posit that it is important to have a good solid waste management system in place to avoid environmental damage which usually affects not only people, but the entire ecosystem. The rate of municipal solid waste disposal versus recycling in Kazakhstan is 94% and 6% respectively (Skryhan, Shilova, Khandogina, Abashyna & Chemikova, 2018) whereas in the European Union, the rates for municipal solid waste disposal and recycling are 23% and 47% respectively, the balance is catered for through recycling and composting activities which are not exercised in Kazakhstan (Levaggi, Levaggi, Marchiori & Trecrici, 2020).

According to O'Sullivan (2023), greenhouse gas emissions, energy resource consumption, land use and demand for food for consumption are affected by the size of the population. Chen, Li, Liu, Luo, Li, Cheng and Huang (2022) point out that in China, municipal solid waste has caused some environmental and social problems such as leachate and odour, which have reached a record high because of high levels of both economic growth and urbanisation. Odonkor and Sallar (2021) concur with Wei, Huan, and Liu (2021) that municipal solid waste management has caused complex challenges as well as created bottlenecks that suppress sustainable development in urban areas of developing countries.

The above highlights the pressing need for designing approaches that prove to be effective and sustainable in the management of municipal solid waste, particularly in light of the environmental and health implications connected to the increasing quantities and complexity of waste. Sustainable and eco-friendly approaches to municipal solid waste management are therefore required to deal with the problem of municipal solid waste before it gets out of control (Liu and Zheng, 2023). For example, research has suggested anaerobic digestion as a potentially effective technique of treating municipal solid waste, especially kitchen waste (Jin, Sun, Yang, Shang, Ma, He and Li, 2021).

2.2.1 Definition of solid waste

In the context of climate change policies, the definitions of solid waste play an important role in shaping effective strategies and initiatives. Multilateral organisations, with their global influence and expertise, have contributed significantly to the development of comprehensive definitions that encompass the various aspects of solid waste management. These definitions not only provide a common understanding but also guide policy formulation and implementation at

national and international levels. This section examines the definitions of solid waste put forth by influential multilateral organisations (Table 2.1), highlighting their role in influencing climate change policies and promoting sustainable practices for waste management.

By exploring these definitions, we gain valuable insights into the complexities of solid waste and the imperative to address its environmental impacts in the pursuit of a greener and more sustainable future.

In addition to the definitions provided by multilateral organisations, scholars and researchers have also contributed valuable insights into the understanding of solid waste and its management. Scholarly perspectives offer a nuanced understanding of the various dimensions and challenges associated with solid waste management. By reviewing definitions proposed by scholars, further enrichment and understanding of municipal solid is enhanced, contributing to the discourse on solid waste management and its role in climate change mitigation and adaptation. By examining both multilateral organisation definitions and scholarly perspectives, a deeper and comprehensive understanding of solid waste and its significance in shaping effective climate change policies is achieved.

Table 2.1: Definitions of Solid Waste

Institution	Definition
Organization for Economic Cooperation and Development (OECD)	Municipal waste covers solid waste from households including bulky waste, similar waste from commercial activities and trade, offices, institutions, and small businesses, yard and garden trimmings, contents of litter containers and market cleansing, construction and demolitions leftovers.
Pan American Health Organization (PAHO)	Solid and semi-solid waste generated in population centers including domestic and commercial wastes, as well as those generated by the small-scale industries and institutions (including hospitals and clinics), market street sweepings and from public cleansing.
Intergovernmental Panel on Climate Change (IPCC)	Waste includes the following: food waste; garden (yard) and park waste; paper and cardboard; wood and textiles; nappies (disposable diapers); rubber and leather; plastics; metal; glass; and other including ashes, dust, soil and electronic waste.

Source: UNEP – Waste and Climate Change (2013)

Heidari et al. (2019) prefer to define solid waste as complicated and a result of activities from household and commercial activities. Nanda and Berruti (2020) state that municipal solid waste constitutes solid waste collected within a municipal area from commercial institutions, small scale enterprises, offices and households. The same authors say that this comprises yard waste, plastics, rubber products, metal, glass, paper and cardboard, kitchen waste, and electronic waste. Terms used in American contexts are different from those used in the European contexts when referring to waste and at this point all definitions do not separate solid from other forms of waste like gases and liquids.

The process of managing municipal solid waste is a problem affecting all people around the globe, and those that are affected most are the poor people in society as they often lose their properties and lives to solid waste landslides (World Bank, 2018). The seriousness and intensity of this problem is evidenced by the commitment that the World Bank, whose reports and data collection initiatives provide key insights into the global generation of solid waste, its composition, and the challenges faced in its management (see World Bank, 2018). A paradigm has been observed in the management of solid waste between developed and developing countries with the former nations using waste-to-energy technologies to generate heat and power (Nanda & Barruti, 2020; Moya et al, 2017). Moya et al., (2017). Moya et al., (2017) posit that these technologies are appropriate to be used in developing countries because they are an opportunity of turning waste into energy. This task is considered a source of employment creation as the community provides the necessary contractual labour. Municipal solid waste management is a task that is assigned to local government authorities, with an average of 20% of their allocated funds allocated to it (World Bank, 2018). These authorities are mandated to address the coordinated and international aspects of municipal solid waste, including the demographics of the workforce within their jurisdictions, and how to manage both formal and informal workers (World Bank, 2018).

Municipal solid waste has recently gained global attention, with notable increases observed, especially in the East Asian and Pacific regions, which account for 43% of the world's waste by magnitude (World Bank, 2018). The problem of growing quantities of municipal solid waste in urban areas has been attributed to urbanisation, globalisation, and technological advancement (Kumar & Pandey, 2018; Chen, 2018). According to the World Bank (2018), the following are some key global insights regarding the management of solid waste:

- The average global per capita per day generation of waste is 0.74 kg, while at the national level, it ranges from 0.11 kg to 4.54 kg.
- The global annual municipal solid waste generation is projected to rise to 3.40 billion tonnes by the year 2050, up from an annual estimate of 2.01 billion tonnes in the year 2016.
- The growth of municipal solid waste generation is expected to triple in Sub-Saharan Africa, double in South Asia, and double in the Middle East North Africa regions.
- Food and green waste constitute fifty percent of solid waste generated in low and middle-income countries.
- The percentage of municipal solid waste that can be recycled in low-income countries is 16%, compared to 50% in high-income countries.
- The methods of waste disposal globally have been observed as follows: 37% in landfills, 33% through open dumping, 19% undergo recovery through recycling and composting, and 11% is treated through incineration.

Odonkor, Frimpong and Kurantin (2020) point out that successful municipal solid waste management plans begin with the collection of solid waste, which is a key input. Purwani, Hisjam and Sutopo (2020) posit that municipal solid waste is a problem that impacts environmental, social and economic aspects of human beings. Waste generation is proportionate to a nation's economic and social prosperity, for example it has been observed that developed nations tend to produce more quantities of municipal solid waste per capita as compared to developing countries (Moya & Berruti, 2020). Sinthumule and Mkumbuzi (2019) indicate that the management of municipal solid waste is now a global concern for the society and the environment especially in developing countries, where problems such as water pollution, soil pollution, and air pollution are visible. Fan, Klemes, Walmsley and Bertok (2020) posit that solid waste affects the three dimensions of sustainability, that is society, economic and environment. Margallo, Ziegler-Rodriguez, Vazguez-Rowe, Aldaco, Irabien and Kahhat (2019) point out that environmental pressure is faced each time any item that is no longer wanted is discarded and resources are used. Poor waste management exerts pressure on the economy and health of human beings and the ecosystem (Agovino, Cerciello & Gatto, 2018; Agovino, D'Vua, Garofalo &

Marchesano, 2018; Somplak, Kudela, Smejkalova, Nevryl, Pavlas & Hrabec, 2019). It is therefore imperative to come up with strategic frameworks that are aimed at reducing the impact of waste on the environment (Zorpas, 2019).

Municipal solid waste goes through a number of processes that include generation, storage, collecting, treatment, and disposal (Fadugba et al., 2022; Khan et al., 2022). Ojovan et al., (2019) postulates that minimisation of solid waste to levels that are as low as possible and achievable is one of the aims of solid waste management. This is supported by Mostaghimi and Behnamian (2023) who claim that source reduction and reuse of waste characterises municipal solid waste. Mapunda, Kimwiga and Kassuwi (2024) point out that the entry point in inculcation of solid waste minimisation is having a clear and better understanding of solid waste management practices at household level.

Orhorhoro and Oghogho (2019) concur with this view and suggest that waste management activities must be carried out properly to raise awareness effectively. This expanded definition builds upon their previous definition, which states, "It encompasses the generation, control, storage, collection, transportation, processing, and proper disposal of solid waste in accordance with public health guidelines, financial considerations, business practices, product design considerations, administrative issues, legal matters, and environmental concerns" (Orhorhoro, Oghoghorie & Sadjere, 2017a). An additional notable characteristic emphasised in this definition is the monitoring component of solid waste management, which plays a crucial role in facilitating development. Feedback, comparisons, and cost-benefit analysis are essential for making decisions that benefit society. Research states that solid waste generation has a direct relationship with factors such as household income, household size, the size of the house floor area, choice of living style (Baiocchi, Feng, Hubacek & Waters, 2022; Liu, Shyrane & Elliot, 2023). This inherently calls for a budgetary plan for resources like trucks to be allocated to each area for transferring solid waste to treatment and disposal areas (Lockwood, 2023; Reed & Yurechko, 2020).

The primary objective of the management of municipal solid waste is to effectively and efficiently supervise the collection, sortation, treatment, and correct disposal of municipal solid waste generated by metropolitan activities, while ensuring minimal impact on the environment and society (World Bank, 2015). This responsibility falls directly under the control of local

government bodies where residents reside. Fisher, Lange and Scotford (2015) provide a slightly different definition, describing solid waste management as the comprehensive process of collection, transportation, recovery, recycling, and correct disposal of municipal solid waste. This definition also incorporates the management of these processes and the maintenance of dumping sites, along with activities carried out as a merchant or agent. It diverges from other definitions by encompassing additional management pillars, such as supervision, which were typically overlooked. In summary, municipal solid waste management encompasses the process of generating, collecting, processing, transporting, treating, and correct disposal, including recycling. The value addition of reverse logistics in supply chains has attracted the attention of researchers, industrialist and policy makers and demands the participation as well as cooperation of various stakeholders (Abdissa, Ayalew, Dunay & Illes, 2022).

According to the United Kingdom Environmental Act (1990), waste refers to any items that characterise abandoned substances or any flux or unwanted residue resulting from certain practices. Waste is generally in gaseous state, liquid state or solid state (Tang, Li, Tam & Xue, 2020; Zhao, Tan, & Feng, 2020; Zhang Shi, Peng, Wang, Xiong & Wu, 2018). Research indicates that vast amounts of solid waste is made up of plastic which makes the management of solid waste a bit tough (Moharir & Kumar, 2019; Idumah & Nwuzaor, 2019). Orhorhoro and Oghoghorie (2019) provide a simpler definition, stating that solid waste refers to valueless and discarded materials in a solid state that have been rejected by members of society. However, this classification raises questions regarding whether waste within households is considered disposed of and whether tourists can be regarded as members of society as they will be passing by and not permanent members of a society. Orhorhoro and Oghoghorie (2019) further classify solid waste into three classifications relative to their sources: metropolitan solid waste, business solid waste, and waste generated by farming activities. This categorisation provides a clearer understanding of the research focus and the aspects that will be addressed in the study. The study limits its definition of municipal solid waste as material residue that is considered of no profit to the person holding it and subsequently becomes the generator, but the same material can be of value elsewhere. This study considered only waste generated by households within municipal areas.

2.3 Overview of municipal solid waste management in Sub-Sharan Africa

The management of municipal solid waste in developing countries is hampered by a host of challenges that include budget constraints, lack of equipment, lack of infrastructure, and lack of waste treatment centres (Han, Liu, Zhong, Shi, Li, Zeng, Zhang, Fei & Xie, 2018; Mihai & Taherzadeh, 2017; Hildago, 2017; Ncube, Ncube & Voyi, 2017; Mufame, et al., 2016). Globally, an estimated 5.5 million people are exposed to contracting diseases that emanate from poor municipal solid waste management, leading to death. In Sub-Saharan Africa, municipal solid waste management is hampered by lack of efficient and effective solid waste management policies as well as poor institutional inftrastructure (Kubanza, Das & Simatele, 2017). Greencape (2017) claim that South Africa is one of the countries in Sub-Saharan Africa that contributes to massive generation of solid waste and that generation continues to grow. For example, Kubanza and Simatele (2019) point out that in Johannesburg the commercial capital city of South Africa, burning, dumping and burying solid waste are the predominant practices among the poor communities. In these poor communities, household solid waste services are not regarded as essential services as they are ranked below services like clean water, transportation and housing (Kubanza & Simatele, 2019; Hangulu & Akintola, 2017). It is the responsibility of local governments to plan, allocate and design feasible solid waste management strategies (Lukacs de Pereny Martens, 2021; Malinauskaite Jouhara, Czajcsynska, Stanchev & Rostkowski, 2017; Mapunda et al., 2023). Moh (2017) emphasises that effective performance of solid waste management begins at source with community awareness and having enforcement mechanisms in place. Effective municipal solid waste management is a complex process that involves planning, financing and implementing activities and programs aimed at controlling the generation, storage, collection, transportation, and treatment or correct disposal of waste at appropriate landfills or dumpsites (Odonkor, Frimpong & Kurantin, 2020). Managing waste is a crucial obligation of urban authorities in developing countries, and the efficiency and effectiveness of solid waste management have become prominent indicators of governance quality. They reflect how local government authorities handle governance issues, as well as their perception and commitment to sustainable development. Francis-Xavier, Millar and Tanguo (2018) contend that indiscriminate disposal of waste is a sign of ineffective and poor services while effective solid waste management brings about consumer satisfaction.

In Sub-Saharan Africa, blockage of drainage systems is caused by plastic waste that is blown away from disposal sites (Jambeck et al., 2018). Even though a few researchers attempted to carry out studies aimed at addressing the proliferation of plastic waste, there is less evidence that these studies have targeted improving the status of plastic waste hence the paucity of information on plastic waste generation and management in Sub-Saharan Africa (Aleyeru, Dlova, Akinribide, Ntuli, Kupolati, Marina, Blencowe, & Olubambi, 2020).

2.4 Overview of municipal solid waste management in Zimbabwe

The current study offers an extensive general idea of municipal solid waste management (MSWM) in Zimbabwe, focusing on multiple municipalities. This comprehensive examination underscores the inherent significance of the prevailing situation, necessitating a meticulous and thorough investigation. It is important to shed light on the formidable challenges encountered by municipal authorities in their endeavour to provide indispensable solid waste collection services. Chatira-Muchopa, Chidarikire and Tarisayi (2019) posit that there exists pieces of legislation in Zimbabwe that are aimed at guiding the management of municipal solid waste. For example, an instrument called the Environmental Management Act Chapter 20:27 stipulates that all people have a mandate to minimise solid waste taken for treatment (EMA Act Chapter 20:27). In addition, The Urban Councils Act Chapter 29:15 designates municipalities the task of collecting, transporting, and disposing solid waste. These instruments provide a framework for the management of municipal solid waste and therefore it can be argued that in Zimbabwe, there exists a legal framework for the management of municipal solid waste (Chatira-Muchopa, Chidarikire & Tarisayi, 2019). In this section, the frequency of waste collection was examined and the practices adopted by both residents and municipalities are evaluated, scrutinizing the diverse streams of solid waste generated within residential areas. Highlighting these critical aspects enhances our understanding of the complexities accompanying municipal solid waste management in Zimbabwe, a useful starting point to identify potential avenues for improvement and intervention.

2.4.1 Solid waste management in Gweru

The declaration of the pandemic Covid-19 as a disaster by the World Health Organisation in March 2020 made life difficult for operations like waste collection because of stringent measures

like lockdown (Chingwenya & Wadzanai, 2020). Nevertheless, essential service providers like municipality workers were allowed to go to work and could be seen roaming the streets (Dzobo et al., 2020). Ward 12 of Gweru city in Zimbabwe was not spared of these challenges also (Dzawanda & Moyo, 2022). Covid-19 pandemic worsened the challenges of municipal solid waste management because during that time priority was shifted from municipal solid waste management to the pandemic (Dzawanda & Moyo, 2022). The same authors point out that residents were forced to resort to illegal dumping and other forms of mismanagement like burning and burying solid waste. Pande and Makonye (2023) claim that residents in Gweru city, the third largest city in Zimbabwe, have experienced constant outbreaks of cholera and typhoid. The official dumpsite of municipal solid waste poses a challenge because it is situated close to a residential area and industrial park (Pande & Makonye, 2023).

2.4.2 Solid waste management in Bulawayo

Sinuthumule and Mkumbuzi (2019) point out that for the past two decades, the city of Bulawayo has faced a serious decline in service delivery due to the economic collapse in Zimbabwe. Irregular and ineffective solid waste management systems have been witnessed in some suburbs of Bulawayo like Cowdray Park, thereby exposing residents to environmental diseases (Mlilo, Marufu-Dzangare, Chigugudhlo & Chitongo, 2021). Cowdray Park is one of the suburbs where municipal solid waste collection has been unreliable to the extent of going for months without solid waste collection (Mlilo et al., 2021). Mutemani, Chinyama, Mohsin and Kativhu (2022) indicate that an attempt has been made to run community-based solid waste collection programs in several suburbs of Bulawayo with a mind-set of improving solid waste collection. Sinuthumule and Mkumbuzi (2019) argue that less is known about the effects of community-based solid waste management in Bulawayo even though this program was developed more than a decade ago. For instance, Mutemani et al. (2022) posit that community-based solid waste management programs have seen a reduction of fuel costs, maintenance costs and repair costs by 28%, reduction of labour costs by 30% and economic empowerment of residents. Sinuthumule and Mkumbuzi (2019) reiterate that community-based solid waste management is an approach deeply rooted in the principle of Kurt Lewin who theorised that people who participate in problem solving are more likely to change their behaviour.

2.4.3 Solid waste management in Masvingo

In order to address the limited literature on the process of managing municipal solid waste in schools in Zimbabwe, Chatira-Muchopa, Chidarikire, and Tarisayi (2019) conducted a study in Masvingo town. The study aimed to identify the qualities of municipal solid waste, forms of repositories used, and the prevailing preferences for waste disposal within a school setting. The findings of the study reveal that the kitchen bin, classrooms, and administrative areas constitute the primary sources of solid waste, with the following collective outputs: 26% paper, 16.5% plastic, 16% furniture, 12% food, 10% vegetables, and 8% stationery. Remarkably, Chatira-Muchopa et al. (2019) observed that no separation of solid waste occurs at the school level, despite the utilisation of various receptacles such as standard bins, cardboard boxes, plastic bags, old desks, and open dumping practices.

2.4.4 Solid waste management in Harare

In their research, Kwenda, Lagerwell, Eker and Ruijven (2021) highlight the challenges faced by the municipality of Harare, Zimbabwe in efficiently providing solid waste management services to its residents. The study aimed to gain insights into the perceptions and behaviours of household in the process of managing municipal solid waste in Harare City, considering that households are regarded as the primary sources of municipal solid waste. Interestingly, despite being one of the largest producers of solid waste, Harare City has been identified among some the poorest cities in Africa regarding the processes in place of managing municipal solid waste (Kwenda et al., 2021). The per capita generation of solid waste in Harare has been estimated to be approximately 0.38kg, reflecting the magnitude of the waste management issue (Kwenda et al., 2021).

Poshai and Intauno (2024) claim that residents of Harare the capital city of Zimbabwe have resorted to the use of social capital in managing solid waste within their communities through mechanisms like collaboration and formation of community-based organisations. Clean-up exercises and environmental cleanliness training workshops. The same authors used social capital theory in their study because of its usefulness in the analysis of how the theory was applied in established community networks and relationships. Beausaert, Froehlich, Riley and Gallant (2023) posit that the theory of social capital keeps society together by developing networks of trust and resilience.

Together, the waste management in the Zimbabwean cities of Gweru, Bulawayo, Masvingo and Harare presents a comprehensive picture of the challenges and complexities faced in effectively managing solid waste. The reviewed studies highlight common issues such as inadequate waste collection services, inconsistent refuse collection, improper disposal practices, and absence of knowledge concerning solid waste management technologies. The composition of solid waste, with a significant proportion being organic matter, underscores the need for sustainable waste management strategies. Additionally, the identified disparity between the scale of waste production and the capacity to manage it effectively calls for urgent interventions and long-term sustainable programs to address the waste management crisis in these Zimbabwean cities.

2.5 Conceptual framework underpinning the study

Liehr and Smith (1999) contend that a problem under study is best illustrated by a conceptual framework because it integrates concepts or theories. Statistically, the purpose of a conceptual framework is to give a description of the relationships among variables of the study (Adom & Hussein, 2018), thereby providing a visual or pictorial display of the variables (Grant & Osanloo, 2014). This makes it easier for the researcher to define and specify the concept within the problem of the study (Luse, Mennecke & Townsend, 2012). Ravitch and Carl (2016) maintain that reflection of the thoughts revolving around the entire research process are displayed in the conceptual framework which makes it easier for readers and scholars to follow as to whether the methodology used was in tandem with the goal of establishing relationships among variables in the study (Latham, 2017).

The study recognises that households' perception of the attitude of local government authorities plays a crucial role in shaping their behaviour and practices regarding municipal solid waste management. This includes aspects such as the identification of waste types, accurate measurement of quantities, utilisation of proper receptacles, and the appropriate placement of these receptacles. The theory of reasoned action (Amini, Ahmad & Ambali, 2014), and the theory of reasoned behaviour (Ozteken, Teksoz, Pamuk, Sahin & Kilic, 2017) were used in the study to form the basis of the perceptions of residents. Furthermore, households' perception influences their willingness to separate solid waste, their disposition regarding a proposition to pay for services rendered in the management of municipal solid waste, and their readiness to engage in recycling practices. The conceptual framework, as depicted in Figure 2.1, visually

illustrates the interplay and interaction of these variables, highlighting the intricate relationship between households' perception, their actions, and the responsibility of local government establishments in shaping sound behaviours in the management of municipal solid waste. Akintoye (2015) prefers to call a conceptual framework the best way in which a researcher presents his/her assertions and solutions to the phenomena.

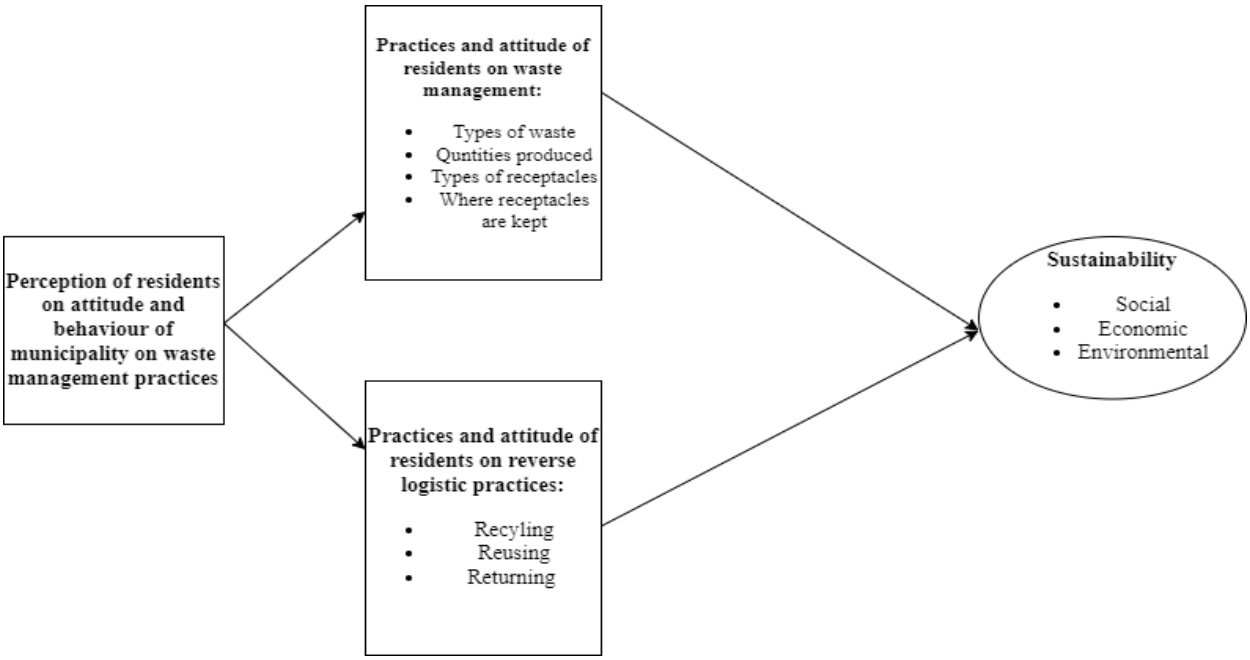

Figure 2.1: Conceptual Framework of the Study

Human beings respond to external stimulation that comes from the use of sensory organs (taste, sight, hearing, touching and smelling), which gives knowledge and perception of what is going on around them (Oyedotun, Kasim, Famewo, Oyedotun, Moonsammy, Ally & Renn-Moonsammy, 2020; Olukanni, Favour, Pius-Imue & Sunday, 2020). Human beings make use of resources, knowledge, beliefs, norms and values to form perceptions of the world around them (Henyo, Buor & Odane, 2023). The same authors contend that these perceptions formed within human beings influence their solid waste disposal practices. As illustrated in Figure 2.1, the perceptions of residents on the services they receive from municipal authorities affect their practices on solid waste management (Henyo et al., 2023). The satisfaction of residents on the quality of services from municipalities also affects their behaviour towards the management of municipal solid waste and their reverse logistics solid waste practices. By understanding these dynamics, policymakers and stakeholders can develop targeted strategies and interventions to

improve waste management practices, enhance community engagement, and foster a positive perception of local government authorities' efforts in achieving sustainable waste management outcomes. The conceptual model in Figure 2.1 forms the basis of the following hypotheses that were formulated:

H_1: The perceptions and practices of the municipalities by households on municipal solid waste management have a positive effect on the way households practice reverse logistics of solid waste.

H_2: The residents' satisfaction with the municipalities' municipal solid waste management has a positive effect on the way residents dispose of solid waste.

2.6 Chapter summary

This chapter has provided a comprehensive general idea of solid waste management, encompassing global, regional, and Zimbabwean contexts. It has examined the definitions, challenges, and trends associated with waste management, highlighting the intricate nature of waste generation, collection, and disposal processes. The review has also shed light on the specific challenges faced by Zimbabwean municipalities, including struggles in providing efficient waste collection services, inadequate infrastructure, and limited community engagement. Furthermore, the conceptual framework and hypothesis for the study have been presented, emphasising the importance of households' perception of local government authorities in shaping waste management behaviours. Building on this foundation, the next chapter addresses the concept of sustainability, exploring the role of reverse logistics in achieving sustainable solid waste management.

CHAPTER THREE

OVERVIEW OF SUSTAINABILITY, REVERSE LOGISTICS AND SUSTAINABLE SOLID WASTE MANAGEMENT THROUGH REVERSE LOGISTICS

3.1 Introduction

This chapter provides a general idea of sustainability principles and their application in waste management practices. The chapter delves into the concept of reverse logistics, highlighting its potential to minimize waste, recover valuable resources, and promote circular economy principles. By understanding the synergies between sustainability and reverse logistics, the chapter aims to offer insights and strategies for sustainable solid waste management through the adoption of reverse logistics practices.

3.2 Overview of sustainability

The United Nations Development Programme (UNDP) highlights the significance of the Agenda for Sustainable Development, adopted by 193 Member States in 2015, which introduced the 17 Sustainable Development Goals (SDGs) to enhance the quality of life (UNDP, 2019). Sustainability is now considered a paradigm shift, urging stakeholders to actively consider the future and prioritize environmental, social, and economic balance (UNDP). Massive industrial activities, that is production and consumption, have been going on uncontrolled resulting in the need for more sustainable ways (Zhao, Che, Yuan & Chen, 2024). Circular economy (CE) was then introduced to achieve sustainable development (Geissdoerfer et al., 2017). Moustakas and Loizidou (2024) point out that waste management has been identified as a relevant field in the promotion and strengthening of circular economy. Yussif (2019) emphasise that transitioning from Millenium Development Goals (MDGs) to Sustainable Development Goals (SDGs) was to secure renewed political commitment globally, forward prosperity and well-being, harness the depletion of natural resources and making sure that future generation will be able to live comfortably. The implementation of SDGs in municipalities demands greater integration between governments and the private sector (Oliveira, de Almeida Ribeiro, Araujo, da Siva, dos Santos, Nogueira & Costa, 2024). This integration helps in implementing the four Rs -reduce, reuse, recycle and recovery- at source level to reduce the problem of illegally depositing solid waste in urban areas (Denath, 2020). In Zimbabwe, the Environmental Management Agency

(EMA) plays a vital role in policy implementation and ensuring compliance with environmental regulations.

In this chapter, an overview of sustainability, reverse logistics, and their role in achieving sustainable solid waste management is provided. This chapter will delve into the principles and practices of sustainability, explore the concept of reverse logistics, and examine their interconnectedness in promoting environmentally conscious waste management strategies. By understanding the importance of sustainability and the adoption of reverse logistics in waste management, organisations can navigate the evolving landscape of environmental responsibility while maintaining their competitiveness in the business realm.

3.2.1 Sustainability and sustainable development

According to Ozili (2022), there has been a growing interest in sustainability and sustainable development among policymakers and academicians. However, one of the main challenges faced in implementing sustainability is the lack of consistent definitions for the concept (Moore, Mscarenhas, Bain & Straus, 2017). The origin of sustainable development can be traced back to the Brundtland Report of the World Commission on Environment and Development, which describes sustainability as this present generation's ability to supply what it requires while conserving the requirements of future generations. Previous studies have suggested as many as 24 definitions for sustainability (Moore et al., 2017).

The attainment of sustainable development requires coordinated and integrated efforts from those affected directly or indirectly by the campaigns for sustainable development in the management of municipal solid waste and must acknowledge the insufficiency of natural resources. This requires dominance and a sense of responsiveness to changes related to sustainability, with a focus on dealing with concerns related to infrastructure and reducing differences in urban dwellings wherein service provision varies in different (Souza & Parente, 2020). Zheng and Bedra (2018) contend that there is need for balancing economic, environment and social dimensions, the three pillars of sustainability. Sustainable development goals therefore offer opportunities to carry research (Leal-Filho, Azeiteiro, Alves, Pace, Mifsud, Brandli, Caeiro, & Disterheft, 2018).

There are differing views regarding the magnitude of sustainability. Elkington (2021) proposes several dimensions that should be associated with people, planet, and profits, emphasising the responsibility of good ecological performance and safeguarding societal rights. These dimensions include cultural, ecological, and knowledge aspects (Santiago & Days, 2012). Khan, Dahalam and Nopiah (2019) suggest that effective and sustainable management strategies are necessary to lessen the adverse impacts of solid waste on the natural environment and human beings. They also emphasise the positive contributions of general considerations of the management of municipal solid waste on the environment, economy, and the impact on the society of sustainable development.

The literature generally agrees on three core dimensions of sustainability or sustainable development: economic, social, and environmental (Ranjbati et al., 2021; Clune & Zehnder, 2020; Kumar & Anbanandam, 2019). The UNITAR Report (2013) highlights how sustainability is enhanced in these dimensions: reducing and eliminating municipal solid waste has environmental effects by minimizing resource extraction, improving economic efficiency by reducing associated financial budgets, and providing social benefits such as healthier and more attractive human settlements, improved social amenities, employment opportunities, and poverty reduction for marginalized populations.

Recent attention has been given to sustainability and sustainable development due to the recognition of climate change, the need for renewable energy, reduced consumption and production, and greenhouse gas emission reduction (Ozili, 2022; Aven, 2020; Wackernegal, Hanscom & Lin, 2017). Human activities and their destructive effects on the environment have further emphasised the importance of sustainability (Pulgarin et al., 2015) and the availability of resources (Olawumi & Chan, 2018). Sustainability is considered interdisciplinary and complex, involving social, economic, environmental, and technological aspects (Nakamura, Pendlebury, Schnell & Szomszor, 2019). Leading institutions in sustainability research include the WHO and the London School of Hygiene, among others, demonstrating the global interest in pursuing research in this field (Bautista-Puig et al., 2021).

Differentiating between sustainability and sustainable development can be challenging as they are often used interchangeably. However, Sheeby and Farneti argue that sustainable development has transformed into the sustainability movement, and both require the participation of

stakeholders at various levels of society to achieve common goals. Local government authorities play a crucial role in developing sustainable development guidelines and adapting approaches to local characteristics, with a focus on economic, environmental, and social priorities. This entails creating structures and arrangements that accommodate the evolving needs of towns and cities, promoting sustainable management practices and investments, and emphasising the training of employees in sustainable development (Souza & Parente, 2020).

3.2.2 Sustainability and municipal solid waste management in urban areas

The management of municipal solid waste encompasses a range of approaches at procedural, governmental, and organisational levels, aiming to protect and improve the quality of urban life (Souza & Parente, 2020). Integrated urban solid waste management emphasises reducing waste at its source through activities such as recovery, reuse, recycling, reduction, and reclamation (Souza & Parente, 2020). Rapid urbanisation and economic growth have led to increased food consumption rates and subsequent growth in municipal solid waste generation (Shabani & Jerie, 2022). However, challenges related to the environment arise from the concentration of waste in urban areas without sufficient investments in public services (Santos, Teixeira & Kniess, 2014). Inadequate waste disposal leads to environmental damage and negatively impacts the quality of life for communities (Munyai & Nunu, 2020; Nedziwe & Murairwa, 2022).

The management of municipal solid waste involves objects that are disposed of in municipal communities, including household solid waste and commercial associated solid waste, handled by municipal authorities at the local level (Victor & Agamuthu, 2013). The involvement of patrons, such as civic organisations and residents, is crucial for the proper management of municipal solid waste, and education plays a significant role in achieving sustainable practices (Silva, Fugu & Santoyo, 2017). Harmonizing waste management practices and involving all stakeholders, considering the local context, is essential for effective municipal solid waste management and sustainability (Udofia, Fofil & Gutis, 2018). Municipalities should introduce waste management technologies to achieve effective waste management and sustainability (Joshi & Ahmed, 2016).

The problems connected to the growing generation of municipal solid waste, inadequate or non-existence of civic guidelines, growing populations, and their environmental impact highlight the

need for environmental awareness and sustainable development in urban areas to ensure a better quality of life and preserve the natural environment.

Campaigns for environmental consciousness are increasingly important in the business arena, and businesses and countries are persuaded to align with these campaigns for environmental consciousness. The process of managing solid waste plays a pivotal role in meeting environmental consciousness goals, and reverse logistics can enhance the process of managing municipal solid waste activities. Nevertheless, the impact of reverse logistics on waste management decisions, particularly in developing countries, remains understudied.

While many researchers have discussed the profitability of reverse logistics activities, limited research has focused on their impact on decisions related to the management of municipal solid waste. For example, the propagation of ISO 14000 requirements and compliance with the European Waste Electrical Equipment (WEE) mandate can guide a firm's reverse logistics processes (Corbett & Kirsch, 2009). The environmental component of reverse logistics may be perceived as a means of complying with existing laws rather than an opportunity for operational improvement (Huscroft et al., 2012). Companies may be motivated to adopt green logistics practices to meet consumer demands and comply with regulatory directives, which often come with financial penalties for non-compliance (Huscroft et al., 2012). Pressure from environmental organisations has prompted companies to focus on reverse logistics processes to extract value from residual products.

3.2.3 Sustainability challenges and opportunities

Malav et al., (2018) articulate that waste can be used to get renewable energy using a concept dubbed waste-to-energy (WtE) in which technology is used to produce heat and energy from waste. Srivastava et al., (2020) postulate that several environmental issues emanating from poor solid management can be reduced and these include the use of fossil fuels that generate greenhouse gases (GHGs) that eventually cause climate change and global warming. Palacio et al., (2018) advance that waste-to-energy approach to solid waste management gives clear advantages such as the substitution of landfilling waste disposal method and significantly reducing the quantities of municipal solid waste in addition to reduced environmental pollution.

Research shows that plastic is the biggest challenge that is faced in solid waste management because it lasts for long periods depending on the type, example plastic bags- 20years, plastic bottles, 450 years, fishing line 600 years (Landon-Lane, 2018; Mazhandu, Muzenda, Mamvura, & Belaid, 2020). Accumulation of vast amounts of plastic waste eventually affects the ecosystem (Mourshed, Masud, Rashi & Joardder, 2017, 2019; Paletta, Leal Filho, Balogun & Foschi-Bonoli, 2019). Improper plastic waste management systems results in soil becoming unfertile, drainage systems clogging and flooding in low-lying areas Carpernter & Wolverton, 2017; Mourshed et al., 2017). Plastic waste has recently been identified as a polluter of ocean ecosystems as well as terrestrial ecosystems (Chiba, Saito, Fletcher, Yogi, Kago, Miyagi, Ogido & Fujikura, 2018; Ng, Lwanga, Eldridge, Johnston, Hu, Geissen, & Chen, 2018) making it the biggest energy of marine life.

House-to-house collection is the most common method of solid waste collection in developed nations (Satterthwaite, 2018). Developing countries have an opportunity to learn from these success stories and implement similar solid waste collection methods. For example, the implementation of source segregation and household participation presents a great opportunity for cost reduction (Birhanu & Barisa, 2015). However, this approach requires municipalities to conduct education campaigns to educate households on proper waste management practices.

Solid waste collection poses significant challenges for governments, particularly in developing nations (Viljoen et al., 2021). Addressing these challenges requires comprehensive strategies and collaboration among stakeholders to achieve effective waste management and sustainable solutions.

3.3 Overview of reverse logistics, waste management and sustainability

The concept of reverse logistics has garnered significant attention from both the business and academic sectors, leading to various definitions being proposed. Although there have been no new definitions introduced recently, some noteworthy developments can be observed in the names used, such as Reverse Logistics 4.0 and Smart Reverse logistics (Sun, Yu & Solvang, 2022). Reverse Logistics 4.0 refers to a perspective that incorporates industry 4.0 principles into the realm of reverse logistics. On the other hand, Smart Reverse logistics is characterized as an architecture that enables the integration of systems at a high level and the utilisation of intelligent technological devices to address various reverse logistics challenges (Sun, Yu & Solvang, 2022).

These devices can include smart bins that are mechanically lifted and emptied without human intervention, thereby reducing exposure to diseases. Table 3.1 provides an overview of key propositions of reverse logistics advanced over the past three decades.

Table 3.1: Definition of Reverse Logistics

Researcher(s)	**Definition**
Leal et al., (2024)	Reverse logistics of municipal solid waste is a set of activities that stakeholders take to promote the collection and return of solid waste back the supply chain for purposes of production, reuse and proper disposal.
Alves et al., (2024.p.343)	"Reverse logistics as a means performance efficiency in urban solid waste management, refers to planning and implementing the flow of materials and information from the point of consumption to the point of origin, also including intermediate point for remanufacturing or recycling selection when necessary."
Govindan & Soleiman, (2017); Prajapati et al., (2019); Jraisat et al., (2022)	The purpose of reverse logistics is to collect end-of-life products and recapture value by means of repair, remanufacture, recycling or ensuring proper disposal.
Bhattacharya & Gopal (2024)	Reverse logistics concerns how products are handled as they go through the return process, recycling and the management of end-of-life waste for value recovery to fulfill the demands of SDG number 12.
Makarova, Shubenkova & Pashkevich (2018)	Reverse logistics can be defined by what it does in that it facilitates the shift from a linear approach to circular economy approach by closing the loop of product life cycles.
Wang et al., (2019)	Reverse logistics assists in efficiently reusing, recycling and proper disposal of waste.
Pishchulov,	Reverse logistics augments the traditional linear flow of goods in the supply

Ritcher, Pakhomova & Tsenzharik (2018)	chain by facilitating the movement of those goods from the market back the various stages in the supply chain thereby closing the loop in the flow of goods.
Geissdoerfer et al., (2017)	Reverse logistics enhances the circular economy paradigm by encouraging collection, recovery and reuse of products subsequently reducing the quantities of solid waste and preventing depletion of natural resources.

Table 3.1 shows a list of definitions of reverse logistics proposed recently by researchers and these do not reflect much diversion from those suggested about four decades about. Leal et al., (2024) alludes that reverse logistics promotes reusing end-of-life products, disposing properly and the use of waste for production. Alves et al., (2024) posit that products that are subject to reverse logistics do not necessarily go to the original manufacturer but can be used by intermediary supply chain. Govindan & Soleiman (2017) emphasise the need for reverse logistics for purposes of recapturing value and they tend to agree with Battacharya and Gopal (2024) although the later researchers further point out that reverse logistics fulfills the dictates of the 12th SDG. Makarova, Shubenkova & Pashkevich (2018) and Pishchulov et al., (2018) argue that reverse logistics is a shift from the linear approach by closing the loop of the product life cycle. Geissdoerfer et al., (2017) reiterate that reverse logistics reduces solid waste quantities and prevents depletion of natural resources.

Collectively, these meanings emphasise that reverse logistics involves the transportation of products or materials from the point where they are consumed to a location where disposal can be undertaken in a safe manner. The process of disposing of these items may involve transforming the materials into a new form that is environmentally benign.

Despite the increasing attention given to reverse logistics, it is still considered a relatively new concept, although terms such as "reverse channels" and "reverse flows" were already used in systematic literature as early as the 1970s and 1980s (Wiel et al., 2012). De Paula, de Campos, Pagani, Guarnieri & Kaviani, (2019) contemplate that reverse logistics is not an easy task as it involves other partners in the process of collecting, sorting distribution, disassembly, repairing, reusing, remanufacturing, recycling, energy recovery and proper disposal of waste. Research

highlights some of the obstacles of smooth operations of reverse logistics as lack of coordination and collaboration among supply chain partners (Plaza-Ubeda, Abad-Segura, Burgos-Jimenez, Boteva-Asenova, Belmonte-Urena, 2021), high levels of uncertainty regarding the quality and quantity of end-of-life products in the supply chain (Trochu, Chaabane & Ouhimmou, 2018) and lack of real-time information that would assit in decision making (Liu & de Giovanni, 2019; Wang & Wang, 2019). There is need therefore to properly design reverse logistics to balance the tradeoff among economic, social and environmental dictates of sustainability (de Paula et al., 2019).

Daugherty et al. (2003), posit that products often flow back up the supply chain, encountering various risks such as damage, defects, customer dissatisfaction, and lower-than-predicted demand. Companies may also face increased return issues if they have more generous customer policies or use concepts like vendor-managed inventory. Additionally, shorter product life cycles and increasingly demanding customers contribute to higher return volumes. Some industries, like the automobile industry, have incorporated reverse logistics into their strategies. For instance, automobile companies employ reverse logistics when dealing with product failures, or in the event that remanufacturing is needed, and repairing older models of cars. In such cases, productivity and efficiency are crucial for the sector to extract some value from the reverse logistics process.

3.3.1 Reverse logistics of municipal solid waste

Solid waste management is a global issue that affects countries regardless of their development status, despite increased efforts and investments in rational waste management (Mesjasz-Lech, 2018). The complexity of municipal solid waste management arises from its bearings on the social, economic, and environmental aspects of sustainability (Purwani, Hisjam & Sutopo, 2020). Each country faces unique challenges in managing solid waste, but stakeholder engagement is essential for the sustainability and viability of effective waste management operations (Mesjasz-Lech, 2018). Educating residents about the environmental impact of mismanaged solid waste and providing them with solutions aimed at establishing closed-loop systems can help solidify sustainable practices (de Vicente Bittar, 2018). This closed-loop approach, known as reverse logistics, aims to build zero-waste cities by preventing, recycling, and recovering municipal solid waste (Dziadkiewicz & Kadlubek, 2017). Coelho and Mateus (2017) emphasise that reverse

logistics is an integral part of sustainability, ensuring that solid waste is properly eliminated or processed in a socially responsible manner. By retrieving economic and ecological value from products at their end-of-life, reverse logistics reduces the volume of solid waste generated (Neto, Alvarez, Carrillo & Flores, 2016). It aims to create flows that are ecologically efficient and economically effective (Mesjasz-Lech, 2018).

