

**A COMPREHENSIVE AUDIT OF HOUSEHOLD WASTE MANAGEMENT
PRACTICES WITHIN THE BLUFF AREA (ETHEKWINI MUNICIPALITY, SOUTH
AFRICA) TO ASSESS SUSTAINABILITY CONSIDERATIONS AND TO INFORM
FUTURE INTERVENTION STRATEGIES**

By

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PREFACE

The work described in this thesis was carried out in the School of Agriculture, Earth and Environmental Sciences, University of KwaZulu Natal, Westville campus, from July 2020 to July 2023, under the supervision of Professor Urmilla Bob and Dr Suveshnee Munien. This study represents original work by Amanda Naledi Gumede and has not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of the work of others it is duly acknowledged in the text.

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I, Amanda Gumede declare that:

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As the candidate's Supervisors, we agree to the submission of this thesis.



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Dr Suveshnee Munien (Co-supervisor)

12/ 12/2023

Date

ACKNOWLEDGEMENTS

This thesis is dedicated to the woman who raised me, my grandmother, uMaKhumalo. I would not have come this far without your prayers and resilience. Your main prayer in your old age has been to see me obtain “the red gown”, I know you are proud.

To my main supervisor, Prof Urmilla Bob, your wisdom, integrity, passion and selflessness continue to inspire me. You have been more than just a supervisor to me, and many of my peers. Thank you for your guidance and patience, Prof. To my co-supervisor, Dr Suveshnee Munien, thank you for seeing something special in me all those years back and pushing me to always strive for the best, I get it now. Your knowledge, encouragement and support have not gone unnoticed. To my family and friends, thank you for being my biggest cheerleaders, I appreciated all of your efforts. Last but not least, a special thank you to all my fieldworkers and participants, this research would not have not been possible without you.

“Now unto the King eternal, immortal, invisible, the only wise God, be honor and glory for ever and ever. Amen”- 1 Timothy 1: 17

ABSTRACT

The process of waste management has predominantly included unsustainable methods such as burying, dumping and burning. Therefore, waste generators such as residential areas need to shift waste management practices from generating and disposing to more sustainable practices that include embracing circular economy principles. The research aimed to undertake a comprehensive examination of household waste management practices in the Bluff area (eThekweni Municipality, South Africa) to assess sustainability considerations and inform future intervention strategies. The study was guided by a multi-conceptual theoretical framework, drawing from the Theory of Planned Behavior (TPB), Integrated Solid Waste Management (ISWM) approach and the circular economy perspective. The study adopted a mixed methodological approach, using quantitative surveys and key informant interviews as the primary data collection tools. A total of 400 household surveys were conducted. Six key informants were purposely selected from targeted relevant groups and organizations. The non-parametric Pearson's chi-square test of independence was used to analyze the quantitative data which was predominantly categorical. Specifically, chi-square tests were used to examine differences across variable categories.

The study found that the Bluff area is largely made up of nuclear families. The households were made up of more males than females, with a fairly youthful population. The highest levels of education attained and employment status of household members portrayed comparable distributions between the sexes, with the majority of the members of households having completed secondary school and being employed. The results further revealed a dominant reliance on piped/ tap water, flush toilets and electricity. Additionally, the results indicate that there is a concerning lack of understanding of what different waste streams are at the household level. In this regard, it was found that households did not recognize the role they play in generating different waste streams. The main household disposal method chosen for almost all generated waste streams, as well as PPE/ COVID-19-related waste streams, was dustbins, which is in line with waste collection and disposal mainly being the responsibility of the Municipality.

The key findings indicate that most of the households reported not separating the various waste streams. Waste separation was significantly influenced by the highest level of education attained by respondents, monthly household income and total household size. Moreover, the

majority of the respondents were not aware of what sustainable waste management is. Television and school were found to be the highest sources of information about sustainable waste management practices. Furthermore, repurposing was the main sustainable waste management practice that households currently used. Not a significant percentage of respondents had previously used and discontinued using sustainable waste management practices. The results further show that households were vastly interested in using sustainable practices such as renewable energy in future. This future interest in accessing sustainable waste management facilities/ equipment was found to be associated with sex, the highest level of education attained, age, employment status and household decision-maker. Moreover, the majority of the respondents were willing to use reducing, recycling, composting and repurposing in the future. This future willingness was significantly correlated with age, total household size, household decision-maker and monthly household income. In terms of barriers, the results reveal that households mainly did not separate waste streams due to a lack of access to the necessary facilities, the practice being time-consuming, and not seeing the need to separate various waste streams. Similarly, the discontinuation of the use of sustainable waste management practices was mainly due to these practices not being easily available and these being time-consuming to engage in. The main problems associated with the use of sustainable waste management practices were also that there was an inadequate supply of equipment, that these were not easily accessible, they were time-consuming to engage in, inconvenient to use and too expensive. It is thus evident that the government and the private sector need to make sustainable waste management equipment/ facilities and practices easily accessible to communities.

The study has considered comprehensive waste management practices within a historically vulnerable and heterogeneous community. Specifically, instead of generalizing and focusing on specific waste streams, the study looked at the main residential waste streams in their entirety while considering sustainability considerations among households of different socio-economic groups. The study further unpacked the willingness-to-adopt and pay for sustainable waste management practices and the challenges experienced that constrain the transition to more sustainable waste management practices. Moreover, the study provided a further adjustment to the TPB to consider waste management practices variables at the household level. It is recommended that the government and eThekweni Municipality strengthen initiatives aimed at improving the socio-economic standing of households and that efforts be

directed at investigating alternative means of domestic waste management through collaborations with surrounding areas. Individuals and households must be made aware of the pivotal role they play in waste management and are motivated and encouraged to integrate waste management into their daily routines. Additionally, increased efforts need to be directed toward understanding and catering to the management of waste streams such as e-waste while also promoting the use of energy-efficient appliances. Waste management research and initiatives need to include children and teenagers to instill environmental awareness as early as possible. Comprehensive waste management also requires collaboration between various stakeholders including waste management officials, community members, researchers and NGOs.

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LIST OF ABBREVIATIONS

ABET	Adult Basic Education and Training
CBC	Community-Based Contractor
CO ₂	Carbon dioxide
DEA	Department of Environmental Affairs
DEFF	Department of Environment, Forestry and Fisheries
DSW	Durban Solid Waste
GISGME	Geographic Information System Geospatial Modelling Environment
ISWM	Integrated Solid Waste Management
Km ²	kilometers squares
KZNGBB	KwaZulu-Natal Gaming and Betting Board
NEMA	National Environmental Management Act
NEM: WA	National Environmental Management: Waste Act
NGOs	Non-Government Organizations
NPOs	Non-Profit Organizations
NWMS	National Waste Management Strategy
OECD	Organization for Economic Co-operation and Development
PMG	Parliamentary Monitoring Group
PPE	Personal Protective Equipment
SDB	South Durban Basin
SO ₂	Sulphur dioxide
SPSS	Statistical Package for the Social Sciences
Stats SA	Statistics South Africa
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UKZN	University of KwaZulu-Natal
UNEP	United Nations Environmental Program
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Preamble

Waste is a term used to define all unusable or undesirable materials that the user purposefully discards (Elsaid and Aghezzaf, 2015). Household waste, the focus of this study, includes waste generated within residential areas, specifically from home (including home-based business) activities that affect the quantity and types of waste (Nell et al., 2022a). Chan et al. (2022), Gören (2023), Heidari et al. (2018), Khan et al. (2022), Nukusheva et al. (2023), Sarfo-Mensah et al. (2019), Silva et al. (2017) and Zikali et al. (2022) state that waste is an inevitable feature of an increasing human population and urbanized world, and so its management has existed for a long time. Zikali et al. (2022) specifically assert that municipalities in developing countries are failing to cope with large volumes of solid waste generated by rapidly increasing urban populations, which results in environmental and public health risks. The process of waste management has predominantly encompassed methods such as burying, dumping and burning, which are not environmentally friendly (Gutberlet, 2018; Kurniawan et al., 2023; Lee, 2020; Sarfo-Mensah et al., 2019; Silva et al., 2017).

Chan et al. (2022), El-Ramady et al. (2021), Khan et al. (2022) and Omole et al. (2016) define waste as the undesirable by-products of human activities. To elaborate, Albira et al. (2018) add that waste generation and waste composition are driven by socio-economic connections and, thus, echo a society's activities. Waste may be categorized based on its source, physical state, threat level and its fate (Omole et al., 2016). Thus, in order for the management of waste to be effective, its characteristics need to be understood (Omole et al., 2016). For instance, Kebaili et al. (2022) and Nukusheva et al. (2023) show that characterizing waste is essential for waste management, especially within countries with increasing populations, in light of urbanization, which leads to an increase in waste generation. However, solid waste management has remained a neglected part of urban development, which has called for more sustainable waste management measures (Mwanza and Mbohwa, 2017).

Rasmeni and Madyira (2019) define waste management as the process whereby waste materials are collected, transported, processed, recycled, reused, repurposed, disposed of, and/ or monitored. Furthermore, Fadhullah et al. (2022), Kawai and Tasaki (2016) and Lima and Paulo

(2018) stress that without waste management, the result is adverse consequences on the environment as well as on public health. The waste management process is guided by the waste management hierarchy, which has three main elements: waste prevention, recycling and composting as well as disposal (Diprose et al., 2022; Nukusheva et al., 2023; Rasmeni and Madyira, 2019). The waste management hierarchy outlines measures to be adopted to evade the undesirable effects of waste on the environment (Menyuka et al., 2020). Cleary (2014) and Diprose et al. (2022) elaborate that the waste hierarchy is one of the foundations of zero-waste and is essential for the identification of the preferred waste management option.

Specifically, Khan et al. (2022) and Kurniawan et al. (2023) show that Integrated Solid Waste Management (ISWM) is viewed as a crucial solution to waste management. Additionally, ISWM policies are fueled by the notion of the promotion of a healthy environment and, thus, a stable economy (Khan et al., 2022; Makgae, 2011; Silvia et al., 2017). Moreover, Gutberlet (2018), Harvey et al. (2020) and Tsai and Lin (2021) elaborate that the social aspects of waste have progressively been of interest to policy-makers. This is because experience has shown that not taking the social aspects of waste (including health and safety, education, social behavior, economic development and equity dimensions) into consideration results in adverse social effects by compromising the execution of policy goals (Gutberlet, 2018; Monterrubio et al., 2020; Tsai and Lin, 2021).

Research shows that one of the important stakeholders of waste management initiatives includes all waste generators, especially due to increased rates of industrialization and population growth (Diprose et al., 2022; Makgae, 2011; Menyuka et al., 2020; Miner et al., 2020; Omole et al., 2016). Additionally, Omole et al. (2016) state that waste generators need to be held responsible for their waste because waste management as a social service cannot be effectively operated. Households are specifically an important stakeholder in waste management, given that household waste is one of the main sources of municipal solid waste (Fadhullah et al., 2022). Thus, waste management rules and regulations are necessary to bind households and communities to sustainable waste management (Mwaza and Mbohwa, 2017). In this regard, Mwaza and Mbohwa (2017) and Debrah et al. (2022) emphasize that in the absence of waste management rules and regulations, sustainable systems are difficult to develop, and by default, the accountability lies with the municipality. Residential waste requires more focused attention to shift waste management practices within these communities from generating and disposing to more sustainable practices that include embracing circular

economy principles that include recycling, reusing, repurposing and disposing of waste in ways that have negligible negative impacts on the environment and human health. Due to the growing commitment South Africa has to being an internationally responsible country by meeting global obligations, the government acknowledges and endorses an integrated approach to waste management as one of the main elements of achieving sustainable development (Makgae, 2011; Schoeman and Rampedi, 2022). The importance of proper and sustainable waste management practices is encapsulated in several policies, strategies and programs, notably the National Waste Management Strategy 2020, which provides a systematic and hierarchical approach to integrated waste management for South Africa (Department of Environment, Forestry and Fisheries – DEFF, 2020).