Solid waste management typically involves four steps: gatekeeping, collection, sorting, and disposal (Banguera et al., 2017). Reverse logistics has gained popularity in recent years and is closely linked to concepts such as circular economy and green logistics. Research has emphasised the use of reverse logistics to change households' attitudes and behaviours, ultimately achieving successful and multicultural sustainable solid waste management (Hines, 2016). In particular, the reverse logistics of municipal hazardous waste has received significant attention due to the need for safe transportation and disposal, aligning with environmental sustainability requirements (Xin et al., 2019).

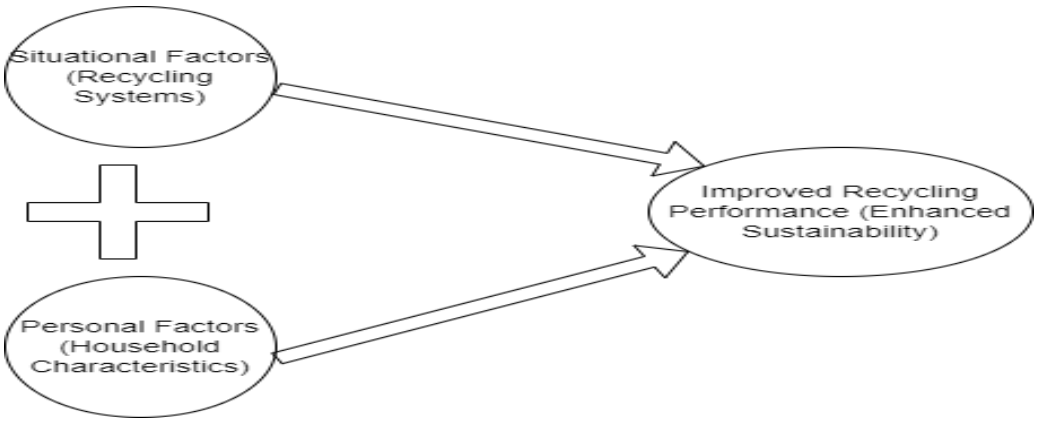

Figure 3.1: Household Solid Waste Reverse Logistics Framework (Jalil et al., 2016)

Figure 3.1 presents a framework for enhanced sustainability resulting from household solid waste reverse logistics. Despite the magnitude of this topic in municipal solid waste management, there is a lack of literature specifically focusing on household solid waste reverse logistics (Jalil, Grant, Nicholson & Deutz, 2016). Active participation of households in solid waste reverse logistics activities, such as recycling and separation, is fundamental for the achievement of waste management programs and overall sustainability. The implementation of solid waste reverse logistics activities within waste management systems can significantly

improve living standards while increasing recovering rates and minimizing the amount of waste sent to landfills.

The behaviour and attitude of households play a critical role in the success of a sustainable solid waste reverse logistics system. Jalil et al. (2016) outlines factors that are believed to contribute to the success of a sustainable solid waste reverse logistics system. Table 3.2 below illustrates these factors.

Table 3.2: Situational Factors and Personal Factors in Solid Waste Reverse Logistics (Source: Adapted from Jalil et al., 2016)

Personal Factors	**Situational Factors**
• Self-awareness • Self-efficacy • Social norms • Household dynamics • Knowledge and experiences	• Convenience • Availability • Accessibility • Engagement • Education

Factors such as knowledge, household dynamics, social norms, self-efficacy, and self-awareness influence the extent to which households actively participate in waste management practices. On the other hand, situational factors, including municipal engagement, availability and accessibility of receptacles, convenience of the system, and provision of education, create an enabling environment for households to engage in solid waste reverse logistics effectively. By considering these factors, a well-designed and implemented solid waste reverse logistics system can contribute to the achievement of a combined and sustainable waste management system.

The effective implementation of reverse logistics in solid waste management depends on the active participation of households, who play a crucial task in separating solid waste into different waste streams. This facilitates the transportation and processing of various waste types. Existing literature emphasises that the success of a well-designed reverse logistics system for solid waste management is heavily dependent on the positive behaviour and attitude of households (Jalil et al., 2016). Establishing a strong connection between situational factors controlled by the municipality and the characteristics of households is essential in designing a municipal solid

waste reverse logistics system that aims to reduce overall waste quantities transported and promote reverse activities such as recycling and reusing end-of-life materials.

3.3.2 Household level of participation in solid waste management

The level of involvement by households in solid waste management varies between developed and developing countries, with higher levels observed in developed countries (Banerjee & Sarkhel, 2019). In developing countries, regulatory authorities are responsible for sorting and separating solid waste once it is collected from households, which poses challenges due to the mixing of waste by households prior to collection. Another notable distinction between developed and developing countries is the selection of technology for solid waste management.

Figure 3.2 presents the proposed pathway of solid waste reverse logistics (Abdissa et al., 2022). The diagram illustrates the participation of end-users, patrons, and the waste management process on the left side. The middle section highlights the legislative part and policies related to solid waste management within authoritative bodies. On the far-right side, the interests of the entire solid waste reverse logistics process are depicted. The system considers solid waste as a valuable resource that can be utilised, such as recycling empty plastic bottles to reduce raw material costs, create jobs, and improve environmental sustainability (de Oliveira & Luna, 2019).

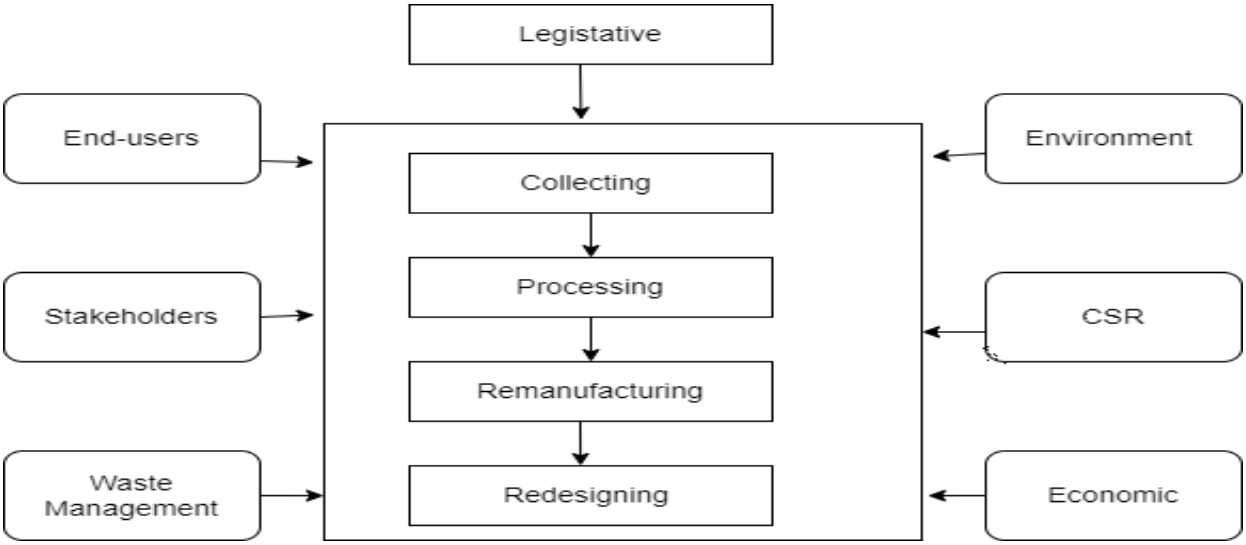

Figure 3.2: Pathway of Reverse Logistics in Recycling Solid Waste (Abdissa et al., 2022)

3.3.3 Economic and social benefits associated with reverse logistics

The adoption of technology, innovation in sustainability (Omri, 2020), and entrepreneurship (Filser et al., 2019) brings numerous benefits such as advancements in transportation, medicine, and production (Szopik-Deepczynska et al., 2018a). Entrepreneurship has become a driving force for economic development (Lope-Rubio et al., 2020, 2021). However, it is crucial for companies to observe guidelines, principles, and statutes set by government and local authorities, such as municipalities, in order to maintain profitability. Failure to adhere to proper waste disposal procedures can result in penalties and reduced profits.

Gatekeeping and prevention strategies are integral components of reverse logistics and returns management (Banihashemi et al., 2019). The prevention aspect focuses on reducing the quantity of returned materials by ensuring product quality and establishing good relationships with end users. For example, promoting products intended for a specific season during an inappropriate time may lead to a high rate of returns. Proper gatekeeping allows management to monitor and reduce the number of product returns without compromising customer service (Genchev et al., 2011).

In developing countries, informal solid waste collectors play a crucial role by gathering and collecting approximately 20% of the solid waste produced, earning income from sifting through the waste (Siddharth, 2019). Effective gatekeeping involves making judgments to restrict the quantity of products allowed into the reverse logistics process. In situations where shipping back a product would result in a significant loss, finding alternative buyers at reduced prices becomes a more economically viable option.

The Reverse Logistics Council (RLEC) reports that handling costs for returned products in the United States alone amount to $35 billion per year, equivalent to 0.5% to 1% of the total US Gross Domestic Product (GDP). This estimation does not include disposal costs, time spent on managing and controlling returns, and converting wasteful returns into assets. With the growing trend of online sales and returns, the volume of reverse logistics movements continues to increase. For instance, during the Christmas season of 1999, online retail sales in the US reached $5 billion, with a return rate of 12% within two months (Bizrate.com, 2000).

According to Daugherty et al. (2003), reverse logistics costs in the United States exceed $35 billion, and the average percentage of items returned is around 6% of sales, although it can differ

conditional to the product category and industry. Sectors such as the book industry, mail order, and greetings cards experience higher return rates. Given the significant number of customers involved in the return process, businesses should prioritize effective reverse logistics management. Understanding the costs associated with reverse logistics, taking appropriate actions based on this knowledge, and making it a top business priority are essential steps.

Tan and Kumar (2006) suggest that the increased adoption of technology and environmental concerns have elevated the significance of logistics. Reverse logistics serves to promote environmental awareness and addresses the need for recycling, sustainable manufacturing processes, and end-of-life management of products. Green supply chain management, often used interchangeably with environmental sustainability, integrates environmental reflections into supply chain management from product design to after-life management (Srivastava, 2007; Sarkis, 2003; Nikbakhsh, 2009). Reverse logistics plays a vital role in managing returns and waste in supply chains. The adoption of technology, environmental awareness, and entrepreneurial efforts contributes to its growing importance. Preventing unnecessary returns, understanding the costs involved, and prioritizing relationship management are critical for effective reverse logistics operations.

3.3.4 General characteristics of reverse logistics

Pena-Montoya, Bouzon, Torres-Lozada and Vidal-Holguin (2020) point out that sustainable solid waste management (SSWM) can effectively be supported by reverse logistics. Features of reverse logistics are best described by activities that take place in the process such as gatekeeping, collection, inspection and sorting (Banihasheni, Fei & Chen, 2019). The same authors differentiate forward logistics from reverse logistics by claiming that forward logistics involves activities that bring products to the customer whereas reverse logistics deals with actions that facilitate the movement of products from the end user back the supply chain for purposes of recapturing value. Reverse logistics is commonly utilised by firms that use various materials such as glass, metals, plastics, and paper for packaging purposes (Jonsson, 2008). For instance, in the beverage industry, empty bottles are collected when new orders are delivered, to reduce deadload in trucks during their return to distribution points. This process continues through some if not all of the partners in the supply chain till the containers reach the facility of manufacture.

However, it is important to note that reverse logistics systems often lag behind forward logistics systems. This can be attributed to factors such as the need for additional space to accommodate returned products and the utilisation of transportation services for trucks on their return trips. Sorting returned products can also be resource-intensive and not always feasible. The varying degrees of reverse logistics implementation across countries can be attributed to different approaches to waste recovery processes.

The interest in reverse logistics has grown due to the recognition that discarded materials can still hold value through recycling and reusing, while also addressing environmental concerns associated with solid waste (Lysons & Farrington, 2006). With the increasing number of products being returned in the supply chain and the growing environmental campaigns within society, companies face the challenge of managing larger quantities of returned products (Swink et al., 2011). Online purchases and the rise of leasing contracts have contributed to the significant increase in product returns, with figures as high as 50% of all electronic transactions being returned. Hazardous products may be found among the products that are returned, necessitating careful handling, proper packaging, and appropriate disposal or salvage procedures.

Reverse logistics performs a fundamental task in managing the return of materials and products, particularly in industries where packaging materials are extensively used. The optimization of reverse logistics processes and the integration of sustainable practices are essential for effective waste management and environmental stewardship. From a behavioural intentions theoretical perspective (Figure 3.3), attitude towards a behaviour is regarded as a contributor to the acceleration of littering (Viljoen et al., 2021). Empirical evidence shows that the theory of planned behaviour (TPB) exhibits strong prediction and realistic interpretation of individual behavioural intentions (Kuang & Lin, 2021; Lou et al., 2022). Research centred on recycling of solid waste has now adopted TPB as a tool for predicting behaviour (Wang et al., 2018; Zheng et al., 2019; Pei et al., 2019; Peng et al., 2021)

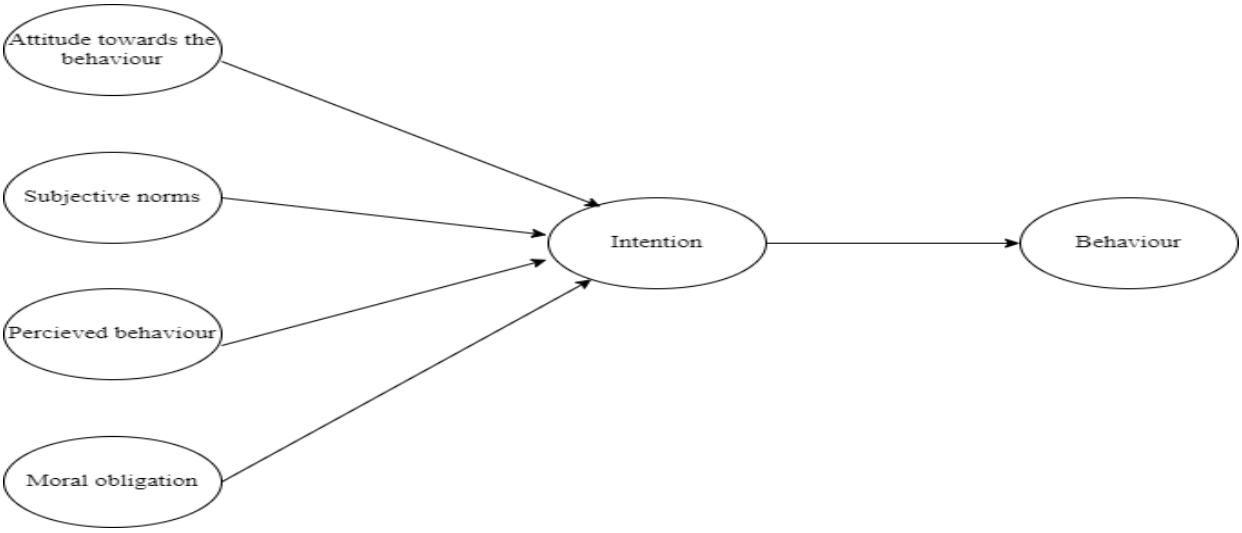

Figure 3.3: Theory of Behavioural Intentions (Viljoen et al., 2021)

3.3.5 Types of solid waste generated by households

The moment a product has no more useful value to the user, it is referred to as waste and the most notable method of getting rid of it is disposal (Grant et al., 2013). The generation of waste can occur at different stages, ranging from mining of raw materials to the consumption of the final product. Waste is generally classified into three categories: matter that can be used as compost, items that can be recycled, and items that are no longer useful (Annepu, 2012). Compostable waste includes food, biodegradables, vegetable market waste, and yard residue like leaves and grass. On the other hand, recyclable items encompass paper/cardboard boxes, plastics, metal, and glass containers. Inert waste refers to items that cannot be effectively utilised and remain in their original state, such as stones, ash, and construction rubble. To manage solid waste effectively, source separation is considered a crucial step (Samah et al., 2013).

The rate at which solid waste is generated in Sub-Saharan Africa surpasses the rate at which solid waste is collected (Bowan & Tierobaar, 2014; Ogwueleka, 2009). Various sources contribute to waste, including households, commercial areas, marketplaces, government workplaces, industries, and healthcare facilities (Kaseva & Mbuligwe, 2005). Waste generation in East African countries is positively correlated with disposable income, where individuals with higher earnings tend to generate more waste compared to low-income earners (Kibwage, 2002). For instance, low-income earners produce an estimated 0.22 to 0.3 kg of waste per capita per

day, while high-income earners generate between 0.66 and 0.9 kg per capita per day (EWAG, 2008; Okot-Omuku, 2008; Scheinberg et al., 2011).

Individuals with higher disposable income have a tendency to purchase a wide range of commodities, leading to an increase in associated waste, such as extra containers and boxes (Okot-Okumu, 2012). This aligns with Scheinberg's (2011) observation that there is a link between the total quantity of solid waste generated within urban councils and the national gross domestic product (GDP) per capita.

3.3.6 Types of receptacles used by households

At the household level, receptacles are employed for the storage of municipal solid waste before collecting, transporting, sorting, and correct disposal by responsible authorities (Musademba et al., 2011). A study carried out by Musademba et al. (2011) in Chinhoyi town, Zimbabwe, found that the most commonly used receptacles included polythene bags, propylene sacks, metal bins, plastic buckets, boxes, and plastic bags. In some cases, households resort to digging pits within their yards to bury solid waste.

Trash cans, typically made of plastic or metal, serve as receptacles for general household solid waste. They vary in size based on individual needs. Hazardous waste containers are specifically designed for holding hazardous waste until proper disposal can be arranged. These containers accommodate various types of hazardous waste, such as cleaning materials, batteries, and paint. Compost bins, on the other hand, are used for collecting biodegradable materials like food scraps and yard trimmings, which are then utilised for composting purposes. Compost bins can be constructed from different materials, including plastic, and are available in various sizes.

3.3.7 Knowledge and attitude of households on municipal solid waste management

Chung and Lo (2014) point out that even though governments provide infrastructure for municipal solid waste management, understanding public concerns, knowledge, preferences and behaviours is essential to achieving integrated municipal solid waste management. Understanding factors that influence the behaviour of households is vital for persuading the participation of citizens in solid waste management. These factors include knowledge, attitudes and practices (KAP) (Byrne & O'Regan, 2014; Pakour et al., 2014; Pearson et al., 2012). In De Feo and De Gisi's (2010) opinion, educating the public, and encouraging the public to participate

in the design of recycling of household solid waste, is the most cost-effective way of reducing household municipal solid waste. Familiarity, awareness, and/or understanding facts about a community in addition to experience, perception, and/or learning through discovery, is important in solid waste management (Babaei et al., 2015). According to Muiruri et al. (2020), attitude represents a state of mind and alertness toward something, which influences behaviour and significantly shapes an individual's thoughts and reactions. Attitude, as defined by Monoh and Oladebeye (2010), refers to the values and feelings that individuals acquire as a result of their concerns about something. Babaei et al. (2015) prefer to define attitude as the community of thought which has settled and become a way of thinking displayed by an individual or group about something. Attitude evokes feelings and emotions, which explains why people respond differently to similar situations. Sujauddin et al. (2008), as cited in Fadullah et al. (2022), highlight that factors such as family size and income play a role in influencing the effectiveness of solid waste management. Conversely, Ekere et al. (2009) suggest that the level of education and the location of the household are contributing factors in effective solid waste management. Practices refer to the actions that an individual or community display based on the knowledge and attitudes possessed by that individual or community, and ultimately, these two (knowledge and attitude) determine the behaviour of an individual or society (Babaei et al., 2015). Minimisation of the generation of municipal solid waste is the best way of dealing with municipal solid waste (Farrelly & Tucker, 2014; Koolivand et al., 2014).

3.3.8 Problems of poor solid waste management

Several problems arise because of poor management of municipal solid waste, including the blockage of sewage and drainage systems, air pollution from smoke emitted during waste burning, land pollution, and water pollution caused by chemicals from illegal dumping of solid waste. Governments, especially those in developing countries, face significant challenges in managing solid waste (Viljoen et al., 2021). Mihai and Taherzadeh (2017) highlight that limited financial resources make it difficult for local government authorities, particularly in rural and remote areas, to manage solid waste effectively. This financial constraint leads to littering and illegal dumping by residents who become impatient when waste is not collected on time (Viljoen et al., 2021). Estoque (2020) points out that there is an association between global premature

deaths caused by environmental diseases and improper municipal solid waste practices by households.

Visible dumping of solid waste on the ground at designated collection centers is a clear sign of poor solid waste management (Atkinson et al., 2019). Residents resort to this practice when municipalities fail to adhere to waste collection schedules within residential areas. The dissatisfaction of residents with poor waste management practices leads to indiscriminate refuse disposal (Francis-Xavier, 2018). Additionally, water sources like streams and rivers are adversely affected by improper solid waste management (Odonkor, Frimpong & Kurantin, 2020). One of the challenges associated with municipal solid waste is the long degradation time, especially for materials like plastic, which can take up 600 years to disintegrate even under harsh weather conditions (Landon-Lane, 2018; Mazhandu, Muzenda, Mamvura, & Belaid, 2020). Institutions and households generate solid waste that has substantial effects on the environment (Moqbel, 2018). A mixture of different types of solid waste produces odor and results in leachate which moves to water bodies (Muhammad et al., 2020). Poorly managed solid waste creates an environment conducive to the proliferation of water-borne diseases, such as cholera, diarrhea, typhoid, and malaria, carried by bacteria (World Bank, 2011; Osei et al., 2010; UNEP, 2009).

This section dealt with the link between reverse logistics, solid waste management and sustainability. Reverse logistics involves the movement of goods back to the supply chain for the purpose of extracting value from products. Municipal solid waste management supports sustainability, whose pillars are economic, social and environmental, within which job creation is enabled (Siddharth, 2019). The introduction of the reverse logistics concept in municipal solid waste management is to change the attitude of households and support sustainable solid waste management (Vidal-Holguin, 2020). Knowledge, attitudes and practices of households in municipal solid waste management are pivotal to achieving integrated municipal solid waste management. Understanding public knowledge, attitudes and practices is key to integrated solid waste management (Chung & Lo, 2014). Attitude refers to the state of mind (Muinuri et al., 2020), and practices refers to actions displayed by an individual or community (Babaei, 2015). The effect of solid waste generated by households on the environment is substantial (Moqbel, 20158). The level of household participation in municipal solid waste management differs from one country to the other (Banerjee & Sarkhal, 2019).

3.3.9 Key takeaways of reverse logistics, solid waste management and sustainability

Reverse logistic 4.0 refers to the perspective that incorporates principles of industry 4.0 into the realm of reverse logistics (Sun, Yu & Solvang, 2022). Latest definitions suggest reuse and production (Leal et al., (2024), recapturing value (Govindan & Soleiman, 2017; Prajapati et al., (2019); Jraisat et al., 2022), fulfillment of SDG number 12 (Bhattacharya & Gopal, 2024), closing the linear approach of supply chain (Makarova, Shubenkova & Pashkevich, 2018), and reducing waste quantities as well as slowing down the rate of depleting natural resources (Geissdoerfer et al., 2017). Reverse logistics is a complex phenomenon that requires holistic approach on the dimensions of sustainability (Purwani, Hisjam & Sutopo, 2020). Household participation levels in solid waste management differs between developed countries and developing countries with higher levels being observed in developed countries (Banerjee & Sarkhel, 2019). Innovation and entrepreneurship opportunities exist within solid waste management (Omri, 2020; Filser et al., 2019). Banihashemi et al., (2019) propose that gatekeeping is an integral component of reverse logistics as it helps in reducing quantities that go back the supply chain. It is important to recognise and categorise solid waste into different streams as different receptacles are required. The importance of the attitude of households is critical in municipal solid waste management. Muiruri et al. (2020) postulate that attitude represents a state of mind and alertness toward something, which influences behaviour and significantly shapes an individual's thoughts and reactions.

3.4 The perception of households on solid waste reverse logistics and municipal solid waste management for sustainability

The concept of attitude, as defined by Ajzen and Fishbein (1980), refers to the feelings of favourability or unfavourability that individuals or groups hold toward a particular concept. Zelenzny (2000) emphasises the incorporation of environmental concerns in influencing the perception and attitude of individuals, where the depth of connection to the concept determines the level of attitude. According to Ajzen (1991), attitudes act as antecedents to behavioural intentions, which in turn influence human behaviour based on the perceived favourability or unfavourability of the concept. Positive attitudes toward a behaviour enhance the strength of the intention to perform that behaviour (Ajzen, 1991). Ifegbesan (2010) and Kumar (2012) agree that

attitudes play a significant role in shaping residents' intentions and behaviour related to solid waste management. Their attitudes serve as predictors of their behaviour in this context.

Bernstein (2004) argues that awareness campaigns and education are crucial in informing the public about the negative impacts of poor solid waste management. Such initiatives help residents understand their responsibilities and rights concerning waste management and the services provided by municipalities. In Malaysia, a study by Goh, Tong and Ahmed (2013) found that residents' attitudes have a moderating effect on their intention to recycle solid waste. Therefore, a comprehensive and effective integrated solid waste management system should consider the attitudes and perceptions of residents as active participants in its implementation.

3.4.1 Perception of households on solid waste recycling

Various research approaches have been employed to investigate households' perception of municipal solid waste management. Amini et al. (2014) utilised the Theory of Reasoned Action, while Ozteken et al. (2017) applied the Theory of Reasoned Behaviour (TRB). Shigeru (2011) conducted a study to identify household characteristics and recycling behaviour. Abas et al. (2020) found that inadequate knowledge about the importance of waste segregation and improper handling practices contributed to solid waste mismanagement. Kamruddin et al. (2016) conducted waste characterization research but did not cover aspects such as household knowledge, attitudes, and practices related to solid waste. Building on Emery et al.'s (2003) findings on the socioeconomic status of households as a factor influencing solid waste management, Fadullah et al. (2022) focused their study on aligning their findings with Sustainable Development Goal (SDG) 3 (Good Health and Well-being) and SDG 12 (Responsible Consumption and Production).

3.4.2 Perception of households on paying for solid waste

Alzamora and Barros (2020) define pay-as-you-throw as an approach in which solid waste is charged on the basis of the quantities of solid waste generated individually. Willingness to pay-as-you-throw (PAYT) is a concept introduced by municipalities to solve the problem of ‘besieged city’ (Meng et al., 2018; Meng et al., 2019). The strategy of this concept is not only to reduce municipal solid waste from its source, but also to improve the efficiency of recycling municipal solid waste (Tong et al., 2020; Bergeron, 2017; Agamuthu, 2011). Yao and Zhou

(2023) contend that the PAYT approach makes residents conscious of the ‘polluter pays’ concept thereby presenting positive behavioural incentives for residents to reduce the generation of municipal solid waste. PAYT has proven to be effective in that it stimulates solid waste separation and reduction at source (Carattini, 2018; Alzamora & Barros, 2020; Sasao et al, 2021; Zhang et al, 2022; Valente, 2023). Although the fixed fee charging approach is advantageous in that it offers residents lighter economic burdens, is easy to supervise and simple to process charges (Chen & Cai, 2017; Xue & Fan, 2017), it is also associated with inefficiency of solid waste management and burdens governments heavily (Xiao et al., 2020; Zhang et al., 2022). Zhang, Ma and Du (2023) postulate that PAYT has gained global adoption including countries like United States, Germany, Italy, Sweden, Japan, Netherlands and Korea.

The willingness-to-pay (WTP) for waste management services and facilities performs a crucial part in the accomplishment of the management of municipal solid waste programs (Suleman et al., 2015). The efficacy and productivity of solid waste management strategies are directly influenced, positively or negatively, by residents' willingness-to-pay (Rahman, Salequzzaman, Bahar, Uddin, Islam & Hrun, 2005). In a study by Linderhof, Allers and Wiersman (2001) cited in Suleman et al. (2015), a model for charging households, known as weight-based pricing, was proposed. This model was implemented in Oostzaan, Holland, where the price charged included the direct resource cost along with an additional component for external environmental costs. However, Longe and Ukpebor (2009) criticized this model, stating that it is challenging to accurately establish the volume of solid waste generated by households, making it difficult to implement in developing countries. Zhang, Ma and Du (2023) point out that policy design and application of the PAYT approach is a challenge.

Previous research on willingness to pay focused on factors that influence waste disposal (Yeung & Chung, 2018; Li et al, 2018; Han et al 2019; Chung & Yeung 2019), and determinants of the classification effect and behaviour (Xiao et al., 2020; Luo et al., 2020; Li et al., 2020). Zhang et al. (2023) contend that some research has focused on the analysis of the introduction of policies on the basis of social needs and how acceptable a policy would be by the public. This is regarded as important because such research can guide local governments and policy makers in the most practical and feasible ways by suggesting solutions that are current and work.

3.4.3 Perception of households on separating solid waste at source (Household level)

The separation and sorting of municipal solid waste before final disposal plays a crucial role in the recovery of reusable, recyclable, and repairable materials (Muirui et al., 2016). Source separation of waste not only facilitates the recovery of important materials but also prevents the disposal of valuable and reusable materials. According to Mafume et al. (2016), households' perception and attitude towards solid waste management are influenced by their non-participation in waste management programs, which in turn affects their willingness to practice waste separation at the household level. Perception, as a primary cognitive process, is essential for acquiring knowledge (Suleman, Simon & Richard, 2015). Mariwah, Kendie and Dei (2010) argue that knowledge, values, beliefs, norms, and resources all play a role in shaping human perception, although they also note that perceptions can sometimes be formed without prior knowledge of the subject matter.

Research points out that waste segregation is lacking in emerging nations such as Africa (Dlamini, Rampedi and Ifegbesan, 2017) and Asia (Vassanadumrongdee and Kittipongvises, 2017). A slightly different observation was reported by Burdeos and Amarille (2023) who said that even though participants in Butaan City participated in waste segregation, levels of recycling were low. Fadhullah et al. (2022) suggest that there is still room to promote segregation practices in urban areas. Shaira, Ismail, Zeena, Arooj, Shreya, Shafir and Nazeer (2020) conducted a study to assess the knowledge, attitude and practices of households in Karnataka District, India. They found out that the majority of respondents had knowledge about the types of plastics, sources of plastics and impact of single use plastics, even though a minority did not know that plastics cause global warming. In addition, respondents in that study revealed that they were willing to replace plastics, and some used non-plastic bags for their shopping. Abas, Yusoh, Sibly, Mohamed and Wee (2020) contend that lack of knowledge of the importance of separating waste and proper solid waste handling cause inefficiency in solid waste management. Knowledge, attitudes and practices in the management of solid waste are key to efficient solid waste management and the culture of segregating waste must start from homes where the young generation can be taught the importance of solid waste management (Abas et al., 2020). Usoh, Tom, Orji, Edet and Sampson (2023) conducted a study in Uyo Metropolis to establish the perception of households on effective solid waste management. They discovered that only a minority of those who participated segregated solid waste at their homes while the majority of

respondents did not segregate solid waste at their homes. Stoeva and Alriksson (2017) postulate that segregating solid waste at source reduces the quantities of solid waste that eventually go to landfills while not doing so reduces or completely eliminates other municipal solid waste options such as composting and recycling.

3.4.4 Improper methods used by households when dealing with solid waste

Improper waste disposal in densely populated residential areas can be ascribed to a lack of knowledge and poverty. It is a common sight to witness waste being dumped in drains or along roads, sometimes obstructing the movement of vehicles. Taiwo (2009) highlights a concerning behaviour observed in Nigeria, where residents openly urinate along highways during the daytime. Individuals who dispose of solid waste in unauthorized and undesignated areas often do so away from their own residences or areas where their neighbors live. They disregard the consequences that their actions may have on their neighbours when they eventually build structures in those locations. Furthermore, they may show indifference towards the presence of human urine until the smell becomes noticeable in their vicinity.

3.4.4.1 Open dumping

Dumping refers to the practice of depositing large quantities of solid waste in inappropriate locations (Viljoen et al., 2021). Open dump sites pose significant environmental hazards, leading to the degradation of natural resources and pollution of the environment (Yazdani et al., 2015). Residents engage in indiscriminate dumping of waste in any available open space, often preferring to do so at night when they are less likely to be seen. This practice is prevalent in many developing countries due to limited resources for proper waste collection, treatment, and disposal. It is considered a fast, cost-effective method of reducing municipal solid waste, but it is an unsustainable practice that results in environmental contamination and the spread of diseases (Ferronato & Torretta, 2019). Open burning, another common practice, has various negative environmental impacts, including visual impairments, air pollution, odour, greenhouse gas emissions, vector-borne diseases, and surface and groundwater pollution (Ferronato & Torretta, 2019). Developing countries face the challenge of open dumping due to its perceived cost-effectiveness, although residents may not be aware of the potential breeding grounds for disease-carrying organisms created by these dumping sites (Fadullah et al., 2022). Additionally, open

dumping exposes surrounding areas to water and air pollution (Choon, Tan & Chong, 2017; Fauziah & Agamuthu, 2012).

3.4.4.2 Open burning

Open burning refers to the process of heating and burning materials that produce fumes openly into the atmosphere (New Hampshire Department of Environmental Services, 2013). In low-income countries, open burning is often observed as an illegal method of municipal solid waste treatment implemented by residents as a final disposal system (Ferronato & Torretta, 2019). This practice involves burning non-biodegradable waste such as plastics, wood, hair extensions, and paper. The burning and unrestrained combustion of waste from municipal areas, building sites, agrarian occupations, and other causes have gained attention due to their environmental impact (Park et al., 2013).

Figure 3.4: Burning litter in a drum (Photograph by Author)

During open burning, carbon dioxide and other harmful particles are released into the air, posing health risks such as cancer, birth defects, and respiratory challenges (Lemieux et al., 2004; Israel, 2006/7). In Mumbai, India, approximately twenty-two thousand tonnes of pollutants are discharged into the atmosphere annually through the open burning of solid waste in open spaces or landfills (Annepu, 2012). Official dumpsites can also contribute to open burning through chemical reactions among different types of waste, or by informal waste collectors scavenging the area (Annepu, 2012). Pollutants emitted from open burning incorporate sulphur dioxide

(SO2), particulate matter (PM), nitrogen oxides (NOx), hydrocarbons (HC), and carbon monoxide (CO). Since open burning occurs at ground level, it directly affects the air quality in the surrounding area, increasing the exposure of nearby residents to these pollutants (Annepu, 2012).

Open burning, as defined by Kumar et al. (2017) and Cogut (2016), involves the combustion of rubbish in containers, open-air ovens, ditches, heaters, or hearths in an uncontrolled manner and at low temperatures. Residents resort to open burning when there is inconsistent or no solid waste collection provided by local authorities. However, the smoke emitted from open burning poses risks to citizens, with vulnerable groups such as the elderly, children, and individuals with sensitive respiratory systems being particularly affected (Kumar et al., 2017). The smoke from open burning can cause short-term effects such as nausea, headaches, and rashes, and in the long run, it has been associated with heart diseases.

As indicated above, the fumes generated by open burning contain various contaminants, including hydrochloric acid, sulphur oxides, nitrogen oxides, mercury, furans, dioxins, arsenic, lead, and carbon monoxide. Exposure to dioxins and furans has been linked to liver-related challenges, certain cancers, and destruction of the immune system. Air pollution resulting from the release of hydrogen fluoride, another byproduct of open burning, is associated with cancers of the liver, pancreas, and larynx (Ncube et al., 2017; Ancona et al., 2015). These contaminants pose significant health risks to individuals exposed to the fumes from open burning.

3.4.4.3 Burying

Burying litter as a form of municipal solid waste disposal is indeed a global issue that has detrimental effects on the environment, social life, and economic sustainability (Gupta et al., 2015; de Souza et al., 2017). When residents opt for burrowing and burying solid waste, it leads to significant environmental pollution. The burial of solid waste releases gases into the air, underground water, and soil, contributing to pollution and environmental degradation.

One of the gases produced during the decomposition of buried waste is methane, which is classified as a greenhouse gas. Methane has a significant impact on global warming and climate change. By burying solid waste, residents unintentionally contribute to the increase in greenhouse gas emissions, further exacerbating the environmental consequences.

Additionally, burying solid waste limits the potential land use options. Once waste is dumped and buried extensively, the land becomes unsuitable for any other purpose. This restriction on land use can have long-term implications for urban planning, infrastructure development, and overall economic sustainability.

It is unarguable that burying solid waste as a means of disposal has far-reaching environmental implications, including air, water, and soil pollution, as well as the contribution to greenhouse gas emissions. It is thus important to promote more sustainable and efficient waste management practices to mitigate these negative impacts and work towards a more environmentally friendly and economically viable approach.

3.4.5 Barriers to solid waste segregation at source (Household level)

The barriers to recycling at the household level highlight various factors that contribute to the lack of participation in local recycling programs (Babazadeh, Nadria, Masaferi and Allahverdipour, 2018; Kattoua, Al-Khatib and Kontogianni, 2019; Kushwash, Gokarn, Ahmed and Pant, 2023). These barriers include:

1. Lack of awareness on the process of separation and storage: Many households may not be aware of how to properly separate and store recyclable materials, leading to confusion and a lack of participation. Research shows that lack of awareness is different from lack of knowledge in that citizens who lack awareness are at the lowest level and do not even know that waste separation is important.
2. Lack of information on the process of separation and storage: Similar to the previous point, inadequate information or education about the recycling process can hinder households from effectively participating in recycling initiatives. The mandate to provide citizens with information on the separation of solid waste lies with municipalities.
3. Lack of knowledge on waste segregation process: Some households may lack knowledge about the specific requirements for segregating different types of waste, making it challenging for them to participate in recycling programs. This differs from lack of awareness in that people know that it is good to separate solid waste, but they do not know how to do it.

4. Lack of encouragement from local government authorities: When local government authorities do not actively promote or encourage recycling initiatives, households may be less motivated to participate. Encouragement takes many forms such as providing feedback on milestones achieved, including statistics on volume reductions and disease avoidance as a result of properly separating solid waste. This gives citizens some motivation to do the correct thing, which is separating solid waste.
5. Lack of official programs for recycling: If there are no formal recycling programs established in the community, households may not have the necessary infrastructure or resources to recycle their waste.
6. Limited availability of facilities in the municipal area or nearby: Inaccessible or limited recycling facilities within the municipal area or in close proximity to households can act as a barrier to participation. When residents separate solid waste and because of lack of sufficient space the separated waste ends up mixed, they see no reason why they should do the process in the first place.
7. Limited capacity of existing segregation process: If the existing segregation process is not well-equipped to handle the recycling demand, households may perceive their recycling efforts as futile. After separating waste, households would be expecting to see ongoing processing of solid waste, but if they witness waste collectors mixing waste, they resent their efforts and stop separating.
8. Lack of time for separation: Recycling may require additional time and effort for proper segregation and storage, which can be a challenge for households with busy schedules or other responsibilities. If separation is not done promptly, doing it later becomes a challenge because of lack of time, especially for the working class.
9. Demanding process of separation and storage requiring a lot of effort: When the process of separating and storing recyclable materials is perceived as too demanding or labour-intensive, households may be deterred from participating.
10. Recycling (segregation and storage) is not considered a necessary process: If households do not view recycling as an essential or important process, they may prioritize other activities over recycling efforts.

Addressing these barriers requires a multi-faceted approach involving awareness campaigns, education, infrastructure development, and policy interventions to promote and facilitate recycling at the household level.

3.5 Observation and level of satisfaction of households with municipal authorities

The satisfaction of residents with the services provided by municipalities plays a crucial role in their behaviour towards solid waste management. Municipalities offer various services related to the process of managing municipal solid waste, including collecting, transporting, sorting, composting, education, and final disposal. These are explained further below. The argument posited is that if residents are satisfied with the services provided by municipalities, they are more likely to actively participate in waste separation, recycling, and other waste reduction practices. On the other hand, if residents are dissatisfied with the services, they may be less motivated to engage in responsible waste management behaviours and may resort to improper disposal practices. Therefore, it is crucial for municipalities to continuously evaluate and improve their solid waste management services to meet the expectations and needs of residents.

3.5.1 Role of local authority in solid waste management

Integrated solid waste management falls under the accountability of local municipal authorities (ElSaid & Aghezzaf, 2017; Rigamonti, Sterpi & Grosso, 2016; Topic & Biadermann, 2015; Rada et al., 2014). These authorities are responsible for various aspects of solid waste management, including collecting, transporting, treatment, disposal, and education outreach. Globally, to improve the management of municipal solid waste, several policies, guidelines and regulations have been promulgated and enacted (Pheakdey, Quan, Khanh & Xuan, 2022). Sarkodie and Owusu (2021) point out that it is the responsibility of the government to promote the 3Rs (reduce, reuse and recycle), a technique whose success largely depends on the participation and awareness of solid waste generators. The role of the national authority (government) is to develop legislation, design policy, capacitate local authorities, and monitor and supervise municipal solid waste management. The primary role of local authorities, with support from provincial authorities, is the collection and transportation of municipal solid waste from its sources of generation, such as households, to designated treatment facilities (UNDP, 2019). In addition to their operational responsibilities, local government authorities have an important

mandate to educate residents regarding the risks linked to mismanagement of municipal solid waste. They recognize that not all residents are aware of the potential dangers, and therefore it is crucial to provide education and awareness programs. These programs aim to inform residents about proper management practices of municipal solid waste and the likely environmental and health implications of improper waste disposal.

By assuming accountability for integrated solid waste management and engaging in educational efforts, local municipal authorities perform a critical part in encouraging sustainable and environmentally sound waste management practices within their communities.

3.5.1.1 Incineration and landfilling

A landfill is a legally designated area specifically designed for the purpose of disposing of solid waste generated from municipal activities (Khor & Udin, 2013; Kinobe et al., 2015). It serves as a controlled and separated site where solid waste is buried, taking into consideration environmental concerns. Landfills are typically considered as the final alternative in the reverse logistics practices of waste management. In cases where products cannot be recycled or treated through other methods, they may be incinerated or placed in landfill sites. This is often due to the limited capacity of existing waste disposal facilities.

Monzambe, Mpofu and Daniyan (2021) argue that landfill location decisions are largely dependent not only on economic factors, but also on environmental and social factors. Hailu, Hanchiso and Bereta (2019) point out that landfill space is finite and its distance from residential and commercial places is crucial. The same authors indicate that a host of problems associated with landfill sites that are close to residential places include decrease in value of properties, health problems, odours, noise and animals that scavenge. These measures aim to mitigate potential odours, emissions, and other environmental impacts associated with landfill operations.

3.5.1.2 Composting

Composting, as defined by Hoorweg, Thomas and Otten (2000), is a biological process that involves the use of microorganisms to accelerate the decomposition of organic materials, transforming them into humus. The primary objective of composting is to produce a nutrient-rich soil amendment that can enhance soil fertility.

The technologies and scales employed in composting can vary widely, as highlighted by Lohri et al. (2017). Different methods such as windrow composting, vermicomposting, and in-vessel composting may be utilised depending on the specific context and available resources. Regardless of the technique used, composting offers several benefits. It offers an effective and sustainable approach to organic waste management, resulting in reduced costs, decreased pollution, and the production of valuable bio-fertilizer.

Figure 3.5: (a) Windrow and (b) Vermicomposting

Windrow composting is a method of composting that involves the arrangement and maintenance of organic waste in long, narrow piles called windrows. As mentioned by Annepu (2012), windrow composting relies on aerobic decomposition, which occurs in the presence of oxygen. This method is commonly used at the household level and in agriculture for processing substantial amounts of organic solid waste.

In windrow composting, biodegradable materials such as food waste, crop residues, and animal manure are stacked in rows, allowing for the natural breakdown of organic matter. The windrows are periodically turned to provide aeration, promote microbial activity, and facilitate the decomposition process. Through aerobic digestion, the organic waste is gradually transformed into compost, a nutrient-rich material that can be used to improve soil fertility.

Vermicomposting, also known as vermiculture, is another composting method, as mentioned by Annepu (2012). Vermicomposting utilises different species of worms, such as red worms (Eisenia fetida), to accelerate the decomposition process. The worms consume organic waste,

breaking it down and producing nutrient-rich castings, also known as vermicast or worm castings. These castings are highly beneficial for soil health and plant growth.

Composting offers several advantages over other waste management methods. Hoornweg and Bhada-Tata (2012) insist that composting is a cost-effective approach compared to alternatives like incineration, which require expensive infrastructure such as incinerators. Composting also helps divert organic waste from landfills, lowering the necessity for landfill space and minimizing greenhouse gas emissions.