1.2 Motivation for the study

The residential area of Bluff is one of the communities located within the South Durban Basin (SDB) in the eThekweni Municipality, South Africa (Naidoo et al., 2013). According to Adebayo et al. (2013) and Jaggernath (2010), the SDB is an industrial hub that is a product of the apartheid government, created in the 1970s to also house non-white communities. Many residents of these communities of color who are from historically disadvantaged backgrounds are required to work within these hazardous circumstances due to their socio-economic status (Jaggernath, 2010). Thus, these communities suffer largely as a result of environmental pollution (primarily air pollution) caused by the industries within this area (Bob et al., 2016; Jaggernath, 2010; Leonard and Lidskog, 2021; Smith and Carrington, 2015).

Additionally, the apartheid government intentionally deprived communities of color services that are crucial for social development such as education, health care, housing, safety and security and other relevant infrastructure (Gradín, 2019; Magaisa, 2021; Pirtle, 2022; Strauss, 2019). Thus, the majority of South Africans have not completed high levels of formal education, are living in unemployment or in low-paying jobs, and still do not have proper access to essential infrastructure and services (Gradín, 2019; Pirtle, 2022; Venter et al., 2020). It is important to note that in many ways, Bluff represents typical residential areas in South Africa. Specifically, households include informal residents as well as low-income, middle-income and high-income formal dwellers. Thus, there are variations in socio-economic profiles, which permit comparisons to be undertaken. This ensures that intra-community heterogeneity is unpacked, which differs from many previous studies where there are high levels of generalizations within communities. The importance of unpacking community

differences is highlighted by Dixon et al. (2017), Mannarini et al. (2017), Räsänen et al. (2020), Rouhani (2017) and Titz et al. (2018), who challenge the notion that communities and the conditions, as well as subjects therein, are homogenous units of analysis. For these reasons, the Bluff area was selected for this research due to the perceived vulnerability of the households and community at large.

Although numerous environmental sustainability-related research has been conducted at the community level within South Africa, and the SDB specifically (Adebayo et al., 2013; Jaggernath, 2010; Mapani et al., 2022; Naidoo et al., 2013), limited (if any) studies have been conducted to consider the comprehensive waste management practices of households within this area. Additionally, research tends to focus on specific waste streams rather than examining the main residential waste streams in their entirety, as this study does. Furthermore, the focus on sustainability considerations among households of different socio-economic groups tends to be neglected, which results in generalizations that are problematic as discussed earlier. Willingness-to-adopt and pay for sustainable waste management practices, as well as challenges experienced that constrain the transition to more sustainable waste management practices, tend to be ignored when considering household consumption and practices in relation to key domestic waste streams. These aspects are important when developing intervention strategies and waste management infrastructure in residential areas.

Duru et al. (2017) reaffirm that environmental sanitation is a vital component of overall community health, which is, in turn, crucial for the social and economic development of an area. Lazo and Gasparatos (2022), Menyuka et al. (2020) and Selvakumaran and Wahid (2022) further reiterate that waste management is a serious concern affecting metropolitan areas globally. Therefore, a comparison between different economic groups as well as social groups within the same community makes the study vital. This is more so in the case of the SDB, which is a residential area and an industrial hub that has various waste disposal and management issues. It is thus envisaged that this research will provide a holistic outlook of the sustainable waste management practices of the households within this community that will contribute to knowledge in the field, which is aligned with developing the waste policy economy in South Africa (and globally) as indicated by Elgie et al. (2021) and Tahulela and Ballard (2020).

1.3 Research aim and objectives

Aim

This study aimed to undertake a comprehensive examination of household waste management practices in the Bluff area (eThekweni Municipality, South Africa) to assess sustainability considerations and inform future intervention strategies.

Objectives

- To establish the socio-economic profile of households in the Bluff area to enable a comparative analysis of waste management practices in relation to socio-demographic variables.
- To establish household profiles in relation to the use/ consumption patterns of the following:
 - Energy
 - Water and sanitation facilities
 - Waste disposal facilities or services
- To establish current household waste management practices in relation to the following key domestic waste streams:
 - Solid waste
 - Water and sanitation
 - Organic/ refuse waste
 - e-waste/ energy
- To establish respondents' levels of awareness and understanding of sustainable waste management practices and the benefits thereof.
- To examine the extent to which residents use/ adopt sustainable/ green/ environmentally responsible waste management practices.
- To establish the willingness-to-adopt/ use and willingness-to-pay for sustainable waste management practices.
- To identify the challenges experienced in residential areas that constrain the shift to embrace more sustainable waste management practices.
- To forward recommendations based on research findings (including priority areas for government intervention and action).

1.4 Overview of conceptual/ theoretical framework

A multi-conceptual theoretical framework is used to guide the study, drawing on the Theory of Planned Behavior (TPB), the ISWM approach and the circular economy perspective. The TPB has been widely and successfully used when a change of behavior is being explained and predicted (Ajzen, 2020; Bosnjak et al., 2020; Yuriev et al., 2020). Ajzen (2011; 2020) and Zhang et al. (2015) stress that the TPB mainly deals with intentions and is primarily concerned with behaviors that are driven and directed by goals and by conscious self-regulatory processes. In this regard, human behavior is led by behavioral intentions, which are fed and clarified by behavioral, normative and control beliefs as well as attitudes, subjective norms and perceptions of behavioral control (Ajzen, 2011; Ajzen, 2020; Bosnjak et al., 2020; Lee et al., 2010; Yuriev et al., 2020), with attitudes, subjective norms and perceived behavioral control being the three primary constructs (Heidari et al., 2018).

TBP states that based on an individual's intentions to adopt a behavior, as well as from the professed behavioral control, we should be able to forecast the performance of a behavior (Ajzen, 2011; Ajzen, 2020). Likewise, the attitudes toward the behavior, perceived behavioral control and subjective norms should allow us to predict intentions (Ajzen, 2011; Lee et al., 2010). Specifically, attitude towards the behavior refers to the degree to which a person views a behavior; an individual's thoughts of whether or not their significant others want them to engage in the behavior are known as subjective norms, and finally, perceived behavioral control is an individual's belief that they are able to perform the behavior (Lee et al., 2010).

Regarding waste management specifically, the TPB allows for the identification of influences behind waste management behaviors (Wu et al., 2022; Zhang et al., 2015). More generally, TPB has also been used to examine pro-environment behaviors (Yuriev et al., 2020). Additionally, the literature suggests that the TPB be adjusted to incorporate supplementary concepts such as environmental knowledge, social motivation, moral obligation, situational factor and past behavior (Heidari et al., 2018; Pakpour et al., 2014; Rao et al., 2022; Sogari and Van Loo, 2023; Zhang et al., 2015). This is because factors such as moral obligation and environmental awareness play a crucial role in defining key attributes of the TPB, such as an individual's attitude (Ramayah et al., 2012; Zhang et al., 2015). Pakpour et al. (2014) and Zhang et al. (2015) reaffirm this by stating that moral obligation was found to be a significant determinant of household waste behavior when an extended TPB was applied. Studies conducted by Mason et al. (2022), Pakpour et al. (2014), Ramayah et al. (2012), Wu et al.

(2022) and Zhang et al. (2015) also explicitly show that the adjusted TPB constructs are able to meaningfully predict household waste behaviors. This is particularly useful in communities that have low household waste reduction rates (Pakpour et al., 2014).

The chapter further looks at the ISWM approach. According to Fadhullah et al. (2022), one of the main sources of municipal solid waste is household waste, which may be made up of food waste, plastic, paper, glass, metal and rags. Thus, the ISWM approach is seen as a vital solution to waste management (Khan et al., 2022), more so in light of waste management currently being a boundless worldwide concern (Abdulghaffar and Williams, 2021; Adipah and Kwame, 2019). Thus, necessitating an all-encompassing waste management system that considers the role of households in the waste generation and waste management discourse. Specifically, the ISWM approach stresses the importance of a comprehensive and participatory lens on waste management, making it a sustainable approach (Korneliussen, 2021). This also means the integration of various waste management practices (Smith, 2020; Wani et al., 2018), especially prioritizing the most preferred methods as outlined by the waste hierarchy (Diprose et al., 2022).

The circular economy approach is the alternative to the linear economy, where sustainable waste management strategies are encouraged to keep materials in use for as long as possible (Mapani et al., 2022; Schröder et al., 2021; Stahel, 2016; Umhlathuze, 2021; Yadav et al., 2023; Zhang et al., 2022). Chapter two further elaborates on this approach. Specifically, the circular economy approach discourages the under-utilization of useful materials (Elgie et al., 2021; Kurniawan et al., 2023; Taelman et al., 2018). Additionally, under the circular economy approach, sustainable economic growth is foreseen whereby job creation is improved while also protecting the environment (Edmond, 2019; Stubbs, 2021a; Stubbs, 2021b).

1.5 Overview of research methodology and data sources

The study adopted a case study approach whereby the Bluff area in eThekweni Municipality, KwaZulu-Natal, South Africa, served as the case study for the reasons detailed above. Yin (2011) and Taylor and Søndergaard (2017) explain that a case study approach seeks to attain results by analyzing factual situations and, in turn, obtaining and recording the findings. As mentioned, the study aimed to undertake a comprehensive examination of household waste management practices to assess sustainability considerations and inform future intervention strategies. To achieve this, as well as the objectives of a study, a mixed methodological

approach (using quantitative surveys and key informant interviews as the primary data collection tools) was adopted. Thus, this study assumed a triangulation approach, which allowed for more confidence in the findings.

Gupta and Gupta (2022) and McCusker and McCusker and Gunaydin (2015) state that quantitative research seeks to obtain answers to questions such as ‘how many’ and ‘how much’, which is achieved through measuring, counting and statistically examining the subject of the research. Ndanu and Syombua (2015) further stress that validation is the core basis of quantitative research. The survey used for the purpose of this study was largely quantitative. Gupta and Gupta (2022) and Hennink et al. (2020) state that qualitative research allows for the identification of the subject matter as perceived by the study respondents while also understanding the explanations that they give to a specific subject. The qualitative component of the study comprised key informant interviews, which were used to unpack some of the policy and implementation dynamics, specifically in relation to residential waste services provision. In summary, qualitative research seeks to discover and understand the meaning behind a certain topic, whereas quantitative research employs associations between quantifiable variables to examine impartial theories (Creswell, 2013; Ghauri et al., 2020; Patten and Newhart, 2017). Therefore, in this study, key informant interviews and quantitative survey research approaches yielded the desired results, increased reliability and validity, and, in turn, achieved the study objectives.

A total of 400 household surveys were conducted. In order to eliminate bias, households were randomly selected using spatially based random sampling (the Geographic Information System Geospatial Modelling Environment, GISGME, tool). Key informants were purposely selected and targeted relevant groups and organizations, namely, the eThekweni Municipality waste management officials, Non-Government Organizations (NGOs) and civil society organizations within the SDB area (councilors, rate payers’ organizations, etc.), as well as researchers who have undertaken or are undertaking environmental sustainability research in the area. At least two key informants from each of the groups were identified using the purposive sampling approach. Thus, the qualitative aspect sample size was six key informants. According to Bergin et al. (2019), drawing perspectives from key informants allow for alternative understanding because these people have extensively participated in a specific subject.

The quantitative data was analyzed using the Statistical Package for the Social Sciences (SPSS), where descriptive and advanced statistics were used. For the qualitative aspect, data was analyzed using descriptive thematic analysis. The analysis of the quantitative and qualitative data was conducted thematically by integrating results from the primary data collection (survey and key informant interviews) and the literature review undertaken. In this manner, the analysis was conducted concurrently. As previously mentioned, some quantitative research focuses on generalizations (such as the methods employed in this study), while qualitative research probes in-depth issues. Therefore, combining the two methods and analyzing the collected data in its entirety improves the reliability and validity of the research and thus, the two complement each other.

1.6 Overview of chapters

The first chapter of this thesis served as an introduction to the pressing issue of waste management in South Africa and specifically, the need for a comprehensive examination of household waste management practices within communities such as the Bluff area, which are previously disadvantaged and mixed communities with a heterogeneous socio-economic background. Additionally, this chapter provided an outline of the aim and objectives as well as overviews of the theoretical/ conceptual frameworks and research methodology and data sources for this study.

Chapter two elaborates on the TPB, which is the theoretical framework that has been employed in the study. The conceptual framework, which is an adjustment of the theoretical framework, is also discussed in this chapter. Moreover, the ISWM and the circular economy approaches, which have also been used to guide the study, are discussed in chapter two. Literature on various topics that feed into and, thus, affect household waste management in a developing world and historically disadvantaged context is reviewed in chapter three. Thereafter, a thorough description looking into the background and conditions of the Bluff area, as the study area, is given in chapter four. Moreover, the data sources, study design and research methodology are further outlined in chapter four. This is followed by a presentation of the study results and the discussions thereof in chapter five. Lastly, chapter six provides a summary of the key findings while also offering relevant recommendations for future household waste management sustainability considerations to inform future intervention strategies.

1.7 Conclusion

Sustainable and ISWM at the household level are crucial, not only for the environment but also for general public health. A comprehensive examination of domestic waste management is particularly important as households generate different types of waste streams. Moreover, waste generators are an important agent for effective waste management. The Bluff area (which is the study area for this research) is a heterogeneous community, made up of residents in the low-, middle-, and high-income brackets as well as informal residents. Therefore, the study is vital, especially as it conducts a holistic assessment of the sustainability considerations of households of different socio-economic groups regarding various waste streams generated in the household. This is essential in order to assess sustainability considerations as well as inform future intervention strategies in this community and in other similar communities in South Africa. This chapter has outlined a broad overview of the background, motivation and importance of the study. Additionally, the research aim and objectives were provided as well as the summary of the conceptual framework adopted for the study. The chapter then provided an overview of the research methodology and the data sources as well as an overview of the succeeding chapters of this thesis.

CHAPTER TWO

A REVIEW OF THEORETICAL/ CONCEPTUAL FRAMEWORKS RELEVANT TO THIS STUDY

2.1 Introduction

Chukwuere (2021), Collins and Stockton (2018) and Regoniel (2015) define theoretical and conceptual frameworks as tools used by researchers to outline and explain their comprehension of the relationship between specific elements or factors in a research study. In this regard, the researcher analyses literature related to the topic of study in order to clarify the reasoning behind a specific subject (Regoniel, 2015). This solidifies the substance of the study as noted by Chukwuere (2021) and Lederman and Lederman (2015). This is achieved by using preceding related studies and thinking to outline the intentions of the study and the necessary steps to fulfill the intentions (Regoniel, 2015).

According to Adom et al. (2018), a theoretical framework differs from a conceptual framework in that a theoretical framework is embedded in already existing theories in the literature that speak to the aims and objectives of the study. According to Adom et al. (2018: 438), a theoretical framework “is a blueprint that is often ‘borrowed’ by the researcher to build his/ her own house or research inquiry”. This theory acts as a guide, keeping the researcher within the boundaries of the recognized theories in the field so as to avoid divergences (Adom et al., 2018; Collins and Stockton, 2018). Furthermore, Adom et al. (2018) and Chukwuere (2021) add that the theoretical framework is connected to the research problem and so works as the center of the study. This means that it influences the research design and the chosen research approach, data analysis tools, strategy and procedures for the study (Adom et al., 2018; Chukwuere, 2021).

Adom et al. (2018) and Chukwuere (2021) define a conceptual framework as a means through which the researcher details how they intend on exploring a specific research topic/ problem and outline the connections between the prominent themes or concepts of the research. A conceptual framework is vital as it gives direction to a study; it essentially acts as a map that the researcher uses to guide the study and thus, realize their set aims and objectives (Adom et al., 2018; Collins and Stockton, 2018; Regoniel, 2015). Adom et al. (2018), Chukwuere (2021) and Collins and Stockton (2018) state that the theoretical or conceptual framework secures the foundation of a study in theoretical ideas. This ensures that the results of the study are more

eloquent, that they conform to the research field's theoretical constructs, and that they are not just widely acceptable in the field but also generally applicable, which guarantees the expansion of knowledge (Adom et al., 2018; Collins and Stockton, 2018).

For this study specifically, a theoretical and conceptual framework are essential to establish the theoretical foundations in the literature related to household waste management and the sustainability considerations thereof, as well as to build on these based on and to guide the aim and objectives of the study. Moreover, the study explores the use of various materials in the household and the related domestic wastes produced. The study does this within a heterogeneous community, that is, with households of different socio-economic standing. Thus, for these reasons, a conceptual framework is essential in order to detail how these aspects and dynamics are explored and linked in the research. Drawing on multi-conceptual approaches is in keeping with theoretical frameworks used to examine waste management issues because, as Heidari et al. (2020) assert, waste generation and disposal are associated with complex behaviors and multiple dimensions. Furthermore, Newaz and Appolloni (2023) state that a strong theoretical integration is important to understand waste recycling behaviors.

Given that a theoretical or conceptual framework is a vital aspect of waste management research, this chapter discusses the main explanations and concepts that improve understanding of the topic to guide the study and inform future research based on the findings. Thus, the conceptual framework provides the focus of the research in relation to key variables, methodological choices (including the data collection and analysis processes), and assumptions that increase the credibility, validity and reliability of the research. It also foregrounds the research gaps that this study is intended to address to contribute to knowledge production in the field of waste management studies.

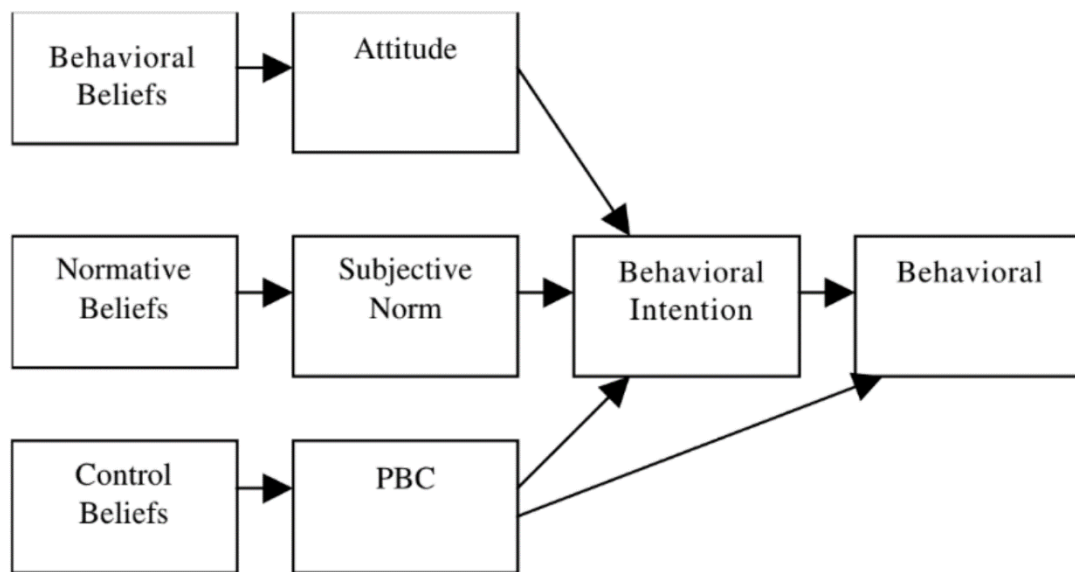
Yoda et al. (2014) emphasize the importance of appropriate waste management as an essential and beneficial part of and for society. In environmental action practices such as sustainable waste management, specifically at the household level, Scott et al. (2015) stress the importance of considering attributes such as perceptions, behavior, consumption, decision-making, cost considerations or affordability, and habit which drive environmental actions and affect participation at this level. To this end, the study uses the TPB as the theoretical ground on which the study is based and builds from. Additionally, considering that this study considers the comprehensive waste management practices of households, the ISWM and circular

economy approaches were deemed crucial and so are further used to reinforce the importance of sustainability considerations in waste management systems, thus, guiding that aspect of the study.

2.2 The TPB

The TPB is a theoretical/ conceptual framework that has been vastly and effectively used to forecast and clarify an individual's behavior (Ajzen, 2020). The TPB was initially conceptualized based on the shortcomings of the Theory of Reasoned Action (TRA). The TRA sought to establish an individual's intentions using their attitudes toward behavior and subjective norms (Heidari et al., 2018; 2020; Santoso and Farizal, 2019; Wu et al., 2022). Specifically, Ramayah et al. (2012) state that the TRA assumes that a person's intentions to or not to carry out a behavior are the direct determinants of the behavior. Moreover, since this theory hypothesizes that these intentions are a result of the individual's attitude and subjective norms, it insinuates that it is up to the individual to decide whether or not to perform the behavior (Ramayah et al., 2012).

The TRA was also criticized for dealing mainly with behaviors that are perceived to be comparatively simple, where the main component necessary for the successful performance of a behavior is essentially an intention (Gross, 2017). Gross (2017) elaborates that this simply insinuates that according to the TRA, the performance of a behavior solely rests on the formation of an intention and that the individual having sufficient control over the behavior is not crucial. Thus, based on the criticism of these assumptions, the TPB (Figure 2.1) was conceptualized to include an additional variable to the TRA; perceived behavioral control (Santoso and Farizal, 2019; Ramayah et al., 2012). Ramayah et al. (2012) add that this third attribute assumes that an individual behaves sensibly and considers the implications of those behaviors. Heidari et al. (2020) assert that the main variables considered when using the TPB are attitudes, subjective norms, perceived behaviors control and intentions.



PBC= Perceived Behavioral Control

Figure 2.1: The TPB (Gross, 2017: 7)

The TPB hypothesizes that intentions or the willingness of an individual to perform a behavior, as well as the perceived behavioral control, determine their behavior (Hagger et al., 2022; Heidari et al., 2020; Sniehotta et al., 2014; Zhang et al., 2015). Ajzen (2020) describes this intention to perform a behavior or behavioral intention as the initial antecedent, whereby the stronger it is, the more likely it is for the actual behavior to follow. Additionally, LaMorte (2019) emphasizes that behavioral intentions play the motivation factor role that affects specific behavior. Unanticipated incidents such as the lack of resources, lack of skills and insufficient time may, however, hinder individuals from acting on their intentions (Ajzen, 2020). This means that overcoming such barriers and the availability of the necessary skills and resources determines the degree to which individuals have actual control over specific behaviors (Ajzen, 2020). Thus, Ajzen (2020) reiterates that the greater the individual's control over the behavior, the greater the chances are that the intention will be followed through.

According to Ajzen (2020), Hagger et al. (2022), Heidari et al. (2018; 2020), Whitmarsh et al. (2018) and Zhang et al. (2015), the TPB uses attitudes, subjective norms and perceived behavioral control as some of the constructs which are responsible for an individual's intentions to perform a behavior (Figure 2.1). Ajzen (2020) refers to these factors as determinants of

intentions. Omotayo et al. (2020) add that the TPB is founded on the assumption that people's choices, decisions and actions are influenced by rational thinking.

Ramayah et al. (2012) and Zhang et al. (2015) describe attitudes as the individual's positive or negative evaluation of performing a behavior and subjective norms as the individual's insights into social pressures to or not to engage in the behavior. Additionally, Ramayah et al. (2012) and Zhang et al. (2015) define perceived behavioral control as the standard against which a person's perception of their capability to fulfill a specific behavior is quantified. Therefore, the TPB postulates that the motivation to participate in a behavior is provided by a commendatory attitude as well as a supportive subjective norm; however, a solid intention to perform a behavior is only formed when a sufficiently strong perceived behavioral control is present (Ajzen, 2020; Hagger et al., 2022).