Additionally, composting provides a valuable end-product that can be used as a soil amendment. The compost produced through this process is rich in organic matter and nutrients, improving soil structure, water-holding capacity, and nutrient availability for plants. Furthermore, composting can contribute to closing the nutrient cycle by returning organic matter to the soil, reducing the reliance on synthetic fertilizers.

While composting is suitable for both rural and urban areas, Atega, Fabale, Jardeleza Fantonalgo and Uybarreta (2018) suggest that residents often associate composting with rural settings due to the availability of space. However, composting can be adapted to different scales and settings, including urban environments, through innovative techniques such as community composting and vermicomposting in small spaces.

Both windrow composting and vermicomposting are effective methods for managing organic waste, reducing environmental impacts, and producing valuable soil amendments.

3.5.1.3 Reduction of solid waste

The concept of waste reduction emphasises the importance of communities and organisations taking measures to minimize the generation of waste. This can be achieved through improved consumer habits and production changes aimed at reducing unnecessary waste (Jaillon, Poon & Chiang, 2015; Mwacharo, 2015). Feng et al. (2017) point out that various studies have highlighted the existence of wasteful practices during the design and production phases. For example, at the household level, food waste often occurs when the intended consumer does not show up, prefers something else, or consumes less than what was prepared.

To address waste minimization, Jaillon et al. (2015) propose several measures that can be implemented in the management of municipal solid waste. These methods incorporate consulting

with the anticipated end user before meals are prepared, which may help reduce food waste. In manufacturing, the suggested measures involve using materials with reusable packaging, employing refillable containers, opting for durable and repairable materials, selecting with a reduction of noxious or non-noxious ingredients (Jaillon et al., 2015), utilising materials before their expiry dates (Sarkis et al., 2015), and adopting low-waste technologies.

El Gazzar and Gomaa (2014) advocate for waste management practices that start at the source to minimize the overall amount of waste that ends up being discarded. They refer to this approach as source reduction or preventing large quantities of solid waste, which has the added benefit of lowering the quantity of lethal substances generated. Together, waste reduction strategies aim to minimize waste generation through various approaches, such as involving consumers in decision-making, adopting sustainable production practices, and implementing source reduction measures. These efforts not only reduce waste but also contribute to environmental protection and the conservation of resources.

3.5.1.4 Recovery/recycling

Recycling and recovery involve the utilisation of processed recyclable materials in industrial processes, thereby incorporating them into the production of new products. This practice helps to reduce the demand for virgin raw materials (Annepu, 2012). It is central to note that a significant percentage of the environmental impact of products occurs during the extraction and processing of raw materials, prior to their disposal (The World Bank, 1999; Annepu, 2012).

One example of recycling and recovery is the utilisation of by-products from water purification processes for electricity generation, which serves as an alternative to disposal of municipal solid waste into the environment (Cosimato, 2015; Rao et al., 2015). The generated power can be used for electricity or steam generation.

Recycling performs a fundamental task in reducing the overall environmental and public health impacts of materials throughout their life cycle (Annepu, 2012). However, for recycling to be effective, it is essential to have solid waste materials separated at the source due to their differing characteristics. Once mixed and collected, it becomes challenging to process them efficiently. In developing countries, the practice of collecting mixed solid waste is common, while in more

developed countries, machines are used to collect solid waste, with a requirement for waste separation at the source (Annepu, 2012).

There is no doubt therefore that recycling or recovery contributes to the reduction of environmental impacts by incorporating processed recyclable materials into the production of new products. Proper waste separation at the source is vital for successful recycling and maximizing its benefits for the environment and public health.

3.5.1.5 Waste collection and transportation

According to Nathiya and Thandapani (2019), the process of collecting municipal solid waste typically includes the use of trucks and crews that move around residential areas to pick up solid waste from designated points. The collected waste is then transported to a shared removal point or discarding point. This collection task is both complicated and expensive, often utilising a significant portion, ranging from sixty to eighty percent, of the allocated finances by the local government authority or parent ministry.

Municipal solid waste management encompasses a range of activities. Viljoen et al. (2021) outline these activities as including planning, financing, collecting, transporting, storage, and final removal in a manner that minimizes the impact on the environment and ensures the well-being of both humans and other living organisms.

3.5.2 The role of public health inspectors on solid waste management

The practices of public health inspectors play a significant role in shaping the attitude of households towards municipal solid waste management. Informal waste collectors, when invited and accepted by health inspectors, participate in the improvement of solid waste management (Majeeb et al., 2017). The implementation of recycling programs and the inclusion of informal waste collectors have been identified as measures to enhance solid waste management.

Studies have shown that public health inspectors' positive engagement in promoting source separation can result in attitude changes among households, with observed percentages ranging from 17% to 76% (Padilla & Trujilla; Vassanadumrongdee, 2018). This demonstrates the influence of public health inspectors on shaping household behaviours in solid waste management.

3.5.3 Level of satisfaction with local government authorities

According to Lazo and Gasparatos (2022), the satisfaction level of households with the support they receive from local government authorities, including public health inspectors, is a crucial factor influencing their attitudes towards the management of municipal solid waste. One significant effort made by authorities is the implementation of source separation measures, such as providing separate receptacles for different types of solid waste (characterization). These initiatives play a vital role in discouraging negative behaviours like illegal dumping and backyard burning of solid waste.

The social dimension of municipal solid waste management has been the subject of research aiming to identify factors that affect solid waste management. It is believed that individual participation in waste management is largely influenced by the attitudes and behaviours of households (Ma & Hipel, 2016).

3.5.4 Sources of solid waste in municipal areas

In Table 3.4, various sources of municipal solid waste have been identified, including institutional sources (such as colleges, universities, and schools), commercial sources, municipal sources (such as streets and recreational facilities), and residential sources. The focus of this study is specifically on solid waste generated at the household level, which is often referred to as residential waste.

Table 3.3: Sources of Municipal Solid Waste (Annepu, 2012)

Sources	**Typical Waste Generators**	**Components**
Residential	Single and multi-family dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, oil, tires) and household hazardous wastes
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, government centers, hospitals, prisons	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas

In Figure 3.6, a favourable hierarchy of sustainable solid waste management is presented, consisting of five components. The first component is the segregation of solid waste at source, then comes the process of recycling, composting, transforming solid waste into energy, and finally, disposal as the least favourable option. This hierarchy promotes the environmentally friendly reduction and reuse of solid waste (Annepu, 2012).

Source reduction, as defined by the Environmental Protection Agency (EPA), involves designing, manufacturing, procuring, or using materials in a way that reduces their quantities or noxiousness before they enter the waste stream. The goal of source reduction is to prevent large quantities of waste from entering the waste stream (Bhada & Themelis, 2008).

Recycling and composting have been recognized as the most effective methods for handling solid waste (Annepu, 2012). However, there are economic limitations to recycling, including a lack of ready market for classified waste items, insufficient separation starting from the source, and product proposal constraints that often lead local government authorities to send all municipal solid waste to designated dumpsites (Annepu, 2012).

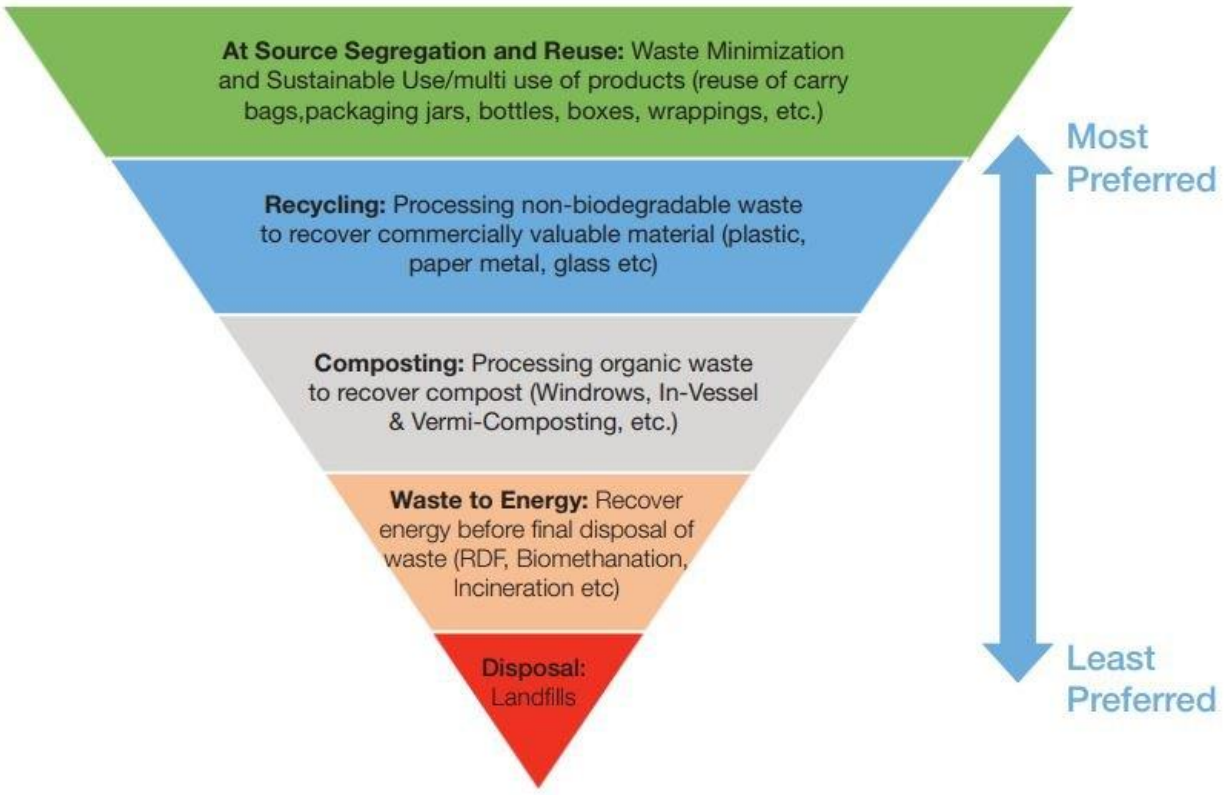

Figure 3.6: Hierarchy of Sustainable Solid Waste Management (Environmental Protection Agency, 2020)

3.6 Policies and regulations

The process of managing municipal solid waste in Zimbabwe is overseen by several policies and guidelines whose objective to ensure that municipal solid waste management practices are conducted in an efficient and effective manner. Key pieces of legislation include the Environmental Management Act, which provides a comprehensive model for environmental protection, including the management of solid waste; the Public Health Act, which also acts a crucial part in the management of municipal solid waste; the Urban Council Act that governs waste management in urban areas; as well as the Environmental Impact Assessment (EIA) Policy, which assesses the potential environmental impacts of projects, including waste management facilities.

3.6.1 Environmental Management Act of 2002 in Zimbabwe

The management of the environment in Zimbabwe is governed by the Environmental Management Act (Government of Zimbabwe, 2002). The Act provides a detailed model for the protection of the environment, including the management of solid waste. Section 69 of the Act prohibits illegal dumping of municipal solid waste in the environment due to its detrimental negative impacts on public health. To reduce solid waste, Section 36 of the Act requires individuals to take appropriate steps such as reuse and proper disposal in designated landfills. Unauthorized dumping of waste is prohibited under Section 83 of the Act. Public transport providers are expected to ensure that passengers do not litter and should provide receptacles for waste disposal (Government of Zimbabwe, 2007).

The Act emphasises the responsibility of individuals to manage waste properly and discourages littering. Public transport providers are encouraged to facilitate proper waste disposal by providing receptacles or stopping at designated places for waste disposal. Solid waste management should adhere to formulated standards as stated in Section 10 of the Act.

According to Section 83 (1) of the Act, no-one is allowed to dispose or ditch litter except in designated containers or places:

> No person shall discard, dump or leave any litter on any land, or water surface, street, road or site in or at any place, except in a container provided for that purpose or at a place which has been specially designated, indicated, provided or set apart for such purpose. (Government of Zimbabwe, 2002).

The Environmental Management Act (2002) Chapter 20:27 empowers the Environmental Management Agency (EMA) to develop policy documents that set standards for behaviours impacting the environment. Non-household waste producers are required to develop annual waste management plans under SI. Number 6 of 2007, and failure to comply is considered an offense.

The responsibility of local municipalities is to establish applicable municipal solid waste disposal locations in residential areas under their jurisdictions for solid waste collected from households and other institutions (Sec.14 of S.I 6 in Mangizvo, 2010a). SI. 98 of 2010 discourages using plastics as a form of packaging, favouring biodegradable materials, and sets minimum

requirements for plastic usage. Supermarkets in Zimbabwe have implemented measures such as charging customers for plastic bags to discourage their disposal and promote reuse.

3.6.2 The Public Health Act [Chapter 15:09]

The Public Health Act also plays a crucial role in the process of managing municipal solid waste. The Act was enacted by Parliamentary Act to address solid waste management, including waste generated by institutions and the central government. According to the Act, local government authorities are entrusted with the duty of ensuring a clean environment within their jurisdictions to safeguard public health. This entails regular collection of solid waste to prevent its accumulation and the subsequent risk of disease outbreaks. In accordance with Section 85 of the Act, local government authorities are obligated to provide residents and other waste-generating institutions with receptacles for waste disposal. They are also responsible for maintaining and monitoring waste disposal sites. Breaching environmental regulations and standards outlined in Sections 87 and 88 of the Act can incur penalties.

3.6.3 The Urban Council Act [Chapter 29:15]

The Urban Council Act is an important legislation that governs waste management in urban areas. According to Jerie (2013), the Act was enacted to regulate waste management specifically in urban settings. As a result, local government authorities bear the responsibility of managing waste generated by households and other institutions within urban areas. Councils are tasked with the collecting, transporting, and proper disposal of municipal solid waste in designated areas in and around urban communities (Ministry of Local Government and Public Works, 2021). Section 229 of the Urban Councils Act grants local government authorities the authority to develop by-laws related to solid waste management, which must be approved by the Minister of Local Government.

3.6.4 The Environmental Impact Assessment Policy (EIA)

The Environmental Impact Assessment Policy (EIA) performs a critical function in evaluating the potential environmental effects of various projects, including waste management facilities. This policy mandates institutions and municipalities to establish and implement measures aimed at safeguarding human health and the environment from the impacts of solid waste generated by these entities. Compliance with standards, such as the requirement for solid waste collection sites

to be situated at least 500 meters away from residential areas, is among the measures outlined (Jerie & Zulu, 2017; EPA, 2020). In Zimbabwe, municipalities are obligated to conduct environmental impact assessments (EIAs) prior to selecting landfill sites and commencing the construction of solid waste treatment plants.

The above policies and regulations collectively provide guidelines and standards for solid waste management in Zimbabwe. By promoting proper waste collection, transportation, and disposal practices, as well as addressing public health concerns, these regulations contribute to the sustainable management of solid waste in the country.

3.7 Prior research

The literature highlights the significance of reverse logistics in solid waste management as a means to achieve sustainable development. Kumar (2020) conducted a study in India, focusing on the relevance of reverse logistics in managing plastic waste, which is widely used in packaging and extensively reaches households. Pena-Montoya et al. (2020) assessed the development stage of reverse logistics as an approach for attaining sustainable solid waste management. Recent research has also emphasised the task of reverse logistics activities in reducing solid waste quantities through recycling and reusing end-of-life products. Additionally, reverse logistics has been recognized in the framework of circular economy research as a potential strategy for sustainable solid waste management. Ludeke-Freud, Gold and Bocken (2018) point out that circular business models demand that companies restructure, rethink and redesign their business model to capture value from end-of-life materials. This approach was also promoted by the Ellen MacArthur Foundation (2019), which states that implementation of efficient reverse logistics processes that enrich the return of materials in circular economies are a must. Heikkila, Malahat and Deviatkin (2023) advocate for better reverse logistics designs for recyclable materials because reverse logistics is regarded not only as offering higher resource efficiency but also a reduction in emissions. Kalmykova, Kadagopan and Rosado (2018) contend that the reverse logistics concept promotes the idea of keeping products and materials in the circular economy for prolonged periods while capturing value from them. Heikkila, Malahat and Deviatkin (2023) add that the concept of reverse logistics sees a reduction in raw material requirements and the use of virgin resources.

Several studies have explored the enactment of reverse logistics in specific industries and contexts. Tung (2019) investigated how the concept of reverse logistics has been applied in the plastic chain, while Mesjasz-Lech (2018) promoted its adoption in the management process of municipal solid waste for smart cities. MacAllister (2015) identified influencing factors in solid waste management in the developing world and emphasised the role of reverse logistics. Industries such as the Brazilian agricultural sector (plastic containers), the Coca-Cola company (empty beverage bottles), and the paper and metal industries have implemented reverse logistics practices. These industries leverage reverse logistics in the collection of materials such as metals, plastics, glass, and paper, which are then transported to manufacturing plants for reprocessing.

However, it is worth noting that reverse logistics practices are often less organized compared to traditional forward flow structures. Challenges such as the need for separate space for reverse products and the time-consuming sorting process are commonly cited. Despite these challenges, the potential of reverse logistics in mitigating the mismanagement of municipal solid waste is recognized.

In the Zimbabwean setting, investigations have been conducted on solid waste management in urban areas, particularly in Harare, with studies by Shabani and Jerie (2022), Mahamba (2015), and Mandere (2015) advocating for sustainable solid waste management practices, including the potential implementation of reverse logistics.

3.8 Chapter summary

This chapter has provided a comprehensive literature review associated with the research questions of the study that include the perception of households on municipal solid waste management, the perception of households on the services they get from local municipalities on solid waste management, the level of satisfaction of households with the services they receive from municipalities and the subsequent behaviour of residents on solid waste management such as practicing reverse logistics. The literature review commenced by offering an overview of sustainability and sustainable development, elucidating the distinction between the two terms based on the existing body of knowledge. Subsequently, the focus shifted to examining the concept of reverse logistics in the context of solid waste management, as well as providing an in-depth understanding of solid waste and its relationship to sustainability. Significant attention was given to the perception of households regarding solid waste reverse logistics and municipal solid

waste management. The review explored the various methods employed by households in managing the solid waste they generate and the barriers they encounter in segregating waste. Furthermore, the literature emphasised the importance of household satisfaction with the services provided by local government authorities in the realm of solid waste management.

Overall, this chapter has synthesized and presented a comprehensive review of the relevant literature, setting the foundation for the subsequent chapters that will delve into research paradigms and methodology. The insights derived from this literature review will inform the subsequent analysis and contribute to a deeper understanding of how the concept of reverse logistics impacts the management of municipal solid waste and sustainability. In the subsequent chapter, the research paradigms and methodology employed in the study are covered.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter presents the research design and methodology employed to fulfil the objectives of the study, which aimed to explore the perceptions of households regarding the behaviour and satisfaction of municipal services in solid waste management, as well as their attitudes towards reverse logistics of municipal solid waste management for sustainability. Building upon the literature review conducted in the previous chapter, this chapter provides a detailed outline of the research methods employed to gather and analyse the data necessary for addressing the research objectives.

The research philosophy that underpins the study is first discussed, providing insights into the underlying principles and assumptions guiding the research approach. Subsequently, the research layout and approach used for data collection and analysis are explained in detail. This includes a description of the target population and the determination of the sample size, as well as the selection method employed for identifying the respondents who participated in the study.

4.1.1 The meaning of research

Research is regarded as a systematic and sequential process, wherein various steps are undertaken, even though they may not always require completion of preceding steps before proceeding to the next (Cooper & Schindler, 2015). Therefore, understanding the sequence of these steps is crucial. Advancement of human knowledge is also achieved through research which has been defined as a process of discovery, gaining new knowledge and problem-solving (Bhattacharyya, 2006; Kumar, 2008; Gratton & Jones, 2010; Thomas, Nelson & Silverman, 2011).

4.2 Research design

Cooper and Schindler (2015) posit that a research design gives a detailed approach of how the researcher proposes to carry out the study within the practical constraints of location, time,

money and the availability of the investigator. The purpose of research design is to give a detailed layout of the steps that will be taken by the researcher, starting from the development of hypotheses, how to operationalise the data collection and how data will be analysed. Its purpose is to form the basis for gathering empirical evidence in a study through clearly demonstrating how the proposed investigation will be carried out to answer the research problem (Blumberg, Cooper & Schindler, 2014). This study used a research model that was conceptualised and operationalised through empirical work from literature. Research objectives which were crafted based on research questions on the perception of residents on the attitude and behaviour of municipalities on municipal solid waste management, as well as the residents' behaviour on reverse logistics activities, guided the research design.

4.2.1 The meaning of research design

Edmonds and Kennedy (2017) highlight the inseparable nature of the two components encompassed by the term "research design" in obtaining meaningful answers. Researchers across various domains engage in systematic, transparent, and replicable research to explore the causes, relationships, and behaviours of specific phenomena, thereby advancing the existing body of knowledge (Eriksson & Kovalainen, 2015). The fundamental objective of research is to address emerging questions and provide solutions to identified problems, necessitating a scientific approach (Green & Thorogood, 2014). Cooper and Schindler (2015) assert that research design serves as a blueprint for achieving research objectives and answering questions. Babbie (2013) describes research design as a strategic plan guiding the researcher's study conduct. Furthermore, Creswell (2014) emphasises the importance of researchers not only selecting the overall research method, such as qualitative, quantitative, or mixed methods, but also choosing specific study approaches within each research design. An appropriate study framework is provided for by a research design (Asenahabi, 2019).

Research design refers to the blueprint for data collection, measurement, and analysis used in a study (Cooper & Schindler, 2015). Its purpose is to guide researchers in making crucial choices regarding methodology and resource allocation to obtain answers to the research problem. Cooper and Schindler (2015) prefer to define research design as a model that provides a specified method for conducting the study, aiming to address the identified problems. It entails a structured sequence of events undertaken to investigate a phenomenon, following a schematic

plan deemed most suitable for the study. The design outlines the steps to be taken, from hypothesis development to operationalization and data analysis. It serves as a model for organizing the research work, defining the study variables and their presumed associations (Blumberg, Cooper & Schindler, 2014). Collins and Hussey (2009) suggest that a research undertaking may serve multiple purposes, including exploration, description, analysis, and prediction.

The research model's conceptualization and operationalization involved an exploratory literature review, leading to the formulation of concrete hypotheses. The pragmatic examination stage of the investigation contributed to the descriptive and analytical aspects of the research by providing relevant data. The proposed research design aims to obtain responses to the study's questions concerning reverse logistics activities and waste management decisions for achieving sustainable development. A mixed research approach was selected by the researcher. According to Akintoye (2007), the numerical concept aligns with conventional, positivist, investigational, or pragmatist hypotheses, while the qualitative concept corresponds to techniques for building or naturalizing, descriptive methods, or post-positivist/postmodernist viewpoints. Hair, Babin, Money and Samouel (2003) emphasise the need for a functioning method to examine the connections between commendable style and an epistemological pragmatism, enabling researchers to observe, realise, and explain phenomena. This understanding necessitates researchers' commitment to establishing coherence in data analysis through persistent literature referencing, embracing a systematic pattern. Bryman and Bell (2015) refer to the architects of constructed beliefs as principles derived from systematically gathered and analysed data, following a transparent corridor of study. Grounded theory has been chosen as the approach for this study, employing literature and theory to understand and enlighten the realism or existing progress related to the concept of the reverse logistics trend in municipal solid waste management decisions for sustainable development. Grounded theory establishes a link between data gathering, scrutiny, and the resulting model.

4.2.2 The adoption of reverse logistics theory and pragmatic assumptions

Reverse logistics was adopted in this study as a theory, viewed from its economic, social and environmental benefits that it offers society. Acquired knowledge is used by researchers to craft questions which then give assumptions in the study area (Dawson, 2013; Saunders, Lewis &

Thornhill, 2016). Researchers use fields of epistemology and ontology to address research questions. The employment of a systematic process in conducting research where techniques of data collection and data analysis are clearly defined results in generation of knowledge (Saunders, 2010). This systematic process of conducting research, resulting in knowledge generation as the output, is referred to as research methodology. Ontology issues are mainly concerned with things that exist within society (Al-Saadi, 2014) and these include the beliefs and reality of the society (Ormtorn Spenser, Bernard & Sanpe, 2014). Epistemology refers to the knowledge possessed, and assumptions made to discover what is around society. In other words, theory (ontology) is used to come up with a set of queries (epistemology) in the methodological assessment of a study (Denzin & Lincoln, 2005). Epistemology is the illustration of truth that is realized as a result of the application of philosophies of truth or actuality of phenomenon in ontology (Bryman & Bell, 2011; Saunders et al., 2016; Dawson, 2013; Greener & Martell, 2015).

The study appreciates the ontological approach which is based on the idea of acknowledging and disclosing the truth about accepting and applying reverse logistics in municipal solid waste management. The epistemological approach has the ability to raise awareness, leading to acceptance and adoption of a successful reverse logistics operation in municipal solid waste management. The two approaches were adopted in this study in the journey to discover different viewpoints of the study topic.

4.2.3 Research paradigm and the adoption of reverse logistics in municipal solid waste management

The ontological and epistemological postures established at the meeting points of positivism and interpretivism theories were used in this study as a pragmatic approach. Greener and Martell (2015) posit that the exploration concept is a set of philosophies that researchers use in making decisions about the scope of analysis and the possible outcomes, to give credible interpretations. A set of communal notions, practices, values and concepts resembles a research paradigm (Dawson, 2013; Johnson & Christensen, 2012). Saunders (2012) contends that a model that is used in a study is motivated by a research paradigm that is fundamentally determined by the research questions. A multidimensional approach that sought to address the research objectives

was used in the study. A positivist approach was considered as suitable to solicit data that was deemed appropriate for quantitative probabilities.

4.2.4 Positivism paradigm

This study used a positivist approach to solicit data because the technique was considered to be both an established and well-known concept (Moore, 2010; Bryman, 2016). Nel (2019) argues that the positivism approach is a philosophy of knowing (epistemology) in which it is believed that knowledge acquisition takes place through direct observation and can be trusted because it is factual. Park, Konge and Artino (2020) contend that the functional relationship between the independent variable (IV) and dependent variable (DV) can be stated quantitatively based on priori hypotheses, a characteristic of positivism that relies on a hypothetico-deductive method. This study used the attitude of municipalities towards solid waste management as the explanatory factor (IV) and the behaviour of residents towards solid waste management as the dependent variable (DV). The positivism approach was chosen in this study because it separates the researcher from participants during data collection to minimize bias (dualism) and is objective in that there is absence of the researcher's influence, flaws and limited outliers on the data, thereby further reducing bias and increasing internal validity (Park, Konge & Artino, 2020).

4.2.5 Positivism paradigm approach in the adoption and implementation of reverse logistics

A quantitative approach was used in this study to understand the impact of the perception of residents on the attitude of municipalities in municipal solid waste management for sustainability. Data collection, presentation, analysis, and interpretation were undertaken in this study to accomplish the dictates of the positivism philosophical foundations, which work on quantifiable data. The impact of the perceptions of residents on the attitude of municipalities in solid waste management, which in turn affected the residents' behaviour towards reverse logistics activities, required quantitative explanations, a feature of positivism. Statistical assessment of the data collected was facilitated by the management of boundaries (Chen & Hirschheim, 2004; Fuchs, Wittings, Rofer & Kunz, 2009) in which data was collected both physically (research site) and theoretically (solid waste management). Nevertheless, positivism faces criticism on the basis of its limitations in the explanation of phenomenon (Guba & Lincoln, 1994). Laws and principles cannot explain with precision the causal relationship between the

perception of the attitudes of municipalities and the behaviour of residents towards reverse logistics activities. Since the adoption of the positivism approach could not fully explain the causal relationship between residents' perceptions of the attitude of municipalities towards solid waste management and their (residents) subsequent behaviour towards reverse logistics activities, that weakness paved the way for the description of the interpretivism paradigm.

4.2.6 Interpretivism paradigm

The interpretivism paradigm approach was also used in this study as a technique to complement the shortfalls of the positivism approach, which was described in the previous section. Chowdhury (2014) refers to an emphasis on the meaningful nature of the character of people and how they participate in both cultural life and social life. Interpretivism brings vigor in research by allowing the researcher to participate through conducting interviews in which immediate answers or further clarification can be sought. Meaning and the interpretation of events surrounding a given setting is made possible by the use of the interpretivism approach in research (Guba & Lincoln, 1994). Saunders et al. (2016) as well as Bryman and Bell (2011) claim that the interpretivist approach gives a better perception about the human beings and their daily settings. Semi-structured interviews were used in the investigation process to trying to understand how participants were thinking and behaving related to the topic under study.

Research affirms the interpretivism approach's rationale that the societal sphere is a complex corporate organisation to which theory cannot be attached with ease and precision (Saunders et al., 2016). The interpretivism approach allows the investigator to participate in the study through interviews, with the advantage of this allowing for better clarification and immediate responses to better understand what is taking place. Spoken words and non-verbal cues are said to assist the investigator to have a better interpretation and understanding of the events and activities in the study area (Bryman & Bell, 2011). The interpretivism approach aims at understanding the area surrounding the study better (Saunders et al., 2016; Bryman & Bell, 2011).

4.2.7 The application of the interpretivism approach to reverse logistics in municipal solid waste management

The philosophy of interpretivism accorded the researcher the opportunity to participate in the study through conducting in-depth interviews to establish the impact of reverse logistics on

municipal solid waste for sustainability. In-depth interviews were conducted by the researcher to get a deeper understanding of how municipal authorities adopted and implemented reverse logistics activities in the management of municipal solid waste generated from households. Saunders et al. (2012) affirm that the interpretivism approach is employed in research to establish the truth. There are generally ample opportunities for the observation of research variables or concepts when the interpretivism approach is adopted in a study (Dawson, 2013; Mukherji & Albon, 2010). This study used the interpretivism approach to gain greater comprehension of the nature and traits of reverse logistics activities as well as the adoption and implementation of study variables in their natural settings. Interviews were conducted with purposively selected workers in waste management departments of municipalities. The researcher was accorded the opportunity to interact with solid waste management workers to establish how they understood and behaved towards reverse logistics activities for the attainment of sustainable development (Dawson, 2013; Bryman & Bell, 2011).

The interpretivism approach assisted the study by giving a better understanding of the phenomenon of reverse logistics and solid waste management through addressing concepts which had not been addressed by the positivist approach. The application of the interpretivism approach to a study facilitates the establishment of the stability and significance of the researcher's subjective experience (Saunders et al., 2012).

Despite the advantages of the interpretivism approach, there are weaknesses associated with the approach, such as failure to offer sufficient assurance, which captures the significant worries in research. Queries concerning reliability, credibility, validity, authenticity, and trustworthiness of research findings are subjective in nature, and subject to different interpretations of people and their feelings and thoughts. Ling and Ling (2010) argue that varying interpretations may be present at the same time, and they may individually be supported because of the independence of distinct investigators. This study made use of both the positivism and the interpretivism approaches to moderate the weaknesses of the quantitative as well as the qualitative techniques.

4.2.8 Pragmatism

Saunders et al. (2012) define pragmatism as a philosophical approach that considers several methods of viewing the world when conducting a study because different approaches give different versions of answers to the problem. The use of the pragmatic paradigm approach gives

credibility, reliability and relevance to results of a study (Kelemen & Rumens, 2008; Dawson, 2013). Epistemological perceptions of pragmatism are given by the researcher's knowledge of the environment (Saunders et al., 2016). Christ (2010) suggests that the ontological approach gains attention due to various assumptions made in research inquiries. The philosophical approach of pragmatism is regarded as the connecting position in the way of life and practices that distinguishes understanding and inquiry (Cameron, 2011; Goldkuhl, 2012). The introduction of only one concept in a study was opposed by Saunders et al., (2012) on the basis of lack of adequacy to satisfy the dictates of the research questions. To rationalise thinking in research, it is encouraged to use multiple methods in a study (Saunders et al., 2012; Cameron, 2011). John Dewey, Charles Sanders Pierce and Williams James, early rationalists, forbade the positivist attitude that social science studies possess the attributes of improving understanding through making use of systematic techniques (Saunders et al., 2013). Merten (2015) points out that John Dewey, Williams James and Charles Sanders Pierce were the initial advocates of the application of 'common sense and practical thinking'. By adopting different investigative approaches and procedures, the investigator is accorded the chance to deal with challenges that concentrate on the study and not on the deficient assumptions and systematic attempts (Ling & Ling, 2010; Saunders et al., 2012).

The positivist approach was preferred over other paradigms concerning the adoption of reverse logistics activities in municipal solid waste management. Kaushik and Walsh (2019) point out that social experiences of people are influenced by their perceptions of the world around them and their actions are guided by a set of beliefs. The pragmatism approach was considered good for the study because it provides the opportunity to find out how residents perceived the world settings around them in as far as solid waste management is concerned. However, philosophers in social sciences have noted shortfalls that are considered pertinent in the use of one-track ontological and epistemological beliefs, and they put across the rationalised concept as the most applicable viewpoint to apply when aiming to get valid and reliable interpretations of the truth. The use of both quantitative and qualitative methods has been suggested as a better approach to avoid the philosophical-driven criticism associated with the use of only one method (Saunders et al., 2012).

4.2.9 Pragmatism consideration in the adoption and implementation of reverse logistics activities and municipal solid waste management

Pragmatism was considered the most ideal approach in this study because of the setup of the study objectives, thereby rendering other approaches weaker. Research objectives in a study make it either possible or impossible to accept different approaches (Saunders, 2012). Research questions determine the paradigm to be used in a study (Chen & Hirschheim, 2004).

4.3 Research approach

The study adopted a mixed method approach. It was considered a best practice because the approach makes use of both quantitative and qualitative approaches. Poth and Munce (2020) contend that the use of mixed research methods assists in the integration and synergising of data from several sources, thereby assisting in studying problems that are complex. Brierley (2017) argues that mixed methods, when adopted in research, overcomes the disadvantages of either of the two approaches (quantitative or qualitative) when taken as monomethod. Shorten and Smith (2017) state that viewing the phenomenon from different perspectives and using different research lenses can be achieved by making use of mixed methods research through purposeful data consolidation. To improve understanding and have a better achievement of the research intentions, this study applied various components of rationale. Allemang, Sitter and Dimitropoulos (2021) point out that the pragmatism approach makes use of the combined strengths of qualitative and quantitative methods to strengthen the outcomes of the study. The section that follows gives a summary of the divergent study techniques and how they are applied in research.

4.3.1 Qualitative approach

Data that were gathered using the qualitative approach required application of qualitative principles. Participants were interviewed using a semi-structured questionnaire. Muzari, Shava and Shoniwa (2022) argue that the three theoretical frameworks that principally anchor qualitative research are phenomenology, hermeneutics, and ethnography. Hermeneutics is referred to as the science required to understand, the skills set needed to interpret, and the ability to communicate (Flick, 2014) through data analysis and interpretation tools, and eventually present the findings comprehensively. The ability of the researcher to elaboratively give a

description of the lived experiences of the participants by making use of his/her own words is referred to as phenomenology (Muzari, Shava & Shoniwa, 2022). Studying the people in their natural settings to understand deeply their way of life with the aim of capturing, providing thick interpretation and explanation of specific aspects of their life is referred to as ethnography (Lune & Berg, 2017; Hoberg, 2001). The qualitative approach presented the research with the opportunity to gather findings that are attached to participants in their real-life settings, giving them a uniqueness that elucidated their behaviour in municipal solid waste management.

The study made use of the qualitative approach because the technique is concerned with the day-to-day settings of participants (Denzin & Lincoln, 2005) in addition to being concerned with the processes rather than the outcomes, given that its foundations are based on how people come to understand, how meanings are conveyed, and how roles are shaped (Zireva, 2013). The development of theory in the qualitative approach is bottom-up as opposed to top-down (Chisaka, 2013), thereby leading to grounded theory (Mohajan, 2018).

4.3.2 Quantitative approach

The gathering of numerical information and its evaluation adopted the quantitative research approach. A structured questionnaire was utilised in this study to solicit information regarding the perceptions of households on municipalities' municipal solid waste management. The data collected was instrumental in the presentation, analysis and interpretation of the perceptions of residents on municipalities' attitudes on municipal solid waste management, which in turn influenced the behaviour of residents on solid waste management. Borgstede and Scholz (2021) state that numerical representation is employed in quantitative studies to analyse and draw conclusions about empirical phenomena. Apuke (2017) points out that quantitative research approaches involve data collection and quantification, which are then treated statistically to contest or support knowledge claims. The study used inferential statistics to analyse the data collected and to present the results.

4.3.3 Justification of the mixed methods approach

The adoption of the mixed methods approach ensured that shortfalls associated with the use of mono approaches were critically addressed. The mixed research approach assisted in broadening the scope of awareness as well as insights of municipal solid waste reverse logistics adoption and

implementation. Subjective and quantifiable study techniques helped the investigator get a clear and better understanding of the research phenomenon. Greener and Martell (2015) contend that a mixed approach enables triangulation by making use of more than one technique of gathering and analysing data. There are complementary efforts, initiation of insights, knowledge development and expanding the breadth and the range of the research by making use of a mixed methods approach. Creswell and Plano Clark (2018) point out that the use of large numerical data in quantitative and small sample sizes in qualitative data supports researchers to obtain rigorous assessment of the problem quantitatively, as well as conduct in-depth data analysis though qualitative approaches. Scholars in mixed methods research commit their efforts to coming up with a design that is standard and methodical in nature (Timans et al., 2019). Several types of mixed methods have been suggested (Wilkinson & Staley, 2019; Plano Clark & Ivankova, 2016) that possess the potential to make researchers understand the best possible options in mixed methods, which is considered both parsimonious and practical (Creswell & Plano Clark, 2018). Dawali, Shrestha and Giri's (2021) suggested types of mixed methods research are convergent parallel mixed methods design, explanatory sequential design, and exploratory sequential design.

4.3.4 Convergent parallel mixed method design

Creswell and Plano Clark (2018) point out that convergent design is considered an efficient and popular mixed method design that follows pragmatist theoretical assumptions. Data is collected concurrently, and the analysis is done independently using qualitative and quantitative approaches (Creswell & Plano Clark, 2018; Schoonenboom & Johnson; Shorten & Smith, 2017). Dawali, Shrestha and Giri (2021) postulate that a better understanding of the phenomenon is gained by the researcher through using a convergent design, which gives the investigator the opportunity to look for common concepts within the data sets. This study integrated data by converging the findings of quantitative methods and qualitative methods which were presented separately (Creswell & Plano Clark, 2018). While quantitative data analysis made use of statistical applications to interpret and present findings, qualitative data analysis involved transcribing spoken words, coding and developing themes. Concurrent timing was used in data collection to ensure that neither of the techniques influenced the other (Dawali, Shrestha & Giri, 2019) in addition to giving each data collection method equal importance.

4.4 Population and sample sizes (quantitative and qualitative)

Shukla (2020) defines population as a set of units with similar characteristics or features with which a study will be undertaken and findings of the study can be generalised. The author further defines sample size as that part of the population which represents the population given that it bears the same characteristics or features as the population. The following sections discussed the study population and sample.

4.4.1 Population and sample size (Quantitative Approach)

The number of households in the study area, as obtained from municipal figures, was 22 105, representing the population. For the quantitative data technique, a sample size of 450 was selected. Yamane's Formula was used to determine the sample size, and it is represented by the equation:

$n = N/(1 + N(e^2)$

Where:

n = sample size

N = population

e = acceptable sampling error

n = N / (1 + N(e^2))

$n = 220105/\{1+22105(0.05^2)\}$

$=22105/\{1+22105(0.0025)\}$

$=22105/1+55$

$=22105/56$

$=394$

In this case, a sampling error of 0.05 was used, and an additional ten percent was added to account for potential non-response. Therefore, the initial calculation yielded a sample size of 394, which was adjusted to 450. The number of households in the study area obtained from municipalities' figures was 22 105, representing the population. From this figure, a sample size of 450 was used for the quantitative data technique.

4.4.2 Population and sample size (Qualitative Approach)

Asiamah, Mensah and Oteng-Abayie (2017) state that it is necessary to identify and pick the correct target population when conducting research to produce credible results. The target population for the qualitative approach was supervisors and managers in solid waste

management departments of municipalities. These were targeted because of their direct responsibilities and knowledge on municipal solid waste management, enabling them to give relevant and credible information (Lakhani & Maqbul, 2024). Recently, attention has been focused on the sample size in qualitative research with questions arising as to whether the determination of the sample should be a priori (Sim, Saunders, Waterfield & Kingstone, 2017). Curtis, Gesler, Smith and Washburn (2000) contend that rigorous addressing of the sample size in qualitative research is fundamental to understanding and validating the results obtained. Saunders et al. (2017) suggest the rule of thumb, conceptual model, numerical guidelines and statistical formular as four methods of determining the sample size in the qualitative research approach. Malterud, Siersma and Guassora (2016) posit that the conceptual model tactic uses the rationale that determination of the sample size is based on 'information power'. The researchers were referring to the information that a study is seeking to address that uses the conceptual model in that study.

Numerical guidelines as a technique of determining sample size in qualitative research are indicated by Guest, Namey and McKenna (2017), who concluded that two or three groups are enough to give 80% of the themes and three to six groups are sufficient enough to give 90% of themes that emerge in a study. Hennink, Kaiser and Marconi (2017) prefer to consider qualitative research sample size in relation to 'saturation', pointing out what they referred to as 'code saturation' and 'meaning saturation'. In the former, additional issues are identified and in the later further insights are gained. Ando, Cousins and Young (2014) propose saturation in the context of thematic analysis and concluded that 12 interviews would be a sufficient sample size. The use of meta-themes was advanced by Hagaman and Wutich (2017) who define meta-themes as cross-cultural themes as opposed to site specific themes. Statistical formular was advanced by Fugard and Potts (2015a) whereby they proposed the use of binominal distribution to determine the minimum number of participants required to coincide with a specific level of confidence; for example, eighty percent confidence interval. This method was further popularised by Tran, Porcher, Tran and Ravaud (2017) who derived mathematical models for the identification of the saturation point that represents a desired balance between themes identified and number of participants in a study. This study adopted the use of saturation point as this was regarded as good enough to give further insights in the study.

4.4.3 The study area

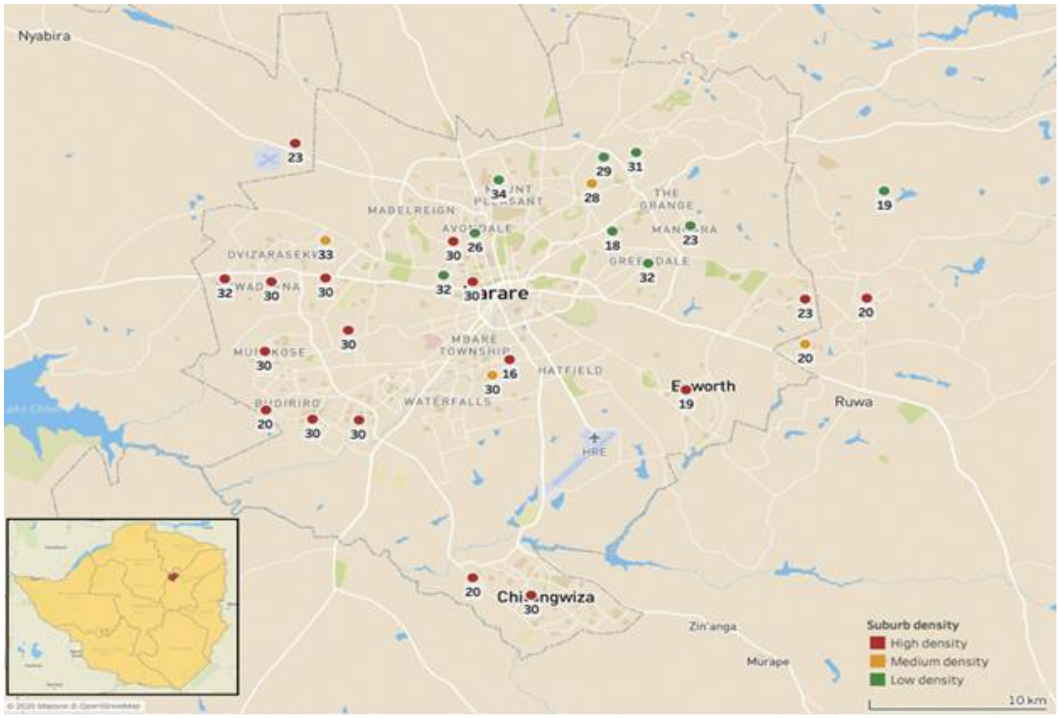

Figure 4.1: Study Area (Google Maps)

Zimbabwe is a country located in the southern part of Africa and covers an approximate area of 390,757 square kilometers (ZNCCRS, 2015). It is situated between latitudes 15°-23° S and longitudes 25°-34° E and shares natural borders with South Africa to the south, Mozambique to the east, Zambia to the north, and Botswana to the west (World Bank, 2021). According to ZIMSAT (2022), the population of Zimbabwe is estimated to be 15.1 million people. The country is divided into ten provinces, with the capital city, Harare, located in Mashonaland Central Province.