The TPB shows that three different considerations guide human behavior (Ajzen, 2006). Attitudes, subjective norms and perceived behavioral control are presumed to be founded on the evaluation and power of accessible behavioral, normative and control beliefs (Sniehotta et al., 2014). Firstly, behavioral beliefs focus on the probable outcomes and experiences that are related to the behavior (Ajzen, 2006). Behavioral beliefs underpin attitudes and are related to the consequences of performing or not performing a specific behavior.

Secondly, normative beliefs underpin subjective norms, and these are about the expectations of significant others about an individual performing a behavior and whether or not significant others actually perform the behavior themselves. Lastly, according to the TPB, control beliefs underpin perceived behavioral control (Goss, 2017). The perception of the capacity to perform a specific behavior is the basis of control beliefs. This means that control beliefs are based on the presence of factors that may allow or hinder the performance of a specific behavior (Ajzen, 2006; Gross, 2017; Heidari et al., 2020).

Sniehotta et al. (2014) outline/ summarize the three conciliation hypotheses that are made by the TPB:

- Attitudes and subjective norms have a full effect on behavior, whereas perceived behavioral control has a partial effect which is mediated by intentions.

- The results of behavioral, normative and control beliefs on intentions as well as behavior are arbitrated through attitudes, subjective norms and perceived behavioral control, in that order.
- The TPB mediates the effects of all other influences, such as environmental, social, biological, economic, cultural and medical.

2.2.1 Attitudes

According to LaMorte (2019), attitudes in the context of the TPB may be explained as the extent to which an individual has a positive or negative assessment of a specific behavior. Specifically, Wu et. (2022) state that an individual's attitude is based on a rational perspective towards a personal assessment of behavior. This includes considering the result of engaging in the behavior of interest, perceived costs and benefits (LaMorte, 2019; Wu et al., 2022). Ajzen (2020) explains that attitudes towards a behavior are presumed to be functions of already existing principles regarding any possible consequences of the behavior called behavioral beliefs. Specifically, behavioral beliefs are an individual's subjective likelihood that performing a specific behavior will result in a certain outcome or experience (Ajzen, 2020). Therefore, these behavioral beliefs are hypothesized to result in either a positive or negative attitude towards a behavior (Ajzen, 2020).

2.2.2 Subjective norms

According to LaMorte (2019) and Wu et al. (2022), subjective norms are the confidence one has regarding whether or not many people favor or reject a specific behavior. That is, believing whether or not people who are important to the individual or peers believe that the individual should participate in the behavior (LaMorte, 2019). These essentially refer to social pressures to participate in a particular behavior (Ajzen, 2020); or the view that the majority of people who are important to the individual think that the individual should or should not participate or carry out a specific behavior (Fishbein and Ajzen, 2011).

Fishbein and Ajzen (2011) elaborate that the word 'subjective' in the term subjective norms is used because although it is an individual's perception that significant others desire, expect or prescribe them to participate or not participate in a specific behavior, the perception does not necessarily reflect that the majority of these important others think that the behavior should be engaged in or not. Additionally, there may also be instances where significant others put

normative pressure on an individual when the individual is under the assumption that significant others are themselves performing or not performing in a specific behavior (Fishbein and Ajzen, 2011). When an individual perceives a lot of social pressure, their intentions to engage in a specific behavior are also increased, which in turn increases the chances of them actually engaging in the behavior (Wu et al., 2022).

Ajzen (2020) and Fishbein and Ajzen (2011) state that these normative beliefs are broken down into two types: injunctive and descriptive. The injunctive normative belief refers to the anticipation that a specific referent individual or group favors or condemns the performance of the behavior in question (Ajzen, 2020). Furthermore, to be able to predict intention and behavior, the injunctive norm needs to be compatible with measures of intention and behavior with respect to the elements of target, action, context and time (Fishbein and Ajzen, 2011). Injunctive norms usually relate to a prescription that applies to the same extent to all members of a group of people who are in a specific social environment, role, or position (Fishbein and Ajzen, 2011).

On the other hand, descriptive normative belief refers to whether or not significant others actually engage in the behavior themselves (Ajzen, 2020). Descriptive norms are largely based on the assumption that peer pressure is a vital determinant of specific behaviors (Fishbein and Ajzen, 2011). It is important to note that, in the case of descriptive norms, certain behaviors may be irrelevant or do not apply to the most respected or important others (Fishbein and Ajzen, 2011).

2.2.3 Perceived behavioral control

According to LaMorte (2019), perceived behavioral control is an individual's insight of effortlessness or trouble associated with participating in a specific behavior. Ajzen (2020) adds that perceived behavioral control is based on accessible control beliefs, which are said to deal with factors that are present and can thus ease or hinder the performance of a behavior. Moreover, Ajzen (2020) states that control factors are those such as necessary skills and capabilities, time, money, resources as well as cooperation by other individuals. Thus, control beliefs refer to an individual's subjective likelihood that a specific factor, which may or may not hinder a behavior, will be present in a particular situation. According to LaMorte (2019), perceived behavioral control differs according to the specific situation and behavior. This

means that an individual will have different perceived behavioral control based on the specific situation.

Furthermore, Ajzen (2011) states that factors which are beyond the individual's control are partially responsible for whether or not intentions predict behavior. This means that control over the behavior is responsible for moderating the strength of the intention-behavior relation (Ajzen, 2011). It is important to note that the information from which people draw their beliefs is related to the presentation of a certain behavior, which is thus often flawed and inadequate or is based on illogical premises and is influenced by selfish motives and emotions that may fail to imitate reality (Ajzen, 2011).

Perceived behavioral control is presumed to moderate the impact of attitudes and subjective norms on the individual's intentions within the TPB framework, whereas actual behavior control is presumed to moderate the impact of intentions on behavior (Ajzen, 2020; Hagger et al., 2022). Sniehotta et al. (2014) elaborate that the extent to which perceived behavioral control directly influences (as opposed to indirectly by means of intentions) an individual's behavior relies on the extent of the actual control over the behavior. As previously stated, this means that a positive attitude and an encouraging subjective norm lead to auspicious behavioral intentions, which in turn leads to an individual believing that they are able to perform that specific behavior (Ajzen, 2020). Likewise, Ajzen (2020) highlights that an individual is anticipated to act on their intentions as far as they have control over the performance of the behavior at hand.

In addition to behavioral intentions, attitudes, subjective norms and perceived behavioral control, Fishbein and Ajzen (2011) and LaMorte (2019) state that social norms and perceived power are also constructs of the TPB, which have an effect on an individual's actual control over a specific behavior. The social environment within which an individual exists may have a big impact on the person's intentions and actions; this concept is known as a social norm (Fishbein and Ajzen, 2011). Specifically, social norms are authorizations or prohibitions to specific behaviors that are because of a generalized social agent (Fishbein and Ajzen, 2011; Herdiansyah et al., 2021).

LaMorte (2019) adds that social norms are conventional codes of behavior amongst a community of people within a cultural context. Specifically, Cislighi and Heise (2019) add

that social norms are based on confidence in what others do and favor. These are seen to be typical or normative within a group of individuals (LaMorte, 2019). Perceived power means the perceived existence of attributes that may facilitate or inhibit participation in a behavior (LaMorte, 2019). This is said to affect and influence the perceived behavioral control over all the aforementioned attributes (LaMorte, 2019).

2.2.4 Adjustments to the TPB

The TPB dictates that attitudes, subjective norms and perceived behavioral control are the solitary forecasters of intention (Ajzen, 2020). Moreover, Ajzen (2020) adds that actual control and intention are seen as the sole factors which determine behavior. This essentially means that no supplementary constructs should be necessary to get an accurate prediction of behavior and intentions. However, as previously highlighted, the TPB does, in principle, allow for the integration of supplementary variables or predictors which are incorporated to enhance the potential of the TPB forecast behavioral intentions (Heidari et al., 2018; 2020; Ramayah et al., 2012; Sogari and Van Loo, 2023; Wu et al., 2022), as depicted on Figure 2.2.

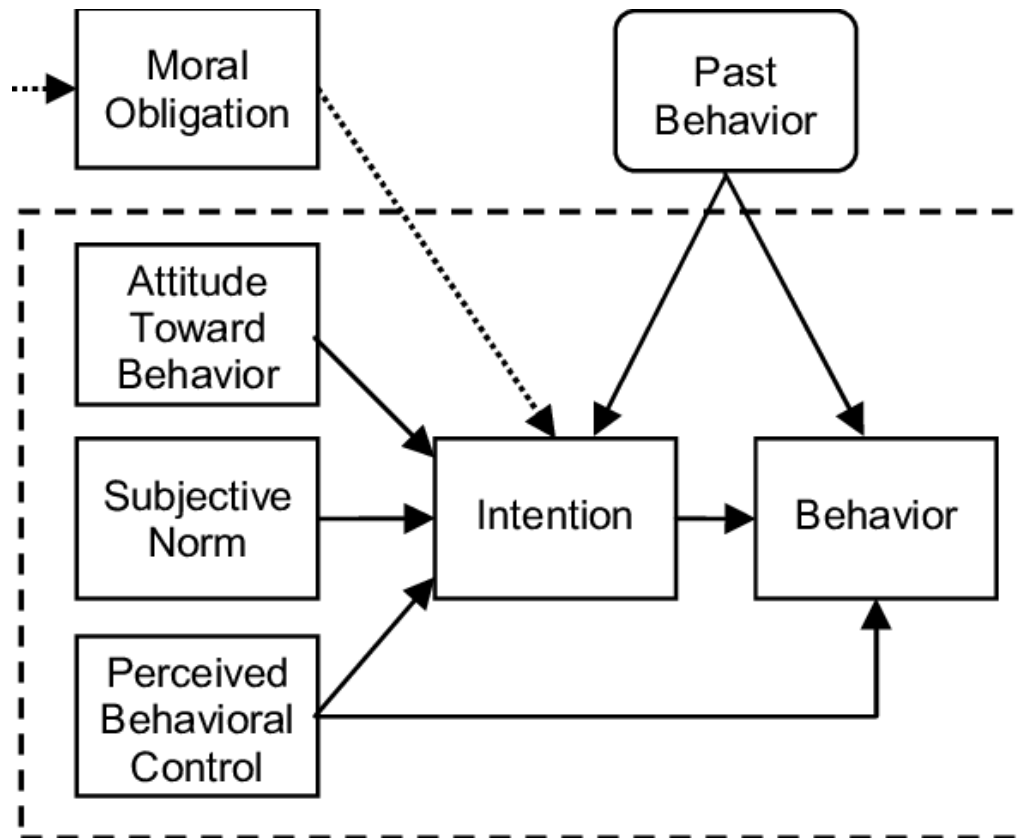


Figure 2.2: An example of the adjusted TPB including moral obligation and past behavior (Harding et al., 2006: 13)

Ajzen (2020) states that investigators usually propose additional factors; among these are anticipated effect (how the performance of the behavior would make one feel), past behavior (used as an indicator of the strength of the habit) and self-identity (the extent to which one considers oneself as the kind of individual who performs a specific behavior). An example of an adjusted TPB by Harding et al. (2006) is depicted in Figure 2.2, where moral obligation and past behavior are included as additional variables for the purpose of their study. The adjusted/extended TPB may also include additional constructs such as environmental knowledge, moral obligation, situational factor, social motivation and past behavior (Cao et al., 2023; Heidari et al., 2018; 2020; Ma et al., 2023; Pakpour et al., 2014; Swarna et al., 2022; Zhang et al., 2015). Heidari et al.'s (2020) study on food waste reduction in residential households also extended the TPB to include additional variables such as marketing addiction that influences consumption, perceived attribution of responsibility, moral attitudes, and waste-preventing behaviors. Cao et al. (2023) extend the TPB to include self-identity and moral norms to predict waste sorting intentions among tourists. Based on the aforementioned, Pakpour et al. (2014) and Zhang et al. (2015) conclude that the adjusted TPB is a suitable model for the measurement of household waste management behaviors, such as waste separation at source and recycling.