4.4.4 Study plan

This study adopted a work plan proposed by Babbie (2012). The plan was adopted for its simplicity and ease of understanding and implementation. The plan presented in Table 4.1 consists of several stages, starting with defining the research problem, generating ideas related to the problem, delimiting the scope of the study, operationalising the variables, analysing the collected data, and concludes with disseminating the findings to relevant stakeholders.

Table 4.1: The outline of the research project and work plan

No.	Phase	Operational Assignments
1	Determining the difficulty	• Formulating the problem • Identifying the problem • Information detection • Determining the research thought
2	a. Generation the idea	• Clarifying expressions • Indicating testable variables
	b. Implementation	• Deciding research assumptions and rationalising • Establishing techniques of assessing the variables • Selecting procedures to conduct the research
3	c. Delimiting the study population	• Defining the population • Choosing data sources
	d. Choosing instruments to be used	• Measurement questionnaires • Semi-structured interview guide • Pilot study survey and modification
	e. Sample size	• Choosing the method of establishing the study sample • Choosing the study sample
4	Experimental study conducting	• Collecting data, analysing and interpreting • Carrying out investigations
5	a. Treating Data	• Validation of observed facts • Preliminary data coding and sorting
	b. Analysing data	• Analysing tentative data • Premises evaluation • Concept development grounded on outcomes discovered • Generalisation of research discoveries
6	Informing	• Outcomes informing and impacts • Concluding article development • Contributions, meanings, commendations

Source: Babbie, 2012, p. 112-113

The formulation of hypotheses plays a crucial role in advancing theories based on data through the process of component analysis; and the methodology employed in this study is iterative or recursive, where data collection and analysis occur simultaneously, informing each other (Bryman & Bell, 2015).

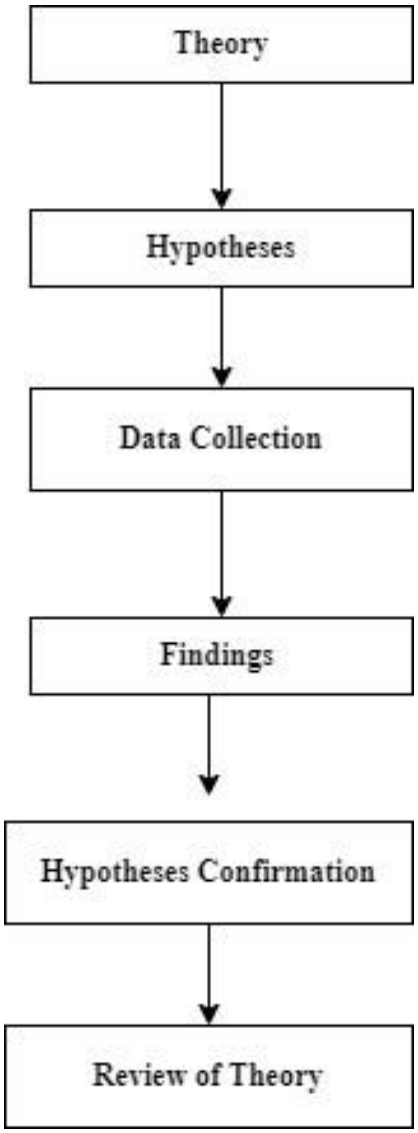

Figure 4.2: The Deductive Process in Empirical Study
Source: Bryman and Bell, 2015

The survey focused on assessing the perceptions of households on the municipal solid waste management services they get from municipalities which impact on their behaviour toward reverse logistics activities and achievement of sustainability goals. Within this framework, the research aims to address the gaps and divergent questions regarding the pragmatic assessment of reverse logistics and waste management in the context of sustainable development. To gather data, a questionnaire was employed as a study tool to collect enumerative reactions from the sample population, while a semi-structured interview guide was employed to gather knowledge from management.

4.5 Problem statement and objectives of the study

Despite the efforts of advocacy groups and global initiatives like the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), waste management remains a significant challenge in many developing nations, including Zimbabwe. Makwara and Magudu (2013) highlight the collapse of waste management systems in Zimbabwe, leading to uncontrolled dumping of municipal solid waste and posing health hazards to residents. Mafume et al. (2016) note the absence of reverse logistics activities such as reuse in municipal towns and cities of Zimbabwe, resulting in the accumulation of litter in various locations. The adoption of technology in waste disposal facilities in developing countries lags behind (Mafume et al., 2016).

Reports indicate widespread dumping of solid waste in various locations in Zimbabwe, including rivers, wetlands, roadsides, and woodlands (The Standard, June 24, 2012; Mutungwe et al., 2014). In Chinhoyi, a city in Mashonaland, Zimbabwe, Mutungwe et al. (2014) found that only 25.9% of respondents made use of municipal facilities for solid waste disposal, while the majority employed alternative methods such as rubbish pits, composting, or indiscriminate dumping.

A distinction exists between formal and informal municipal solid waste management. Formal management is characterised by organised systems, strategic dump sites, and adherence to municipal regulations, while informal management lacks these structures (Mahamba, 2015). Factors such as inadequate trial of municipal by-laws and limited scientific and commercial competence of municipal authorities contribute to the improper disposal of waste in undesignated sites by residents (Cheng, 2010; Mahamba, 2015).

While significant research has focused on formal structures and types of municipal solid waste, less attention has been given to understanding the behaviour and attitudes of households in managing solid waste. This knowledge gap hampers efforts to effectively educate households and implement appropriate management interventions. Therefore, this study aims to examine the perception of households regarding municipal services and their satisfaction levels, and how these factors influence their behaviour towards solid waste management. Additionally, the research investigates the potential of reverse logistics in addressing the municipal solid waste management crisis in Zimbabwe and achieving sustainability.

4.5.1 Primary objectives

The primary objective of this study was to propose a practical configuration for applying reverse logistics activities in municipal solid waste management, with the aim of achieving improved sustainability in local government municipalities.

4.5.2 Secondary objectives

To realise the primary objective, the subsequent five subordinate objectives were addressed, namely:

i. To establish the perceptions of households/residents on municipal authorities' practices on the management of municipal solid waste in selected municipalities in Zimbabwe.

ii. To determine the practices of residents/households on the management of municipal solid waste in selected municipalities in Zimbabwe.

iii. To determine whether the attitude and behaviour of municipalities towards municipal solid waste management, as perceived by the residents, influence the way in which residents manage their municipal solid waste.

iv. To ascertain the state of sustainability in selected local government municipalities in Zimbabwe, and

v. To determine if there is a relationship between reverse logistics of municipal solid waste and sustainability in local government municipalities in Zimbabwe.

4.6 Hypotheses

Founded on the objectives outlined above, the following propositions were formulated:

$H_0$1: The perceived attitude and behaviour of the municipality regarding solid waste management has a positive effect on the way residents dispose of solid waste.

$H_0$2: The residents' satisfaction with municipalities' solid waste management has a positive effect on the way residents dispose of solid waste.

4.7 The methodological approach

The present study utilised a mixed research approach, combining both qualitative and quantitative methods for data collection and analysis. This approach was chosen to provide a more comprehensive understanding of the phenomenon under investigation by employing the triangulation approach of data collection and analysis. Mixed methods research has been widely advocated and found useful in various disciplines such as social science, education, and business research.

Qualitative data was collected through interviews, allowing the researcher to gather in-depth insights and perspectives from the participants. On the other hand, quantitative data was collected using a structured and self-administered questionnaire, enabling the researcher to obtain numerical data for statistical analysis. This combination of methods facilitated a more holistic exploration of the research topic.

The qualitative data obtained from the interviews was analysed using thematic analysis, which involved identifying patterns, themes, and categories within the data. This approach helped in understanding the underlying meanings and experiences of the participants.

For the quantitative data analysis, descriptive statistics were employed to summarise and present the numerical data. Hypothesis testing was also conducted to examine the relationships and associations between variables of interest.

The adoption of a mixed research approach allowed the researcher to address research questions that could not be adequately answered by solely relying on either qualitative or quantitative methods. By integrating both approaches, a more nuanced and comprehensive understanding of the research problem could be achieved.

Inglesi-Lotz (2017) emphasises the enrichment of knowledge through research that systematically and creatively gathers information to address research questions. An essential aspect of conducting meaningful research lies in formulating an appropriate research design (Chivhanga, 2018). Adopting a phenomenological approach, as suggested by Chivhanga and Monyai (2021), enables researchers to capture finely nuanced responses from participants, thereby exploring their perceptions, beliefs, and opinions regarding the variables under investigation.

4.8 Quantitative versus qualitative research

The methods that were used in the study are discussed in the following paragraphs to give a clear explanation of the differences between these two methods. The study employed both qualitative and quantitative methods to capitalise on the strengths of each method while mitigating their respective limitations. The use of these two complementary methods allowed for a more comprehensive and robust investigation of the research topic.

4.8.1 Qualitative research

Qualitative methods were used in the research to permit the understanding of gathered data. A semi-structured questionnaire was utilised to probe participants while seeking knowledge to address the specific aims of the research. Qualitative research is considered as an enquiry practice that captures the interpretations of participants within their respective contexts, encompassing elements such as their perspectives, culture, morals, identifications, and ways of discerning (Kothari, 2004). The development of probes in qualitative research greatly depends on the researcher's strategy for investigating issues within specific context. (Creswell, 2014). Qualitative research thus takes place in a specific location and time, making it problematic to make a sweeping statement on discoveries, instead favouring transferability of the results (Luton, 2015).

Creswell (2018) elucidates that qualitative techniques are grounded on broadening the scope of inquiries and actions within the study, collecting facts from the target location or setting, analysing the data, and determining implications from the results. Leedy and Ormrod (2015) point out that qualitative research seeks to generate words and definitions of a phenomenon through discussions. Eriksson and Kovalainen (2015) echo this sentiment, adding that qualitative research explains and describes participants' understanding of the research problem. Saunders et al. (2012) postulate that the scholar can make use of inductive analysis in qualitative research to develop different understandings of the nature of comparative hurdles, enabling the formulation of assumptions described as a "theoretical model."

Previously, Neuman (2011) and Creswell (2018) highlighted various types of designs in qualitative research, including narrative research, phenomenology, grounded theory, ethnography, and case study. Narrative research involves participants sharing their experiences

and interactions concerning a phenomenon, related to the study topic. These stories are then presented in a narrative account, allowing readers to derive meaning from them (Yin, 2018).

Grounded theory is another approach where the researcher develops a general theory or conceptual framework by consulting the perspectives of multiple participants regarding a phenomenon. Data collection occurs in stages and is refined and integrated into meaningful groups or themes relevant to the study topic (Neuman, 2011; Creswell, 2018).

Phenomenological research focuses on exploring past phenomena through the experiences of research participants. Advocates of this approach argue that human interests shape science and that the world is socially constructed. Although findings may be subjective, the researcher is considered part of the world being studied (Sorensen & Walker, 2018; Kar & Ramalingam, 2013).

Ethnography involves the study of common patterns of language, actions, and behaviours within a specific context over a given period. This research design typically employs observations and interviews to gain a deeper understanding (Creswell, 2018).

Case study, as explained by Yin (2018), involves a thorough evaluation of a specific case, which can be an event, process, program, or individual. Various data collection techniques can be employed over a specific period to gather comprehensive information (Creswell, 2018).

Considering these different design approaches, the adoption of a research strategy depends on the specific objectives and the strengths and weaknesses associated with each approach (Yin, 2018; Neuman, 2011; Creswell, 2018). The adoption of a research strategy that would better achieve the study objectives was determined after considering the principles, strengths, and weaknesses of the various design strategies discussed. The study adopted a phenomenological research approach because it aims at identifying people's perspectives, understanding, and perceptions of the phenomenon under study (Edmonds & Kennedy, 2017; Ritchie, Lewis, Nicholls & Ormston, 2013; Marshall et al., 2013). Real-life settings in qualitative research enable researchers to gain a better understanding of the phenomenon being studied, resulting in more valid and less artificial results (Sorensen & Walker, 2018; Emmel, 2013; Doody & Noonan, 2013).

4.8.2 Quantitative research

The research also employed a quantitative approach to gather and analyse data related to the research objectives. This method involves the collection of numerical data that can be statistically analysed (Sekaran, 2015; Neuman, 2011). The quantitative research approach assumes that the phenomenon being studied can be observed and measured (Mvubu, 2018). In this study, a questionnaire with structured questions was used as the data collection instrument to gather knowledge about the parameters of interest, namely residents' perception, residents' satisfaction, and residents' behaviour on reverse logistics activities, waste management, and sustainability. The gathered facts played a crucial role in providing a better understanding of these concepts. The statistical software SPSS version 26 was used to analyse the data, particularly applying inferential statistics to test the relationships between the study variables.

Kothari (2004) argues that the quantitative research practice involves thorough statistical assessment conducted in a coherent, reliable and fixed approach. Creswell (2018) explains that the objectivity of theories is tested using the quantitative research approach through the measurement of variables using instruments, allowing for theory testing and control of alternative explanations. Saunders et al. (2012) suggest that quantitative research contributes to the development of theory by employing scientific approaches that align with the positivist perspective. The emphasis on objectivity and the ability to replicate findings gives the quantitative research approach an advantage (Sekaran & Bougie, 2016). Creswell (2018) proposes two types of research designs falling under the quantitative technique: surveys and experiments.

Survey research involves obtaining quantitative and numeric descriptions of trends, attitudes, and individual views from a sample of participants (Creswell, 2018). Questionnaires are commonly used as the instrument for data collection in cross-sectional or longitudinal studies, with the aim of generalising findings to the entire population.

Experiments, on the other hand, are used to test the effects of treatments on outcomes. One group receives the treatment while another group does not, and the outcomes of both groups are observed (Creswell, 2018).

In this study, a quantitative survey approach was adopted to gather information from households regarding their attitudes and behaviours toward solid waste management in their residential

areas. The quantitative approach was selected in this study because of its ability to address the shortcomings of the qualitative approach (Odewole, 2024). In addition, the quantitative approach can be designed well to permit easy collection of data and its analysis, thereby articulating the evidence of the study findings (Braun & Clarke, 2020; Bryne, 2022). A structured questionnaire was used as the data collection instrument, and the data were entered into an Excel Spreadsheet for interpretation, drawing conclusions, and providing recommendations.

4.9 Qualitative phase of the empirical research

The qualitative research technique employed in this study is not focused on seeking generalisation of the findings to a wider population (Sutton & Austin, 2015). To maintain ethical standards in the research process, the researcher took several measures. At the beginning of each interview session, participants were assured that their identities and the information they provided would be kept confidential. Furthermore, an Ethical Clearance letter was obtained from the university's Ethics Committee to emphasise the commitment to research ethics. The researcher also sought guidance from supervisors at regular intervals to ensure the interviews were conducted in an organised manner. These measures were implemented to ensure the ethical conduct of the study and protect the rights and privacy of the participants.

4.9.1 Interview instrument

This study utilised a semi-structured interview guide as an instrument for gathering information from participants. Interviews were chosen as the preferred method due to their widespread use, trustworthiness, and the opportunity they provide for direct communication, immediate feedback, and clarification. The semi-structured interview guide was designed to elicit information from the interviewees regarding municipal solid waste management, enabling the researcher to gain insight into the thoughts and feelings of the participants and develop a clearer understanding of the behaviours and attitudes of local governments and households towards solid waste management (Sutton & Austin, 2015).

In successful interviews, a semi-structured interviews approach is often adopted, focusing on the respondent's beliefs, values, experiences, perspectives, and understanding of the topic. Open-ended questions were utilised to avoid bias and allow interviewees the freedom to respond without constraint. Unlike quantitative data, which may not provide insights into the reasons and

rationale behind a phenomenon, qualitative techniques delve deeper and offer explanations for behaviours. Sutton and Austin (2015) emphasise that while quantitative research reveals how many people agree or disagree with a particular statement, qualitative research seeks to understand why people display certain behaviours. In this study, the researcher aimed to uncover some of the reasons why local government authorities fail to collect solid waste regularly. By employing qualitative research principles, the study examined a wide range of household attitudes and behaviours towards local government authorities in relation to solid waste management within their respective areas.

Construction of the interview guide was guided by research objectives four and five which the study sought to fulfil using the qualitative approach. The literature review about sustainability and reverse logistics of municipal solid waste helped in shaping the research objectives. The target audience of the instrument used in the qualitative approach was municipal authorities whose knowledge about sustainability and reverse logistics of municipal solid waste was considered important. The structure of the instrument began with warm-up questions whose aim was to engage the participants in the conversation. The questions sought to further probe when participants started working for the municipality and what their duties in municipal solid waste management were. Questions were designed such that they would allow for probing and they were simple and clear. After designing the first draft of the interview guide, the instrument was tested on colleagues to subject it to criticism and remove unnecessary questions.

4.9.2 Preparing for data collection (Qualitative Approach)

The preparation for data collection involved selecting the appropriate method for conducting interviews. Burnard, Gill, Stewart, Treasure and Chadwick (2008) distinguish between three types of research interviews: unstructured, semi-structured, and structured. Structured interviews utilise a predetermined set of questions for data collection, while unstructured interviews do not follow any preconceived theories and allow for more open-ended exploration of a phenomenon. In between these two approaches lies the semi-structured interview, which combines the advantages of both methods. The study employed the semi-structured approach to benefit from the flexibility of probing for more information while still maintaining some control over the data collection process. The researcher had the ability to intervene when necessary to steer the discussion back towards the purpose of the interview.

Interviews are believed to provide a deeper understanding of the factors surrounding a study topic and offer insights into the phenomenon under investigation (Gibson et al., 2000). They allow for the exploration of an individual's unique experiences, beliefs, views, and motivations, leading to a deeper understanding of the social phenomenon being studied (Gill et al., 2008). Active listening skills, including non-verbal cues such as nodding or maintaining eye contact, are crucial during research interviews as they demonstrate attentiveness to the interviewee's words.

To ensure clarity and avoid confusion during the interviews, the researcher conducted rehearsals of the questions to be asked. The questions were designed to be open-ended and neutral, and they were arranged in a logical sequence, starting with easy questions before moving on to more complex ones. This approach allowed the respondents to initially relax and gain confidence before delving into more challenging topics. The researcher aimed to keep each interview within a timeframe of twenty to forty minutes.

Prior to conducting the interviews, appointments were made with the relevant personnel in the solid waste management section of the local government authorities. Informing the respondents about the interviews in advance helped prepare them for the process and increased the likelihood of obtaining honest answers. Providing participants with information before the interview is part of the informed consent principles, which grants participants the right to be aware of the study and to withdraw from the interview at any time should they feel uncomfortable or threatened.

4.9.3 Data collection

Data collection is a crucial process that often generates large volumes of data (Sutton & Austin, 2015). Various methods have been suggested for collecting data through interviews, such as audio recording, video recording, and taking notes. In this study, audio recording was employed as the primary method of data collection. Prior to recording, the researcher informed and obtained consent from each participant regarding the recording of the interview. This ensured transparency and respect for ethical considerations.

In addition to audio recordings, field notes were taken during the interview process. These notes were carefully recorded without interfering with the flow of the interview or causing any disruptions to the participants. Field notes served as a valuable supplementary resource during the data analysis phase, as they helped the researcher recall important events, observations, and

nuances from the interview sessions. The notes provided additional context and details that supported the analysis and interpretation of the data.

4.9.4 Analysing data

In this research, a strong commitment to honesty and respect for the views of the participants was maintained, as emphasised by Sutton and Austin (2015). The analysis of the data collected through the interviews began by transcribing the participants' voices into written text. This transformation from spoken words to written text enabled a deeper engagement with the data and facilitated the learning process.

The analysis of the data followed a phenomenological approach, which was deemed essential in understanding the behaviour of local government authorities in relation to solid waste management. The phenomenological approach aligns with the belief that behaviour is socially constructed, implying that individuals engage in certain actions and behaviours based on their understanding of societal expectations and norms. In interpreting the data, the researcher skilfully considered the perspective and position of the participants, aiming to understand and present their narratives from their own point of view.

By adopting a phenomenological approach and acknowledging the social constructivist theory, this research sought to gain insights into the experiences, beliefs, and motivations that shape the behaviour of local government authorities in relation to solid waste management. This approach allowed for a deeper understanding of the participants' perspectives and provided valuable insights into the complex dynamics at play in the context of the study.

4.9.5 Categorisation

In line with Saunders (2010), the data collected using qualitative techniques in this research underwent a process of categorisation into meaningful descriptive classes to facilitate data analysis. The research objectives and the conceptual framework provided guidance in organising the empirical data gathered through qualitative interviews into various categories that aligned with the research goals.

Before carrying out the interviews, participants were presented with an Informed Consent form, which sought their permission to record the interviews. The semi-structured in-depth interviews

were audio recorded, and later transcribed verbatim, ensuring that the participants' voices and perspectives were accurately captured.

To make sense of the collected data, the researcher engaged in a process of organising the transcriptions into coherent and meaningful categories that were appropriate to the study objectives. This categorisation permitted a systematic discovery of the data and facilitated the identification of patterns, themes, and key findings.

In instances where certain information appeared ambiguous or required further clarification, the researcher reached out to the participants for additional insights. This proactive approach helped ensure the accuracy and comprehensibility of the data, as well as provided an opportunity to address any potential misunderstandings or uncertainties.

By categorising the data and seeking clarification when needed, the research aimed to enhance the quality and reliability of the analysis, ultimately leading to a more comprehensive understanding of the phenomenon under investigation.

4.9.6 Unitising data

Also adhering to the approach described by Saunders et al. (2016), the process of unitising data was employed in this study. Unitisation involves attaching related components of data into pre-established categories that have been created based on the research objectives. According to the authors, these components can take the form of individual words, sentences, paragraphs, or any other relevant textual data that aligns with the chosen category.

In this research, handwritten notes were used to transcribe the audio-recorded data obtained from the interviews conducted with the participants. The transcription process aimed to accurately convert the spoken information into written text, ensuring that the data could be easily analysed and interpreted. To maintain a high level of transparency and rigor in the reporting of findings, the transcription process was carried out with the assistance of an experienced research supervisor, who provided guidance and ensured the fidelity of the transcribed data.

Once the data had been transcribed, a thorough reading and re-reading of the transcriptions were conducted to identify themes and patterns within the data. This involved a process of coding the primary findings, which entailed assigning labels or codes to specific segments of the data that captured key concepts, ideas, or phenomena. These codes were then organised into categories,

forming descriptive themes that represented meaningful clusters of related information. Finally, the themes were further developed and analysed to gain a deeper understanding of the data and to draw insights and conclusions relevant to the research objectives.

By employing this systematic process of content analysis, the study aimed to ensure the comprehensive examination of the data and the identification of significant themes and patterns that emerged from the participants' narratives. This approach facilitated the interpretation and synthesis of the qualitative data, allowing for a rich and nuanced understanding of the phenomenon under investigation.

4.9.7 Writing up the findings

In this study, the data collected through qualitative techniques were subjected to analysis, presentation, and discussion to derive meaningful interpretations and insights. Prior to data collection, a thorough literature review was conducted to gain a comprehensive understanding of the study topic. This literature review served as a foundation for designing the semi-structured interview guide, which was utilised as the primary instrument for gathering data from households who served as participants in the study.

4.9.8 Trustworthiness

The study aimed to ensure trustworthiness by considering the criteria proposed by Guba (1981) and further elaborated by Lincoln, Lynham and Guba (2011). Credibility was addressed by taking the necessary steps to measure and test what was expected in the study. This involved conducting field visits, observing relevant phenomena, using multiple approaches, and cross-checking data. By exploring data collection strategies and ensuring transparency in coding procedures, the study aimed to establish credibility. The use of a comprehensive literature review and semi-structured interviews contributed to the credibility of the study, as they provided a solid foundation and detailed insights into the research topic. Informing participants about the study objective and giving them the opportunity to refuse participation further enhanced credibility.

Transferability refers to the possibility of applying research findings to other contexts. The study made efforts to clearly explain the entire research process, including the objective, methodology, presentation, and analysis of results. By providing sufficient information about the perceptions

and behaviours of households towards solid waste management, the study aimed to facilitate the transferability of findings to similar or related scenarios.

Dependability was addressed by ensuring that the research process could be repeated to produce similar results. The researcher provided a clear account of how data were collected, recorded, analysed, and stored, allowing for an audit trail of the entire process. Using the same instrument, the semi-structured interview guide, and following a consistent procedure for conducting interviews further enhanced dependability.

Confirmability refers to the extent to which the study findings reflect the participants' ideas and experiences rather than the researcher's biases. By following rigorous data analysis procedures and interpreting the data based on the participants' perspectives, the study aimed to establish confirmability.

By considering these four criteria of trustworthiness, the study aimed to ensure the credibility, transferability, dependability, and confirmability of its findings. This approach enhances the quality and reliability of the research, making it valuable for future reference and application.

4.10 Quantitative phase of the empirical research

Quantitative techniques employ a range of statistical and mathematical tools and methods to gather, analyse, and interpret numerical data within a study (Murgan, 2015). This approach is widely utilised across various disciplines, including social sciences and business studies. Quantitative research is characterised by its emphasis on hypothesis testing, as well as the use of techniques such as regression analysis, multivariate analysis, and factor analysis to generate predictions and draw general conclusions about the phenomenon under investigation (Foddy, 2010). Kaiser-Meyer-Olkin (KMO) a measure of sampling adequacy (Shrestha, 2021) and Bartlett’s tests of sphericity (Thao, Tan & Tuyet, 2022) on residents’ perceptions and satisfaction were used in the study. Tekler, Low, Chung and Blessing (2019) point out that Bartlett’s tests are appropriate for evaluating whether data is suitable for exploratory factor analysis. High factor loadings that are close to one (1) are an indication of strong relationships. Factor analysis is a multivariate statistical technique applied to a single set of variables to determine which variables form logical sub-sets within that set (Pituch & Stevens, 2016).

4.10.1 Designing the questionnaire

According to Murgan (2015), questionnaires are commonly used as instruments to gather information in research studies. Foddy (2010) further categorises questionnaires into three types: structured, semi-structured, and unstructured. Structured questionnaires are particularly useful for collecting quantitative information as they can be pre-coded with response options such as "strongly disagree," "disagree," "neutral," "agree," and "strongly agree" (Foddy, 2010). Each response was assigned a numerical code, such as 1 for "strongly disagree" and 5 for "strongly agree." In structured questionnaires, respondents are typically provided with closed-ended questions, where they select an option by ticking a box or circling a number that best represents their response (Sansoni, 2011). The questionnaire was designed to address research objectives one, two and three. These objectives were developed after a review of the literature related to households' perceptions, attitudes and practices on municipal solid waste management. It was given to experts in supply chain, environmental science and statistics to examine the flow of questions and their relevance to the study area. Questions which were deemed irrelevant were removed and others which had been considered were left out, but essential ones were added.

In this study, a structured questionnaire was employed to gather information from the participants. The questionnaire consisted of four sections. Section A collected demographic information, including gender, age, level of education, and duration of residency. This data was used to analyse participant attributes, such as household composition and family roles (e.g., mother, father, child). Section B of the questionnaire contained items related to participants' perceptions of municipal practices, specifically the frequency of solid waste collection by municipal authorities. Participants were asked to rate their agreement on a six-point Likert scale, ranging from "strongly disagree" to "strongly agree." Section C focused on participants' satisfaction levels with municipal solid waste management. The Likert scale included options such as "extremely dissatisfied," "dissatisfied," "slightly dissatisfied," "slightly satisfied," "satisfied," and "extremely satisfied." Lastly, Section D aimed to gather information about residents' opinions and practices regarding solid waste management, including knowledge of waste types and quantities. The questionnaire used in the study is provided in Appendix E of this thesis.

4.10.2 Pilot study

According to Coon (2014), constructing a questionnaire as a research instrument requires careful attention to detail. However, it is possible for mistakes or unclear statements to be identified at a later stage. To address this, Babbie (2012) recommends conducting a pilot study before distributing the questionnaire on a larger scale. This step was indeed followed by the researcher in this study to ensure that respondents would fully understand the questions without the need for additional clarification or having to skip certain questions due to ambiguity. The pilot study allowed for any necessary revisions or refinements to be made to the questionnaire before its full distribution. The results of the pilot study were not included in the final analysis of the findings.

4.10.3 Preparing for data collection (Quantitative Approach)

As part of the data collection preparation for this study, the researcher obtained permission to conduct the research in municipalities from the local government authorities. Gatekeeper's letters were obtained from the respective authorities to demonstrate that permission was granted to the researcher. These documents have been included in Appendix G of the thesis.

4.10.4 Data collection

The process of collecting data in this study commenced with an extensive literature review of textbooks, academic journals, theses, and dissertations on solid waste management. The review followed a funnel approach, starting with a generalised exploration of literature at the global level and gradually focusing on the specific area of study. This literature review provided secondary data for the study.

For primary data collection, a concurrent method was used. Quantitative data was gathered using a self-administered questionnaire distributed to the participants. The questionnaire aimed to gather information related to the first three objectives study. Interviews were conducted with local government authorities to address research questions number four and five concerning reverse logistics and sustainability. It should be noted that household participants were not able to provide answers to the predictors in the interview guide.

The data collection period spanned two weeks, during which hard copies of the questionnaire were left with the respondents to allow sufficient time for completion. Street names and

addresses of the households where the questionnaires were distributed were recorded to facilitate easy identification during the data collection process.

4.10.5 Response rates

Data collection often presents challenges, including the issue of a poor response rate, which refers to the proportion of individuals who provide complete answers to the questions compared to the total number of questionnaires initially sent out. Cooper and Schindler (2015) emphasise that respondents' motivation to participate in research can be influenced by various factors, including the skills and confidence of the researcher. In this study, the researcher made efforts to engage participants through both qualitative and quantitative approaches, ensuring that the language used was clear and comfortable for them and that they understood the purpose and objectives of the study.

4.10.6 Analysing questionnaires

Data analysis in this study involved the use of Microsoft Excel spreadsheet to analyse the collected data. The following statistical tests were carried in the study:

a. Descriptive statistics: The primary purpose of descriptive statistics is to provide a generalised description of the characteristics of the collected data. Quinlan (2011) refers to this set of data as a simple summary of the study sample. Descriptive statistics typically include measures such as means and standard deviations, which are applicable to the specific dataset. Frequency tables and graphs were utilised to present these data in a suitable manner (Sekaran & Bougie, 2014; Der & Everitt, 2011).

b. Binomial test: The binomial test is employed when an experiment has two potential outcomes, such as yes or no. This test requires the tested variable to be numeric or dichotomous in nature. Hothorn and Everitt (2014) suggest that string variables can be converted to numeric using an automatic recode method.

c. One-sample t-test: T-tests are commonly used to compare mean scores of continuous-level (interval or ratio) data that are normally distributed (Der & Everitt, 2011). A one-sample t-test serves various purposes, including testing against a predefined value, an expected value, common sense expectations, or the results of a replicated experiment compared to the original study (Der & Everitt, 2011). In this study, a one-sample t-test

was employed to compare the findings against a scalar value, specifically the central value of the Likert scale.

d. ANOVA (analysis of variance): ANOVA is utilised to compare means of a variable across three or more groups in a study (Moder, 2010; Wuensch, 2009; Moder, 2007). In this study, ANOVA was employed to test for significant differences in the average attitudes and behaviours of households towards solid waste management.

e. Pearson's correlation: Pearson's correlation is used to assess the strength of a linear association between two interval variables, represented by the correlation coefficient 'r' (Quinlan, 2011). Values of Pearson's correlation closer to either +1 or -1 indicate the strength of the positive or negative relationship, respectively (Sansoni, 2011).

f. Factor analysis was utilised in the study to reduce the number of variables to a smaller set through identification of redundant and overlapping items for each predictor (Hair, Anderson, Tatham & Black, 2018). Factor analysis was linked to research objectives one, two, and three.

Descriptive statistics tests were conducted in this study to ensure accurate interpretation of the data and to establish meaningful relationships rather than mere chance occurrences. Descriptive statistics provided detailed profiles of the respondents. Inferential statistics were utilised to infer the significance of attitudes and behaviours of households towards solid waste management.

4.11 Validity and reliability considerations

Validity and reliability are essential considerations when evaluating the quality and credibility of a measurement tool in research. Cooper and Schindler (2015) emphasise that validity refers to the degree to which a measuring instrument accurately assesses the construct or concept it intends to measure. In other words, a valid measurement tool should accurately capture the true differences or variations among the participants being tested. It ensures that the measurement tool effectively represents the intended concept and provides meaningful and accurate data.

On the other hand, reliability pertains to the consistency, precision, and accuracy of a measurement procedure. It focuses on the stability and reproducibility of the results obtained from the measurement tool. A reliable measurement tool produces consistent outcomes when applied to the same participants or under similar conditions. It ensures that the measurement tool

yields dependable and trustworthy data. Considerations made for this study in respect of these two aspects are explained in turn below.

4.11.1 Validity

Validity is a critical aspect of measurement tools used in research, as it determines the extent to which the instrument accurately assesses the intended construct or concept (Cooper, Schindler & Sharma, 2018). The concept of validity encompasses both external and internal validity. External validity refers to the generalisability of the research findings beyond the specific sample and context, allowing for inferences across different times, settings, and individuals. In this study, the sample was drawn from selected local government municipalities in Zimbabwe, under the Ministry of Local Government, with the aim of generalising the findings to other similar municipalities.

On the other hand, internal validity focuses on the causal relationship between variables. It examines whether the measurement tool effectively captures the intended cause-and-effect associations. In this study, the aim was to explore the effects of reverse logistics activities and municipal solid waste management decisions on sustainability in local government municipalities.

Cooper and Schindler (2015) propose three types of validity: content validity, criterion validity, and construct validity. Content validity refers to the extent to which the measurement instrument adequately represents all the relevant items under study. Criterion validity assesses whether the instrument can capture the essential characteristics of the phenomenon being measured. Construct validity aims to detect and measure the underlying concepts being evaluated and examines how well the measurement instrument embodies these concepts.

To establish the credibility of the measurement instrument, various methods can be employed. Prior research can provide theories and principles to assess the relationships between variables. Nomological validity, for example, can be used to determine if the scale demonstrates the expected associations based on theoretical assumptions and previous research. Convergent validity, as defined by Churchill (1979), involves a cluster of measurements that accurately characterise the structure of the construct and assesses the degree of factor loadings' significance.

Higher correlations among dimensions of the same construct indicate that the measurement tool effectively captures the intended concept.

To ensure accuracy and consistency in the questionnaire, it was derived from the conceptual framework guiding the research study. Pilot testing with experts in solid waste management and reverse logistics helped identify and eliminate any ambiguous or repeated questions, ensuring the instrument's quality before distributing it to the participants. Additionally, several statistical tests such as Cronbach's Alpha, Bartlett test, multicollinearity, normality test, and eigenvalues were conducted to assess the reliability and validity of the measurement instrument. By employing rigorous methods to establish validity and reliability, this study ensured the accuracy and meaningfulness of the findings.

4.11.2 Reliability

Reliability is another crucial characteristic of measurement tools in research, assessing the accuracy and consistency of the instrument in measuring the intended construct (Sekaran, 2015). It reflects the ability of the measurement procedure to produce consistent results when applied repeatedly or by different investigators (Hair, Anderson, Tathan & Black, 1998). Ghauri and Gronhaug (2010) define reliability as the ability of a questionnaire to reproduce the same study pattern and generate consistent outcomes, while Saunders et al. (2016) emphasise its role in ensuring the relevance, precision, and simplicity of the findings.

To establish the reliability of the questionnaire in this study, several steps were taken. Hair et al. (1998) describe reliability as the degree of internal consistency among the values of a construct, indicating how well they represent the underlying concept. It involves assessing the consistency of results obtained from the measurement instrument. The stability of the research instrument was ensured by distributing the same questions to the sample population, even though they were in two languages (English and Shona, a local language). This consistency helped eliminate potential participant error and bias.

In order to address participant error, the researcher provided sufficient time for participants to respond, allowing them to carefully consider their responses over a two-week period. This approach aimed to minimise any rush or hasty answers that might have compromised the accuracy of the data. To mitigate researcher bias, triangulation was employed by obtaining

perspectives from both service providers (municipality employees) and recipients of the service (residents), ensuring a balanced assessment.

Reliability assessment involves two levels: item reliability and construct reliability (Cooper & Schindler, 2008). Item reliability examines the extent to which an item's variation is attributable to the underlying concept being measured, rather than measurement error. This is measured through the square of factor loadings, with values above 0.50 (Chau, 1997) or 0.70 (Chin, 1998) considered reliable.

Construct reliability, on the other hand, focuses on the consistency and stability of the measurement instrument in measuring the intended construct. It can be assessed through techniques such as factor analysis. Bryman and Bell (2014) note that while the use of core stability techniques aids in establishing the trustworthiness of the research instrument, the aim is to reduce variables to manageable levels. Dancey and Reidy (2002) suggest that a sample size of at least 100 participants is generally sufficient for factor analysis.

Cronbach's Alpha test was performed on the quantitative data to evaluate how reliable the items used for the constructs were. Cronbach's Alpha measures the internal consistency of a dataset, with values ranging from 0 to 1 (Sekaran and Bougie, 2016). An alpha coefficient above 0.70 is considered acceptable for satisfactory internal reliability (George & Mallery, 2013), although values below 0.70 may be acceptable in exploratory research (Hair, Babin, Money & Samouel, 2003). A Cronbach's Alpha value between 0.65 and 0.95 is generally deemed satisfactory for testing the reliability of quantitative data (Chua, 2013).

4.12 Summary

This chapter presented the methodology employed in the study. The research design was discussed, providing a clear picture of the research type, the scope of the study, the methods of data collection used, and how the data were presented and analysed. The problem statement of the study was revisited and highlighted. Data collection was described, encompassing both qualitative and quantitative approaches. The next chapters present and analyse the findings, beginning with the quantitative results.

CHAPTER FIVE

ANALYSIS AND DISCUSSION OF THE QUANTITATIVE RESULTS

5.1 Introduction

In this chapter, the results of the quantitative data collected from households in the selected municipal areas are presented. The data collection process utilised a structured questionnaire as the instrument. The questionnaire was administered in three selected municipalities that were further divided into performing and non-performing areas. A performing municipality refers to the state of municipal solid waste that is not lying around in the area and non-performing refers to municipalities with physical evidence of municipal solid waste lying around. Nhubu and Muzenda (2019) prefer to structure residential areas as either low density suburbs or high-density suburbs. Practical matters that delineate performing areas from non-performing areas include: waste collection efficiency; cleanliness and hygiene as evidenced by the presence of litter and waste within residential areas; the degree of complying with regulations; how engaged residents are in solid waste management; and the impact of solid waste on the environment. The chapter is organised into four main sections: response rate, data processing, research results, and hypotheses. Each section is interconnected, building upon the previous and leading to the subsequent section.

5.2 Response rate

A total of 450 questionnaires were distributed to households, and 340 questionnaires were returned, resulting in a response rate of 76%. Out of the returned questionnaires, 12 were found to be unusable, leaving a total of 328 questionnaires (73%) that were included in the analysis. The response rate of 76% exceeded the recommended threshold of 70% proposed by Mangione (1995), indicating a favourable level of participation.

The high response rate can be attributed to several factors. Firstly, the researcher effectively communicated the purpose of the study to the households, emphasising the aim of improving environmental conditions and reducing the spread of diseases associated with inadequate solid waste management. This likely motivated households to participate in the study. Additionally, the wording of the questionnaire was simplified after testing it among experts in the field of environmental management (Bryman & Bell, 2015). This ensured that the questionnaire was

clear and easily understandable to the respondents. The structured questionnaire was designed in a way that the sections progressed from simpler to more complex questions, aiding comprehension for the respondents.

5.3 Data processing

The collected data from the respondents were entered into SPSS for analysis. The questionnaire was designed to provide multiple-choice options for each question, allowing respondents to indicate their level of agreement or disagreement by ticking the appropriate box. According to Bryman and Bell (2015), closed questions with predefined choices facilitate quantitative data processing. For instance, the choices provided in the questionnaire ranged from strongly disagree to strongly agree, allowing for an assessment of the distribution of responses. The returned questionnaires were organised based on the respective areas of administration (performing or non-performing area) and numbered sequentially from one (1) to three hundred and twenty-eight (328), representing the last fully completed questionnaire.

5.4 Research results

In the following, the results of the quantitative data collected are presented, providing a comprehensive analysis of the responses from respondents. To create a comfortable and open environment for the respondents, it was important to gather information about their profiles, which helped establish a context for their participation in the self-administered questionnaire.

5.4.1 Profile of respondents

The first section of the results focuses on the demographics of the respondents, including their gender, age, level of education, position in the family (father, mother, son, or daughter), and the number of years they have been staying in their current residential place.

5.4.1.1 Gender of respondents

In terms of gender, a pie chart (Figure 5.1) was utilised to visually represent the distribution of respondents. This chart was chosen as it is an effective way to present complementary variables, allowing for easy analysis of the percentage of each gender in the collected data.

Figure 5.1 illustrates that 65% of the respondents were female, while 35% were male. The gender representation observed in the study reflects the complexities and multifaceted nature of gender dynamics. It is important to note that there is no universal explanation for these disparities, as they are influenced by various factors. Societal norms play a significant role, as they often assign traditional caregiving responsibilities to women. Results of the study that women have a large percentage coincide with findings by Mukhurji, Sekiyama, Mino and Chaturvedi (2016) who posit that gender roles assigned to women include household activities that are closely engaged with solid waste management. This can either limit or increase their opportunities for participation in research studies or other activities outside the home. Additionally, unequal access to education opportunities can contribute to gender disparities. In some societies, parents and guardians may prioritise the education of boys over girls, leading to unequal educational attainment. Mak, Iris and Tsang (2020) posit that gender has an impact on how an individual perceives and engages in solid waste management, for in their study, they established that women had positive perceptions and were more engaged than men.

Work-life balance is another factor that can impact gender representation. Women may face greater expectations and responsibilities related to household and family care, which can limit their availability to participate in studies or other activities outside the home. It is important to recognise that these reasons are diverse and can vary across different contexts. They contribute to the observed higher representation of women in this study, as they might have been more available or accessible during the data collection period.

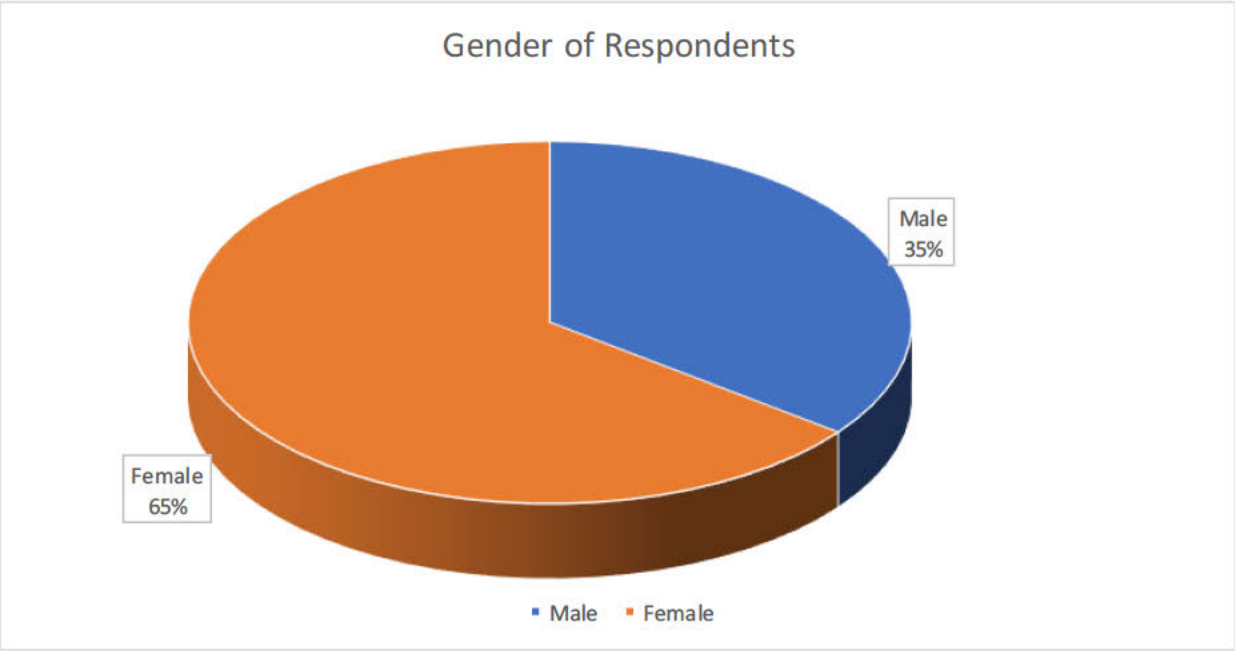

Figure 5.1: Gender of Respondents

5.4.1.2 Age of respondents

Table 5.1 provides an overview of the age distribution among the respondents. The largest proportion, comprising 54.3% of the participants, fell within the age range below 30 years. Following that, the age range of 31-40 years accounted for 22.9% of the respondents. The remaining age groups (41-50 years, 51-60 years, and above 60 years) are not specified in the table. However, it is worth noting that the percentage of respondents above 60 years of age was the smallest.