According to Ajzen (2020), it is essential that any additional variables to be added to the TPB are to be added with caution and this should only be done after empirical exploration and serious deliberation. Ajzen (2020) further proposes that the following criteria should be met by the proposed extra variables:

- The proposed predictor/s need to be behavior-specific and must conform to the principle of compatibility. This means that it needs to be possible to measure and define these predictors in alignment with the action, target, context and as time elements that define the behavior criterion.
- These proposed extra variables should be conceptually independent of the TPB's already existing predictors to avoid redundancy.
- The proposed extra variables should potentially be relevant to a wide spectrum of behavior studies by social and behavioral scholars.
- It should be possible to devise the proposed additional variable as a casual factor responsible for the specific action or intention.

2.2.5 Shortcomings/ limitations of the TPB

LaMorte (2019) and Sniehotta et al. (2014) highlight that the TPB has seen a considerable amount of criticism. These limitations of the TPB need to be clearly explored and conceded (Miller, 2017). For instance, the equilibrium between rationality and parsimony has been scrutinized (Sniehotta et al., 2014). In this regard, Sniehotta et al. (2014) elaborate that because the theory is based solely on volitional behavior perhaps requires further elaboration or extension of the explanatory concepts. Additionally, Zhou et al. (2022) show that a limitation is that the theory primarily focuses on the subjective attributes of individuals. Similarly, the TPB has been criticized for not having sufficient predictive soundness (Sniehotta et al., 2014). Sniehotta et al. (2014) state that the measures of the TPB are not responsible for most of the variability in the perceived behavior.

The TPB does not justify the presence or influence of other attributes such as threat, mood, fear or past experiences on intention and motivation or behavior (LaMorte, 2019). Moreover, while normative effects are accounted for, the theory does not account for economic or environmental attributes that may impact an individual's intentions to participate in specific behaviors. There also is no mention or consideration of a timeframe between the time of intent and the actual action of the behavior (LaMorte, 2019). Furthermore, Jun and Arendt (2016) and Sniehotta et

al. (2014) claim that certain arguments, assumptions and conceptualizations of certain aspects of the TPB are untrue. To elaborate, Sniehotta et al. (2014) explain that the assumption that the TPB mediates all other influences on behavior that are outside the theory is, theoretically and based on observation and evidence, problematic.

LaMorte (2019) states that the TPB adopts a linear decision-making process for behavior without taking into account any changes that may occur over time. Additionally, Jun and Arendt (2016) show that attention to logical decision-making is not accurate because not all behaviors are influenced by logical considerations of the factors involved in the behavior. For instance, when measuring physical activity, Sniehotta et al. (2014) show that attributes such as age, socio-economic standing, environmental features as well as mental and physical health are able to objectively forecast this activity when the predictors of the TPB are monitored.

Sniehotta et al. (2014) note that experimental studies supporting TPB have been scarce. The assumption is that this might be because the TPB does not speculate on how perceptions change, which raises the question of whether or not the TPB can be considered a theory of behavioral change (Sniehotta et al., 2014). A theory of change is essential for the conception of replicable theoretical interventions which would help adapt attitudes, subjective norms and perceived behavioral control, which would, in turn, allow for independent tests (Sniehotta et al., 2014). However, Sniehotta et al. (2014) do add that there is not enough clarity, which means that there is not enough evidence to falsify the TPB.

According to LaMorte (2019), adding the element of perceived behavioral control was vital for the theory, however, there is no mention or consideration for actual control over a behavior. Extended/ adjusted forms of the TPB may be viewed as a failure of the functionality of the theory (Sniehotta et al., 2014). The adjustment to the theory insinuates that the TPB alone is not able to provide sufficient and sustainable explanations for behavior (Sniehotta et al., 2014).

2.3 A further adjustment to the TPB

Muniandy et al. (2021) and Smith (2020) show, in support of the TPB, that the theory's main variables are effective in determining sustainable waste management behavior. Additionally, as discussed earlier, the TPB is flexible and allows for the integration of additional variables in order to enhance the potential of the theory to suit a specific context as well as to overcome some of its shortcomings (Ajzen, 2020; Cao et al., 2023; Heidari et al., 2018; 2020; Ramayah

et al., 2012; Sogari and Van Loo, 2023; Wu et al., 2022). Furthermore, Bardus and Massoud's (2022) study in Lebanon to examine behavioral intentions to sort household waste uses the TPB and includes other background factors such as crowding index; gender; generic attitudes toward recycling, reusing, reducing, and recovering; and satisfaction with the current waste management systems (both collection and treatment). Moreover, Singh and Sushil (2017) reiterate that for the process of sustainable waste management to be effective, additional attributes, for instance, affordability, need to be considered. For these reasons, this study builds on the TPB to consider additional variables deemed vital for the purpose of this study. The additional variables incorporated in the study include the level of awareness and understanding of sustainable waste management, current waste management practices/ habits, willingness-to-adopt/ pay for sustainable waste management practices and challenges that constrain the shift to use sustainable waste management.

2.3.1 Application of the TPB to this study

Figure 2.3 depicts the TPB in relation to the additional variables added for the purpose of this study. When looking at household waste management behavior in the context of the TPB, it may be influenced by factors such as the amount of waste generated, availability of resources like refuse bins, time considerations as well as the perceived advantages or rewards of participating in specific practices (Omotayo et al., 2020). Additionally, Wu et al. (2022) reiterate that the TPB promotes sustainable environmental behavior.

Muniandy et al. (2021) show that attitudes, subjective norms and perceived behavioral control have a positive impact on sustainable waste management behavior. Thus, the TPB as well as the additional variables, will help in the comprehensive examination of waste management practices in the Bluff area and establish household sustainability considerations. This will help ascertain intention and behavioral influences within the households.

As depicted in Figure 2.3, this study explores the influences of the level of awareness and understanding, current waste management practices/ habits, willingness-to-adopt/ pay for sustainable waste management practices and challenges that constrain the shift to use sustainable waste management in relation to the standard TPB variables (attitudes, subjective norms and perceived behavioral control) on household waste management practices.

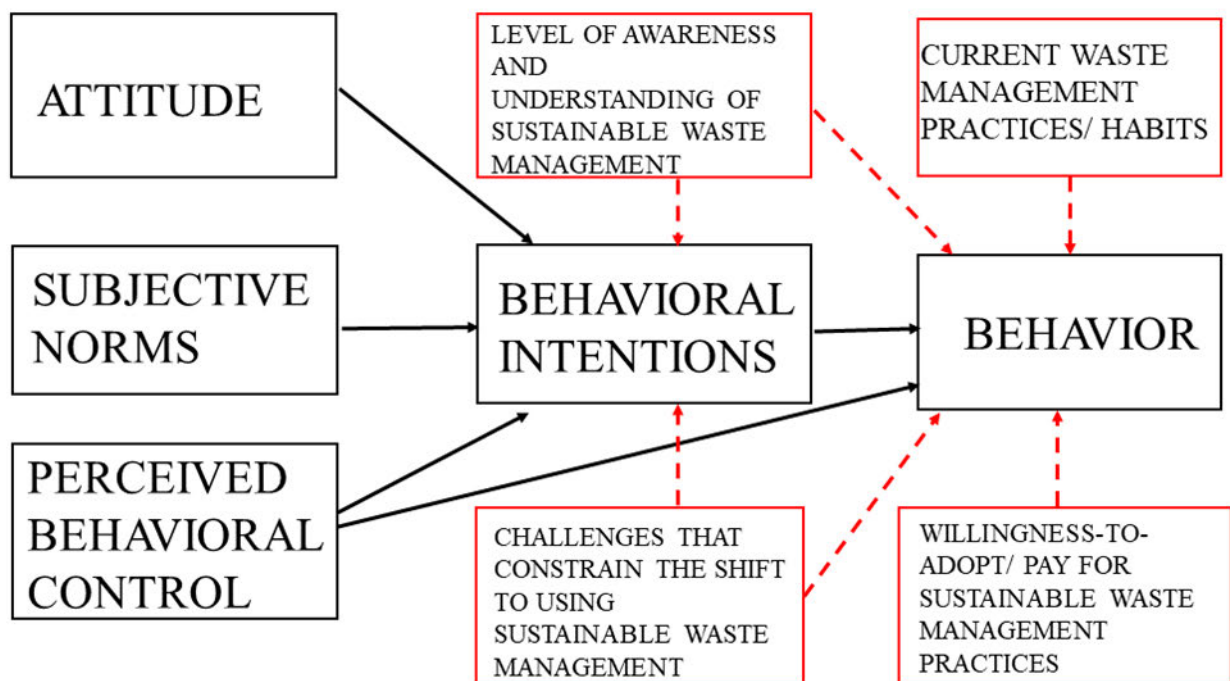


Figure 2.3: An adjustment to the TPB to consider waste management practices variables at the household level (Author, 2021)

As discussed earlier, the TPB is deemed the most useful theoretical framework to guide the specific intentions of this study in terms of conducting a comprehensive waste management examination at the household level. Specifically, attitudes are considered an essential influence on behavior (Muniandy et al., 2021). Thus, in terms of attitudes and waste management, moral obligation may be used to explain the extent to which households care for their surroundings through how they choose to manage waste (Omotayo et al., 2020; Strydom, 2018a).

To assess household or an individual's attitudes toward waste management, Liu et al. (2019) and Omotayo et al. (2020) state that household perceptions of the end results of their waste management practices may also be considered. Therefore, positive attitudes have a positive impact on sustainable waste behavior (Muniandy et al., 2021); this is vital for effective solid waste management (Smith, 2020). Awareness is also seen to affect attitudes, where an absence of awareness about waste management behaviors, like recycling, has a significant effect on people's attitudes and behaviors (Smith, 2020; Vinti et al., 2023).

As previously defined, subjective norms refer to the apparent social pressures to perform or not to perform a certain behavior (Muniandy et al., 2021). Regarding subjective norms, how significant others manage their waste, as well as what significant others think about or their expectations of how the household manages waste, should be examined (Liu et al., 2019; Omotayo et al., 2020). For instance, when applying the TPB to sustainable waste management behavior such as recycling, Muniandy et al. (2021) and Strydom (2018a) indicate that subjective norms have a direct and positive impact on one's intentions to recycle. Moreover, policies or legislature put in place by the government on local waste management may be an attribute of subjective norms in this context (Omotayo et al., 2020).

Lastly, perceived behavioral control, which is the feeling an individual has regarding the ease or complexity of performing a specific behavior (Muniandy et al., 2021), is important to consider in household waste management. Concerning perceived behavioral controls and household waste management, Liu et al. (2019) and Omotayo et al. (2020) propose a focus on the access that households have to waste management facilities (if any) and the state under which these facilities are maintained as well as the overall state of the surrounding environment. Similar to the hypothesis made regarding subjective norms, Muniandy et al. (2021) and Strydom (2018a) propose that perceived behavioral control also has a positive correlation with one's intentions to recycle.

2.3.2 Levels of awareness and understanding of sustainable waste management

Bautista (2019), Kurniawan et al. (2023), Mamady (2016), Vinti et al. (2023) and Whitmarsh et al. (2018) affirm that levels of awareness and understanding have a substantial influence on waste management behaviors and on the intentions thereof. Mamady (2016) reiterates that generally, the more knowledge and understanding people have, the more positive their attitudes are towards a specific behavior and, thus, their engagement in the behavior. According to Bautista (2019), this includes behavior such as waste segregation, waste reduction and recycling. Whereby the lack of knowledge results in poor waste management practices. In this regard, Bautista (2019) adds that enhanced awareness and understanding of waste management better inform sustainable waste management behavior.

For instance, Mutungwe et al. (2014) show in their study that most of the respondents were aware that dumping waste in undesignated locations was illegal and of the fact that the site of waste disposal is important. However, the study also revealed that the vast majority of the

respondents thought that bins were not provided in strategic positions around/ within the community (Mutungwe et al., 2014). Regardless of this information, approximately 96.5% of the respondents in the study reported that they discarded waste in the evenings so as not to get arrested for illegal activities (Mutungwe et al., 2014). It is thus evident that levels of awareness and understanding play a significant role in the intentions behind sustainable waste management practices as well as the associated behavior (Kurniawan et al., 2023).

2.3.3 Current waste management practices/ habits

Habit can be used to forecast specific behavior (Gardner, 2015). In this context, Gardner (2015) defines a habit as the process whereby an erudite encouragement-action relationship leads to an urge to participate in a specific behavior. Habits are said to be characterized by their persistence even in situations where motivating factors decrease or disappear (Gardner, 2015). In this light, Omotayo et al. (2020) propose that waste management practices or habits that are implemented within a specific community speak to how environmentally safe (and aware) that society is.

In terms of habits/ current waste management practices, Bautista (2019) concludes that individuals who already engage in waste management practices like segregation or waste reduction were most likely to engage in more sustainable waste management, like reusing old materials such as containers as well as in practices like recycling. Hence the importance of adding this variable to the conceptual framework of this study. Current household waste management practices are envisaged to inform the choices made within the household regarding waste management practices. Furthermore, this information will help gauge the perceptions around sustainability considerations in the household.

2.3.4 Willingness-to-adopt/ pay for sustainable waste management practices

Bhawal Mukherji et al. (2016), Han et al. (2019) and Miner et al. (2020) show that environmental knowledge notably has a positive correlation to the willingness-to-participate in sustainable waste management practices. Additionally, Han et al. (2019) stress that willingness-to-adopt or pay for waste management practices forms part of the foundation of sustainable and effective domestic waste management practices. For instance, Chikowore (2021) finds that although Zimbabwean households are willing to pay the minimum costs for waste management services, they are not willing to incur more to access more efficient waste management services. These results speak to the important role played by the willingness to

waste management behaviors adopted by households. That is, in determining whether or not households participate in improved waste management strategies.

In a study that looked at the levels of awareness of as well as solid waste management practices in an urban Zimbabwean community, it was found that some community members were willing to adopt proper waste management practices, however, some were not willing (Mutungwe et al. (2014). Additionally, Mutungwe et al. (2014) state that, for the most part, community members consider waste management the responsibility of the municipality. To this end, community members blame the municipality for the creation of dumping sites as a result of the failure of the municipality to collect waste timeously (Mutungwe et al., 2014). Furthermore, Mutungwe et al. (2014) found that for this reason, the community did not engage positively in waste management. This example shows the crucial role that willingness-to-adopt or pay for waste management plays in waste practices behavior. Thus, reiterating the necessity to understand this aspect/ factor in light of the TPB.

2.3.5 Challenges that constrain the shift to use sustainable waste management

Challenges experienced in household waste management practices have a significant influence on waste management behavior. According to Smith (2020) and Yukalang et al. (2017), issues such as those associated with waste collection (insufficient waste collection sites/ points, irregular collection of waste, or inadequate waste management facilities and services) discourage efficient waste management practices. Specifically, Smith (2020) and Viljoen et al. (2021) confirm that obstacles in practices like waste collection affect waste management intentions and the behavior thereof as they lead to subsequent issues like the illegal dumping of waste and littering. Raab et al. (2021) give an example of the suburbs of Guatemala City where households mainly burn their waste to get rid of it as a result of insufficient waste collection services in the city. Furthermore, Smith (2020) elaborates that limited waste policies, regulation and implementation of legislation, sustainable waste management initiatives, and insufficient information are some key challenges that need to be addressed in South Africa.

2.4 The ISWM approach

The management of solid waste has been a great global concern (Abdulghaffar and Williams, 2021; Adipah and Kwame, 2019). Economic development and population growth have subsequently led to an increase in waste generation and, thus, the need for proper waste management (Leblanc, 2019a). Developing countries are no exception, as Adipah and Kwame

(2019) and Nukusheva et al. (2023) show that economic growth, rapid increase in population rates, urbanization and industrialization have perpetuated the increased production of solid waste. Additionally, inefficient waste management also has detrimental environmental and health implications (Fadhullah et al., 2022; Leblanc, 2019a). Specifically, Leblanc (2019a) and Nukusheva et al. (2023) show that inefficient waste handling as well as improper management result in various challenges, including the attraction of insects and rodents, an increase in greenhouse gases, the pollution of water bodies and blocking drains, which result in increased floods.

Elsaid and Aghezzaf (2015) define a waste management system as the all-encompassing management of practices, measures, processes, responsibilities and resources required to determine waste management processes that conform to environmental regulations. According to Elsaid and Aghezzaf (2015), a waste management system is necessary for a sustainable and comprehensive environmental management system. This system also includes strategies that are put in place to avoid or reduce the amount of waste generated before waste needs to be disposed of (Elsaid and Aghezzaf, 2015). Specifically, a solid waste management system encompasses the generation, storage, collection, transportation, treatment, processing as well as disposal of waste products (Elsaid and Aghezzaf, 2015; Wan et al., 2019). Thus, a proper solid waste management system necessitates sustainable solid waste management, especially in developing countries (Fadhullah et al., 2022).

Evidently, the ISWM is considered a contemporary and methodical solid waste management approach (Leblanc, 2019a). According to Korneliussen (2021), the ISWM approach is comprehensive and participatory and intends to enhance livelihoods, governance as well as waste management, making it a sustainable process. Adipah and Kwame (2019) add that ISWM analyzes every aspect (technical and non-technical) of a solid waste system in unison so as to encourage environmentally friendly waste management practices.

Smith (2020) and Wani et al. (2018) emphasize that the ISWM approach is holistic in that numerous waste management planning procedures are integrated. These procedures include practices such as waste minimization, prevention, recycling, composting, construction, design, incarnation and operation of waste management sites like landfills (Ugwu et al., 2021; Vesere et al., 2021; Wan et al., 2019; Wani et al., 2018). This means that waste management practices such as reduction, recycling and repurposing are considered important attributes of an ISWM

system (Kurniawan et al., 2023; Leblanc, 2019a). Therefore, it is evident that the ISWM approach is founded on the waste hierarchy (depicted in Figure 3.3 and further explained in the next chapter) (Korneliussen, 2021).

Specifically, an emphasis is placed on the importance of assessing local needs and situations to ensure that the ideal waste management attributes are chosen and applied based on specific contexts (Leblanc, 2019a). However, developing countries are still lagging far behind as far as municipal solid waste management is concerned (Adipah and Kwame, 2019; Nukusheva et al., 2023). As a result of social and economic challenges, municipal solid waste management system issues are not given sufficient priority (Adipah and Kwame, 2019; Nukusheva et al., 2023). Therefore, encouraging proper waste collection, transportation and waste disposal, in conjunction with practices that reduce waste generation and encourage recycling, results in a comprehensive waste management system that combats all waste-related challenges (Leblanc, 2019a).

The ISWM approach is embedded in the encouragement of adopting the most preferred attributes of the waste hierarchy, making practices like waste reduction, recycling and composting crucial to an ISWM system (Kurniawan et al., 2023; Leblanc, 2019a; Wani et al., 2018). This approach is important for the purpose of this study as sustainability considerations were assessed. Specifically, under the ISWM approach, sustainable waste management practices and efficient waste collection, transportation and disposal are encouraged for a comprehensive system (Leblanc, 2019a).

The ISWM system encourages the combination of already existing sustainable waste management practices to improve waste management (Kurniawan et al., 2023; Leblanc, 2019a). This is especially important, particularly for the current study, which considered the comprehensive waste management practices of households in relation to various waste streams generated at this level. Kurniawan et al. (2023) and Leblanc (2019a) elaborate on four main components of ISWM. These include source reduction, recycling and composting, waste transportation as well as landfilling (Kurniawan et al., 2023; Leblanc, 2019a). These components are briefly elaborated on in the next subsections and further in the next chapter.

2.4.1 Source reduction

Source reduction is also known as waste prevention and is directed at decreasing the amount of waste that is generated (Leblanc, 2019a), ideally before waste is contaminated with other waste streams or sent for disposal (Wani et al., 2018). According to Diprose et al. (2022) and Leblanc (2019a), reducing waste at source may include reusing products such as reusable packaging, which is a crucial aspect of a circular economy; designing products that are durable and recyclable, and thus sustainable; lengthening product life by restoring goods, which is also crucial for a circular economy; storing and processing food better to reduce food spoilage and thus, waste; and refraining from using products that cannot be reused or recycled and do not last long.

According to Adipah and Kwame (2019) and Wani et al. (2018), waste reduction is the best, and thus most preferred, waste management practice because it discourages the generation of waste. Through the reduction of waste at source, costs such as those associated with waste handling, transportation and disposal are also decreased (Leblanc, 2019a). Additionally, Vesere et al. (2021) show that waste reduction is a crucial aspect of the circular economy. Specifically, because the practice promotes sustainable consumption as it facilitates the transition from waste to the management of resources (Vesere et al., 2021).

2.4.2 Recycling and composting

Leblanc (2019a) and Smith (2020) explain that recycling deals with gathering, sorting and recovering reusable and recyclable materials, and then processing the recyclable materials to make new products. Smith (2020) states that recycling follows after products and materials have been reused and, instead of being disposed of, get recycled. According to Vesere et al. (2021) and Wani et al. (2018), recycling aids in the reduction of waste materials reaching landfills while also presenting economic gain for those involved in the process.

Composting deals with gathering organic waste and turning it into soil supplements as a part of organics recycling (Leblanc, 2019a). Fadhullah et al. (2022) and Wani et al. (2018) add that through composting, the fertility, moisture-retaining capacity and humus content of the soil are increased. Both recycling and composting are important for environmental health, for the economy through job creation, and for the diversion of materials from waste streams to produce cost-effective sources of materials to be used further (Leblanc, 2019a).

2.4.3 Waste transportation

Fan (2023) and Haerani et al. (2019) state that the transportation of waste is part of the multifaceted system of waste management. According to Judd (2021), substantial investments in waste management transportation, equipment and infrastructure is necessary for the collection, transportation and disposal of waste material. Additionally, most of the solid waste management budget allocation is consumed by the transportation of waste (Fan, 2023; Judd, 2021). These modes of transportation include trucks and trailers, landfill tippers, storage and treatment tanks (Judd, 2021).

Leblanc (2019a) states that in order for efficient waste management, the transportation of waste needs to also be integrated methodically with other waste management practices. According to Haerani et al. (2019), challenges in waste transportation arise as a result of the inadequate capability of the vehicle, low transportation frequency, high duration of transportation time and when a long transportation route is chosen. Therefore, developing and enhancing road infrastructure is crucial to improving the performance of waste management systems (Elsaid and Aghezzaf, 2015). Waste types, in the forms of solid and non-solid states, are usually collected and thus transported from curbsides, transfer stations and businesses (Fan, 2023; Haerani et al., 2019; Leblanc, 2019a). From these points, the waste may need to be reloaded onto other vehicles before being taken to landfill sites (Leblanc, 2019a). For instance, Elsaid and Aghezzaf (2015) state that it is essential that total distances traveled by waste management vehicles are minimized while also ensuring that the capacity and shift times are not infringed upon.

2.4.4 Landfilling

The final mode of waste disposal for materials that are not recycled is usually through landfills and combustion (Kurniawan et al., 2023; Leblanc, 2019a). Specifically, landfilling deals with disposing of waste in a controlled manner on land that may or may not be pre-treated (Wani et al., 2018). Leblanc (2019a) adds that these landfill sites need to be efficiently designed, constructed properly, and managed systematically. Agamuthu (2012) states that regardless of advancements in waste management practices, such as reduction and recycling, waste landfilling has remained the ultimate waste disposal option. For instance, the low disposal costs associated with landfilling have made this option the most preferred in many countries, but mostly those that are developing (Agamuthu, 2012).