Table 5.1: Age of Respondents

Age Group		Frequency N=328	Percent	Cumulative Percent
Valid	Up to 30	111	33.8	33.8
	31-40	75	22.9	56.7
	41-50	74	22.6	79.3
	51-60	58	17.7	97
	Above 60	10	3.0	100
	Total	328	100	

These findings suggest that the majority of the respondents in the study were relatively young, with a significant concentration below the age of 30. The distribution reflects the composition of the sample and provides insights into the age demographics of the respondents involved in the study.

5.4.1.3 Qualifications

These findings suggest that a considerable portion of the respondents in the study had acquired higher education qualifications, reflecting the impact of educational initiatives and the importance placed on education in Zimbabwean society. Table 5.2 presents the qualifications of the respondents.

Table 5.2: Level of Education

Level of qualification		Frequency	Percent	Cumulative Percent
Valid	Primary	23	7.0	7.0
	Secondary	104	31.7	38.7
	Tertiary	201	61.3	100.0
	Total	328	100	

As the Table shows, the largest percentage, accounting for 61% of the respondents, possessed tertiary education. This indicates that a significant proportion of the respondents had completed higher education or obtained a degree from a university or college. Following that, 32% of the respondents had attained secondary education, indicating completion of high school or an equivalent level of education. The smallest percentage, 7% of the participants, had primary education, signifying completion of primary school.

It is worth noting that the Zimbabwean government, particularly after independence, promoted education for all citizens. However, due to economic challenges, funding for tertiary education has been reduced over time, resulting in limited support for university students.

5.4.1.4 Position in the family as household head

The results presented in Figure 5.2 illustrates the distribution of respondents based on their position in the family. The term ‘position’ in the family was preferred in the study more than

'household head' because the literature does not agree on a clear definition (Posel, 2001). The term household head has been used in surveys to refer to a member of the family who makes the majority of decisions for the good of the household but in other cultural set-ups, the term refers to an older member of the family (Posel, 2001). The data reveals that mothers accounted for the highest percentage, with 58% of the respondents identifying themselves as mothers. This suggests that a significant proportion of the respondents were female household heads or played a prominent role in managing their households. Following mothers, 30.5% of the respondents identified themselves as fathers, indicating their position as male heads of the family. Sons and daughters had the lowest representation, with 5.5% and 5.8% respectively. This indicates that children, both sons, and daughters, had a relatively minor role in household decision-making and management.

The findings suggest that the responsibility for running the family often falls to women, even when the husband is present. Women play a significant role in managing households and assuming leadership positions within the family structure. The lower representation of sons and daughters indicates that children are not typically tasked with household responsibilities, except in cases where the parents have retired, relocated to rural areas, or in unfortunate circumstances such as parental death.

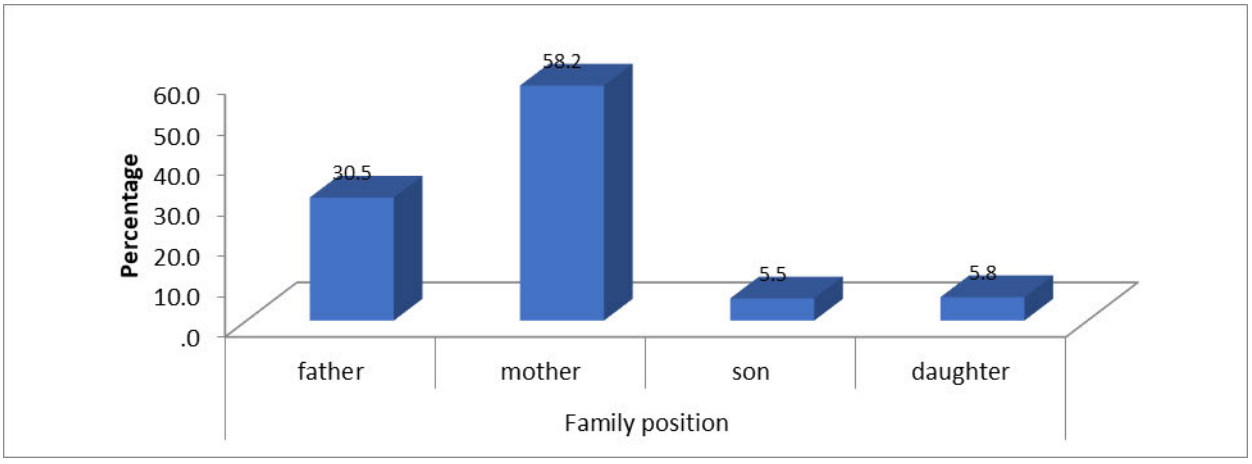

Figure 5.2: Position of Respondent in the Family

5.4.1.5 Number of years stayed at the present residence

The data on the number of years of residency is valuable for understanding the respondents' level of familiarity with their surroundings and their experiences with solid waste management over time. It provides a basis for examining any potential correlations between the duration of residency and attitudes or behaviours towards solid waste management practices.

Figure 5.3 provides insights into the length of time respondents had stayed at their present residential place. The results indicate that 25% of the respondents reported staying at the same place for more than 20 years. This suggests a long-term residency and the potential for observing persistent patterns in the behaviour of municipal authorities and the attitudes of respondents towards solid waste management. The second largest group, comprising 23.5% of the respondents, reported staying at the same place for a duration between 15 and 20 years. This indicates a significant proportion of respondents who have been residing in their current location for a substantial period.

On the other hand, the lowest percentage, 15.5%, represented respondents who had stayed at the same place for a duration between 10 and 15 years. This group may have had relatively shorter exposure to the local environment and the waste management practices carried out by the municipal authorities.

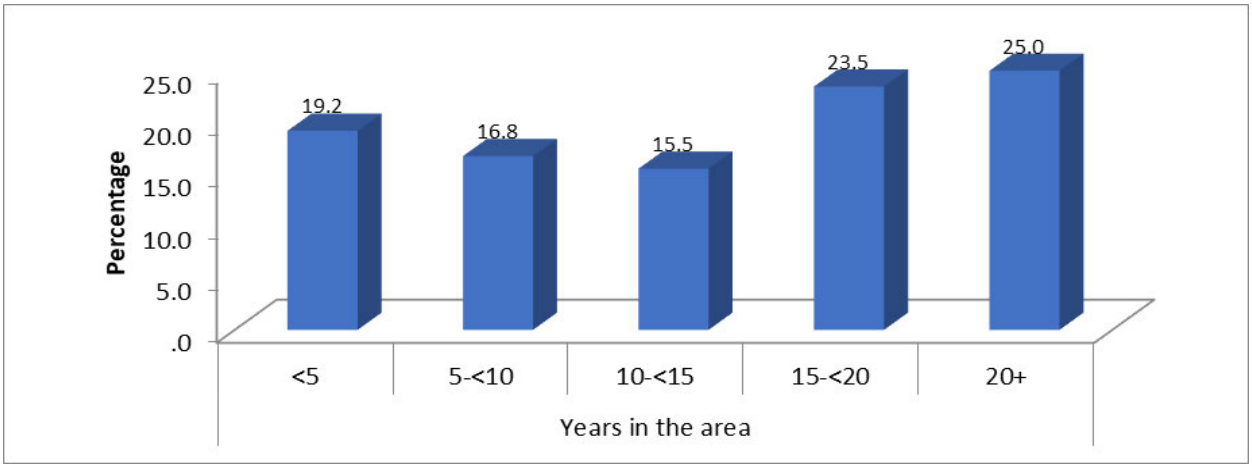

Figure 5.3: Number of years stayed at current residence.

5.5 Discussion on results of research objectives

The following sections discuss the results of the quantitative data collected to address the objectives of the study. Fifty-nine items were used to solicit for information from respondents. These items were measured on a six-point Likert scale which ranged from 1 to 6 (1= strongly disagree; 2= disagree; 3= slightly disagree; 4= slightly agree; 5= agree; and 6= strongly agree).

5.5.1 Perceptions of households/residents on municipalities' services on municipal solid waste management

The first objective of the study aimed to determine the perceptions of households regarding the services provided by municipalities in relation to solid waste management. A structured questionnaire consisting of ten items was used to gather information from the respondents. The items were rated on a six-point Likert scale, ranging from strongly disagree to strongly agree. The Likert scale was chosen as it allows for a wide range of response options, making it easier to construct and interpret. Likert scale is widely used in social sciences research as it combines several items into a single composite score (Tanujaya, Prahmana & Mumu, 2022). The options were presented in ascending order, from the least favourable to the most favourable agreement.

Descriptive statistics, such as measures of central tendency (mean) and dispersion (standard deviation), were utilised in analysing the responses. The mean provided an indication of the average level of agreement or disagreement, while the standard deviation measured the extent to which the responses varied around the mean (Sekaran & Bougie, 2016). A smaller standard deviation suggested a relatively uniform response, while a larger standard deviation indicated more varied responses.

Table 5.3 presents the findings, showing the level of agreement or disagreement on each item measuring residents' perceptions of municipal practices in solid waste management. All the mean scores obtained for the items were below the neutral score of 3.5, indicating a significant disagreement among the respondents on services provided by municipalities on solid waste management.

The highest mean score of 3.07 was associated with the item assessing whether the municipality attended to complaints raised by residents on municipal solid waste. This mean score suggests that responses from residents were favourable but slightly above the midpoint of the scale,

leaving room for more improvement by municipalities in services they offer. The lowest mean score of 2.91 was related to the item measuring whether the municipality provided education to households on solid waste disposal and the associated health hazards. This suggests that the perception of residents on services they get from municipalities is slightly unfavourable. The result concurs with the findings of Chu, He, Fan, Zhang, Huang and Wang (2021) who contend that education and publicity are important in residents' satisfaction of services from municipalities on waste management. The response by residents to measure their satisfaction on frequency of solid waste collection showed a mean score of 2.96, a value that is slightly below the midpoint. This indicates that responses from residents were slightly unfavourable; therefore the results suggest that frequency of solid waste collection is a factor that satisfies the residents' perceptions of waste management services they receive from municipalities. This affirms Chu et al. (2021) who posit that residents are satisfied if collection of solid waste is conducted on a regular basis.

In terms of standard deviation, the item measuring if the municipality provided receptacles for municipal solid waste had the highest value of 2.092, indicating a considerable variation in residents' perceptions. Conversely, the item assessing if the municipality cleans garbage piles in the streets and open spaces had the lowest standard deviation value of 1.920, suggesting a relatively consistent perception among the respondents.

Table 5.3: Measures of Central Tendency for Perception of Residents on Municipal Practices

	N	Mean	Std. Deviation	Std. Error Mean
2.1 Regularly collects refuse from households according to a schedule.	328	2.96	1.981	.109
2.2 Cleans the garbage that piles up in the streets and open spaces.	328	3.00	1.920	.106
2.3 Educates households on solid waste disposal and associated health hazards.	328	2.91	1.964	.108
2.4 Provides receptacles/bins to residents when needed	328	3.04	2.092	.116
2.5 Educates households on solid waste recycling	328	2.96	2.084	.115
2.6 Attends to complaints raised by residents on solid waste collection	328	3.07	2.017	.111
2.7 Gives households advice on the effect of solid waste on health.	328	3.04	2.046	.113
2.8 Penalises and prosecutes those who violate solid waste management laws/rules	328	3.12	2.037	.112
2.9 Inspects the way solid waste is disposed of in all residential areas.	328	3.05	2.037	.112
2.10 Provides deposit containers and/or places for residents to deposit solid waste	328	3.07	2.029	.112

It is worth noting that the sample distribution consisted of two-thirds from non-performing areas and one-third from performing areas, allowing for a comparison between these two groups. The findings suggest a significant disagreement among residents regarding the practices of municipalities in solid waste management. The data provides insights into specific areas where perceptions differ, such as the provision of deposit containers (mean value of 3.07), education on solid waste disposal and health hazards (mean value of 2.91), and recycling education (mean value of 2.96). Mean values from this study are close to the midpoint in the six-point Likert scale

although a few are on the weak side suggesting that some interventions are necessary to improve residents' perceptions. These findings are essential for understanding the residents' perspectives and can help inform interventions and improvements in municipal solid waste management practices.

Figure 5.4 illustrates a moderate level of disagreement among residents regarding the actions taken by municipalities in relation to solid waste management. The questions asked in this section aimed to determine whether municipalities collected solid waste regularly from residential areas and provided receptacles to residents. It also sought to assess the importance of educating residents on the consequences of mismanaging solid waste, highlighting the responsibility that municipalities should not overlook.

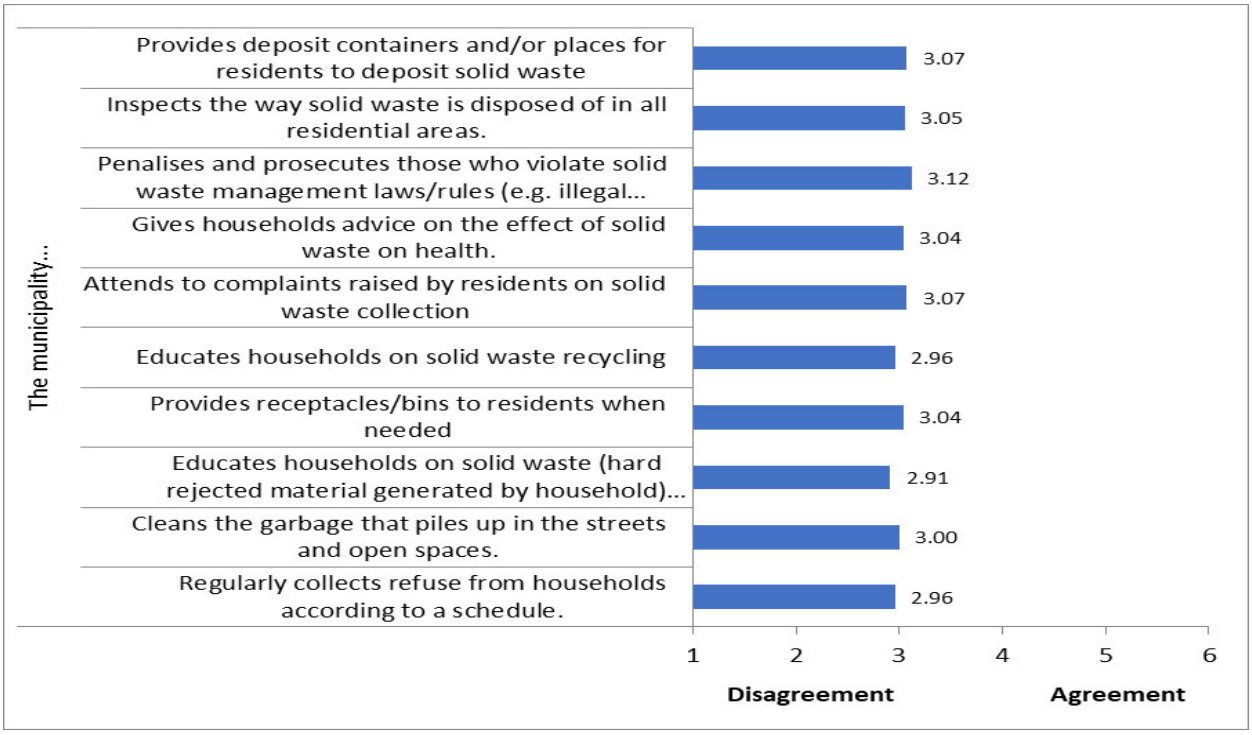

Figure 5.4: Summary of Combined of Residents' Perception on Municipalities

5.5.2 T-test for whole sample (performing and non-performing areas)

However, when the results are analysed separately for non-performing and performing areas, interesting findings emerge. The data that were collected from non-performing areas show a significant level of disagreement among residents regarding the perception of municipal

authorities' actions. On the other hand, the data that were collected from performing areas indicate a significant level of agreement among residents regarding the attitude of municipal authorities. In both cases, the obtained p-values are significant, indicating either significant disagreement or significant agreement.

To further analyse the differences between the mean values and variances in the collected data, a t-test was conducted. Table 5.4 presents the results of the t-test, revealing a negative and significant t-value (-4.905) and a p-value (0.001) for the item that solicited information about the rate of solid waste collection. This indicates that the observed data is unlikely to have occurred by chance and is practically significant, considering that the data were collected from two municipalities performing differently in municipal solid waste management. The obtained p-value (<0.001*) is low, providing evidence against the null hypothesis. Results show that the mean value (2.96) for perception of respondents on the frequency of solid waste collection is below the hypothesised mean value (3.5), suggesting that residents perceive the service from municipalities as below standard and inefficient. This concurs with Olukanni, Pius-Imue and Joseph (2020) who posit that inefficient municipalities negatively influence practices of the public.

Table 5.4: Combined T-test for the two areas (Non-Performing and Performing)

The municipality...	n	Mean (SD)	t	df	p-value
2.1 Regularly collects refuse from households according to a schedule.	328	2.96 (1.981)	-4.905	327	<.001*
2.2 Cleans the garbage that piles up in the streets and open spaces.	328	3.00 (1.920)	-4.688	327	<.001*
2.3 Educates households on solid waste (hard rejected material generated by household) disposal and associated health hazards.	328	2.91 (1.964)	-5.397	327	<.001*
2.4 Provides receptacles/bins to residents when needed.	328	3.04 (2.092)	-3.959	327	<.001*
2.5 Educates households on solid waste recycling.	328	2.96 (2.084)	-4.664	327	<.001*

2.6 Attends to complaints raised by residents on solid waste collection.	328	3.07 (2.017)	-3.833	327	<.001*
2.7 Gives households advice on the effect of solid waste on health.	328	3.04 (2.046)	-4.047	327	<.001*
2.8 Penalises and prosecutes those who violate solid waste management laws/rules (e.g. illegal dumping).	328	3.12 (2.037)	-3.361	327	<.001*
2.9 Inspects the way solid waste is disposed of in all residential areas.	328	3.05 (2.037)	-3.957	327	<.001*
2.10 Provides deposit containers and/or places for residents to deposit solid waste.	328	3.07 (2.029)	-3.810	327	<.001*

5.5.3 One sample statistic for non-performing area

There was also a significant level of disagreement among residents regarding their perception of municipalities' services for solid waste management. Results in Table 5.5 show that the observed mean values for all items used to measure residents' perceptions were below two on a scale of six, indicating unfavourable agreement. The item with the highest mean value of 1.82 pertained to whether municipalities penalised and prosecuted individuals who violated solid waste management laws. This result agrees with the finding of Chu et al. (2021) who point out that the method of charging for waste collection is a factor that indicates how satisfied residents are with waste management services obtained from municipalities. Less difference in level of disagreement was observed on an item which sought to establish whether municipalities offered any education to households on recycling solid waste whose mean value was 1.57. The standard deviation value (0.784) for the same question had the lowest value of 0.784, suggesting that residents had relatively similar perceptions of disagreement regarding municipalities' efforts to educate them on recycling solid waste.

Low mean values in the non-performing area on items that sought to solicit information on the performance of municipal authorities reflect that waste collection and cleanliness in the area are still way below the acceptable levels. The results concur with Anchan (2021) who reiterates that when residents perceive that the responsibility to clean the streets lies with municipalities, they display an attitude of throwing litter anywhere. Henyo, Buor and Odame (2023) posit that a

positive attitude in residents can be cultivated by imparting knowledge and educating them on waste management.

Table 5.5: One Sample Statistic for Non-Performing Area

	N	Mean	Std. Deviation	Std. Error Mean
2.1 Regularly collects refuse from households according to a schedule.	218	1.71	1.028	.070
2.2 Cleans the garbage that piles up in the streets and open spaces.	218	1.78	.955	.065
2.3 Educates households on solid waste disposal and associated health hazards.	218	1.62	.813	.055
2.4 Provides receptacles/bins to residents when needed	218	1.67	.926	.063
2.5 Educates households on solid waste recycling	218	1.57	.784	.053
2.6 Attends to complaints raised by residents on solid waste collection	218	1.76	.911	.062
2.7 Gives households advice on the effect of solid waste on health.	218	1.71	.943	.064
2.8 Penalises and prosecutes those who violate solid waste management laws/rules (e.g. illegal dumping).	218	1.82	1.038	.070
2.9 Inspects the way solid waste is disposed of in all residential areas.	218	1.77	1.076	.073
2.10 Provides deposit containers and/or places for residents to deposit solid waste	218	1.79	1.070	.072

5.5.4 One sample statistic for non-performing area

A two-tailed test was conducted for the area performing well, and the results in Table 5.6 indicate a significant level of agreement among residents regarding the practices of the municipality in solid waste management. All the items used to measure residents' perceptions received mean values greater than 3.5, indicating agreement, implying that households had positive perceptions on municipal authorities' services towards municipal solid waste. For

example, the mean value for the measure of residents' perception on municipalities providing receptacles or bins to residents when needed had a value of 5.76, implying that almost all respondents agreed. This result concurs with the findings by Ikiriko, Enwin, Johnbull, Udom and Nwokaeze (2023) who point out that provision of waste management facilities is a good gesture by municipalities that satisfies residents. Respondents showed a high level of satisfaction with the rate of solid waste collection (mean value of 5.45), which agrees with what the literature says is an indicator of satisfaction (Li et al., 2021; Puche-Regaliza et al., 2021; Wang et al., 2020; Chatterjee & Suy, 2019; Qiu & Yu, 2019; Puche-Regaliza et al., 2018). Items that were used to measure how households perceived services they received from municipalities exhibited low standard deviation values. The practical implications of these low standard deviation values indicate that there was low variability among respondents, giving a reflection that the differences between the mean values of non-performing area and performing area are likely to be statistically significant. In addition, these values show consistency in responses from respondents and that gives confidence in the accuracy of the measurements of the study.

Table 5.6: One Sample Statistic for Performing Area

	N	Mean	Std. Deviation	Std. Error Mean
2.1 Regularly collects refuse from households according to a schedule.	110	5.45	.500	.048
2.2 Cleans the garbage that piles up in the streets and open spaces.	110	5.44	.498	.048
2.3 Educates households on solid waste disposal and associated health hazards.	110	5.48	.502	.048
2.4 Provides receptacles/bins to residents when needed.	110	5.76	.427	.041
2.5 Educates households on solid waste recycling.	110	5.73	.447	.043
2.6 Attends to complaints raised by residents on solid waste collection.	110	5.68	.468	.045
2.7 Gives households advice on the effect of solid waste on health.	110	5.68	.468	.045
2.8 Penalises and prosecutes those who violate solid waste management laws/rules (e.g. illegal dumping).	110	5.70	.460	.044

2.9 Inspects the way solid waste is disposed of in all residential areas.	110	5.61	.490	.047
2.10 Provides deposit containers and/or places for residents to deposit solid waste	110	5.62	.488	.047

5.5.5 Separated results of residents' perception of municipalities on solid waste management

The results presented in Figure 5.6 demonstrate a clear distinction between the perceptions of residents from non-performing and performing areas regarding the management of solid waste by municipality authorities. Residents from non-performing areas expressed a significant level of disagreement on the measured items, whereas residents from performing areas exhibited a significant level of agreement with the way municipality authorities handled solid waste. Figure 5.5 shows the disparity of the perception of residents between services provided by municipalities to performing area and non-performing area. These services include regular collection of solid waste, educating residents on solid waste management, penalising offenders, and attending to complaints about solid waste. Strong disagreements to statements relating to these items were observed in non-performing area while strong agreement was observed in performing area.

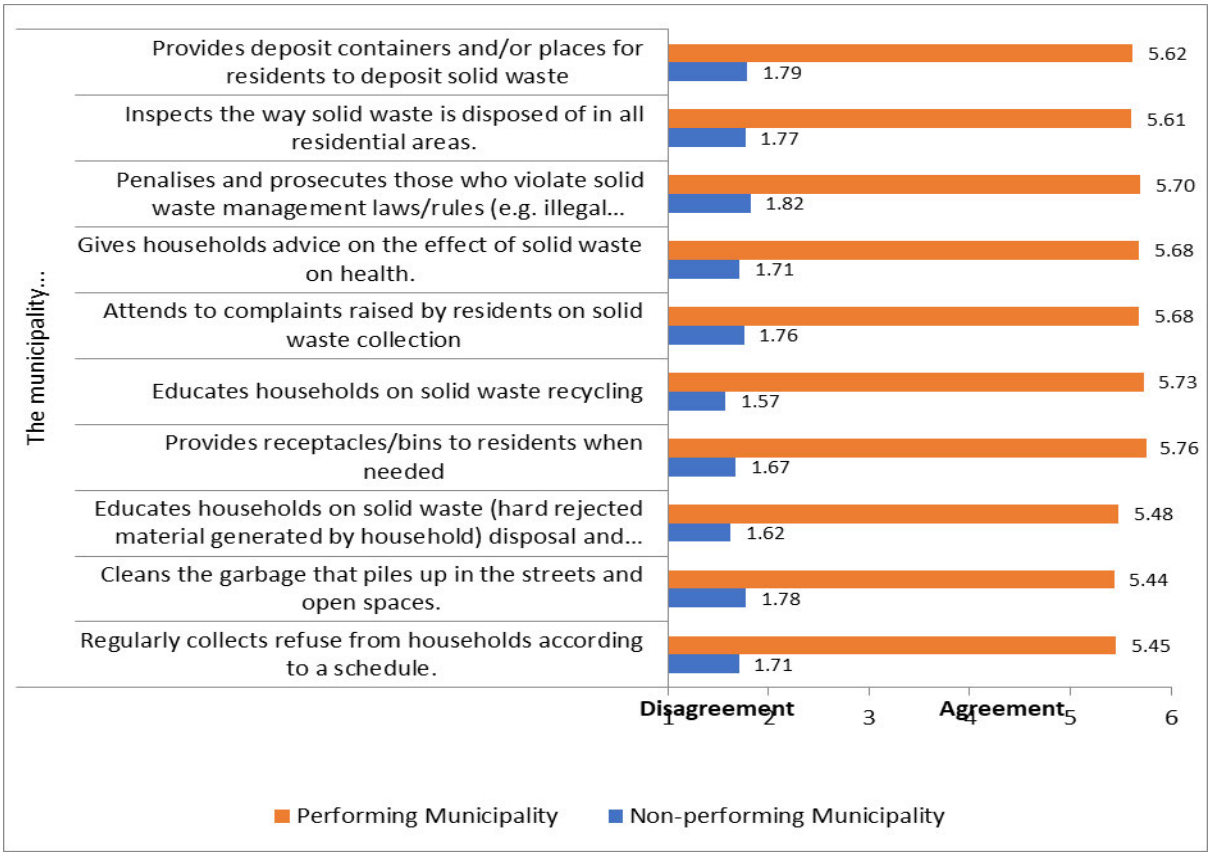

Figure 5.4: Separated Results of Residents' Perception of Municipalities on Solid Waste Management

5.5.6 Residents' satisfaction with municipal waste management

The combined analysis of data from both performing and non-performing areas revealed a significant level of dissatisfaction with municipal solid waste management, as indicated by mean scores below 3.5. The majority of items showed a significant level of dissatisfaction, except for one item measuring the cleanliness of streets after solid waste collection, which did not indicate either satisfaction or dissatisfaction.

However, when the results were analysed separately for each area, residents from the non-performing area expressed a significant level of dissatisfaction with the management of solid waste by municipal authorities. On the other hand, residents from the performing area reported a significant level of satisfaction with the way solid waste was managed in their area.

5.5.7 Households satisfaction and practices of municipal solid waste management

The second objective of the study aimed at examining the solid waste management practices of households. A total of 23 items were used to collect data, which were further divided into two sections. The first section focused on determining the satisfaction of residents with the services provided by municipalities, while the second section aimed at gathering information on the solid waste practices of the residents.

The results of residents' practices towards solid waste management in non-performing municipalities is presented in Figure 5.6. It indicates a significant disagreement on items 1 to 6 (mean values lower than 3.5), reflecting varying practices among the residents. In contrast, items 7 to 12 demonstrate a significant agreement (mean values higher than 3.5), suggesting a shared approach to solid waste management practices.

Further examination of the data by separating the non-performing area and the performing area reveals interesting insights. In the non-performing area, significant disagreement is observed, indicating diverse practices among residents in managing solid waste. Conversely, the performing area shows a significant agreement among residents, highlighting a unified approach to solid waste management practices.

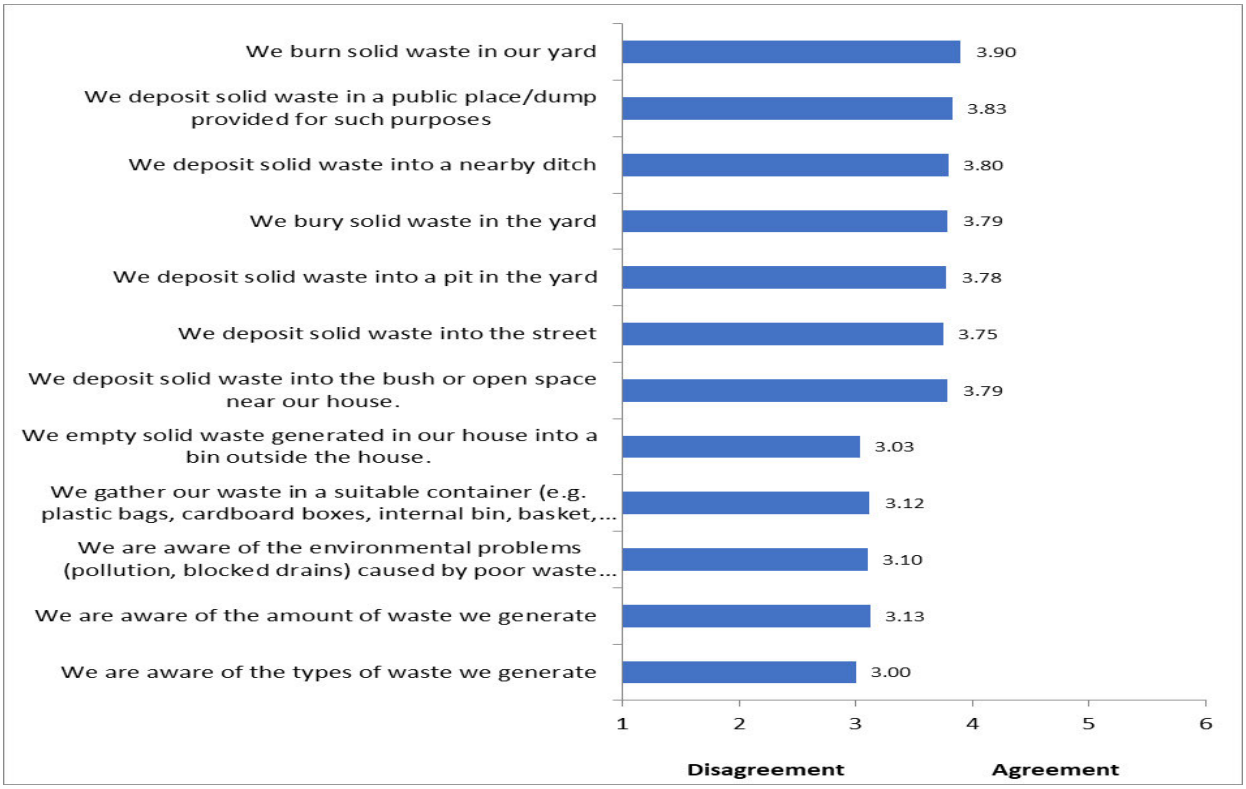

Figure 5.5: Residents' Practices and Opinions of Solid Waste Management

5.5.7.1 Households practices of municipal solid waste management in non-performing municipalities

The results presented in Table 5.7 illustrate the differences in residents' practices towards solid waste management when the data is split between the non-performing area and the performing area. In the non-performing area, there was a significant disagreement regarding items 1 to 5, which pertain to the expected practices of residents, such as being aware of the types of waste they generate and using approved receptacles for solid waste disposal. However, there was a significant agreement among respondents in the non-performing area for items 6 to 12, which relate to actual practices such as depositing solid waste in accessible areas like bushes and engaging in burning of solid waste.

These findings indicate that residents in the non-performing area exhibited significant agreement in engaging in undesirable practices, such as burning of solid waste within their yards, as evidenced by a mean value of 5.22 on a six-point Likert scale. On the contrary, low mean values were observed on items that sought to find practices of residents on solid waste management,

such as being aware of the types of waste generated (1.76), possessing knowledge of the impact of poor solid waste management on the environment (1.84) and knowing the amount of solid waste residents generate (1.89). Observed mean values for items that sought to establish negative practices of residents on solid waste management were on the high side, such as depositing solid waste in open spaces (5.02), burying solid waste in the yard (4.92), and disposing of solid waste in the street (4.87). These findings are in agreement with previous research that point out that negative solid waste management by residents pose risks (Munyai & Nunu, 2020; Nedziwe & Muraiwa, 2022). This highlights a concerning behaviour that hampers effective solid waste management in the area.

Table 5.7: Residents' Practices regarding Solid Waste (Non-Performing Area)

	n	Mean	Std. Deviation	Std. Error Mean
4.1 We are aware of the types of waste we generate.	218	1.76	.693	.047
4.2 We are aware of the amount of waste we generate.	218	1.89	.764	.052
4.3 We know the environmental problems that poor solid waste management causes.	218	1.84	.776	.053
4.4 We gather our waste in a suitable container (e.g. plastic bags, basket, etc)	218	1.81	.790	.053
4.5 We empty solid waste generated in our house into a bin outside the house.	218	1.72	.699	.047
4.6 We deposit solid waste into the bush or open space near our house.	218	5.02	.837	.057
4.7 We deposit solid waste into the street.	218	4.87	.865	.059
4.8 We deposit solid waste into a pit in the yard.	218	4.92	.844	.057
4.9 We bury solid waste in the yard.	218	4.87	.860	.058
4.10 We deposit solid waste into a nearby ditch.	218	4.95	.907	.061
4.11 We deposit solid waste in a public place/dump provided for such purposes.	218	4.96	.879	.060
4.12 We burn solid waste in our yard.	218	5.22	.796	.054

5.5.7.2 Households' practices of municipal solid waste management in performing municipalities

Table 5.8 displays the responses from respondents from the performing municipalities who strongly agreed with positive behaviours for items 1 to 6, while expressing disagreement with items 6 to 12 that were used to assess their practices.

Specifically, participants in the performing municipalities strongly agreed mean with statements related to their awareness of the types of solid waste generated at the household level and the proper disposal of solid waste into designated bins or receptacles located outside their homes. This was evidenced by mean values that were between 5.47 and 5.71 on a six-point Likert scale. Conversely, they disagreed with statements indicating practices such as depositing solid waste on the street or burning solid waste in their yards as shown by mean values ranging from 1.29 to 1.65 on a six-point Likert scale.

These results suggest that residents in the performing area exhibited more favourable and responsible practices towards solid waste management, aligning with the expected behaviours outlined in items 1 to 5. The findings indicate a positive trend in their adherence to proper waste disposal practices, which contributes to effective solid waste management in the performing area. This is evidenced by high mean values such as a mean value of 5.64 on a statement that read 'we empty solid waste generated in our house into a bin outside the house.' On the contrary, low mean values were observed on negative behaviour, such as a mean value of 1.29 on a statement that read 'we burn solid waste in our yard.'

Table 5.8: Residents' Practices Regarding Solid Waste (Performing Area)

	N	Mean	Std. Deviation	Std. Error Mean
4.1 We are aware of the types of waste we generate.	110	5.47	.502	.048
4.2 We are aware of the amount of waste we generate.	110	5.57	.497	.047
4.3 We are aware of the environmental problems (pollution, blocked drains) caused by poor solid waste management.	110	5.59	.494	.047
4.4 We gather our waste in a suitable container (e.g. plastic bags, cardboard boxes, internal bin, basket, etc.) inside the house.	110	5.71	.456	.044
4.5 We empty solid waste generated in our house into a bin outside the house.	110	5.64	.483	.046
4.6 We deposit solid waste into the bush or open space near our house.	110	1.36	.483	.04
4.7 We deposit solid waste into the street.	110	1.53	.502	.048
4.8 We deposit solid waste into a pit in the yard.	110	1.53	.502	.048
4.9 We bury solid waste in the yard.	110	1.65	.481	.046
4.10 We deposit solid waste into a nearby ditch.	110	1.51	.502	.048
4.11 We deposit solid waste in a public place/dump provided for such purposes.	110	1.59	.494	.047
4.12 We burn solid waste in our yard.	110	1.29	.456	.044

5.5.8 Comparison of residents' practices in performing and non-performing municipalities

The findings obtained from the data collected provide valuable insights into the responses of participants in both the non-performing and performing areas. In the non-performing area, significant disagreement was observed among residents regarding certain statements used to elicit information. Residents in this area expressed agreement with statements such as 'we burn solid waste in our yard' and 'we deposit solid waste in ditches.' Conversely, residents in the

performing area displayed significant disagreement with these same statements. Figure 5.7 provides insights into the responses obtained from the respondents.

Furthermore, the results for questions related to residents' knowledge about the quantities and types of solid waste they generate exhibited a significant disagreement in the non-performing area, whereas a significant agreement was observed in the performing area. This indicates that residents in the non-performing area have limited awareness regarding the quantities and types of solid waste they generate, while residents in the performing area demonstrate a better understanding of both aspects.

These findings suggest that there are notable differences in knowledge and behaviours between the two areas. Residents in the non-performing area exhibit a lack of awareness and engagement in proper solid waste management practices, as indicated by their agreement with undesirable behaviours. In contrast, residents in the performing area display a higher level of awareness and adherence to recommended practices, as reflected in their disagreement with unfavourable behaviours and their knowledge about solid waste quantities and types.

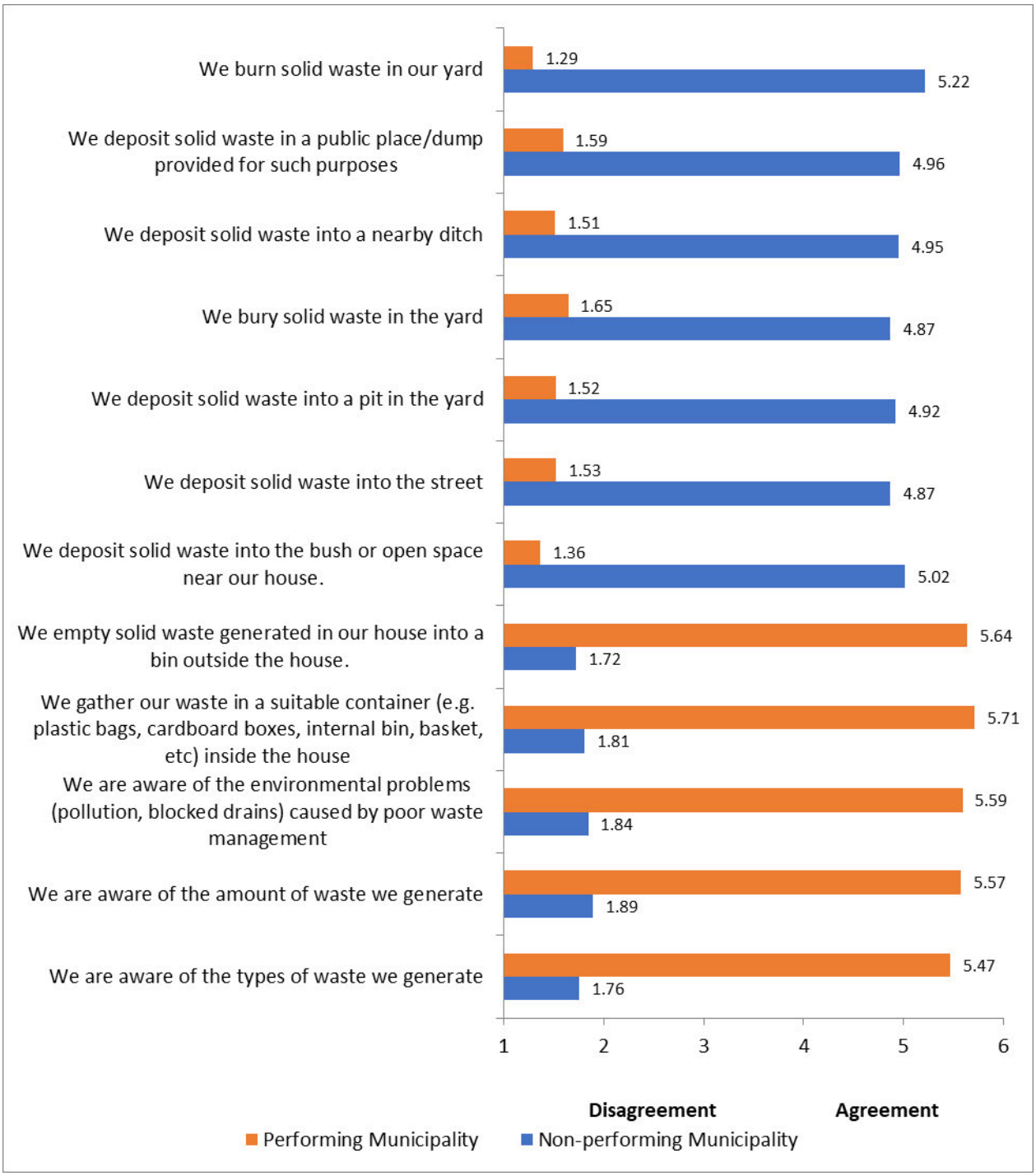

Figure 5.6: Combined Results of Residents' Practices

5.6 Households' reverse logistics practices on the management of municipal solid waste

The study also examined the residents' attitude towards solid waste reverse logistics practices, specifically focusing on re-using, recycling, and returning items that still hold value but are no longer in use. To gather relevant information, a set of 16 items was utilised, categorised into two sections. The first section aimed to assess the residents' practices concerning solid waste reverse logistics, while the second section focused on measuring the residents' agreement regarding the importance of proper solid waste management.

By analysing the responses to these items, insights were gained into the residents' attitudes and behaviours towards reverse logistics practices for solid waste. This understanding is crucial for identifying areas where improvements can be made to promote sustainable waste management practices and encourage the adoption of environmentally friendly approaches.

Through the study's findings, valuable insights can be obtained regarding the residents' current practices related to reverse logistics of solid waste and their level of agreement on the significance of proper solid waste management. These insights will help in formulating targeted strategies and interventions to promote positive attitudes and behaviours towards sustainable waste management practices among the residents.

5.6.1 Residents' attitudes and behaviour towards solid waste reverse logistic practices

The analysis of the residents' practices towards reverse logistics for solid waste management revealed a significant agreement across all the items. The mean scores obtained were higher than 3.5, indicating a positive inclination towards engaging in reverse logistics practices. Interestingly, participants from the non-performing area exhibited slightly higher mean scores than the overall mean.

5.6.1.1 Residents' attitudes and behaviour towards solid waste reverse logistic practices (non-performing area)

Table 5.9 show results of data collected from the non-performing area. It is worth noting that some specific practices related to reverse logistics did not show statistically significant results in the non-performing area. For instance, the questions pertaining to donating items such as containers to schools (p-value=0.259), returning items like batteries to manufacturers (p-value= 0.278), and salvaging useful parts from household equipment like generators (p-value= 0.122)

did not yield significant p-values within the non-performing area sample. These observed p-value results that are above the threshold of 0.05 (the 95 percent confidence interval) suggest that evidence to reject the null hypothesis is not enough.