The type (composition and amount) of waste that ends up in landfills is determined by an area's waste management strategies and measures (Agamuthu, 2012). Specifically, Agamuthu (2012) shows that around 65 to 80% of all municipal solid waste that is collected in developing countries is disposed of in landfills. Approximately 40 to 70% of this waste is said to be organic waste (Agamuthu, 2012). To reiterate, Mintz et al. (2019) state that there are severe local and global detrimental environmental effects of waste that end up in landfills.

2.4.5 A sustainable ISWM system

Sustainable waste management is viewed as an important approach to waste management that guarantees a safe environment for human health and resource conservation (Adipah and Kwame, 2019; Haerani et al., 2019). As previously stated, as a global concern, a proper solid waste management system needs to be sustainable (Fadhullah et al., 2022). This is best achieved through the implementation of the most preferred attributes of the waste hierarchy (Adipah and Kwame, 2019; Smith, 2020). Specifically, waste reduction is the most preferred method through the prevention of waste generation; and waste disposal is the least preferred (Adipah and Kwame, 2019). Moreover, it is essential that waste recycling and reusing are also encouraged (Adipah and Kwame, 2019). Where the most preferred/ waste diversion methods are not possible, means to salvage the intrinsic value of a waste material into energy should be sought after (Adipah and Kwame, 2019).

According to Elsaid and Aghezzaf (2015) and Wani et al. (2018), to make solid waste management systems sustainable, they need to conserve the environment, and be socially tolerable and inexpensive. Elsaid and Aghezzaf (2015) propose a sustainable ISWM framework to serve as the foundation for a holistic sustainable waste management system to accomplish sustainability (Figure 2.4). In this regard, Korneliussen (2021) and Wilson et al. (2013) emphasize that sustainable ISWM considers both physical and governance attributes of waste management.

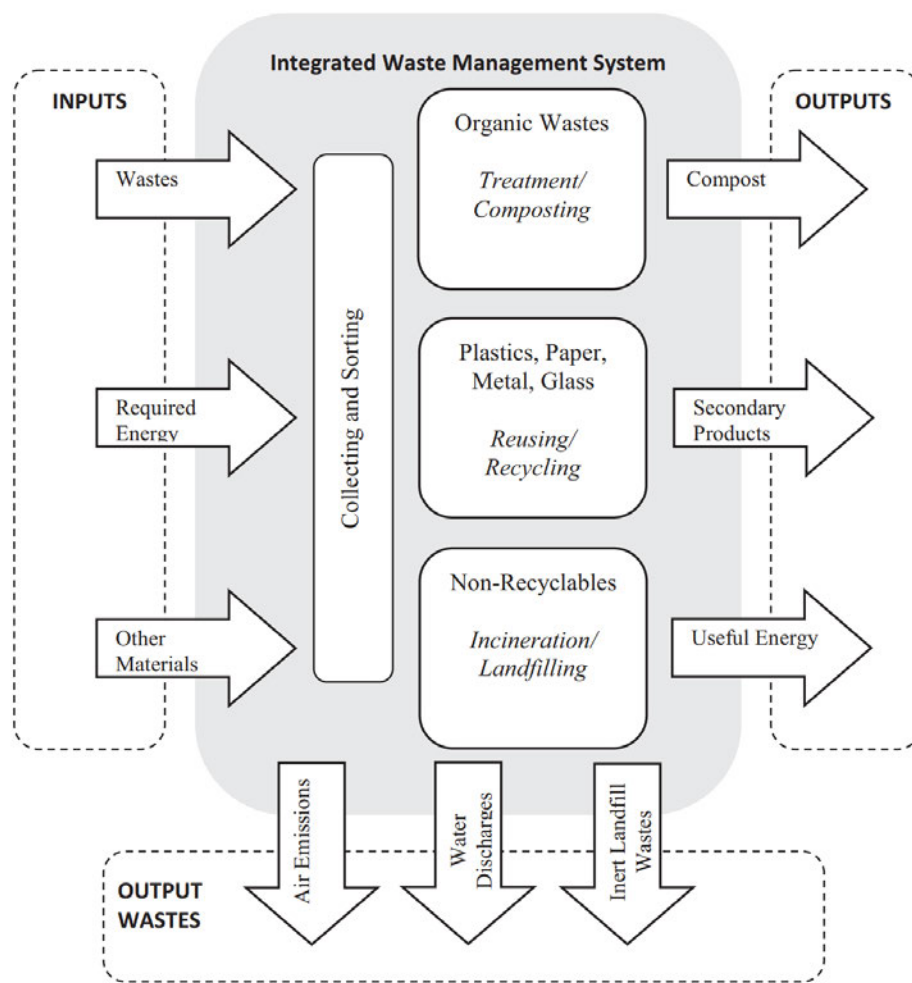


Figure 2.4: A sustainable ISWM System framework (Elsaid and Aghezzaf, 2015: 1092)

The physical components include collection, recycling and disposal (Wilson et al., 2013). The governance components include considering all users as well as service providers, comprehensible institutions that are supported by practical policies, and financial sustainability (Wilson et al., 2013). In this regard, households are a crucial component as household waste is one of the main sources of municipal solid waste (Fadhullah et al., 2022; Lazo and Gasparatos, 2022). This is specifically crucial in the current study, which looks at the comprehensive waste management practices at the household level and the sustainability considerations among these households of different socio-economic standing in a community where the municipality is responsible for most of the waste management.

The framework proposed by Elsaid and Aghezzaf (2015) outlines inputs and outputs. The inputs outline waste that is collected from households and commercial spaces; input energy to be used for the operation of machines used to treat and recover material, as well as other materials that may be used in the production/ manufacturing of secondary products (Elsaid and Aghezzaf, 2015). According to Mintz et al. (2019), collection points for recyclables such as paper and plastic are generally easier accessible and located conveniently near or within residential areas, whereas the collection of materials like e-waste is not as easily done. This is a serious issue, given the increase in the use of appliances within households (Uhunamure et al., 2021).

Waste is collected and, if need be, is sorted to separate those materials that may be recovered and then the materials that need to be cleaned (Elsaid and Aghezzaf, 2015; Kurniawan et al., 2023; Smith, 2020). Additionally, plastics are further separated based on resin type, glass according to color, and lastly, metal based on the material (Elsaid and Aghezzaf, 2015). Glass is then crushed before melting to produce secondary products, and plastics are shredded for recycling (Elsaid and Aghezzaf, 2015). Organic wastes are then composted, incinerated or fermented, and the non-recyclables are then either incinerated for energy production or thrown away in landfills (Elsaid and Aghezzaf, 2015). As depicted in Figure 2.4, energy, secondary products and compost may be the valuable outputs of this system (Elsaid and Aghezzaf, 2015). However, there still may exist waste outputs in the form of toxic air emissions and water pollutants from recycling treatment and incineration (Elsaid and Aghezzaf, 2015).

A key component of the ISWM approach is, as argued by Gören (2023), the development of waste management and recycling technologies that turn waste into resources, especially in rapidly developing nations. This is also linked to the circular economy approach discussed next, which strengthens and supports the approach to sustainable development (Mandpe et al., 2023).

2.5 The circular economy approach

The circular economy approach is seen as a shift in how goods and services are produced and consumed whereby goods and materials are kept in use for as long as possible, thus closing gaps in production network cycles (Elgie et al., 2021; Schröder et al., 2021; Yadav et al., 2023; Zhang et al., 2022). This approach is an alternative to the linear economy, where materials are disposed of straight after consumption (Kurniawan et al., 2023; Zhang et al., 2022). Elgie et al.

(2021), Schröder et al. (2021), Stahel (2016), Umhlathuze (2021) and Zhang et al. (2022) define a circular economy in the context of waste management as a method aimed at decreasing the undesirable environmental effects of the economy through the use of sustainable waste management strategies like recycling, reusing, repairing and remanufacturing. A circular economy in waste management differs from the inefficient linear economy system, where useful materials are under-utilized and essentially taken to landfills (Kurniawan et al., 2023; Mandpe et al., 2023; Taelman et al., 2018). Bardus and Massoud (2022: 1-2) state that “the primary purpose of circular models is to mitigate the environmental stresses generated by resource-depleting anthropogenic activities by prolonging the lifecycle of products and extracted resources to the fullest while maximizing production efficiency”. Yadav et al. (2023) indicate that waste can be converted to high-value assets if treated properly with smart solutions adopting the circular economy approach.

The concept of a circular economy, although fairly recent, shows great potential for sustainable economic growth that encompasses improved job creation as well as environmental protection (Di Vaio et al., 2023; Edmond, 2019; Mapani et al., 2022; Stubbs, 2021a; Stubbs, 2021b). However, Knickmeyer (2020) emphasizes that active participation from communities in waste management is crucial in a circular economy. For example, Knickmeyer (2020) demonstrates that activities such as waste segregation within households are essential. Moreover, a change in behavior, as well as consumer culture coupled with the revision of existing policies and amenities, are necessary to fully embrace a circular economy (Knickmeyer, 2020). Thus, in essence, the participation of several stakeholders, and waste generators specifically, is necessary for a circular economy (Mapani et al., 2022; Taelman et al., 2018).

Enhancing resource throughput and proficiency while guaranteeing that materials are used properly at every point in their lifecycle and within the supply chain is crucial (Organization for Economic Co-operation and Development (OECD), 2020). Preston et al. (2019: 2) assert that “diverting to a sustainable growth pathway will require both substantial improvements in the efficient use of primary resources and a significant degree of displacement of primary resources with secondary materials - those recovered from waste streams and repurposed or remanufactured for further use”. Thus, a circular economy ensures that materials that have reached the end of their useful life become resources, therefore ‘closing loops’ associated with the industrial ecosystems through waste minimization (Kaza et al., 2018; Preston et al., 2019; Stahel, 2016; Zhang et al., 2022). In particular, products are created and enhanced to be

disassembled and reused as part of a cycle (Kaza et al., 2018). In this regard, reusing and repairing are seen as the most preferred options when compared to recycling, which is least preferred in a circular economy (Schröder et al., 2021). Preston et al. (2019) schematically represent (Figure 2.5) the key elements of a circular economy that embrace three activities: creating loops (a product is reused, repaired or recycled when it reaches the end of its designed operational life rather than thrown away), slowing flows (decreasing demand for new products by shifting to new ways of designing and making products that remain in use for as long as possible) and narrowing flows (shifting to more efficient ways of using products such as sharing products).