Table 5.9: Residents' Behaviour on Reverse Logistics (Non-Performing Area)

One-Sample Test						
Attitudes Towards Reverse Logistics	Test Value =3.5					
					95% Confidence Interval of the difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
5.1 We separate our waste into different waste streams before putting it into bins/ containers.	3.429	217	.001	.454	.19	.72
5.2 We reuse some of our waste like containers.	4.281	217	.000	.532	.29	.78
5.3 We donate items like containers to schools to use them.	1.131	217	.259	.138	-.10	.38
5.4 We return some items (e.g. car batteries) to the producers.	1.088	217	.278	.133	-.11	.37
5.5 We take useful parts from equipment before selling them.	1.554	217	.122	.183	-.05	.42
5.6 We swap old household items for new versions.	2.694	217	.008	.328	.09	.56
5.7 We deposit items like old batteries in municipality bins.	3.431	217	.001	.436	.18	.69

5.6.1.2 Residents' attitudes and behaviour towards solid waste reverse logistic practices (performing area)

Table 5.10 shows results of the data collected from the performing area. The observed mean differences between the test values of 3.5 and respondents' mean scores had p-values that were less than the traditional 0.05 level of significance. The results are statistically significant, indicating strong agreement on all items related to reverse logistics practices among residents. High t-values and low p-values suggest that the observed differences are unlikely to be due to random chance. This suggests that residents in the performing area are actively engaged and committed to reverse logistics activities. The precision of the estimates of the mean differences further supports 95% confidence interval. Understanding the attitudes, perceptions, and knowledge of solid waste management within households is crucial in achieving effective waste management strategies. Saat Hanawi, Subhi, Zulfakar and Wahab (2016) conducted a survey focusing on the practices and attitudes of households towards solid waste management, which served as a foundation for subsequent studies, despite their limited sample size of less than 30. Additionally, Shigeru (2011) emphasised that the behaviour of households towards recycling solid waste is influenced by their specific characteristics. These findings concur with what Qiu and Yu (2019) highlight, that the socio-economic status and characteristics of households play a significant role in the generation and management of municipal solid waste.

Table 5.10: Residents' Attitude towards Reverse Logistics (Performing Area)

One Sample Test						
Attitudes Towards Reverse Logistics	T-test value= 3.5					
					95% Confidence Interval of the Difference	
	t	df	Sig, (2-tailed)	Mean Difference	Lower	Upper
5.1 We separate our waste into different waste streams before putting it into bins/ containers.	43.443	109	.000	2.064	1.97	2.16
5.2 We reuse some of our waste like containers.	43.443	109	.000	2.064	1.97	2.16
5.3 We donate items like containers to schools to use them.	40.658	109	.000	1.827	1.74	1.92
5.4 We return some items (e.g. car batteries) to the producers.	40.764	109	.000	1.936	1.84	2.03
5.5 We take useful parts from equipment before selling them.	40.439	109	.000	1.882	1.79	1.97
5.6 We swap old household items for new versions.	45.519	109	.000	2.118	2.03	2.21
5.7 We deposit items like old batteries in municipality bins.	44.400	109	.000	2.091	2.00	2.18

5.6.2 Level of agreement on importance of good solid waste management practices

Table 5.11 shows the results of the test for residents' level of agreement on supporting solid waste management. The observed results for items (6.1 to 6.9) that measured waste management practices show statistically significant differences between respondents' mean scores and the test value (3.5). The observed mean scores of respondents were substantially higher than the test-value for all waste management practices, suggesting strong agreement or support for solid waste management practices. High t-values and low p-values suggest that the observed differences are unlikely to have occurred due to random chance. As a result, the study failed to reject the hypothesis and concluded that there is no statistically significant difference between the sample mean and the hypothesised population mean. The findings demonstrate a significant agreement

among residents on all nine items used to assess their perception of the importance of managing solid waste.

Table 5.11: The Importance of Solid Waste Management

One-Sample Test						
It is important ……..	Test Value =3.5					
					95% Confidence Interval of the difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
6.1 To clean the garbage that is lying in the road and open spaces.	31.593	327	.000	1.866	1.75	1.98
6.2 To educate our children on proper solid waste disposal and hazards.	49.304	327	.000	2.067	1.98	2.15
6.3 To deposit solid waste in closed containers for collection.	47.950	327	.000	2.027	1.94	2.11
6.4 Not to dump solid waste in public places (e.g. streets, bush etc.).	46.296	327	.000	2.037	1.95	2.12
6.5 Not to burn solid waste anywhere and at any time of the day.	35.963	327	.000	1.921	1.82	2.03
6.6 Not to bury solid waste anywhere and at any time of the day.	41.930	327	.000	1.936	1.85	2.03
6.7 To separate solid waste into different groups (e.g., paper, plastic).	48.070	327	.000	1.991	1.91	2.07
6.8 To, where possible, reuse solid waste that is not broken.	45.322	327	.000	1.976	1.89	2.06
6.9 To recycle materials that cannot be reduced to their natural state (e.g. . . . plastics, clothes, metal).	48.784	327	.000	2.040	1.96	2.12

5.7 KMO and Bartlett’s test of sphericity

The study employed the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity to analyse all the items used in the study concerning residents' perception and satisfaction with municipalities' approach to solid waste management in their areas. The KMO test was used to evaluate the strength of correlation among the variables, providing an assessment of the suitability of the data for factor analysis. The Bartlett's test of sphericity, on the other hand, determined whether the correlation among the variables was statistically significant. These tests were conducted to ensure the robustness of the data analysis and to validate the use of factor analysis in examining residents' perception and satisfaction regarding solid waste management by municipalities.

5.7.1 KMO and Bartlett’s test of sphericity on residents’ perceptions and satisfaction

Table 5.12 presents the items that were used to collect information from those who responded to the study. The inclusion of the KMO (Kaiser-Meyer-Olkin) test and Bartlett's test of sphericity in this study was essential as the tests provided valuable insights into the suitability of the data for factor analysis. Tekler, Low, Chung and Blessing (2019) contend that KMO and Bartlett’s tests are ideal for evaluating whether data is suitable for exploratory factor analysis. Higher factor loadings (values that are close to 1) indicate stronger relationship between observed variables and latent factors. Notably, item number 6 in question 3 was excluded from the analysis due to its loading onto multiple factors, which could potentially confound the results. The KMO results indicated satisfactory values for all factors, surpassing the recommended threshold of 0.6. Results from the study show that eighty-nine percent (89%) of the respondents agreed that municipalities educate households on municipal solid waste recycling. Sixty percent (60%) of respondents who were in the low side agreed that municipalities provide containers and/or places for residents to deposit municipal solid waste. Additionally, the Bartlett's test of sphericity yielded a statistically significant result, further supporting the appropriateness of conducting factor analysis on the data.

Table 5.12: Factor Loadings - Residents' Perceptions and Satisfaction of Services from Municipalities on Waste Management.

	Factor	
	1	2
2.5 Educates households on solid waste recycling.	.891	
2.3 Educates households on solid waste disposal and health hazards.	.821	
2.7 Gives households advice on the effect of solid waste on health.	.813	
2.6 Attends to complaints raised by residents on solid waste collection.	.777	
2.8 Penalises and prosecutes those who violate solid waste management laws/rules (illegal dumping, burying/burning solid waste in the area, etc).	.763	
2.4 Provides receptacles/bins to residents when needed.	.743	
2.1 Regularly collects refuse from households according to a schedule.	.697	
2.2 Cleans the garbage that piles up in the streets and open spaces.	.691	
2.9 Inspects the way solid waste is disposed of in all residential areas.	.632	
2.10 Provides deposit containers and/or places for residents to deposit solid waste.	.601	
3.1 Reliability of the municipality to collect the waste within our area.		.858
3.2 The cleaning/cleanliness of public spaces in and around our residential area.		.803
3.9 The cost charged for solid waste collection and associated services.		.720
3.10 The frequency of solid waste collection in and around our residential area.		.704
3.4 The provision of refuse bins in and around our residential area.		.704
3.11 The state of cleanliness of the streets after solid waste collection.		.689
3.8 The level of inspection of solid waste in and around our residential areas.		.632
3.7 The time taken to respond to complaints related to solid waste.		.574
3.3 Education/information provided by the municipality regarding disposal options, health hazards relating to waste, etc.		.574
3.5 The information/education provided by the municipal authority on how to recycle solid waste.		.561

The results pertaining to the perception of residents on municipalities and their satisfaction with solid waste management, as gathered from the data, are presented in Table 5.13. The Cronbach's Alpha coefficients, which measure the internal consistency of the items, indicate satisfactory values. It is worth noting that a Cronbach's Alpha value of 0.8 or higher is generally considered acceptable (Bryman & Bell, 2015). This suggests that the items used in the study exhibit a reliable level of consistency in measuring the constructs under investigation.

Table 5.13: Residents' Perception and Satisfaction on Municipalities Services

Factor	Construct	Items included	Variance extracted	Cronbach's alpha
1	Municipal waste management (MWM)	2.1 – 2.10	86.43	.989
2	Satisfaction of residents (SAT)	3.1 – 3.5, 3.7 – 3.11	1.74	.984

5.7.2 KMO and Bartlett's test of sphericity on residents' practices and opinion

Factor analysis with Promax rotation was conducted on a set of 28 items derived from three different sets of questions to gather data from the participants. The results of the factor analysis, presented in Table 5.14, indicate that the extracted factors account for 64.75% of the total variance in the data. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was found to be 0.941, indicating that the data were suitable for factor analysis. Additionally, the significant result obtained from Bartlett's test of sphericity further supports the adequacy of the data for reliable factor extraction. The rotation process converged after five iterations, suggesting a stable and meaningful factor solution was obtained. Results from the study show that for the first factor which sought to establish residents' practices on solid waste management, 94.8% of respondents agreed that they gather solid waste in suitable waste containers, and 89.8% said that they are aware of the amount of solid waste they generate at household level. The second set of questions which sought to find out the practices of residents on reverse logistics activities saw results indicating that 78.7% of the respondents said that they deposit solid waste in closed containers for municipalities to collect. That same set of questions saw 46.3% of respondents state that they

do not bury solid waste anywhere anytime of the day. The third set of questions sought to establish whether sustainable practices were in place in residential places. Factor analysis show that 84.4% of respondents said that they returned some items like old car batteries to suppliers, while 56.9% replied that they deposited used items in bins provided by municipalities.

Table 5.14:Factor Loadings - Residents' Practices and Opinions of Solid Waste Management

	Factor		
	1	2	3
We gather our waste in a suitable container (e.g., plastic bags, cardboard).	.948		
We deposit solid waste into a nearby ditch.	.946		
We empty solid waste generated in our house into a bin outside the house.	.945		
We deposit solid waste into a pit in the yard.	.937		
We bury solid waste in the yard.	.934		
We deposit solid waste into the street.	.931		
We are aware of the types of waste we generate.	.919		
We are aware of poor solid waste management environmental problems.	.914		
We deposit solid waste into the bush or open space near our house.	.913		
We burn solid waste in our yard.	.910		
We are aware of the amount of waste we generate	.898		
To deposit solid waste in closed containers for the municipality to collect.		.787	
To, where possible, reuse solid waste that is not broken.		.738	
To educate our children on proper solid waste disposal.		.719	
Not to dump solid waste in public places (streets, open spaces, bush etc.).		.705	
To clean the garbage that is lying in the road and open spaces.		.664	
To recycle materials that cannot be reduced to their natural state (plastics).		.661	
To separate solid waste into different groups (paper, plastic, glass).		.648	
Not to burn solid waste anywhere and at any time of the day.		.567	
Not to bury solid waste anywhere and at any time of the day.		.463	

We return some items (e.g. car batteries) to the producers.			.844
We donate items like containers to schools and other institutions.			.815
We separate our solid waste before putting it into bins/containers.			.697
We reuse some of our waste like containers.			.688
We take useful parts from household equipment before selling them.			.651
We swap and top old household items for new versions.			.590
We deposit items like old batteries in bins provided by the municipality.			.569

5.7.3 Reliability test – Cronbach's Alpha

The reliability analysis results presented in Table 5.15 indicate the internal consistency and reliability of the selected composite variables for further data analysis. According to Bryman and Bell (2015), a Cronbach's Alpha value higher than 0.8 is considered acceptable in terms of reliability. Cronbach's Alpha is a measure of internal consistency that assesses the reliability and homogeneity of the items used in data collection. Generally, values above 0.7 are considered acceptable, values above 0.8 are considered good, and values above 0.9 are considered excellent (Ursachi, Horodnic & Zait, 2015). However, Hulin, Netemeyer and Cudeck (2001) contest that values that are greater than 0.95 must be interpreted with care as they may indicate redundance. The obtained Cronbach's Alpha values for all the selected composite variables in this study exceeded the acceptable threshold, indicating their reliability and suitability for further analysis.

Table 5.15: Reliability Test - Cronbach Alpha

Factor	Construct	Items included	Variance extracted	Cronbach's Alpha
1	Waste management practices (WMP)	4.1 – 4.5, 4.6* - 4.10*, 4.12*	42.95	.987
2	Importance of waste practices (IMP)	6.1 – 6.9	16.65	.874
3	Reverse logistic waste practices (RLWP)	5.1 – 5.7	5.15	.886

(*) highlights some items which were excluded because of cross-loading.

5.7.4 T-test for the whole sample

The results of the two-tailed t-test conducted in this study are presented in Table 5.16. The results from an independent t-test to explore differences between the performing and non-performing municipalities, presented in Table 5.16, reveal that: there is significantly more agreement that, compared to non-performing municipalities, performing municipalities practice waste management; residents are satisfied with the waste management practices undertaken by the municipality, and waste management is being practiced by residents. In addition, while there is agreement that reverse logistic waste practices are practiced and deemed important at both groups of municipalities, there is significantly more agreement at performing municipalities than at non-performing municipalities regarding these constructs.

Table 5.16: T-test for the whole sample

Construct	Category	n	Mean (SD)	t	df	p-value
Municipal waste management (MWM)	Non-performing municipality	218	1.72 (0.675)	-74.725	311.493	<.001*
	Performing municipality	110	5.62 (0.264)			
Satisfaction of residents on municipalities services received (SAT)	Non-performing municipality	218	1.90 (0.947)	-54.834	249.107	<.001*
	Performing municipality	110	5.55 (0.188)			
Waste management practices (WMP)	Non-performing municipality	218	1.93 (0.375)	-92.284	326	<.001*
	Performing municipality	110	5.56 (0.241)			
Reverse logistics waste management practices (RLWP)	Non-performing municipality	218	3.81 (1.281)	-18.648	250.711	<.001*
	Performing municipality	110	5.5 (0.261)			
Importance of waste management (IMP)	Non-performing municipality	218	5.44 (0.705)	-2.781	287.248	.006*
	Performing municipality	110	5.58 (0.219)			

The study conducted one sample t-test comparing residents' attitudes towards reverse logistic activities and the results were presented in Table 5.17. The observed t-values representing the magnitude of the difference between the sample mean and the hypothesised population mean was 3.5 by the t-values. P-values indicate the probability of obtaining the observed differences if the null hypotheses were to be taken as true. All the observed p-values were extremely low (0.000), indicating that the observed differences were statistically significant at the 0.05 significance level that is traditionally used. The differences between the observed mean and the test values were shown by the mean differences. Results of the test for the differences between the attitudes of residents on municipal waste management in performing and non-performing areas showed that there exist significant differences between the two groups. However, results show that attitudes of residents in performing areas were more positive and the mean differences

of that group ranged from 2.0656 to 2.1653. Results in Table 5.17 show that the test for the difference in satisfaction of residents with municipalities between the performing and non-performing areas shows significant differences. Mean values of performing areas ranging from 2.0141 to 2.0851 suggest that residents in performing areas have more positive attitudes, and therefore were more satisfied by the services provided by municipalities. A comparison of the differences of the attitudes of residents on waste management practices in performing and non-performing areas tends to obscure results of tests on waste management and satisfaction. Results in performing areas show more positive attitudes of residents, with mean values ranging from 2.0114 to 2.1026.

Results for the t-test for differences in attitudes towards reverse logistics practices in performing and non-performing areas exhibit significant differences. Nevertheless, the mean differences are a bit lower in the performing areas as they range from 1.9481 to 2.0467. The t-test value (3.626) for the attitude of residents on reverse logistics waste practices shows a significant agreement. This suggests that residents in non-performing areas recognise the need for reverse logistics. The t-tests for the attitudes of residents in performing and non-performing areas on the importance of waste management practices show significant differences in both groups. Values ranging from 2.0393 to 2.1223 for mean differences in the performing areas were observed. This category also witnessed a significant agreement on attitudes of residents in non-performing areas, thereby suggesting that residents regard management of solid waste as important.

The overall observation in the attitudes of residents in performing and non-performing areas was that there were significant differences towards reverse logistics practices. More positive attitudes were consistently displayed in performing areas compared to non-performing areas as evidenced by strong mean differences in performing areas. These results suggest that if intervention policies aimed at improving reverse logistics practices are exercised, they are likely to have a positive impact, especially if they are channelled towards improving residents' attitudes in non-performing areas.

Table 5.17: One Sample Test

Municipality		Test value=3.5					
						95% Confidence Interval of the Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Non-performing	MWM	-38.996	217	.000	-1.78165	-1.8717	-1.6916
	SAT	-24.973	217	.000	-1.60175	-1.7282	-1.4753
	WMP	-61.951	217	.000	-1.57465	-1.6247	-1.5245
	RLWP	3.626	217	.000	.31455	.1436	.4855
	IMP	40.533	217	.000	1.93578	1.8417	2.0299
Performing	MWM	84.115	109	.000	2.11545	2.0656	2.1653
	SAT	114.511	109	.000	2.04959	2.0141	2.0851
	WMP	89.392	109	.000	2.05702	2.0114	2.1026
	RLWP	80.305	109	.000	1.99740	1.9481	2.0467
	IMP	99.432	109	.000	2.08081	2.0393	2.1223

MWM: Municipal waste management
SAT: Satisfaction of residents on municipalities' services received
WMP: Waste management practices
RLWP: Reverse logistics waste management practices
IMP: Importance of waste management

5.8 Hypotheses testing

Path analysis is widely utilised in social science research as it enables researchers to examine hypotheses regarding the relationships between variables. The process involves constructing a model that represents the proposed relationships, which is then tested using statistical techniques to assess whether the collected data support the hypothesised relationships. Path analysis is a powerful tool that allows for the testing of complex relationship models and the exploration of causal relationships among variables, such as the perception of residents on the services received

from municipalities and their approach to solid waste management. By employing path analysis, researchers can gain valuable insights into the underlying dynamics and interconnections among variables in their study. The study developed a conceptual model that depicted the relationship between predictors (independent variables) and outcomes (dependent variables) in the study. The importance of path analysis in research is that it predicts the parameters of the model as well as the path coefficients that represent the direction and strength of the relationship between the variables. Chi-square was used in this study to test the goodness-of-fit of the model. Relationships that are positive are exhibited by coefficient values that are positive and relationships that are negative are shown by negative coefficient values. Path analysis was used to investigate causal mechanisms and explore various factors that influenced the outcomes of the study.

5.8.1 Path analysis for non-performing area

The relationships between variables in the study are depicted in Figure 5.8. It can be observed that there is a significant negative relationship between residents' perception of municipalities' attitude and behaviour towards waste management and their practices of reverse logistics for solid waste. This suggests that by increasing intervention on residents' attitudes towards municipal services in non-performing areas, the attitudes of residents towards reverse logistics activities falls down. A positive coefficient (0.15) was observed on the relationship between attitudes of residents on municipal waste management and reverse logistics waste practices. This suggests that by increasing interventions on municipal waste management by a factor, residents' attitudes towards reverse logistics practices increases also by 15%. Residents' satisfaction with the attitude and behaviour of municipalities shows a negative relationship (-0.17) with their practices of reverse logistics for solid waste. This suggests that by increasing factors that satisfy residents' attitudes on municipal services in non-performing areas, a seventeen percent (17%) drop in residents' practices on reverse logistics was observed.

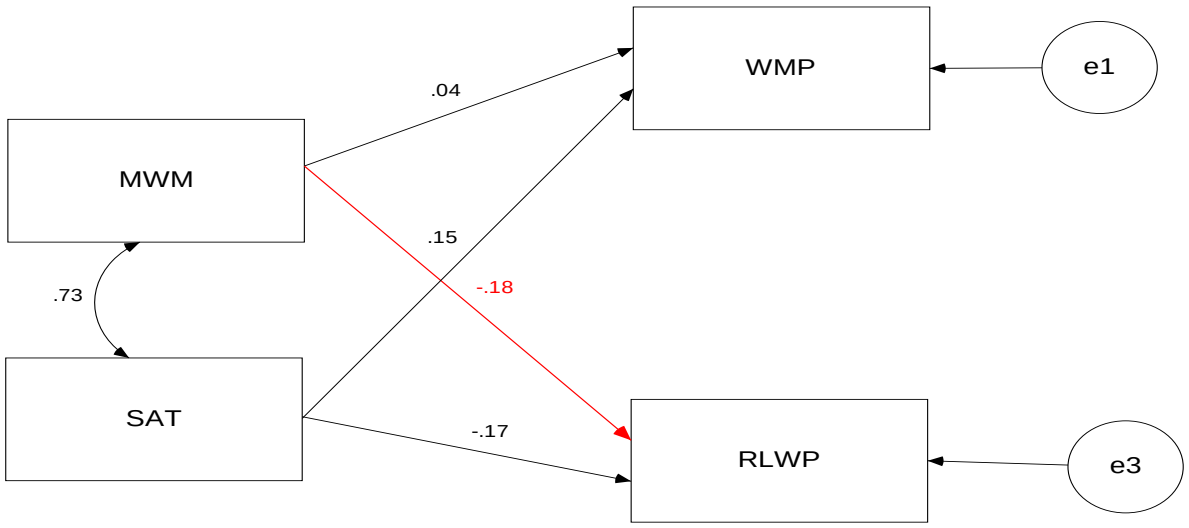

Figure 5.7:Path Analysis of Residents' Perception on Municipalities (Non-performing area)

Conversely, residents' satisfaction with municipalities' attitude and behaviour towards waste management is negatively related to their practices of reverse logistics for solid waste. The path between residents' satisfaction and reverse logistics practices also exhibits a significant negative association. Additionally, the figure demonstrates that residents' satisfaction with the municipality's approach to solid waste management influences their attitude and behaviour towards both solid waste management practices and reverse logistics practices for solid waste management.

5.8.2 Path analysis for performing area

Figure 5.9 shows the path analysis revealed a significant positive coefficient value of 0.21, indicating that municipalities' waste management has a positive impact on residents' perception of how municipalities handle solid waste. This suggests that in the performing area, where municipalities effectively manage waste, efforts to increase residents' perception of municipal services on waste management positively influences their own waste management practices. Furthermore, satisfaction with municipalities' waste management was found to have a positive effect on residents' reverse logistics waste practices, as indicated by a coefficient value of 0.23. Reverse logistics practices involve actions such as waste separation, item reuse, returning items like car batteries, and salvaging useful parts before disposing of them in designated locations for municipal collection.

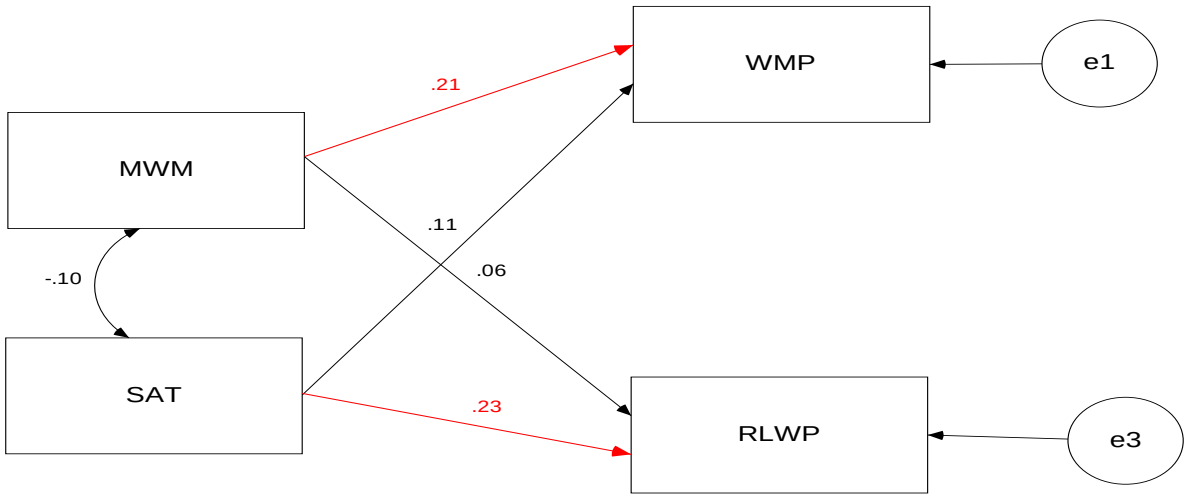

Figure 5.8: Path Analysis of Residents' Perception on Municipalities (Performing Area)

Results of the multi-group path analysis conducted on the collected data are illustrated in Table 5.18. A chi-square statistic of 24.485 and a p-value <0.001 suggest that the structural weight does not fit the data well. Other indices were considered together with the chi-square statistic because of its sensitivity to sample sizes. Model b1 represents residents' perceived path between municipalities' waste management services and residents' waste management practices. The chi-square statistic for that model was 2.764 and the p-value was 0.096, suggesting that the model's fit is marginal but not statistically significant at the 0.05 level of significance. The path representing perception of residents' satisfaction with municipalities' services and residents' waste management practices had a chi-square statistic of 4.115 and a p-value of 0.042, indicating that the model's fit is statistically significant at the 0.05 level of significance. A chi-square statistic of 0.375 and a p-value of 0.540 was observed as the result for the test of the perception of residents on the relationship between municipalities' waste management and residents' reverse logistics waste practices. This result suggests that the model fits the data well and the relationship represented by this model is not statistically significant. Model b4 represents residents' perceived path between residents' satisfaction with municipalities' services and residents' reverse logistics waste practices. The chi-square of 9.078 and a p-value of 0.003 connote that the model's fit is statistically significant at the 0.05 level of significance.

Table 5.18: Model Indices Table

Model	df	X^2 statistic	p-value
Structural weights	4	24.485	<.001*
Model b1	1	2.764	.096**
Model b2	1	4.115	.042*
Model b3	1	.375	.540
Model b4	1	9.078	.003*

* indicates significance at .05 level

** indicates significance at .1 level

Legend for Table 5.18

Model b1 Municipal waste management and residents' waste management practices

Model b2 Residents' satisfaction and residents' waste management practices

Model b3 Municipal waste management and residents' reverse logistics waste practices

Model b4 Residents' satisfaction and residents' reverse logistics waste practices

5.8.3 Hypothesis 1 (H_a1): The perceived attitude and behaviour of the municipality regarding solid waste management

The study employed the paths between municipal waste management and municipal waste practices, as well as between municipal waste management and reverse logistics practices, to examine the hypothesis regarding the perceived attitude and behaviour of residents in relation to the services provided by municipal authorities. Results from the data that were collected and tested, were analysed and explained using tables.

Results from the study (coefficient, 0.038; p-value=0.700) in non-performing areas shown in Table 5.19 revealed that a very weak but positive relationship exists between municipalities' waste management services and residents' waste management practices. The p-value is greater

than the traditional significance level of 0.05, implying that the result is not statistically important. The observed results (coefficient, -0.185; p-value=0.048) on the perception of residents on municipalities' waste management services and the residents' behaviour on reverse logistics waste practices show a negative coefficient and a statistically significant p-value. This suggests that improving municipal waste management services results in decrease of residents' participation in reverse logistics waste practices.

The results for testing residents' perceptions on municipalities' services in performing areas show a positive coefficient (0.208) and a statistically significant p-value (0.027) for the relationship between municipalities' municipal waste management and residents' municipal waste practices. This suggests that the perception of residents is that improving municipal services on waste management will increase the residents' waste management practices. Results (coefficient, 0.058; p-value=0.537) for testing the perception of residents on services provided by municipalities for relationship between municipal waste management and reverse logistics waste management suggest weak but statistically significant observations. Thus improving the perception of residents on municipalities' services will increase residents' reverse logistics waste practices.

Table 5.19:Path Coefficients Residents' Perceptions (Non-Performing Area & Performing Area)

	Independent variable	→	Dependent variable	Standardized regression coefficient	Unstandardized Regression coefficient	CR (Critical ratio)	p-value
Non-performing area	MWM		WMP	.038	.021	.385	.700
	MWM		RLWP	-.185	-.350	-1.974	.048*
Performing area	MWM		WMP	.208	.190	2.218	.027*
	MWM		RLWP	.058	.057	.617	.537

5.8.4 Hypothesis 2 (H_a2): The residents' satisfaction with municipalities' solid waste management

The hypothesis stating that residents' satisfaction with services from municipalities regarding solid waste management positively affects the way residents dispose of solid waste was examined through two paths in the study. The first path investigated the relationship between residents' satisfaction and their municipal solid waste practices, while the second path explored

the association between residents' satisfaction and their reverse logistics practices. The subsequent sections of the study provide detailed explanations of the findings pertaining to these paths.

Table 5.20 shows results of the test for residents' satisfaction with the services they get from municipalities. In non-performing municipalities, the path between residents' satisfaction and residents' waste management practices had a coefficient of 0.148 and p-value = 0.130, suggesting a weak positive relationship. The p-value is greater than the traditional significance level of 0.05, implying that the result is not statistically important. The observed results (coefficient, -0.172; p-value=0.065) on the relationship between residents' satisfaction on municipalities' waste management services and the residents' behaviour on reverse logistics waste practices show a moderately negative coefficient and a marginally statistically insignificant p-value. This suggests that as satisfaction on municipal waste management services increases, a decrease in residents' participation in reverse logistics waste practices is observed.

In performing municipalities, results for testing residents' satisfaction on municipalities' services show a weak positive coefficient (0.106) and a statistically insignificant p-value (0.258). This suggests that improving residents' satisfaction with services from municipalities does not necessarily improve the residents' reverse logistics waste management. Results (coefficient, 0.228; p-value=0.015) for testing satisfaction of residents on services provided by municipalities and residents' reverse logistics waste management suggest a strong positive relationship. This implies that as satisfaction of residents on municipalities' services increases, residents' reverse logistics waste practices also tend to increase. In addition, the result is statistically significant because the p-value is less than the traditional 0.05 level of significance.

Table 5.20: Path Coefficients Residents' Satisfaction (Non-Performing Area & Performing Area)

	Independent variable	→	Dependent variable	Standardized regression coefficient	Unstandardized Regression coefficient	CR (Critical ratio)	p-value
Non-performing area	SAT		WMP	.148	.059	1.515	.130
	SAT		RLWP	-.172	-.233	-1.845	.065
Performing area	SAT		WMP	.106	.136	1.130	.258
	SAT		RLWP	.228	.317	2.442	.015*

5.9 Summary

This chapter presented the findings of the quantitative data analysis, addressing research objectives one to three. Data that were collected from respondents were presented in tables and charts, analysed and discussed. Analysis of data used measures of central tendency, KMO and Bartlett's test of sphericity, Cronbach Alpha test and path analysis. The objective of the first research question was to determine the perceptions of households regarding municipal solid waste management by local government municipalities in Zimbabwe. The study utilised a set of 21 questions on a six-point Likert scale to gauge residents' perceptions and satisfaction with municipalities' approach to solid waste management. Overall, there was a moderate disagreement among residents regarding municipalities' actions in solid waste management. The questions covered various aspects such as educational initiatives on solid waste recycling, responsiveness to residents' complaints, and provision of deposit containers.

Further analysis was conducted by dividing the data into two categories: non-performing areas and performing areas. The results revealed a significant disagreement in the data collected from non-performing areas, while a significant agreement was observed in the data collected from performing areas. This indicates that respondents in non-performing areas were less aware of important waste management issues, such as the different waste streams and quantities generated, and tended to engage in illegal waste disposal practices like dumping and burying. On the other hand, residents in performing areas showed knowledge of waste streams and quantities generated and refrained from illegal waste practices.

The second research objective aimed at determining the waste disposal practices of households within local government municipalities in Zimbabwe. The study used 19 items divided into two categories: one to assess residents' practices and the other to measure their agreement on reverse logistics practices. The analysis revealed a significant disagreement on items related to knowledge of waste streams and environmental problems caused by poor waste management, while there was a significant agreement on items related to practices like separating waste into different streams.

A split analysis was conducted based on the data collected from non-performing municipalities and performing municipalities. The results showed a significant disagreement on knowledge-related items in non-performing municipalities, indicating a lack of awareness and engagement in appropriate waste management practices. A significant agreement on knowledge-related items and a significant agreement on practice-related items was observed in performing municipalities, suggesting that residents were aware of waste management principles and that they are highly engaged in municipal waste management.

The third research objective aimed at investigating the practices attitudes of households towards reverse logistics practices within local government municipal areas. Path analysis was conducted to examine the relationships among the study variables. The combined analysis indicated a favourable path decision for non-performing areas, highlighting a negative and significant relationship between residents' perception of municipalities' attitude and behaviour towards waste management and reverse logistics practices. Additionally, a negative and significant relationship was observed between residents' satisfaction with the way municipalities handled waste management in non-performing areas and their engagement in reverse logistics practices. However, a significant and positive relationship was found between residents' satisfaction with municipal waste management and their waste management practices, as well as between residents' perception of municipal waste management and their waste management practices. This implies that when residents perceived municipalities to handle waste management effectively, they were more likely to practice appropriate waste management methods and refrain from improper practices like dumping or burning waste.

In the performing areas, the analysis revealed significant positive relationships among the variables. The findings of the quantitative analysis conclude chapter five. The subsequent chapter presents the analysis and discussion of the qualitative findings.

CHAPTER SIX

ANALYSIS AND DISCUSSION OF THE QUALITATIVE RESULTS

6.1 Introduction

Chapter five of the study provided an analysis of the quantitative results of data that were collected to satisfy objectives one to three. This chapter focuses on the analysis and discussion of the qualitative findings, which address objectives four and five of the study. Objective four aimed at assessing the level of sustainability in selected municipalities in Zimbabwe, while objective five aimed at exploring the relationship between reverse logistics of solid waste and sustainability in these municipalities.

The qualitative approach was employed in this study to gather information and gain insights into the research objectives. A semi-structured questionnaire was used to collect data and address specific aspects of the study objectives. The qualitative approach allows for the interpretation of data within the context of participants' views, culture, values, and perspectives (Kothari, 2004). The construction of the semi-structured questionnaire (interview guide) was influenced by the researcher's approach to investigating the issues within the study environment (Creswell, 2014). The literature review conducted prior to the study informed the selection of variables and the development of a semi-structured questionnaire used in the interviews. The aim was to establish the relationship between solid waste management and sustainability. It is important to note that qualitative research is context-specific and time-bound, making it challenging to generalise findings. Instead, the focus is on transferring the knowledge gained from the study (Luton, 2015). According to Creswell (2014), qualitative research involves formulating research questions and objectives, collecting data in the target setting, analysing the data, and deriving meaning from the results. Saunders et al. (2012) suggest that researchers can use an inductive approach in qualitative research to develop a nuanced understanding of complex phenomena and formulate theoretical models or assumptions based on the findings.

6.2 Population and Sample Size

The population for this study consisted of all employees working in solid waste management departments of local government municipalities. The sample size was determined based on several factors, including the research questions, available resources, and statistical requirements.

The selection of participants was purposeful, focusing on individuals who had the relevant knowledge and experience to provide insights into the research questions. The aim was to ensure that the selected participants could effectively respond to the specific inquiries of the study.

While statistical considerations were considered when determining the sample size of the quantitative phase of the study to ensure representativeness, the concept of saturation was considered for the qualitative phase. Saturation occurs when collecting additional data does not provide any new or significant insights (Hennink & Kaiser, 2022). Saturation refers to the point at which data collected stops showing any new insights and rather signs of repetition are identified (Francis, Johnson, Robertson, Glidewell, Entwistle & Grimshaw, 2010). O'Reilly and Parker (2013) point out that saturation has become a critical aspect in qualitative research studies, while Fusch, Fusch and Ness (2018) contend that no new and relevant data can be collected after the saturation point. Mwita (2022) suggests that saturation signals to the researcher that data collection has to stop. Once the point of saturation was reached, further sampling was deemed unnecessary.

6.2.1 Sample size

In the qualitative phase of the study, a total of seven participants were involved. The participants included one public relations officer and six waste collection supervisors who were responsible for solid waste management in the selected municipalities.

Before conducting the interviews, a pilot test of the semi-structured interview guide was conducted. Four experts, two from the academic field and two from the environmental field, were involved in the pilot testing. Their input was valuable in refining and structuring the interview questions. The experts who participated in the pilot study were not included as final interviewees.

Ethical considerations were taken into account throughout the study. Prior to conducting the interviews, the researcher obtained an ethical clearance letter from the university. Additionally,

gatekeeper's letters were obtained from each of the local authorities to gain access to the participants.

The participants were given the opportunity to familiarise themselves with the interview guide before the actual interviews took place. The interviews were conducted face-to-face, following the traditional method. The researcher clearly explained the purpose of the research to the participants and sought their voluntary participation. It was emphasised that the participants had the right to withdraw from the study at any point if they felt uncomfortable.

Confidentiality and privacy were assured to the participants. The researcher emphasised that the content of each interview and its results would be kept confidential and would only be used for the purpose of the research.

6.3 Interviews with participants

Interviews were conducted with seven participants who were employees of local municipal authorities. The purpose of these interviews was to address objectives four and five of the study, which focused on the state of sustainability in the municipalities and the relationship between solid waste management and sustainability.

The interviews were audio-recorded and transcribed, and the data were organised into meaningful categories. Any unclear issues were followed up with the participants for clarification, ensuring that the findings accurately represented their perspectives. Thematic analysis was employed to analyse the collected data, with the researcher repeatedly listening to the recordings and reading the transcriptions to familiarise themselves with the contents. Keywords and phrases that were frequently mentioned by the participants were identified and used for coding the data. The coded data were then organised into themes corresponding to the research objectives.

The subsequent sections of the chapter present the data collected during the interviews, providing empirical evidence to support the conclusions drawn from the participants' responses. The sections are organised into the following categories: company profile, general information, objective number four, and objective number five.

To ensure anonymity, the participants were assigned codes (e.g., Participant 1: Municipal 1) instead of using their actual names. This safeguarded their identities throughout the reporting of the study.

6.4 Presentation of data: Company profiles

This section entailed requesting participants to provide a concise overview of their municipalities' profiles. Prior to commencing the interviews, specific questions were posed to gather information regarding the fundamental characteristics of each municipality. Table 6.1 presents a summary of participant details, including their affiliated municipal area, position within the organisational structure, area type (e.g., high density), and the date and time of the interviews.

Table 6.1: Profiles of participants

Area	Participant	Position in Organisation	Type of Area	Municipal name	Date	Time
1	1	Public Relations Officer	High density	Harare	27/12/22	14:00hrs-14:40hrs
1	2	Waste Collection Supervisor	High density	Harare	28/12/22	10:10hrs-10:45hrs
1	3	Waste Collection Supervisor	Low density	Harare	28/12/22	14:00hrs-14:30hrs
2	4	Waste Collection Supervisor	High density	Chinhoyi	29/12/30	10:00hrs-10:45hrs
2	5	Waste Collection Supervisor	High density	Chinhoyi	29/12/30	11:00hrs-11:30hrs
3	6	Waste Collection Supervisor	High density	Norton	30/12/22	09:30hrs-10:00hrs
3	7	Waste Collection Supervisor	High density	Norton	30/12/22	10:15hrs-10:50hrs

6.4.1 General questions of engagement

Initially, general information was obtained from the participants to establish a comfortable and conducive environment for their participation. The researcher began by explaining the purpose of the study and ensuring that participants were aware of their rights, including the option to withdraw from the interview if they felt uncomfortable. Once the participants were ready, the

recording of the interviews commenced. The first question inquired about the number of households under the supervision or jurisdiction of each participant. The findings revealed variations in the number of households across the different areas represented in the study, ranging from 700 to 3,000 households.

Regarding the collection of solid waste, the participants unanimously stated that the waste collected by the municipal authorities is transported to landfills for disposal. Landfills are designated areas approved by the authorities and are typically inaccessible to the general public.

Participant 1 articulated that

> *Solid waste is collected directly from households, and skips are utilised in specific instances such as shopping centres and other institutions. The primary purpose of collecting this waste is for landfilling (Participant 1).*

Participant 2 explicated that the council lacks treatment options due to the mixed composition of the collected waste, which includes diverse metals and items.

> *The council does not have options for treatment due to the mixed nature of the collected waste, which includes various metals and items. The council lacks the capacity to separate or process the waste at this stage (Participant 2).*

Participant 3 highlighted the diverse practices among individuals, some of whom bury the waste, while others salvage valuable items from it. The other participant elucidated that:

> '*solid waste is transported to the Pomona landfill for disposal, and incineration is employed primarily in institutional settings like clinics and colleges rather than for household waste'* (Participant 4).

Subsequently, the investigation shifted focus towards reverse logistics activities associated with solid waste management practiced by the municipalities. Participants uniformly indicated that formal reverse logistics activities are not practiced by the municipal authorities, primarily due to the challenges posed by the mixed nature of the waste, which hampers effective selection and segregation. However, participants also revealed the existence of voluntary initiatives undertaken by individuals and external partners. Their accounts shed light on these dynamics.

Participant 1 clarified that while the council itself refrains from engaging in reverse logistics, individuals within the community undertake certain activities, such as collecting plastics, bottles, and scrap metals for personal use or alternative purposes.

> *The council itself does not practice any reverse logistics activities, but from the individuals yes because they do pick up on things like plastics like bottles like scrap metals and some other items. They find options that they use these items for (Participant 1).*

Participant 2 expanded on the absence of formal reverse logistics activities by the council but highlighted the involvement of external partners, such as large corporations like Delta, which encourage customers to return empty bottles to grocery stores or implement charges for these bottles during subsequent purchases. Such companies have dedicated personnel who periodically collect these materials from designated points in council areas.

> *At the moment we do not have reverse activities as Council but however we have somehow, though is not formal, we have some of our partners that are voluntarily doing so. These are the different companies; we have big corporates like Delta they do beverages, and they use bottles and plastics in producing their products. They have their own people who volunteer to pick these plastics and to store them in special points in our council areas which they collect periodically but that is separate from council systems. Such companies either request customers to take empty bottles to grocery stores or charge customers for the empty bottles each time they purchase these beverages. (Participant 2)*

Participant 3 underscored the practice of repurposing items like bottles for decorative or secondary use, resulting in a reduction in the quantity of waste collected by the municipality.

> *We tend to have items like bottles, like champagne empty bottles are very much appealing some people can actually use them to display in their display cabinets. Whereas some recycle where they can actually want them for secondary use of that particular package. This results in a reduction of the quantity that is collected by municipality. Some they actually use it for decorative purposes, other packaging materials like 5 litre containers and then used for purposes of collecting water, another waste stream reduction in the final quantity of the solid waste (Participant 3).*

Participant 4 acknowledged the lack of engagement in reverse logistics by the council and highlighted individual efforts to recycle plastic bags while shopping, driven by legal requirements that impose charges for these bags. Moreover, consumers reuse empty containers from products like Mazoe Orange Crush drink. Participant 5 acknowledged the current limitations of recycling and waste reduction efforts due to the mixed nature of the collected waste. Participant 6 noted the presence of certain options pursued by individuals or organisations, such as recycling plastics and steel products for marketing purposes. Nonetheless, the majority of waste remaining after these activities is no longer considered valuable.

These accounts provide insights into the absence or limited extent of reverse logistics activities practiced by the municipal authorities, while highlighting individual or external efforts in recycling and repurposing certain materials.

6.5 Coding emerging themes sustainability (environmental, economic and social)

The qualitative data was analysed using thematic analysis, a technique that uses codes and descriptive statements. The three pillars of sustainability were used as guiding principles around which discussions in the interviews were carried out. The environmental pillar of sustainability sought to establish the behaviour of municipalities towards conservation of natural resources such as water, land and forests in the wake of municipal solid waste management. The study enquired as to the economic achievements or initiatives aimed at promoting economic growth within municipal areas. Such initiatives included employment creation in the area of solid waste management, initiatives like resource utilisation at local level and innovations. Other economic initiatives included revenue generation from municipal solid waste, encouraging both consumers and suppliers within local areas to practice green procurement. Eco-certification of municipalities was considered an important initiative towards economic sustainability. Statements which were gathered from participants were analysed to code and record statements about social sustainability. These included statements about community engagement and participation, social and equitable justice, opportunities, health and safety and the well-being of the society.

6.5.1 State of environmental sustainability in municipalities

The investigation also examined the measures of environmental sustainability taken by local government authorities within municipal areas. This data was useful for purposes of answering question associated with the first research objective. To assess the fluctuation in the quantities of solid waste generated and collected in the selected municipalities in Zimbabwe, the study inquired about the volumes collected from participants. This data collection aimed to ascertain whether there were any efforts towards achieving sustainable development goals and served as a basis for making informed assessments regarding the environmental sustainability of the municipalities.

6.5.1.1 Quantities of solid waste collected

Table 6.2 shows data gathered regarding the quantities of solid waste that municipalities were collecting. Participant explanations shed light on the state of solid waste volumes and environmental sustainability within their respective municipalities. An increase in solid waste volumes, particularly in suburban areas, was reported during the time of Covid-19 and thereafter, while acknowledging challenges in collecting all the waste leading to a growth in volumes.

Table 6.2: Quantities of Solid Waste Collected

	P	**Coded**	**Quote to support the code**	**Comment**
Sustainability measures (Environmental)		Ascertain state of sustainability in municipalities measured by volume of solid waste.	*At the moment we do not have reverse activities as Council but however we have somehow, though is not formal, we have some of our partners that are voluntarily doing so.*	Municipalities do not practice any reverse logistics activities.
	1	Ascertain state of sustainability in municipalities measured by volume of solid waste.	*We have not been able to collect all solid waste resulting in an increase in volumes of solid waste.*	Lack of adequate resources was cited as the cause.
	2	Ascertain state of sustainability in municipalities measured by volume of solid waste.	*There has been a reduction but if you analyse it critically it is just a shift from commercial centres to residential places.*	Shift of people from eating mostly at workplaces to consuming food from home.
	3	Ascertain state of	*……tips include secondary usage of*	Education on solid

		sustainability in municipalities measured by volume of solid waste.	*packaging materials and decorative purposes therefore, in a way there has been a recognisable reduction in the quantities that are now produced by households.*	waste management to households by municipalities.
	4	Ascertain state of sustainability in municipalities measured by volume of solid waste.	*We do not have reduction rather an increase in terms of the solid waste that we have in our cities or urban areas.*	Rural urban migration
	5	Ascertain state of sustainability in municipalities measured by volume of solid waste.	*The growing number of residents in urban areas has resulted in an increase in solid waste generated, collected and transported to landfills.*	Population growth in urban areas.
	7	Ascertain state of sustainability in municipalities measured by volume of solid waste.	*In our area there has been an increase of illegal dumping of solid waste especially in the bridges, especially in open spaces and even on roads*	Surge in volumes accompanied by old infrastructure.

6.5.1.2 Environmental impact of mismanaged solid waste

The study also investigated the environmental consequences of mismanaged solid waste, which included air pollution, drainage system blockages, and the spread of waterborne diseases such as cholera, diarrhea, and malaria. Participant 1 highlighted that burning litter contributed to air pollution and that foreign leaves from trees often obstructed drainage systems, impeding water flow during the rainy season. Furthermore, litter accumulated at road corners and became a health hazard, potentially transmitting diseases to individuals.

Table 6.3 provides verbatim responses from participants in the study. One participant noted that illegal dumping resulted in accumulation of solid waste such as plastic in drainage systems. The impacts of mismanaged solid waste extended to tarred roads and recreational parks, as mentioned by Participants 2 and 3. Stagnant water caused by blocked drainage systems weakened roads, leading to the formation of potholes and vehicle damage. The waste also negatively affected recreational areas and hindered the growth of plants due to potential chemical contamination. Participant 7 identified several negative environmental impacts, including increased mosquito

breeding, rodent multiplication, blocked drainage systems, flooding, and weakened roads due to water absorption.

Table 6.3: Environmental Impact of Solid Waste

	P	Coded	Quote to support the code	Comment
Sustainability measures (Environmental)	1	Environmental impact caused by solid waste management	*Of course, things like burning of litter cause air pollution to our environment which is not so good. Drainage systems have been blocked as a result of this litter and then the foreign leaves from the trees they block the drainage system*	
	2	Environmental impact caused by solid waste management	*When solid waste is not collected our drainage systems are blocked.*	
	3	Environmental impact caused by solid waste management		
	4	Environmental impact caused by solid waste management	*Drains are blocked by solid waste and water cannot pass so when it rains it overflows on the roads. Then litter will be found everywhere, making the environment is very ugly.*	
	5	Environmental impact caused by solid waste management	*……there has been pollution of rivers and drainage system which has caused blockages. There has also been rubbish on the roads which has also led to pollution of the streets which has become dangerous for kids to play in those places.*	
	6	Environmental impact caused by solid waste management	*When people throw away litter or refuse anyhow there is an increase of bad smells around the residential area. Council faces some challenges in providing awareness to people in order to entice people to reduce pollution in these areas.*	
	7	Environmental impact caused by solid waste management	*Drainage systems get blocked, and flooding takes place on the roads thereby loosening the roads because lot of water will have been absorbed within the ground.*	

6.5.1.3 Impact of illegal dumping of solid waste

Illegal dumping of municipal solid waste is one of the challenges that developing nations face. The study sought to establish impacts of illegal dumping activities in these selected municipalities. Table 6.4 provides quotes from participants and the codes they fall under. This was considered essential to establish if municipal authorities were aware that residents were practising illegal dumping and the problems associated with illegal dumping activities. Participants highlighted that illegal dumping has significant impacts on the beauty of the surroundings and the overall environment. One participant highlighted that when litter is dumped everywhere, it diminishes the beauty of the place, causing harm to flowers and trees. The environment becomes unappealing and emits unpleasant odour, discouraging potential investments and detracting from the enjoyment of the surroundings.

Participants lamented that dumping waste indiscriminately in urban areas disrupts the aesthetic appeal of the surroundings. Trees, lawns, and flowers that have been carefully planted and maintained are negatively affected. The litter not only distracts from the beauty of the place but also leads to the deterioration of flora, resulting in the death of flowers and damage to trees. Consequently, the environment becomes visually unattractive, and the unpleasant odour emitted by the waste further diminishes its appeal. Such conditions discourage investment, deter people from staying or spending time in the area, and contribute to the overall degradation of the environment. The consequences of illegal dumping extend beyond the visual aspects. Improper waste disposal creates breeding grounds for flies and mosquitoes, leading to an increase in these disease-carrying pests. Participant 3 highlighted that one of the significant obstacles is that residents tend to engage in illegal dumping during odd hours, specifically when municipal workers are not present. Even though there is law that clearly states that individuals caught practicing illegal dumping should be fined according to the city council's by-laws, participants highlighted that residents practice illegal dumping.

Table 6.4: Impact of Illegal Dumping of Solid Waste

	P	Coded	Quote to support the code	Comment
Sustainability measures (Environmental)	1	Illegal dumping of solid waste management	*They also dump some litter ……. and you know the place becomes very ugly becomes very bad, because of many people that come to those places and do that*	Unsightly surroundings.
	2	Illegal dumping of solid waste management	…… *but due to this solid waste management challenge we have seen that most people are now dumping refuse in these places.*	Illegal dumping of solid waste.
	3	Illegal dumping of solid waste management	……. *affected by this waste because some of the waste might have chemicals that might actually affect the growing of plants*	Ecosystem affected.
	4	Illegal dumping of solid waste management	*It used to be very beautiful now that people are dumping solid waste everywhere, that place has become very ugly children no longer have any place to play.*	Unsightly environment.
	5	Illegal dumping of solid waste management	*This causes residents to create their own options which among others are illegal dumping.*	Increase in illegal dumping.
	6	Illegal dumping of solid waste management	*We might see a lot of flies and mosquitoes breeding in those places. Eventually, they carry diseases to houses. Snakes also find these places good to hide*	Breeding places for disease causing insects.
	7	Illegal dumping of solid waste management	*Recreational parks are being affected because people will be dumping refuse all over the show.*	Dumping of solid waste all over.

6.5.2 The state of economic sustainability within municipal areas

The study also solicited information from local government regarding economic sustainability. This study recognises economic sustainability as a crucial component of overall sustainability, prompting an investigation into the existence of economic activities, specifically employment generation, stemming from solid waste management practices. The participants were asked to

expound upon their knowledge and experiences of employment creation associated with solid waste management.

6.5.2.1 Economic employment creation through solid waste picking

Table 6.5 was used to show responses from participants in the study. Participant 1 stated that while the council has not directly generated employment opportunities, informal employment has emerged as individuals engage in the collection and sale of recyclable materials such as bottles, plastic, and scrap metals. The financial gains derived from these endeavours are regarded as commendable, particularly in the current challenging economic climate. Furthermore, such informal employment contributes to crime reduction within the communities. Participant 4 highlighted that the collection and sale of scrap metal and plastics have engendered employment opportunities. Individuals gather discarded scrap metal from the vicinity, which is subsequently sold to buyers, including those from neighbouring countries.

Participant 5 elucidated that employment creation has materialised through the engagement of individuals who provide guidance to neighbourhoods on appropriate waste disposal practices and the segregation of solid waste into designated receptacles. Such employment endeavours contribute to efficient waste management and promote responsible waste disposal behaviour. Participant 7 clarified that the creation of employment opportunities within solid waste management primarily occurs through independent and informal initiatives. Individuals engaging in the collection and segregation of solid waste for personal business purposes have spearheaded employment generation, with limited involvement from the council.

Table 6.5: Economic Employment Creation through Solid Waste Picking

	P	Coded	Quote to support the code	Comment
Sustainability measures (Economic)	1	Economic employment creation.	…. *council's perspective not really, we have not been able to create employment. But from the individuals that come to pick some bottles, plastic, scrap metals, yes employment has been created.*	Municipalities do not employ solid waste pickers.
	2	Economic employment creation.	*…..to some extent people were recruited for labelling the bins or actually directing people on which bins to deposit specific waste*	An opportunity has been identified to label bin according to solid waste type.
	3	Economic employment creation.	*In a way it is negligible, but employment has been created which has actually benefited some people because they are now making a living out of solid waste.*	Negligible though keeps some people busy.
	4	Economic employment creation.	*To some extent people are collecting scrap piles which is being dumped around this area and there are some people actually some cross borders who buy this scrap metal, and therefore it has created some employment.*	A certain level of scrap is being sold across the frontiers of the country.
	5	Economic employment creation.	*Informal waste pickers have invaded most places and they are picking solid waste.*	Informal waste pickers exist.
	6	Economic employment creation.	*There is employment created when we separate the solid waste or the garbage.*	Waste separators now promising livelihood.
	7	Economic employment creation.	*Informally yes there has been employment creation but this is not the responsibility of Council.*	Informal employment created.

6.5.2.2 Availability of markets for picked solid waste

The presence of markets for collected solid waste was investigated in the study. The participants' responses shed light on the availability and nature of these markets. Table 6.6 presents the verbatim comments made by the participants regarding the availability of markets.

It was acknowledged by Participant 1 that markets do exist for the collected solid waste, as indicated by the regular collection of metals and other items. This suggests that there are destinations where these materials are processed, and individuals are compensated. The active search for items in landfills further supports the existence of markets for the acquired solid waste. Participant 2 expressed confidence in the existence of buyers for the collected solid waste. The National Waste Company in Zimbabwe was highlighted as an example, specialising in collecting wastepaper products from institutions. Another company located in Pomona, north of Harare, was also mentioned as a recipient and recycler of waste, although it operates independently of the council. In the case of specific types of solid waste, Participant 3 noted that organisations such as Art Cooperation Paper that provide designated collection points for paper, which is later collected at a specific tonnage and compensated accordingly. Similarly, there are assigned companies that purchase cans from collectors, indicating the presence of ready markets for these materials.

While direct involvement with markets may be limited, Participant 4 emphasised the indirect benefits to the council resulting from individuals collecting scrap iron, paper, and plastics. This collection contributes to a reduction in solid waste quantities and leads to fuel savings for the council. Participant 5 confirmed the existence of ready markets for specific types of solid waste. For instance, Exide Batteries engages in the collection of used car batteries that are no longer functional, suggesting a market for these items. Additionally, Participant 6 mentioned companies like Waverly, Pro-Plastics, and Drip-Tech, which utilise plastic in their production processes. However, it was noted that individuals lack awareness of where to sell their products, indicating a need for education and training to increase market accessibility. Lastly, Participant 7 affirmed the existence of markets for solid waste, particularly wastepaper. The Waste Paper Company was mentioned as an entity involved in the collection and recycling of wastepaper, although it operates independent of municipalities.

The participants' responses collectively indicate that markets do exist for different types of solid waste, either through formal channels or informal arrangements. These markets provide incentives for individuals to engage in waste collection and recycling efforts, contributing to waste reduction and potentially generating economic benefits.

Table 6.6: Market Availability of Picked Solid Waste

	P	Coded	Quote to support the code	Comment
Sustainability measures (Economic)	1	Market availability and proceeds for municipalities.	*Obviously no because these are informal traders. How they do their businesses we do not have control over that, how they are paid and how much they are paid and where they are paid, we are not involved.*	Informal traders
	2	Market availability and proceeds for municipalities.	*We are convinced from council that there are takers for what they are collecting. Otherwise, there would be no motivation for them to do it.*	Waste takers exist.
	3	Market availability and proceeds for municipalities.	*Not monetary per se, but they do pay a small percentage as a way of appreciating and the work we do to take the refuse to that particular dumpsite, and they eventually collect it from one point, about 1% or so which they do return to the Council.*	Nothing monetary going to municipalities.
	4	Market availability and proceeds for municipalities.	*Not directly but indirectly. The council is benefiting because once scrap iron has been collected by these people it means a reduction in solid waste quantities.*	Indirect markets for those who buy solid waste.
	5	Market availability and proceeds for municipalities.	*…..there has not been any revenue received by the council from the sale of solid waste. It appears that the council's income is primarily derived from fixed charges imposed on households rather than revenue from the activities of independent waste collectors.*	No revenue for municipalities.
	6	Market availability and proceeds for municipalities.	*…….the council does not receive a percentage of the proceeds from the sale of solid waste collected by independent waste collectors.*	No revenue for municipalities.
	7	Market availability and proceeds for municipalities.	*In terms of monetary percentage no, but in terms of reducing the tonnage in that particular area, the illegal dumping, yes there is because they do collect all sorts of items and separate them reducing the mass in that area and it helps us as a council on how to manage*	Nothing for municipalities but reduction in solid waste quantities.

6.5.3 Social sustainability within municipal areas

Social sustainability, as the third pillar of sustainability, focuses on the well-being of society. This study aimed at gathering information regarding the impact of solid waste on the health of the community, any social changes observed due to reverse logistics activities in solid waste management, and potential suggestions from participants to address solid waste management issues.

6.5.3.1 Health effects of poor solid waste management

The analysis of qualitative data regarding health effects of improper solid waste management is presented in Table 6.7. Participant 1 emphasised that improper solid waste management, particularly during the rainy season, can contribute to various diseases such as diarrhoea, cholera, typhoid, and bilharzia. Solid waste provides a conducive environment for bacteria to thrive due to its moisture content. If the waste is not properly removed from residential areas, diseases, including malaria, can spread as stagnant water accumulates, providing breeding grounds for mosquitoes. Participant 2 added that the presence of flies can introduce dirt into homes, increasing the risk of cholera and typhoid outbreaks. Children playing in dirty water or swimming in contaminated areas are particularly vulnerable to waterborne diseases. Participant 3 pointed out potential dangers associated with children coming into contact with remnants of solid waste, such as perfume cans, which could lead to accidents or harm their well-being.

In addition, Participant 4 mentioned that flies attracted to decomposing waste can spread dirt and diseases, especially in densely populated areas where houses are in proximity. Limited access to clean water can further exacerbate the situation, as diseases spread more easily. Further discussion regarding the connection between diseases and drainage systems revealed that blocked drainage systems can lead to sewage system issues, affecting streets and consequently impacting the health of residents. The participants identified several health risks associated with improper solid waste management, including the spread of diseases, blockage of drainage systems, and contamination of water sources. These findings highlight the importance of effective waste management practices to safeguard the well-being of communities.

Table 6.7: Health Effects of Poor Solid Waste Management

	P	Coded	Quote to support the code	Comment
Sustainability measures (Social)	1	Health effects of poor solid waste management.	*Yes, there is quite a lot particularly during the rainy season. This solid waste can become a source of many diseases like diarrhoea, cholera, typhoid, bilharzia and others.*	Misplaced solid waste a source of diseases during rainy season.
	2	Health effects of poor solid waste management.	*The connection is there, as long as solid waste is not collected the mosquitoes come and breed there. Rodents, rats and the different bacteria find these places favourable for breeding.*	Illegal dump sites are disease breeding places.
	3	Health effects of poor solid waste management.	*…. one it becomes an eyesore, also children might actually want to use remnants of the products like perfume cans and if they burn them, they might actually explode and as such we have some serious repercussions to the lives of children.*	Illegal dumpsites are an eyesore.
	4	Health effects of poor solid waste management.	*……flies will tend to collect dirt and if it is decomposing then when flies get there, they will come to the households especially in high density suburbs where houses are close together*	Dumped solid waste so close to residential places and disease transmitting insects can reach homes.
	5	Health effects of poor solid waste management.	*Well, the issue of health affecting the well-being of residents is visible in multiplication and presence of diseases such as cholera, typhoid and diarrhoea within residential places*	Residents affected by presence of disease carrying insects.
	6	Health effects of poor solid waste management.		
	7	Health effects of poor solid waste management.		

6.5.3.2 Observable social changes because of employment creation in solid waste

Participants were asked to explain the observable social changes in the behaviour of individuals who are employed as a result of employment creation in solid waste management activities within municipal areas. These employment opportunities could be either formal or informal. Table 6.8 presents the summary of the data that were collected from the participants in the study.

Participant 1 highlighted that when people are unemployed and idle, negative social impacts tend to increase, such as a rise in crime, illicit behaviour, and alcohol consumption. However, when individuals are employed and earning income, crime rates decrease in the community. With a source of income, people are less likely to engage in illicit activities and excessive drinking, leading to a positive change in the community. Participant 2 noted that there are observable social changes resulting from employment creation in solid waste management. Firstly, it provides job opportunities, particularly for the youth, addressing the high unemployment rates prevalent in the country. Secondly, having meaningful work helps prevent drug abuse and other negative behaviours associated with idleness. By keeping individuals occupied, solid waste management contributes to addressing social issues within the community.

A negative development was highlighted by Participant 3 who mentioned that while employment may provide individuals with income, there can be social challenges, such as domestic violence arising from disputes over the use of funds. The newfound economic empowerment can lead to conflicts within households if money is not managed responsibly.

Participant 7 emphasised that the proper collection of garbage has contributed to a reduction in diseases. The community, led by a chairperson, has implemented policies against indiscriminate dumping, resulting in improved health outcomes. Clinics no longer need to spend as much on medicines, benefiting the community as a whole. Participant 5 acknowledged positive social changes resulting from employment creation in solid waste management. However, it was noted that if females earn more than their husbands through these employment opportunities, it may lead to domestic violence due to potential power dynamics and financial disputes. Participant 7 further observed that there have been several social changes following the employment of individuals in solid waste management. The reduction in idle time has contributed to a decrease in violence, including domestic violence. Additionally, the areas where waste is collected have become less attractive to criminal elements, resulting in improved safety for the community.

Table 6.8: Social Changes Resulting from Solid Waste Employment Creation

	P	Coded	Quote to support the code	Comment
Sustainability measures (Social)	1	Social changes because of employment creation.	*People refrain from drinking maybe but long back when people were employed they would drink probably during the weekends that is why it was called 'Hoza Friday'.*	Less time for negative behaviour and activities
	2	Social changes because of employment creation.	*First it is a form of job creation though it is a small scale but there is some form of job creation for the youth.*	Solid waste picking is an informal employer.
	3	Social changes because of employment creation.	*…..result in domestic violence as their spouse might want to understand how the money was used, improper use of funds.*	Negative side is domestic violence.
	4	Social changes because of employment creation.		
	5	Social changes because of employment creation.	*…..positive social changes resulting from employment creation in solid waste management. However, it was noted that if females earn more than their husbands through these employment opportunities, it may lead to domestic violence due to potential power dynamics and financial disputes.*	Power shift may cause resentment in homes.
	6	Social changes because of employment creation.	*…… the areas where waste is collected have become less attractive to criminal elements, resulting in improved safety for the community.*	Dumpsites have been improved a bit.
	7	Social changes because of employment creation.	*….. there have been several social changes following the employment of individuals in solid waste management. The reduction in idle time has contributed to a decrease in violence, including domestic violence.*	Reduced idle time and domestic violence.

6.6 Selective coding analysis (emerged themes)

The study asked questions such as the volumes of solid waste being generated and collected within municipal areas, the impact of mismanaged solid waste, and the impact of illegal dumping. Table 6.9 presents the summary of responses from participants, and an analysis of each of these questions then follows.

6.6.1 Environmental sustainability

The major themes that emerged from questions asked about environmental sustainability were changes in quantities collected, pollution, blocked drainages, odour and littering, and breeding places for insects and rodents.

6.6.2 Economic sustainability

To establish the economic sustainability in the selected municipalities, participants were asked to explain employment creation and availability of markets. Themes that emerged were indirect employment creation, scrap collectors (recycling), solid waste separators and informal waste pickers (reusing). Markets for the picked solid waste were envisaged to exist given the continuous collection of solid waste.

6.6.3 Social sustainability

The study interviewed participants to explain the health effects of poor solid waste management on society. Participants indicated that places that were used as illegal dump sites become breeding places for disease transmitting insects such as flies and mosquitos. To understand evidence or lack of evidence in social sustainability, participants were asked to discuss any developments or changes to society as a result of reverse logistics activities such as recycling, reusing and returning.

Table 6.9: Selective Coding Analysis

Question	Emerged Themes	Participant Interviewed
Environmental Sustainability		
What quantities of solid waste are collected?	There has been an increase in volumes. Decrease in quantities observed in schools and clinics. Municipal solid waste reduction. Composting of bio-degradable matter.	1,2,3,4,5,7
What is the environmental impact of mismanaged solid waste?	Air pollution from illegal burning. Flooded roads due to blocked drains. Blocked drainage systems. Pollution in rivers. Bed smell (odour) Littering. Conservation of recreational facilities adversely affected. Possible climate change.	1,2,4,5,6,7
What is the impact of illegal dumping of solid waste?	Littering. Illegal dumping of solid waste. Ecosystem affected resulting in climate change. Breeding place for rodents and mosquitos. Water, air pollution.	1,2,3,4,5,6,7
Economic Sustainability		
Has there been economic employment creation within your areas?	Indirect employment creation. Bin labelling (community level). Scrap collectors. Solid waste separators. Informal waste pickers.	1,2,3,4,6,7
Please explain the availability of markets for picked solid waste?	Existence of markets as evidenced by continuous waste picking. Waste buyers (reuse, recycle & return). Direct and indirect employment created. No percentage received by municipalities. Reduce solid waste quantities. Budgets and revenue generation.	1,2,3,4,5,6,7
Social Sustainability		
What are the health effects of poor solid waste management?	Solid waste improperly deposited is a source of diseases. Breeding place for rodents and insects. Eyesore in the community. Disease spreading places. Community engaged in awareness.	1,2,3,4,5
Are there any social changes because of employment creation in solid waste activities?	People refrain from beer drinking. Job creation in informal and private sectors. Domestic violence decreases and increases. Shift in power dynamics at homes. Criminal elements reduction at solid waste dump sites. Reduced idle time. Preservation of culture and heritage. Social identity.	1,2,3,5,6,7

6.7 Discussion

A qualitative approach was used in this study for data collection from three selected municipal areas in Zimbabwe. Two of these areas were identified as non-performing in solid waste management, while one was identified as a performing municipality. A total of seven participants were interviewed, with each interview lasting between 30 to 40 minutes. Prior to the interviews, the researcher explained the purpose to the participants, obtained their consent through signed consent forms, and recorded the interview-guide questions and answers. The tonnages of solid waste collected and transported by municipal workers varied across the different areas. It was observed that after collection from households, the solid waste was transported to landfills for disposal. The local government authorities did not have alternative options for managing the collected solid waste besides landfilling. Furthermore, the selected local government municipalities did not engage in reverse logistics activities such as reusing and recycling. However, individuals and some organised groups would selectively pick items from the landfill areas to sell. Interestingly, households were found to be innovative in reusing some of the collected items for other purposes.

6.7.1 The state of environmental sustainability in selected municipalities

To determine the state of environmental sustainability, the researcher asked participants to provide an explanation of environmental, economic and social initiatives targeted at sustaining municipalities. Seven sub-questions were asked to gather information on this topic. The first question aimed to identify the trend in the quantities of solid waste collected and transported by the selected local government authorities. The responses from interviews indicated an increase in the volumes of solid waste collected and taken to dump sites. This increase was attributed to Covid-19 pandemic measures such as lockdowns and restrictions on the number of employees allowed to work. The government only allowed 30% of workers to go to work, while the rest had to work from home. Consequently, individuals were consuming meals at home instead of restaurants, resulting in increased solid waste volumes.

However, Participants 3, 4, 5, and 7 mentioned different reasons for the increase in solid waste volumes in residential areas. Participant 4 attributed the increase to rural-urban migration, as the youth were moving to cities in search of better lifestyles rather than engaging in subsistence farming. Subsistence farming was no longer considered lucrative due to its labour-intensive

nature and the effects of global warming. Participant 5 highlighted that city authorities were allocating land to citizens for development in urban centres, thereby increasing the tonnages managed by local government authorities. Participant 7 identified breakdowns of refuse collection vehicles as a cause of increased solid waste volumes. When the municipality failed to collect solid waste due to vehicle breakdowns, some residents resorted to illegal dumping at undesignated places. Additionally, Participant 3 mentioned a reduction in the volumes collected by the council due to education campaigns by health workers on solid waste reduction and its impact on health.

The study also investigated the impact of solid waste management by residents within their residential areas. The most commonly reported effects were pollution and the spread of waterborne diseases such as cholera, diarrhoea, and malaria. Previous research has linked unsightly solid waste to disturbing odours and cognitive and stress-related syndromes (Ziraba, Haregu & Mberu, 2016; Ncube et al., 2017; Yang et al., 2018; Norsa'adah et al., 2020). Furthermore, the areas surrounding the dumping sites were heavily polluted, becoming breeding grounds for diseases (Choon, Tan & Chong, 2017; Fauziah & Agamuthu, 2012; Fadullah et al., 2022). Blocked drainage systems were identified as a common issue resulting from improper solid waste management. The blockages affected tarred roads, leading to the formation of potholes. When water cannot flow easily in the drainage systems, it accumulates and weakens the soil around tarred roads, causing erosion and further exacerbating the pothole problem. Additionally, some packaging materials containing harmful chemicals hinder plant growth.

The study also examined the effects of dumping on the aesthetics of the surrounding environment. Recreational parks were mentioned as places that no longer appealed to people, resulting in reduced visits. These areas became hiding spots for snakes and stray dogs, posing a danger to individuals. Moreover, the illegal dumping of solid waste led to foul odours when the waste started to decompose. Participants indicated that there are by-laws in place to punish illegal dumpers; however, the main challenge lies in law enforcement. Offenders have studied the patterns of law enforcement agents and tend to dump waste at night or during weekends and holidays when they know agents are absent. Participants attributed this behaviour to residents' impatience, particularly when municipal services are disrupted due to truck breakdowns or other technical challenges. Some participants noted that people have become accustomed to illegal dumping, viewing it as a normal practice.

6.7.2 The state of economic sustainability within municipal areas

The study aimed to determine the economic sustainability within the selected municipalities by requesting participants to explain economic initiatives within their municipalities. The first question addressed whether there was any employment creation resulting from activities related to solid waste management in the municipalities. Most participants acknowledged the existence of employment opportunities, but these individuals or groups were not directly employed by the municipalities. The municipalities' role was limited to transporting the solid waste to dump sites, while the waste pickers would scavenge for items of interest. However, Participants 3 and 5 mentioned that municipalities had appointed people in certain areas to guide residents in depositing solid waste in the correct bins. Additionally, some companies had hired individuals to monitor skip containers in different areas and alert the companies when the quantities reached certain levels.

The study also investigated the availability of markets for the collected solid waste products. Participants reported the presence of markets, including neighbouring countries such as Botswana and South Africa. Within Zimbabwe, some companies purchase these solid waste items to use as raw materials, thereby reducing the demand for new raw materials. The study also explored whether municipalities benefitted monetarily from the sale of picked solid waste items. The common response was negative since the waste pickers and organised groups were not directly affiliated with the municipalities. However, this situation contributed to prolonged use of landfill areas since the waste pickers created space. In cases where waste pickers collected items from residential areas, the quantities of solid waste collected and transported by municipalities were reduced.

Participant number 2 suggested collaboration with other government agencies and privatising solid waste collection. This suggestion aligns with the findings of Abdullah et al. (2017), who conducted a survey on resident satisfaction with municipal services and proposed privatisation as a potential solution to the challenges faced by municipalities.

6.7.3 The state of social sustainability within municipal areas

To evaluate the state of social sustainability in the selected municipalities, the study sought explanations from participants. The first question focused on the effects of improper solid waste

management on residents' health. Most participants highlighted disease outbreaks during rainy seasons as a common consequence. Illegally dumped solid waste hindered the proper flow of water, providing breeding grounds for insects such as mosquitoes and flies. These insects could then transmit diseases, leading to cholera and typhoid outbreaks. Previous studies have also noted the link between dumpsite pollution and diseases such as liver cancer, pancreatic cancer, and larynx cancer (Ncube et al., 2017; Ancona et al., 2015; Jarup, Briggs, de Hoogh, Morris, Hurt & Lewin, 2002). Improper solid waste management has further been associated with birth defects, preterm babies, congenital disorders, and Down's syndrome (Ncube et al., 2017; Norsa'adah et al., 2020). The Expert Panel on Air Quality Standards (EPQS, 2009) has indicated that solid waste releases hydrogen fluoride, which, when deposited in the respiratory system, can cause coughing, chest pains, tightness, and breathlessness.

Improperly placed solid waste is not only unsightly but also poses risks, especially to children who may come across potentially dangerous items, such as empty perfume cans that can explode when burnt. Improper solid waste management can also damage water pipes, sewage pipes, and underground electric cables due to water logging and soil loosening. Poor solid waste practices contribute to the spread of waterborne communicable diseases, which affect both the environment and human health (Estoque, 2020).

Another question explored whether there were observable social changes resulting from employment creation in solid waste management activities. Participants highlighted waste pickers, stating that their occupation provided a source of income. Furthermore, there were reductions in disease incidence due to health workers' education on the importance of proper solid waste management and how to reduce waste quantities.

However, negative effects were also identified. Participants 3 and 5 mentioned instances of violence at dumpsites, where waste pickers would fight over items. Since waste pickers are not part of municipal authorities, conflicts over territories and items can extend to their homes, leading to disagreements and domestic violence. To address the challenges faced in reducing solid waste, participants proposed various practical solutions. Many suggested that municipalities should collaborate with government agencies such as the Environmental Management Agency (EMA) to monitor residents' behaviour. Attracting investments was another commonly proposed solution, as it could bring much-needed funding and capital for state-of-the-art waste

management trucks. Participants also recommended conducting awareness campaigns within residential areas to educate residents about the dangers of mismanaging solid waste and the associated health risks. Enforcement of policies was also suggested, with Participant 2 emphasising the need for law enforcement. This could involve municipal authorities employing undercover agents to apprehend those engaging in illegal dumping, even during night-time. Penalties such as heavy fines or community service within the residential areas, such as working at schools or clinics, could be imposed on the offenders.

Regarding waste collection methods, participants suggested moving away from the traditional approach of trucks going house to house and instead place skip containers at strategic points for residents to deposit their waste. Additionally, Participant 5 proposed government assistance in servicing the solid waste trucks to ensure their operational condition. Participant 4 suggested that municipalities could charge residents based on the weight of the generated solid waste, increasing the fees if certain allowable quantities are exceeded per household. This approach would discourage households from generating excessive waste and encourage waste reduction. Furthermore, characterising solid waste at the source was suggested, enabling reverse logistics activities and allowing municipalities to sell solid waste directly to companies in need of discarded items.

6.8 Summary

This chapter focused on objectives number four and five of the study, using semi-structured interviews to gather information from participants. The findings revealed that the selected municipalities do not practice reverse logistics in solid waste management. Instead, they follow traditional collection methods, where waste is collected from households without separation. However, it was noted that informal traders engage in reverse logistics by collecting items of value from households or foraging through dumpsites.

During the pandemic, there was a noticeable shift in solid waste quantities from commercial areas to residential areas due to the government-imposed restrictions on movement and the closure of food outlets. Participants highlighted the negative impacts of mismanaged solid waste on the environment, including pollution, drainage system blockages, and increased disease transmission. The aesthetics of the areas were also adversely affected by illegal dumping and burning of solid waste.

Informal waste pickers created employment opportunities for themselves and contributed to reducing the overall tonnage of waste that municipalities had to collect. However, concerns were raised about the potential transmission of diseases by these informal waste collectors.

The impacts of mismanaged solid waste were identified as environmental, pollution, health, and aesthetic issues. Improper waste management affected plant and animal life, ecosystem balance, and the health of residents. Burning of waste contributed to air pollution and respiratory illnesses. Solid waste could also contaminate large bodies of water, impacting aquatic life. The beauty of the area was compromised, which in turn affected the value of properties in those areas.

Public participation in solid waste management and associated programs was found to be lacking, highlighting the need for increased community involvement. Source separation was emphasised as a critical step in effective waste management. Furthermore, future studies should explore the relationship between education, professional jobs, and residents' attitudes and behaviours towards waste management practices.

The findings underscore the importance of addressing the challenges of solid waste management to mitigate the negative impacts on the environment, public health, and the aesthetics of communities.

CHAPTER SEVEN

SUMMARY, RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

7.1 Introduction

This chapter provides a reflection on the research objectives of the study and demonstrates how these objectives were addressed throughout the research process. The research objectives served as a guide in structuring the various sections of the study and achieving the desired goals. The literature review played a crucial role in identifying gaps in previous studies and informing the relevant aspects of the research. The chapter also presents the summary of findings, which include the practices of the selected municipalities, the impacts of mismanaged waste, the role of informal waste pickers, and the level of public participation. These findings inform the conclusions drawn from the study regarding solid waste management. Based on the findings, several recommendations are proposed for stakeholders involved in solid waste management. These recommendations address the need for improved waste collection methods, enhanced public participation, education and awareness campaigns, and the integration of informal waste pickers into formal waste management systems. The recommendations aim to mitigate the negative impacts of mismanaged waste and promote more sustainable waste management practices.

7.2 A recap of research objectives

The study's main aim was to develop a feasible framework for reverse logistics that could help local government authorities to adopt reverse logistics activities for use in the management of solid waste so as to achieve improved sustainability. To achieve this aim, five objectives listed in Table 7.1 were pursued. These five objectives guided the research process and aimed at understanding the current practices of waste management, identifying the impacts of mismanaged waste, exploring the role of informal waste pickers, assessing public participation, and ultimately developing a framework for reverse logistics in waste management. By addressing these objectives, the study aimed to contribute to improved sustainability in waste management for local government authorities.

Table 7. 1: Summary of Objectives

Research Objective	**Secondary data** **Empirical data**
Primary objective	
To develop a feasible framework for reverse logistics that could help local government authorities to adopt reverse logistics activities for use in waste management so as to achieve improved sustainability.	Chapter 1 Section 7
Secondary Objectives	
1. To establish the perceptions of households/residents on municipal authorities' practices on the management of municipal solid waste in selected municipalities in Zimbabwe.	Chapter 1 Section 7.1 Chapter 5 Section 5.1
2. To determine the practices of residents/households on the management of municipal solid waste in selected municipalities in Zimbabwe.	Chapter 1 Section 7.1 Chapter 3 Section 6.5 Chapter 5 Section 5.3
3. To determine whether the attitude and behaviour of municipalities towards municipal solid waste management, as perceived by the residents, influences the way in which residents manage their municipal solid waste.	Chapter 1 section 7.1 Chapter 3 section 7 Chapter 5 Section 5.4
4. To ascertain the state of sustainability in selected local government municipalities in Zimbabwe.	Chapter 1 section 7.1 Chapter 3.2 Chapter 6 Section 3.2
5. To determine if there is a relationship between reverse logistics of municipal solid waste and sustainability in local government municipalities in Zimbabwe.	Chapter 1 section 7.1 Chapter 3.5 Chapter 6 Section 3.2

7.3 Discussion of the findings of the study and recommendations

The primary objective of this study was to propose a solid waste reverse logistics framework for municipalities to attain sustainability. This objective was supported by secondary objectives, which included establishing households' perceptions of municipal services on solid waste

management, examining residents' practices related to solid waste disposal, and evaluating residents' satisfaction with the services provided by municipalities. The literature review played a crucial role in guiding the study by identifying existing gaps in understanding residents' perceptions and attitudes toward municipal services. The study area was divided into performing and non-performing area. The working definition used in the study for a performing municipality is a physical reflection of the absence of municipal solid waste that is lying around in the area. A non-performing municipality refers to municipalities with physical evidence of municipal solid waste lying around. Nhubu and Muzenda (2019) refer to performing residential areas as low-density suburbs while non-performing areas are called high-density suburbs. Sinthumile and Mkumbuzi (2019) found that collection of municipal solid waste from elite suburbs takes place once every week while collection of municipal solid waste from high density suburbs takes place every 14 days or 21days.

7.3.1 Perceptions of households on municipal solid waste management

The objective of establishing households' perceptions was to investigate how residents viewed the services provided by municipalities in solid waste management. Residents' perceptions have a significant influence on their behaviour regarding waste management. The study utilised a self-administered questionnaire with 21 items, divided into two sections: residents' perceptions and their satisfaction with municipal services.

The data collected from residents in non-performing municipalities indicated a substantial disagreement with the services provided by municipalities. These services included regular solid waste collection, cleaning of garbage piles in the streets, and educational initiatives for households. Results from the study are aligned with previous studies that indicate that municipal solid waste management is a global challenge (Odonkor et al., 2020; Ferronato & Torretta, 2019). Ten items were used to solicit information from households, and results show negative and significant values. For example, on the high side, the bracketed values (t-value=-5.397; p-value=0.001) were observed on a question that sought to establish whether municipalities offered education to residents on solid waste management. While on the low side, the bracketed values (t-value=-3.361; p-value=0.001) were observed on a question that sought to find out if municipalities penalised residents caught breaking by-laws on solid waste management. Findings from the non-performing municipalities confirmed the dissatisfaction among residents and their

practices of indiscriminate refuse disposal, leading to environmental pollution, as highlighted by Francis-Xavier et al. (2018). Effective municipal services, including education on proper waste handling and provision of receptacles, are essential for achieving positive outcomes in solid waste management, as emphasised by Birhanu and Barisa (2015). These results align with the objective of Sustainable Development Goal 12.5, which advocates for reducing the quantity of solid waste generated and disposed of in landfills (Viljoen et al., 2021).

Conversely, the findings from performing municipalities revealed positive agreement among residents regarding the services provided by municipalities. Path analysis demonstrated a positive relationship between residents' perception of municipal waste management services and their solid waste practices. Understanding residents' perceptions and satisfaction with municipal services is crucial for guiding policy directions and enhancing sustainable solid waste management (Odonkor, Frimpong & Kurantin, 2021). As emphasised by Udofia et al. (2018), obtaining the viewpoints of solid waste service users is necessary for a comprehensive assessment of service efficiency and quality.

7.3.2 Practices of households regarding solid waste disposal

The objective of examining households' practices regarding solid waste disposal aimed to gain insight into residents' actual behaviours and practices in managing their solid waste. The study utilised 19 items to collect data on solid waste practices, focusing on residents' agreement or disagreement with solid waste management at the household level, as well as their real practices. Statistical inferences were used to measure the tendency of centrality of the observed data. In non-performing municipalities the highest mean value (5.22) on a scale of 1 to 6, was observed on an item that sought to establish whether residents burnt solid waste within their yards. This means that residents agreed that they burnt their generated municipal solid waste within their yards. In these non-performing municipalities, the lowest mean value (1.72) was observed on a statement that read ‘we empty our solid waste generated in our house into a bin outside the house’. This implies that no receptacles were available for residents to empty their generated municipal solid waste. Observed results in performing municipalities for residents’ practices showed the highest mean value (5.64) on a statement that sought to establish where solid waste was deposited. This means that residents emptied their generated municipal solid waste in

available receptacles. The lowest mean value (1.29) was observed on a question that sought to establish if residents burnt solid waste. This implies that residents in performing areas were not burning their generated municipal solid waste. Results show that residents in performing municipalities had positive practices on solid waste management as compared to residents in non-performing municipalities.

The data collected from non-performing municipalities revealed that residents had limited knowledge about the quantities of solid waste generated in their households, contrary to Pawandiwa's (2013) claim of average solid waste generation rates in Zimbabwe. Additionally, residents in non-performing municipalities indicated a lack of participation in solid waste management programs, as they did not separate their solid waste into different streams. This lack of participation exacerbates solid waste management challenges, leading to negative attitudes and perceptions among households (Chapungu, 2015; Mafume et al., 2016). Shabani and Jerie (2022) highlighted that non-participation hinders proper segregation and storage of solid waste.

In contrast, residents from performing municipalities displayed significant positive agreement in their attitudes, perceptions, and practices related to solid waste management. They reported refraining from practices such as depositing solid waste in undesignated areas, which can have hazardous consequences for the environment and human health, as emphasised by researchers (Nedziwe & Murairwa, 2022; Munyai & Nunu, 2020; Makwara & Magundu, 2013).

7.3.3 Attitudes of households towards reverse logistics practices

To investigate the attitudes of households towards reverse logistics practices in local government municipal areas in Zimbabwe, data were collected from both non-performing and performing municipalities. The findings revealed significant agreement among residents in both areas regarding their engagement in reverse logistics practices, except for two specific items. Results from the observed data in non-performing municipalities showed p-values that were not statistically significant for three statements (we donate items, p-value=0.259; we return items, p-value= 0.278; we take useful parts from items, p-value=0.122). This implies that residents in non-performing municipalities were not practicing these reverse logistics activities.

Residents in non-performing areas expressed agreement with five out of the seven items related to reverse logistics practices. These included reusing items for secondary purposes, such as

containers, and depositing items like batteries in special containers provided by the municipality. The findings showed that residents in non-performing municipalities did not donate solid waste items to others who could use them, and they did not return items like batteries to original equipment manufacturers (OEM). The low-income status of residents in the non-performing area might contribute to these negative reverse logistics practices, as they may lack knowledge and resources. This observation aligns with the assertion made by Suleman, Simon and Richard (2015) that social diversities, ethnic groups, and income levels strongly influence communities' capabilities in managing solid waste.

In contrast, residents in the performing area demonstrated significant agreement with all the items related to reverse logistics practices. The highest mean value was observed in response to the question about residents swapping old items for new ones, with an option to top up with cash during the purchase. This indicates that residents in the performing area have a better understanding of the impact of poor solid waste management and possess the necessary resources to engage in reverse logistics practices. These residents also demonstrated a higher level of knowledge about returning items to original equipment manufacturers and making donations of containers to schools and other institutions.

The findings from this study are in line with the proposition by Mariwah, Kendie and Dei (2010) that perceptions, attitudes, and behaviours are influenced by knowledge, available resources, beliefs, values, and norms. The results highlight the importance of income levels, resources, and access to information in shaping residents' engagement in reverse logistics practices.

Further research can explore interventions to promote reverse logistics practices among low-income households and provide them with the necessary knowledge and resources. Additionally, investigating the role of local government authorities in facilitating and supporting reverse logistics initiatives can contribute to the development of effective waste management strategies.

Understanding households' attitudes towards reverse logistics practices is crucial for developing sustainable waste management systems. By promoting and encouraging reverse logistics, municipalities can enhance resource recovery, minimise waste generation, and contribute to a circular economy approach.

7.3.4 State of sustainability in local government municipalities

The state of sustainability in selected local government municipalities was assessed through interviews with seven municipal workers. The interviews, lasting between twenty and thirty minutes each, focused on three aspects of sustainability: environmental sustainability, economic sustainability, and social sustainability.

7.3.4.1 State of environmental sustainability in selected municipalities

Regarding environmental sustainability, participants were asked about the changes in the quantities of solid waste collected, transported, and disposed of in their respective areas over the past few years. Participants gave different versions of quantities of municipal solid waste generated and dumped in selected municipalities in Zimbabwe. However, the consensus was that the generated municipal solid waste ends up illegally dumped. This finding agrees with Iyer (2017) who points out that the bulk of solid waste ends up in illegal dumps and there is no doubt that households are the sources of municipal solid waste and they contribute to illegal dumping (Kwakye et al., 2023). This finding supports the assertion by Kolekar, Hazra and Chakrabarty (2017) who point out that differences in economic status of countries, and each individual country's life style and level of education play an important role in the quantities of municipal solid waste that are produced. Participant 3 highlighted the role of education provided by council health workers in changing residents' behaviour, aligning with Suleman, Simon and Richard's (2015) assertion that education plays a vital role in shaping attitudes toward solid waste management. Additionally, Participant 4 attributed the increase in solid waste quantities to migration from rural to urban areas, which strained resources and disrupted collection schedules. This finding concurs with Kaza et al. (2018) who echoes that economic development and growth have attracted the migration of rural people, resulting in increased pressures on urban facilities. Participant 5 linked the increase in waste volumes to population growth and urban expansion. Participant 7 mentioned that aging solid waste vehicles often break down, leading to collection disruptions and residents resorting to illegal dumping. These findings align with Atkinson et al. (2019) who claim that unsightly solid waste collection points are a common issue when receptacles become filled and overflow.

The impact of Covid-19 on solid waste was also discussed. Participant 7 noted that government measures, such as lockdowns and restrictions on work attendance, resulted in residents preparing

meals at home instead of dining out. Consequently, food outlets remained closed for some time. The use of house-to-house solid waste collection methods, where residents separate waste at the source, was mentioned as an advantageous practice that saves time, labour, and other resources associated with waste collection.

Participants were asked about the consequences of mismanaged solid waste. Pollution, blockage of drainage systems, and the spread of waterborne diseases were identified as common issues. Reponses from participants in the study that ineffective solid waste management negatively impacts the environment concur with the findings from Francis-Xavier (2018). Adale and Muleta (2011) noted that solid waste clogs sewage systems and creates breeding grounds for disease vectors. Shaira et al. (2020) also emphasised the role of single-use plastic items in blocking waterways and exacerbating disasters like flooding. Furthermore, the accumulation of leaves among improperly dumped waste in drainage systems was identified as a factor hindering water flow and causing damage to tarred roads.

The effect of illegal dumping on recreational facilities was explored, with participants stating that such facilities become unsuitable for their intended purposes. Unsightly waste lowers community morale, and hazards such as stray animals and potential snake hiding places deter children from using these areas. Dumping waste in recreational spaces also hinders the growth of plants that beautify these spaces. These findings concur with literature that point out that illegal and indiscriminate dumping of municipal solid waste has a negative impact on public health (Abdissa et al., 2022; Ondonkor & Salar, 2021; Rodic & Wilson, 2017).

Participants were asked about the existence of laws and punishments for illegal dumping. Participant 3 mentioned clear by-laws that impose fines on offenders but highlighted the challenge of catching residents in the act, as they tend to dump waste at odd hours. Participant 7 confirmed that residents who engage in illegal dumping are aware of their actions and deliberately do so under the cover of darkness. Social diversities, such as income levels, ethnic groups, education, beliefs, norms, and values, as discussed by Suleman, Simon and Richard (2015) and Mariwah, Kendie and Dei (2010), may contribute to residents' behaviour.

Finally, participants shared their opinions on the reasons behind residents engaging in illegal dumping. Lack of patience when collection schedules are missed, normalisation of illegal dumping as a societal norm, and disruptions in collection schedules were identified as

contributing factors. This was highlighted as a threat to the cleanliness of the municipalities, an observation found in a research study by Nedziwe and Muraiwa (2022) that highlighted this is a problem that is waiting to surface in the future. With regard to reverse logistics activities being practised within municipalities, participants indicated that municipalities themselves did not exercise any reverse logistics activities. A gap does exist in the action of municipalities regarding reverse logistics activities which they have not embraced, despite literature highlighting that reverse logistics activities are on the increase (Julianelli et al., 2020) and can be used to economise and improve the management of municipal solid waste (Mesiasz-Lech, 2018). Nevertheless, it was indicated that households tended to reuse some solid waste materials, which is in line with Banihashemi et al. (2019) who state that one of the reverse logistics activities is reuse. These findings reveal lack of planning by municipalities for reverse logistics activities, which is in contradiction to Vergas et al. (2021) who contend that proper planning of reverse logistics activities is an attribute of solid waste management.

7.3.4.2 State of economic sustainability in selected municipalities

The state of economic sustainability in the selected municipalities was assessed, particularly in relation to solid waste management. Participants were asked about employment creation within municipalities in the context of municipal solid waste management. The responses indicated that informal employment opportunities have been created, primarily through the activities of informal solid waste pickers. These individuals are not considered the responsibility of the municipal authorities. Some companies have placed their own skips in residential areas and have contacts who notify them when a skip is full. The welfare of these informal waste pickers, who often scavenge through waste at dumping sites, is not formally addressed by the municipalities. While specific incidents of misunderstandings may not have been recorded, it is acknowledged that if such incidents result in fatal injuries or deaths, they will require the attention of municipalities and other relevant authorities, such as the police.

The study also aimed at determining the availability of markets for the solid waste collected by these informal pickers. Most participants indicated that they were not formally aware of the markets for these items since the welfare of the waste pickers is not the responsibility of the council. However, Participant 1 suggested that markets exist because the presence of informal pickers rummaging through dumping sites is evidence of demand for solid waste items. Other

companies in industries like plastic, paper, and metal have established designated points where waste pickers can sell their items.

Furthermore, the study explored whether there is any revenue or percentage of proceeds from the activities of these informal traders that is channelled through the council. Most responses indicated that municipalities do not receive revenue from the proceeds of solid waste collected by informal pickers. However, Participants 3 and 7 made important observations: Participant 3 noted that the solid waste collected by informal pickers affects the quantities eventually transported by municipalities. Items like scrap metal, which have substantial weight, can significantly reduce the total weight transported by councils. As a result, the number of trips made by solid waste vehicles is reduced. Participant 7 agreed with this observation, emphasising that the volumes of solid waste carried by the council are reduced. However, there is a lack of information regarding the specific tonnages reduced due to the activities of informal waste pickers in these municipal areas.

The findings suggest that there is a significant presence of informal employment and economic activities related to solid waste management in the municipalities. While the municipalities may not take direct responsibility for the welfare of informal waste pickers, the reduction in quantities transported by councils due to these activities highlights the economic impact of the informal sector. Further research and collaboration between municipalities and informal waste pickers could provide insights into how to better integrate and support these workers while promoting economic sustainability in waste management.

7.3.4.3 State of social sustainability in selected municipalities

The effects of improper solid waste handling on society were discussed with the participants to assess the state of social sustainability in the selected municipalities. One notable observation was that during rainy seasons, illegally dumped solid waste creates breeding grounds for vectors of waterborne diseases. Rodents and rats are reported to invade these areas, and due to their proximity to homes, they can enter homes in search of food. This observation aligns with the findings of Adale and Muleta (2011), who highlighted that sewer clogging and illegal dumping of solid waste provide breeding grounds for mosquitoes and pests, thereby increasing the transmission of vector-borne diseases. Participant 3 also noted that places where solid waste is illegally dumped become unsightly, supporting the claim that illegally deposited waste lowers

the morale of communities, as stated by Odonkor, Frimpong and Kurantin (2020). Participants pointed out that public spaces become an eyesore because of illegally dumped waste, thereby discouraging people from using these public spaces. This was noted by Moqbel (2018) who posits that dumping of solid waste affects social activities. Participants echoed such sentiments about littering in municipalities, is in line with the findings of Rugobo (2017) who noted that littering is common in Zimbabwe.

To assess social sustainability within the municipal areas, participants were asked to explain any observable social changes among those involved in picking solid waste items. Participant 1 observed that individuals who are unemployed may engage in illicit behaviour as they seek to occupy their time. Participant 2 expressed concerns about the future prospects of youth who are unable to find employment, indicating that their future may not be promising. Participant 4 mentioned that disease outbreaks can be reduced through education on the negative impacts of mismanaging solid waste and promoting proper waste management practices. It was also suggested that domestic violence may decrease, as the little income generated from waste picking may provide some essentials for the family.

However, Participants 3 and 5 expressed different sentiments, suggesting that domestic violence may actually increase among waste pickers. They noted that some men who engage in solid waste picking may use their income to purchase alcohol, leaving their families with nothing. This situation can lead to dissatisfaction and conflicts within households.

These findings indicate that improper solid waste handling can have significant social impacts on communities. While education on waste management and income generation through waste picking may have positive effects, there are also challenges such as increased domestic violence and potential negative behaviours associated with unemployment. Addressing these social issues requires a comprehensive approach that combines proper waste management practices, education, and support systems to ensure the well-being of individuals and communities.

7.3.4.4 Suggestions on how to overcome solid waste mismanagement in selected municipalities

Based on the suggestions provided by the participants, below are some recommendations on how to overcome solid waste mismanagement in the selected municipalities:

Collaboration with stakeholders: Work with other stakeholders, such as community organisations, businesses, and NGOs, to develop integrated solid waste management approaches. This collaborative effort can help in policymaking, sharing resources, and finding innovative solutions.

Consultation and feedback: Engage with residents and customers to understand their satisfaction with the existing waste management services. Regular consultations can provide valuable insights and guide improvements in waste management policies and practices.

Awareness campaigns: Conduct awareness campaigns to educate residents about the negative impacts of improper solid waste management. It is important to emphasise the importance of responsible waste disposal, recycling, and reducing waste generation. Education and awareness can help change residents' attitudes and behaviours towards waste management.

Strengthen policy implementation: Develop effective mechanisms to enforce existing policies and laws related to solid waste management. This can include penalties for offenders and creating channels for residents to report violations. Reinforcing policy implementation ensures accountability and discourages improper waste disposal practices.

Improved collection methods: Explore alternative collection methods, such as placing skips or containers in residential areas that can be picked up regularly. This can simplify the waste collection process and encourage residents to dispose of their waste properly.

Weight-based charging: Consider implementing a waste charging system based on the weight of garbage produced by households. Setting a baseline for free waste disposal and charging for excess weight can incentivise waste reduction and proper waste sorting at the household level.

Source separation: Encourage residents to separate their waste at the household level into different categories, such as recyclables, organic waste, and non-recyclables. Source separation makes the waste management process more efficient and facilitates recycling and proper disposal of different waste streams.

Implementing these recommendations requires a comprehensive approach that combines policy measures, public engagement, infrastructure development, and ongoing monitoring and evaluation. Continuous improvement and adaptation based on local context and feedback from

stakeholders are crucial for achieving sustainable solid waste management in the selected municipalities.

7.3.5 Relationship between reverse logistics of municipal solid waste and sustainability in local government municipalities in Zimbabwe

The study aimed to investigate the relationship between reverse logistics of municipal solid waste and sustainability. Both qualitative and quantitative data were collected and analysed using logic. The qualitative approach involved interviews where the initial section focused on gathering information about reverse logistics activities in municipal solid waste management. The findings indicated that municipalities themselves do not engage in reverse logistics, but waste pickers are involved in this aspect. Participant 2 specifically mentioned that corporate organisations in the beverage industry practice reverse logistics for their beverage containers, particularly bottle containers. Customers are initially charged for these containers and can later exchange them for new and filled ones at retail shops.

The relationship between municipal solid waste management practices and sustainability is multifaceted and can have significant economic, social, and environmental implications. These consequences can be discussed individually as follows:

7.3.5.1 Social sustainability

Illegal dumping practices by residents pose a significant danger as they can increase the incidence of diseases among the same residents. Moreover, the improper disposal of solid waste can lead to the blockage of drainage systems, which weakens the soil around tarred roads. Consequently, this increases the likelihood of roads deteriorating into deplorable states characterised by potholes. However, the implementation of sustainable solid waste management practices can effectively mitigate these negative effects. Encouraging community participation, providing education and awareness campaigns, and fostering partnerships are key strategies in achieving sustainable waste management.

It is worth noting that while solid waste picking may be associated with negative aspects such as drug abuse, it also has the potential to provide income and support for families.

7.3.5.2 Economical sustainability

Unregulated and unmonitored practices by residents in solid waste management, such as illegal dumping, have serious consequences, including the spread of diseases. Consequently, the government is compelled to allocate funds towards addressing and controlling disease outbreaks. Conversely, if solid waste management is effectively implemented, the funds that would have been spent on disease control can be redirected towards developmental projects, benefiting the community as a whole.

Proper waste management practices, such as waste reduction, can lead to various cost savings. These include reducing the number of trips and associated expenses involved in the collection and transportation of solid waste to designated dump sites. Additionally, engaging in solid waste reverse logistics activities, such as recycling, reusing, and waste reduction, contributes to employment creation, which has positive social implications.

Composting, when utilised as a solid waste management method, not only helps in waste reduction but also yields organic fertilizers that enhance productivity in agro-based projects. Furthermore, incorporating scrap metals into production processes not only reduces raw material costs but also conserves energy in the overall production processes.

7.3.5.3 Environmental sustainability

Landfilling, even when carried out by authorities, has detrimental effects on the quality of soil, air, and water, contributing to the generation of harmful greenhouse gases (GHGs) that negatively impact the environment. However, through careful planning and implementation of solid waste management practices, such as source reduction and source separation, it is possible to divert waste items to individuals or organisations that can utilise them either as raw materials or for secondary purposes.

7.4 Recommendations for an integrated solid waste management

Based on the findings derived from the data collected through both quantitative and qualitative research methods, the study puts forward the following recommendations. The utilisation of these two approaches was deemed suitable for addressing the research questions of the study. Each section provides a summary of the results corresponding to the respective research objectives before presenting the recommendations. The suggested recommendations aim to offer

viable solutions that yield favourable outcomes for addressing the challenges associated with achieving an integrated solid waste management framework. Data collection was conducted in both non-performing and performing municipalities to facilitate a comparative analysis of the results.

7.4.1 To establish the perceptions of households on municipal solid waste management services received from municipal authorities in Zimbabwe

The study findings indicated a substantial disparity in residents' perceptions of the solid waste management services provided by municipalities. Notably, significant variation in responses was observed regarding the availability of educational programs related to solid waste management. Based on these findings, it is recommended that municipalities take the initiative to implement regular solid waste management education programs for residents. By providing education and awareness, municipalities can ensure that all individuals are well-informed about the consequences of mismanaged solid waste and understand their roles and responsibilities within their communities. This proactive approach to education can contribute to improved solid waste management practices and promote a sense of shared responsibility among residents.

7.4.2 To determine the practices of households regarding their municipal solid waste disposal within local government municipalities

The study aimed to explore the solid waste management practices adopted by residents and how these practices were influenced by their satisfaction with municipal services. The findings revealed that residents in non-performing municipalities expressed dissatisfaction with the services provided by municipalities, leading to the adoption of illegal dumping practices. For instance, when residents experienced missed or delayed solid waste collections, they resorted to illegal dumping.

To address these issues, the study recommends the establishment of effective communication channels between municipalities and residents. In situations where a municipal authority is unable to provide regular waste collection services in a specific area, proactive communication with residents should be prioritised to convey alternative plans or solutions. Additionally, when municipalities encounter challenges that may exceed expected timelines and budgets, it is suggested that they engage the affected communities in order to seek their input and propose

feasible solutions. Baawain, Al-Mamun, Omidvarborna and Al-Amri (2017) posit that in developing countries, a large portion of their overall budget is allocated for municipal solid waste management. Through community engagement and participation, strategies such as composting, source separation, and source reduction can be explored, with clear explanations provided regarding their benefits and potential positive outcomes for waste management.

By fostering open and continuous communication between municipalities and residents, and involving the community in decision-making processes, it is expected that solid waste management practices can be improved and tailored to the specific needs and preferences of the residents. This collaborative approach can lead to the implementation of sustainable waste management strategies that address community concerns, promote effective waste reduction, and enhance overall satisfaction with municipal services.

7.4.3 To find out the attitudes of residents towards reverse logistics practices within selected local government municipalities in Zimbabwe

The study aimed at examining solid waste management practices of residents and the satisfaction of residents with municipal services. The findings indicated that residents in non-performing municipalities expressed dissatisfaction with the services provided by municipalities. Consequently, these dissatisfied residents resorted to illegal dumping of solid waste as a response to issues like missed or delayed waste collections.

To address this issue, the study recommends the establishment of effective communication channels between municipalities and residents. In cases where a municipal authority is unable to collect solid waste in a specific area, clear communication should be provided to residents regarding alternative plans. Additionally, when municipalities face challenges that exceed anticipated time and budget constraints, it is suggested that they engage with the affected communities to seek feasible solutions. By fostering engagement and participation, strategies such as composting, source separation, and source reduction can be proposed, with explanations provided regarding their benefits. Qing, Malleson and Malleson (2018) suggest imposing penalties to deter residents from practicing illegal dumping. This can be done through instruments that are promulgated at national level such as Acts of Parliament, Decrees or Ordinances.

7.4.4 To ascertain the state of sustainability in selected local government municipalities in Zimbabwe

The study aimed to assess the level of sustainability in selected local government authorities in Zimbabwe. Interviews were conducted with individuals in management and supervisory positions within municipalities, as they were deemed capable of providing insights on sustainability-related issues. The interview questions were organised into three sections, corresponding to the three pillars of sustainability.

In terms of environmental sustainability, several challenges were identified. These included the rise in solid waste volumes during the Covid-19 pandemic, the obstruction of drainage systems leading to the spread of diseases, and the deterioration of tarred roads. Socially, mismanaged solid waste posed problems such as the creation of unsightly environments, the disruption of recreational facilities, and an increase in domestic violence. On the economic front, there was a noticeable increase in the operational costs associated with solid waste transportation.

Nevertheless, the study suggests that through collaborative efforts, it is possible to achieve sustainability. Key recommendations include educating residents on proper waste management practices, implementing waste reduction measures at the source, encouraging source separation of waste, and promoting active participation from residents and other stakeholders.

7.4.5 To determine if there is a relationship between reverse logistics of municipal solid waste and sustainability in selected local government municipalities in Zimbabwe

The study employed logical reasoning to examine the relationship between reverse logistics of municipal solid waste and sustainability in selected municipalities in Zimbabwe. The findings indicated that the adoption of reverse logistics activities by residents contributes to a more habitable environment. Proper solid waste management practices were found to offer various benefits, including environmental cleanliness, employment opportunities, and improved health conditions.

Based on the results, the study recommends the implementation of an integrated solid waste management approach. This approach involves clearly identifying and explaining the responsibilities of residents in waste management. Municipalities should utilise their internal resources, gain management support, and adopt an inclusive approach to solid waste

management. These collective efforts are crucial in striving towards sustainable development objectives.

7.5 Integrated sustainable solid waste management framework

Figure 7.1 depicts an integrated approach to solid waste management, showcasing a proposed framework that emphasises the identification and development of individual factors to enhance solid waste management practices. This study proposes a framework for integrated solid waste management that has two independent variables (individual factors and institutional factors), one mediating factor and sustainable solid waste management as the dependent variable. Individual factors consist of the behaviour, attitude, perceptions and practices of households, while institutional factors comprise resources, educational programs, stakeholder inclusion, and management support at municipality level. The mediating factor (integrated solid waste management) includes assessing current solid waste management practices using tools like SWOT analysis, identifying reverse logistics opportunities, establishing solid waste collection points and the integration of existing infrastructure with new approaches. In addition, collaborating with stakeholders and promoting public awareness is vital in the mediating factor. Monitoring and evaluation of the embraced integrated municipal solid waste approach, fostering cultural innovations, continuous improvement and formulation of polices and regulations that support the integrated solid waste management are essential if sustainability is to be achieved.

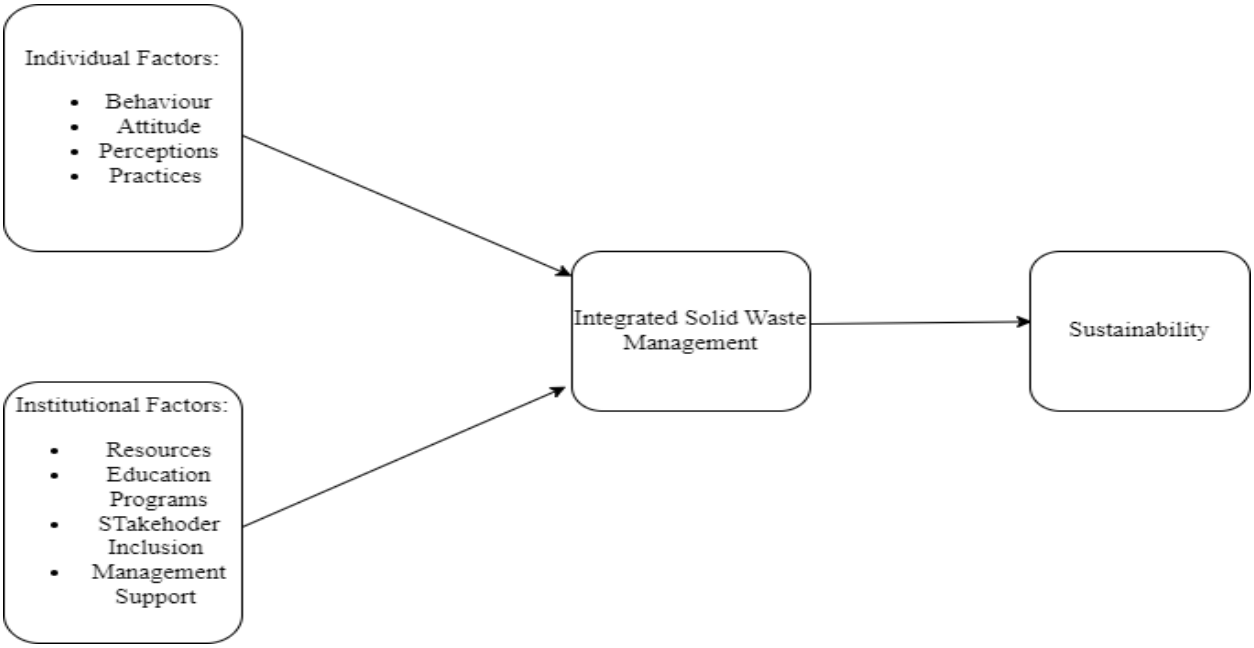

Figure 7.1: Integrated Solid Waste Management Framework

Additionally, it highlights the significance of institutional factors, including adequate resources, management support, and stakeholder inclusion approaches, which are crucial in attaining sustainable development goals in this context. By addressing both individual and institutional aspects, the framework aims to promote effective and sustainable solid waste management practices.

7.6 Practical implications and limitations of the study

The following limitations should be taken into consideration when interpreting the study's findings and should be addressed in future research endeavours to achieve a more comprehensive understanding of solid waste management practices.

Stakeholder interactions: The study focused on three selected municipalities rather than encompassing the entirety of provinces in the country. The qualitative part of the study employed the purposive sampling method as it sought to solicit information from management and supervisors in waste management sections of municipalities. Stakeholders like solid waste pickers were not consulted in the study. It is important to engage and collaborate with stakeholders such as communities and private solid waste collection companies to garner responsibility for sustainable waste management.

Household focus: The study primarily examined the actions of households, neglecting the potential variations in waste generation and consumption patterns among different families residing within a single household. This limitation might have excluded valuable information from other potential participants residing in high-density areas where multiple families often inhabit one household. Insights from the study could support campaigns that are aimed making communities aware of the benefits of implementing solid waste management practices such as reverse logistics. These benefits include reduced costs of transporting solid waste, reduced or prolonged periods of use of landfills, and employment creation for collecting, sorting and waste processing. In addition, it is envisaged that communities would change their behaviour towards municipal solid waste.

Participants and response: The qualitative data collection process relied on a semi-structured questionnaire (interview guide) with middle and senior management within municipalities, excluding operational-level personnel who may have possessed valuable technical insights. Qualitative research takes place in a specific location and time, making it problematic to make a sweeping statement on discoveries, instead favouring transferability of the results. While the researcher made efforts to address unanswered questions through follow-up inquiries, the absence of input from certain staff levels could have restricted the comprehensiveness of the study. Insights from the study results show that municipalities can implement reverse logistics practices to streamline municipal solid waste collection, implement and improve segregation at source, reuse and recycle solid waste. This will reduce environmental degradation and make efficient use of resources.

The quantitative data collection relied on the use of a self-administered questionnaire which depends on the self-reporting manner of respondents. For example, the treatment an individual might have recently received from municipal authorities might affect their perception about municipalities. This may affect the quality of results through bias. A cross-sectional survey was used in both qualitative and quantitative approaches, which limited the quality of data as compared to a longitudinal survey. The limitations of cross-sectional surveys may not capture change in perceptions and behaviours of participants and respondents because the period is short as compared to longitudinal surveys which take longer periods.

7.7 Areas for future research

In addition to the limitations mentioned earlier, the study also identifies several areas that warrant further research in the field of solid waste management. Investigating these aspects will contribute to a more comprehensive understanding of solid waste management and inform the development of effective strategies for sustainability.

The study did not specifically investigate the relationship between consumption patterns and solid waste generation. While it is generally assumed that increased consumption leads to higher waste generation, factors such as packaging materials and practices can also play a role. For instance, single-use packaging materials are commonly used in urban settings, particularly in supermarkets, to prevent food contamination. Future research could explore the complex relationship between household food consumption, packaging materials, waste management practices, and economic development or urbanisation levels. It is also imperative to carry out research on solid waste streams that are generated by households as this will pave way for identifying and prioritising reverse logistics activities. Conducting research on reverse logistics infrastructure locations and planning is essential if sustainable development is to be achieved. Future research may seek to establish the population densities and municipal solid waste generation rates. This will help in identifying locations for storing, sorting and collecting recycled solid waste. It important for future research to identify barriers to participating in reverse logistics activities at household level. In addition, analysis of policy and regulatory frameworks that exist is vital.

Another area for future research is examining the relationship between solid waste generation and family size. Larger households tend to consume more goods, resulting in increased waste generation. The size of the living space occupied by households can also influence the amount of waste generated, including organic waste from gardening or composting practices.

The study suggests investigating the relationship between the level of education and solid waste management behaviour. Generally, higher levels of education are associated with a greater awareness of environmental impacts and responsible waste management practices. Educated individuals may have better access to resources and information on waste management. While the study collected data on participants' educational qualifications, it did not explore the specific relationship between education level and waste management behaviour. Furthermore, the study

identified a gap between household socio-economic factors and health implications, variables that were not used in the study. Future research in this area could bring about focused and sustained public awareness programs.

Exploring the connection between household location and waste management behaviour could provide valuable insights. It is commonly assumed that wealthier households generate more waste due to increased consumption, and urban residents produce more waste than rural residents due to greater reliance on packaged goods. Additionally, households in low-density areas are often wealthier compared to those in high-density areas, potentially leading to differences in waste generation levels. Examination of the influence of socioeconomic factors can also be done in future research studies. Observation of household solid waste management can be used in future research with the aim of providing experience of the phenomenon in the study. This is different from the use of a questionnaire, which is a bit separated from the phenomenon.

A longitudinal approach could be taken which would establish the long term impacts of reverse logistics practices on the efficiency of solid waste management, environmental benefits and economic gains. Future studies can explore how reverse logistics practices can support circular economy initiatives and close material loops whilst reducing solid waste. Furthermore, researchers could explore how digital tools like the internet of things and artificial intelligence can be used to enhance reverse logistics processes such as waste tracking and optimisation. It is also imperative to examine the role of the private sector in supporting municipalities to develop and sustain reverse logistics practices. Future research can explore how funding can be obtained for reverse logistics through initiatives like public private partnerships. In addition, future studies could also assess how effective policies that mandate reverse logistics practices are or how to incentivise reverse logistics practice in municipal solid waste management.

These areas present opportunities for future research, to deepen our understanding of the complex relationships between consumption, education, household characteristics, and waste management practices. By addressing these limitations, future studies can provide valuable insights into effective strategies for sustainable waste management.

7.8 Contribution of the research study

The study highlights a notable difference in the perceptions and practices of residents between non-performing and performing areas regarding the satisfaction of municipal solid waste management services provided by municipalities. The residents in non-performing areas express significant disagreement and dissatisfaction, leading to negative practices such as illegal dumping and burning of waste. On the other hand, residents in performing areas demonstrate positive perceptions and higher satisfaction levels, resulting in more responsible solid waste management practices within their residential areas. Households in non-performing areas lacked adequate knowledge about proper municipal solid waste management practices. This highlights an opportunity for municipal authorities to take intervention measures to educate and campaign for good practices and participation in municipal solid waste management by households.

This finding has important implications for municipalities as it highlights the need to allocate resources and efforts towards improving services in non-performing areas. By addressing the concerns and meeting the expectations of residents in these areas, municipalities can work towards enhancing their solid waste management practices. It is crucial for further research to delve into the reasons behind the disparities in service provision and explore whether they stem from differences in personnel and resource allocation within municipalities.

Understanding the factors that contribute to varying service quality across different areas can help municipalities identify areas for improvement and implement targeted strategies to enhance overall solid waste management performance. By addressing the specific challenges faced by non-performing areas, municipalities can strive towards achieving consistent and efficient service delivery across the board. In addition, the study found that there is still low participation among households in municipal solid waste segregation, which gives the municipal authorities opportunities to campaign and involve residents in municipal solid waste management. In order to address research objectives, a cross-sectional survey was used in the study to assess the practices and perceptions of households on municipal authorities on solid waste management. The study also identified a gap wherein reverse logistics activities are not practiced by municipalities themselves, as indicated by participants in interviews. Opportunities exist for municipalities if they engage in reverse logistics activities such as reduced tonnages of solid

waste and income generation from solid waste. A gap exists in which there is no clarity on integration between municipalities and informal solid waste pickers.

Directly and indirectly, the study contributes to SDG 3 (Good Health and Well-being), SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production) by identifying households' perceptions and practices on municipal solid waste management. Correcting negative household practices on segregation and separation of municipal solid waste for reverse logistics is deemed likely to lead to reduction in environmental pollution and therefore promote ecosystems that are healthier.

7.9 Chapter summary

The chapter serves as a summary of the quantitative and qualitative findings presented in the previous chapters. The main objective of the study was to propose an integrated and sustainable framework for solid waste management, incorporating the concept of reverse logistics. Sub-objectives were established to explore the residents' perception of municipal services and its impact on their behaviour towards effective solid waste management.

Solid waste management encompasses various activities such as collection, transportation, storage, and disposal of waste generated at the household level. Understanding the satisfaction and perception of residents is crucial since they play a significant role in achieving effective solid waste management practices. The collected data revealed a disparity in the perception of municipal services between non-performing areas and performing residential areas. Path analysis was employed to examine the relationship between municipal waste management and waste management practices of residents in non-performing areas, which indicated a negative relationship. Conversely, a positive relationship was observed between residents' satisfaction and waste management practices in the same areas.

The perceptions and practices of residents hold significance in solid waste management, as their perception of municipal services directly influences their behaviour towards waste management. Recommendations were made to enhance integrated solid waste management, including educating and involving households, providing staff training, and allocating necessary resources to municipal workers to boost their morale in carrying out waste management tasks.

An integrated solid waste management framework was proposed, incorporating principles from behaviour theory and institutional theory to guide the implementation of effective waste management approaches. By considering these recommendations and employing the suggested framework, municipalities can strive towards achieving sustainable and efficient solid waste management practices.

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Annexure A: Original EC Letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

16 July 2020

Mr Benson Ruzive (218086640)
School of Management, IT & Governance
Pietermaritzburg Campus

Dear Mr Ruzive,

Protocol reference number: HSSREC/00001631/2020
Project title: Sustainable Waste Management through Reverse Logistics: A Case of Selected Municipalities in Zimbabwe
Degree: PhD

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 19 June 2020 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL** on the following condition:

Please note: Face to face contact is not allowed during the COVID-19 period. Researchers are allowed to collect data using remote means

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 19 July 2021.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/ms

Annexure B: Renewal EC Letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

21 October 2022

Benson Ruzive (218086640)
School Of Man Info Tech & Gov
Pietermaritzburg Campus

Dear B Ruzive,

Protocol reference number: HSSREC/00001631/2020
Project title: Sustainable waste management through reverse logistics: A case of selected municipalities in Zimbabwe

Approval Notification – Recertification Application

Your request for Recertification dated 19 October 2022 was received.

This letter confirms that you have been granted Recertification Approval for a period of one year from the date of this letter. This approval is based strictly on the research protocol submitted and approved in 2020.

Any alteration s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study must be reviewed and approved through the amendment /modification prior to its implementation. Please quote the above reference number for all queries relating to this study.

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

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Annexure C: Amendment Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

07 November 2022

Benson Ruzive (218086640)
School Of Man Info Tech & Gov
Pietermaritzburg Campus

Dear B Ruzive,

Protocol reference number: HSSREC/00001631/2020
Project title: Sustainable Waste Management through Reverse Logistics: A Case of Selected Municipalities in Zimbabwe
Degree: PhD

Approval Notification – Amendment Application

This letter serves to notify you that your application and request for an amendment received on 08 November 2022 has now been approved as follows:

- Change in research instrument
- Additional Supervisor

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

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

Best wishes for the successful completion of your research protocol.

Yours faithfully

[redacted]

.....
Professor Dipane Hlalele (Chair)

/dd

Humanities & Social Sciences Research Ethics Committee
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Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS

Annexure D: Questionnaire

Questionnaire for Residents

My name is Benson Ruzive a student at University of Kwazulu-Natal (PhD in Supply Chain Management) researching on ***Sustainable Waste Management through Reverse Logistics: A Case of selected municipalities in Zimbabwe.*** I am kindly asking you to fill in the questionnaire. The information that you provide is confidential and will be used for academic purposes only. You are therefore kindly requested to answer the questions to the best of your knowledge.

For each question, select the ONE response option that best applies to you.

SECTION A: DEMOGRAPHICS

1.1 What gender were you assigned at birth?

Male	Female

1.2 Indicate your age (years)

Up to 30	31 - 40	41 - 50	51 - 60	>60

1.3 What is your highest level of education?

Primary education	Secondary education	Tertiary education

1.4 What is your position in this family as the household head?

Father	Mother	Son	Daughter

1.5 How many years have you been staying in this area?

<5 Years	5- <10 Years	10- <15 Years	15- <20 Years	20+ Years

SECTION B: RESIDENTS' PERCEPTION ON MUNICIPAL PRACTICES

2 Indicate your level of agreement with the following statements about what the municipality is doing regarding waste management:

THE MUNICIPALITY...	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
2.1 Regularly collects refuse from households according to a schedule.						
2.2 Cleans the garbage that piles up in the streets and open spaces.						
2.3 Educates households on solid waste (hard rejected material generated by household) disposal and associated health hazards.						
2.4 Provides receptacles/bins to residents when needed						
2.5 Educates households on solid waste recycling						
2.6 Attends to complaints raised by residents on solid waste collection						
2.7 Gives households advice on the effect of solid waste on health.						
2.8 Penalises and prosecutes those who violate solid waste management laws/rules (e.g. illegal dumping, burying/burning solid waste in the area, etc).						
2.9 Inspects the way solid waste is disposed of in all residential areas.						
2.10 Provides deposit containers and/or places for residents to deposit solid waste						

SECTION C: RESIDENTS' SATISFACTION WITH MUNICIPAL WASTE MANAGEMENT

3 Indicate your level of satisfaction with the performance of the municipality regarding the following waste management practices.

WASTE MANAGEMENT PRACTICES	Extremely dissatisfied	Dissatisfied	Slightly dissatisfied	Slightly satisfied	Satisfied	Extremely satisfied
3.1 Reliability of the municipality to collect the waste within our area.						
3.2 The cleaning/ cleanliness of public spaces in and around our residential area.						
3.3 Education/information provided by the municipality regarding disposal options, health hazards relating to waste, etc.						
3.4 The provision of refuse bins in and around our residential area						
3.5 The information/education provided by the municipal authority on how to recycle solid waste.						
3.6 The assistance given to us in relation to solid waste recycling e.g. providing rubber gloves; and explaining what to salvage						
3.7 The time taken to respond to complaints related to solid waste.						
3.8 The level of inspection of solid waste in and around our residential areas.						
3.9 The cost charged for solid waste collection and associated services.						
3.10 The frequency of solid waste collection in and around our residential area.						
3.11 The state of cleanliness of the streets after solid waste collection						

SECTION D: RESIDENTS' PRACTICES AND OPINIONS OF WASTE MANAGEMENT

4 Indicate your level of agreement with the following statements regarding waste management in your home:

In our household...	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
4.1 We are aware of the types of waste we generate						
4.2 We are aware of the amount of waste we generate						
4.3 We are aware of the environmental problems (pollution, blocked drains) caused by poor waste management						
4.4 We gather our waste in a suitable container (e.g. plastic bags, cardboard boxes, internal bin, basket, etc) inside the house						
4.5 We empty solid waste generated in our house into a bin outside the house.						
4.6 We deposit solid waste into the bush or open space near our house.						
4.7 We deposit solid waste into the street						
4.8 We deposit solid waste into a pit in the yard						
4.9 We bury solid waste in the yard						
4.10 We deposit solid waste into a nearby ditch						
4.11 We deposit solid waste in a public place/dump provided for such purposes						
4.12 We burn solid waste in our yard						

5 Indicate your level of agreement with the following statements regarding reverse logistic waste practices in your home:

In our household...	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
5.1 We separate our waste into plastics, metal, leather, clothes, wood etc. before putting it into bins/ containers						
5.2 We reuse some of our waste e.g., containers in which we bought items like vegetables from the shop						
In our household...	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
5.3 We donate items like containers to schools and other institutions who can make use of them						
5.4 We return some items (e.g. car batteries) to the producers						
5.5 We take useful parts from household equipment like generators before selling them						
5.6 We swap old household items (e.g., television sets, radio sets or refrigerators) for new versions and pay the difference in value if necessary						
5.7 We deposit items like old batteries in bins provided by the municipality specifically for these waste items						

6 Indicate your level of agreement that it is important to do the following when managing your waste:

It is important ...	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
6.1 To clean the garbage that is lying in the road and open spaces.						
6.2 To educate our children on proper solid waste disposal and associated health hazards.						
6.3 To deposit solid waste in closed containers for the municipality to collect.						
6.4 Not to dump solid waste in public places (e.g. streets, nearby open spaces, bush etc.)						
6.5 Not to burn solid waste anywhere and at any time of the day.						
6.6 Not to bury solid waste anywhere and at any time of the day.						
6.7 To separate solid waste into different groups (e.g. paper, plastic, glass, leather, metal, yard trimmings)						
6.8 To, where possible, reuse solid waste that is not broken						
6.9 To recycle materials that cannot be reduced to their natural state e.g. plastics, clothes, metal						

THANK YOU FOR YOUR TIME

Annexure E: Interview Guide

MUNICIPALITIES INTERVIEW GUIDE

SUSTAINABLE WASTE MANAGEMENT THROUGH REVERSE LOGISTICS: A CASE OF SELECTED MUNICIPALITIES IN ZIMBABWE

Introduction

Good morning. Thank you so much for taking time out of your busy life to participate in this study. I am pleased that you are willing to share your experiences, knowledge, and activities with me.

I am here to discuss about your experiences in solid waste management within the municipalities under your jurisdiction.

This interview should take no more than one hour. Firstly, may I record our discussion to facilitate recollection? (*If yes, switch on recorder*). Despite our discussion being voice recorded, I would like to assure you that the discussion will be anonymous and will be kept confidential. I will keep all recordings safe until it is transcribed word by word. No personal details of any participant will be mentioned in any of the transcriptions. In other words, there will be no information that would allow individual subjects to be linked to specific statements.

The researcher to explain the definition of sustainable solid waste and reverse logistics to each participant.

Do you have any questions or comments before we start?

1. *Explain that this section incorporates all the measures of environmental sustainability within municipal areas.*

1.1. Could you please explain some of the environmental impacts caused by mismanaged solid waste? (See probe section)

1.2. How do you treat residents who are caught breaking laws relating to solid waste management?

1.3. What do you regard as the main reasons for residents to behave in such manners?

1.4. To what extent has the behaviour by residents of dumping, burning and burying solid waste affected recreational facilities?

1.5. Do you have any suggestions on how municipalities can overcome the challenges in the management/reduction of municipal solid waste?

2. *Explain that this section incorporates all the measures of economic sustainability within municipal areas.*

2.1. Could you please explain some of the jobs formal and informal that have been created from solid waste management?

2.2. What markets are available for collected items from solid waste?

2.3. What is the percentage of revenue generated from items sold after picking them from solid waste?

2.4. To what extent has the behaviour by residents of dumping, burning and burying solid waste affected recreational facilities?

2.5. Do you have any suggestions on how municipalities can overcome the challenges in the management/reduction of municipal solid waste?

3. *Explain that this section incorporates all the measures of social sustainability within municipal areas.*

3.1. Could you please explain how the health of residents is affected by improper solid waste management?

3.2. Explain the distraction and/or nuisance caused by dumping of municipal solid waste.

1.3. Explain the observable social changes in behaviour of people who get employed as a result of employment creation formally/informally within municipal solid waste management.

1.4. Do you have any suggestions on how municipalities can overcome the challenges in the management/reduction of municipal solid waste?

4. Do you have any comments/suggestions?

THANK YOU VERY MUCH FOR YOUR TIME. IT IS GREATLY APPRECIATED.

Annexure F: Gatekeeper's Letter (Harare, Norton)

CITY OF HARARE

HUMAN CAPITAL DEPARTMENT
TOWN HOUSE, HARARE, ZIMBABWE
POST OFFICE BOX 990
TELEPHONE 752979 / 753000

EMAIL: hrd@hararecity.co.zw
ADDRESS ALL CORRESPONDENCE TO HUMAN CAPITAL DIRECTOR

University of Kwazulu-Natal
P. Bag X01
Scottsville

1 August 2022

RE: AUTHORITY TO UNDERTAKE RESEARCH: BENSON RUZIVE

This letter serves as authority for Benson Ruzive to undertake a research survey on the topic: **"SUSTAINABLE WASTE MANAGEMENT THROUGH RESERVE LOGISTICS." A CASE OF LOCAL GOVERNMENT AUTHORITIES IN ZIMBABWE.**

The City of Harare has no financial obligation and neither shall it render any further assistance in the conduct of the research. The researcher is however requested to avail a soft and hard copy of the research to the undersigned so that residents of Harare can benefit out of it. The research should not be used for any other purpose other than the study purpose specified.

Yours faithfully

[redacted]

MR B. MATENGARUFU
ACTING HUMAN CAPITAL DIRECTOR

Harare to achieve a WORLD CLASS CITY STATUS by 2025

NORTON TOWN COUNCIL
ALL COMMUNICATIONS TO BE ADDRESSED TO THE CHIEF EXECUTIVE OFFICER

[redacted]

Phone [redacted]
Fax:
Email

JC/lt/2020

27 May 2020

TO WHOM IT MAY CONCERN

RE: PERMISSION TO CARRY OUT A RESEARCH IN NORTON – MR BENSON RUZIVE

This minute serves to confirm that Mr Benson Ruzive, a resident of Norton Town Council and is a student of Kwazulu Natal University studying for a Phd degree. Mr Ruzive is required to carry out a research and his topic is "Sustainable waste management through reverse Logistics", A case of selected municipalities in Zimbabwe. He has been granted permission to carry out the research in Norton. Please assist Mr Ruzive as much as you can as he endeavours to get information for his research.

For any further clarification you may require, please do not hesitate to contact the undersigned.

Yours faithfully
For and On Behalf of Norton Town Council

[redacted]

J Chishakwe
For Town Secretary

TO END/CUT
Please assist
E Tavuyote

MEDICAL OFFICER OF HEALTH
NORTON TOWN COUNCIL
28 MAY 2020
P. BAG 904, NORTON
TEL: 0242 15 2972

[redacted]