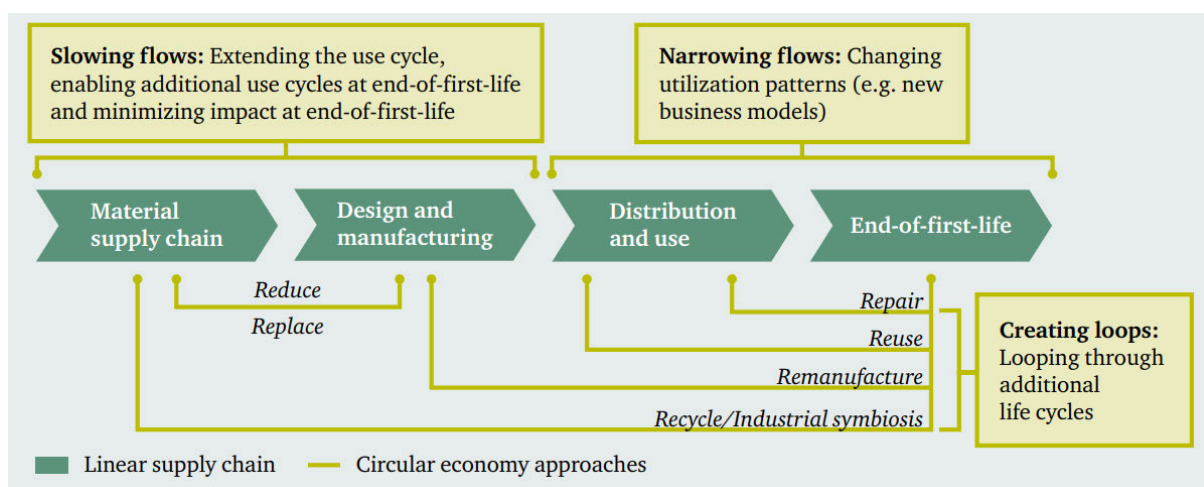


Figure 2.5: Circular economy activities (Preston et al., 2019: 8)

The Department of Environmental Affairs (DEA, 2019), the DEFF (2020) and Zhang et al. (2022) state that the concept of a circular economy is an important tool that may be used to comprehend the contribution of the employment of waste management hierarchy to the green economy. As discussed, a circular economy means a shift from a ‘take-make-waste’ system of operation to one where the loop between resource extraction and waste disposal is closed (DEA, 2019; DEFF, 2020; Mandpe et al., 2023; Stubbs, 2021a). Mandpe et al. (2023) similarly state that the linear economy-based traditional approach (‘take, make, use and dispose of’) cannot be sustained. Specifically, Malinauskaite et al. (2017) explain that this model aims to retain materials and their value within the economy for an extended period through the improvement of waste integration into the cycle. It is vital from both the supply sector as well as environmental viewpoints to shift towards a circular economy as it offers a firm foundation for a sustainable and viable economy (OECD, 2020).

The OECD (2020) states the following as the objectives of a circular economy:

- To reduce the consumption of materials, including virgin materials as well as waste streams such as food, plastic and electronic waste;
- To enhance the worth of materials circulating in the economy; and
- Avoid waste generation while also seeking to decrease hazardous constituents in products and waste.

To reiterate, Iuga (2016) states that through the circular economy, recycled and renewable materials are dispensed, and the consumption of virgin materials and energy resources decreases. This is contrary to the conventional linear economy as it attempts to honor environmental limits and, thus, decrease emissions and the waste of resources (Iuga, 2016; Kurniawan et al., 2023; Schröder et al., 2021; Zhang et al., 2022). A circular economy is achieved through the implementation of the most preferred methods of sustainable waste management, including waste avoidance, reuse, recycling and recovery, in order to reduce waste and decrease the pressure on the use of virgin items as the inputs of production (DEFF, 2011; DEA, 2019; DEFF, 2020; Iuga, 2016). Mandpe et al. (2023: 500) assert that the circular economy “will be achieved by processing the products/ materials/ components after their end of service life into valuable resources for manufacturing other products/ materials/ components” and curtailing the waste volumes and assessing the requirement for virgin raw materials.

The DEFF (2020), Elgie et al. (2021), Mapani et al. (2022) and Kurniawan et al. (2023) show that the circular economy has the potential to decrease any detrimental environmental impacts as a result of resource use and extraction significantly while also reinstating natural capacity and biodiversity. This is because the circular economy aims to remove waste from the economic system by looking at materials at the end of their lifecycle as a crucial source of materials (Schröder et al., 2021). Additionally, it is evident that when a circular economy incorporates the efficient and advanced management of waste and materials, environmental issues related to things like littering and microplastics are addressed efficiently (OECD, 2020).

The circular economy approach is crucial for this study which aims to assess sustainability considerations in the waste management practices adopted at the household level, especially since the South African Government has embraced pursuing a circular economy approach and

launched the African Circular Economy Alliance with Nigeria, Rwanda and South Africa in 2017 (Preston et al., 2019). Bob et al. (2017) assert that the circular economy approach provides the framework for opportunities to manage waste as a potential resource to enable much-needed job creation and contribute to sustainability imperatives in the South African context. Transitioning to a circular economy thus has the potential to create businesses and jobs across value chains of several sectors, including waste management and manufacturing. However, as Mandpe et al. (2023) caution, attaining a circular economy that transforms the current linear approach is a complex task that relates to numerous aspects, including readiness to change practices by a range of stakeholders (including local bodies, industry/ businesses and households), the development of appropriate policies and interventions (support of a regulatory environment), and proper resourcing/ funding. Furthermore, Souza-Piao et al. (2023) advocate for circular economy practices to embrace social inclusion and address the Sustainable Development Goals.

Households, and communities in general, play a crucial role in waste management (Mamady, 2016), and are therefore important in a circular economy. Participation in household activities like waste segregation and minimization; adoption of proper waste behavior; and a change in consumer culture are important for sustainable waste management (Kaza et al., 2018; Knickmeyer, 2020; Kurniawan et al., 2023; Yadav et al., 2023). Moreover, Kurniawan et al. (2023) and Schröder et al. (2021) state that the most preferred options in a circular economy are reusing and repairing, as opposed to recycling; thus, according to Malinauskaite et al. (2017) retaining materials and their value within the economy for as long as possible.

2.6 Conclusion

This chapter has outlined the theoretical frameworks adopted for the purpose of this study. The TPB is suitable and is particularly important for this study as it covers the broad determinants of and attributes that influence waste management intentions and behavior in the household and, thus, clarify the rationale behind waste management practices at this level. Furthermore, the chapter has proposed an adjustment of the TPB as the conceptual framework for this study. In this regard, four additional variables were incorporated into the TPB in an attempt to look at additional influences on waste management decisions and practices and the reasoning behind these practices holistically. Additionally, the ISWM and circular economy approaches are crucial for the study as they highlight the importance of sustainability considerations in waste management systems (within which households form part of important stakeholders as waste

generators and managers). Next, to unpack further on key waste management concepts, some of which have been discussed in this chapter, chapter three reviews the literature pertaining to these concepts and the related issues and arguments related to waste management and sustainability at the household level.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

The social aspect of waste is an important one to probe in the quest to achieve sustainability. To this end, this chapter unpacks the literature informing this study. In this regard, literature related to waste and its generation in relation to the use and consumption of various materials, waste management at various levels and contexts as well as waste management methods are thematically presented. Specifically, this chapter outlines varying arguments around the issue of waste management as well as people's awareness and willingness-to-use and pay for these practices and methods. This is especially important since elements of household waste management, such as socio-economic heterogeneity factors, have not been sufficiently investigated in previous research.

The chapter begins by laying a foundation by critically defining what waste is. Thereafter, a review of discussions around waste management and specifically, sustainable waste management is provided. Considering the role and myriad of benefits of the implementation of sustainable waste management practices in the socio-economic as well as environmental aspects of a society, it is critical to probe the regulations in place, measures taken as well as challenges encountered in the use of such practices. Therefore, literature that reflects on waste management policy in South Africa is also unpacked. In closing, the chapter focuses on challenges that have constrained the use of efficient waste management strategies and practices, especially in a developing world context relevant to South Africa.

3.2 Defining waste

The DEFF (2011: 13) and eThekweni Municipality (2016a: 18) define waste according to the South African Waste Act as “any substance, whether or not that substance can be reduced, reused, recycled and recovered-

- a. that is surplus, unwanted, rejected, discarded, abandoned or disposed of;
- b. which the generator has no further use of for the purposes of production;
- c. that must be treated or disposed of; or
- d. that is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by the mining, medical or other sector; but –
 - i. a by-product is not considered waste; and

- ii. any portion of waste, once reused, recycled and recovered, ceases to be waste.”

This essentially means that waste materials are those that are unwanted or unused, and thus thrown away (Elsaid and Aghezzaf, 2015). According to Saseanu et al. (2019), waste is based on products coming to the end of their life cycle in terms of production and use, as well as on manufacturing and market systems and construction and destruction processes. Thus, the user has no further use for these materials and so disposes or intends to dispose of them at this point (El-Ramady et al., 2021; Oteng-Ababio, 2014). In summary, waste is essentially the consequence of human activities which create substances that have no further use or are no longer desirable (Chan et al., 2022; El-Ramady et al., 2021; Khan et al., 2022; Muzenda, 2014). Gören (2023) states that as the world’s population and standards of living increase, the amount and different types of solid waste are also growing. Gören (2023) further argues that the types of waste are also often difficult to recycle due to composite wastes.

Amasuomo and Baird (2016) and Khan et al. (2022) state that the way people use and, thus, interconnect with their immediate environment leads to various impacts, which include the generation of waste. Therefore, waste is generated through different means and so is expressed in various states (Amasuomo and Baird, 2016). Additionally, waste sources determine the various waste types, waste states and waste compositions (Dikole and Letshwenyo, 2020).

In terms of waste composition, Hoornweg and Bhada-Tata (2012) ascertain that various factors such as culture, energy sources, location, climatic conditions and the economy serve as determinants. Additionally, Kaza et al. (2018) show that waste composition also varies between different income levels. Specifically, Kaza et al. (2018) report that low- and middle-income countries produce about 53%, 56% and 16% of food, green and recyclable waste, respectively, while high-income countries produce approximately 51% of dry and recyclable waste (including plastic, paper, cardboard, glass and metal) and 32% total waste.

Sources, categories, risk levels and material composition are some categories that may be used to classify waste (Adipah and Kwame, 2019). Furthermore, Amasuomo and Baird (2016) and White et al. (2020) state that waste is generally classified using its physical state, physical and chemical properties, where it comes from, its consumption as well as the impact it has on the environment. In this regard, the physical states of waste may be solid, liquid and gas; waste sources include household/ domestic, industrial, agricultural, commercial, construction/

demolition and mining; lastly, the environmental impacts may be hazardous or non-hazardous (Amasuomo and Baird, 2016; El-Ramady et al., 2021; Kawai and Tasaki, 2016; Nyika et al., 2020). According to Adipah and Kwame (2019) and Kebaili et al. (2022), waste classification is crucial for waste management planning, as well as to assist in the waste operation activities like collection and disposal. Waste classification is also essential as it allows for effective sustainable waste management (White et al., 2020). Therefore, it is imperative that waste is classified at its initial point of disposal to avoid contamination (White et al., 2020).

Orhorhoro and Oghoghorie (2019) define solid waste as material that is in a solid state that is no longer useful or wanted. In this regard, Iuga (2016) and Orhorhoro and Oghoghorie (2019) elaborate that solid waste is further categorized based on where it came from; these sources include municipal, agricultural and industrial solid waste. Moreover, municipal solid waste is categorized into organic and inorganic waste (Hoornweg and Bhada-Tata, 2012). Waste is said to currently be one of the most detrimental global issues faced, especially within areas without efficient waste management supervision (Chan et al., 2022).

Amasuomo and Baird (2016) and Stubbs (2021a) stress that what may be considered to be waste by one person may be seen as a resource by the next individual. In this regard, Adzawla et al. (2019) and the DEA (2019) add that, lately, waste is viewed as a vital resource for production. This then dictates that societies shift from waste management to resource management instead, which is still a challenge (Adzawla et al., 2019; Zhang et al., 2022). Additionally, Dikole and Letshwenyo (2020) and Zhang et al. (2022) emphasize that recently, the focus is on material recovery and utilizing waste as energy sources where feasible, as discussed under the circular economy approach.

According to El-Ramady et al. (2021), waste presents significant potential as a useful resource when it is usable. In terms of waste being a resource, the DEA (2019) and the DEFF (2020) explain that a focus on enhancing an economy that promotes the recycling and recovery of secondary resources from waste is particularly important. This is because although waste is a great issue, it is crucial as an industry and as part of a secondary resource economy that is driven by technology and innovation (DEA, 2019).

For instance, El-Ramady et al. (2021) show that waste may be useful as a source of organic nutrients for production in agriculture. Additionally, other useful waste uses include energy

generation and recycling (El-Ramady et al., 2021). As depicted in Figure 3.1, segregating waste streams at the source using the notion of the value chain allows for waste to be used effectively as a resource (Oteng-Ababio, 2014). Also depicted in Figure 3.1 is how hazardous material needs to be disposed of in a guarded manner, which is further reiterated by El-Ramady et al. (2021).

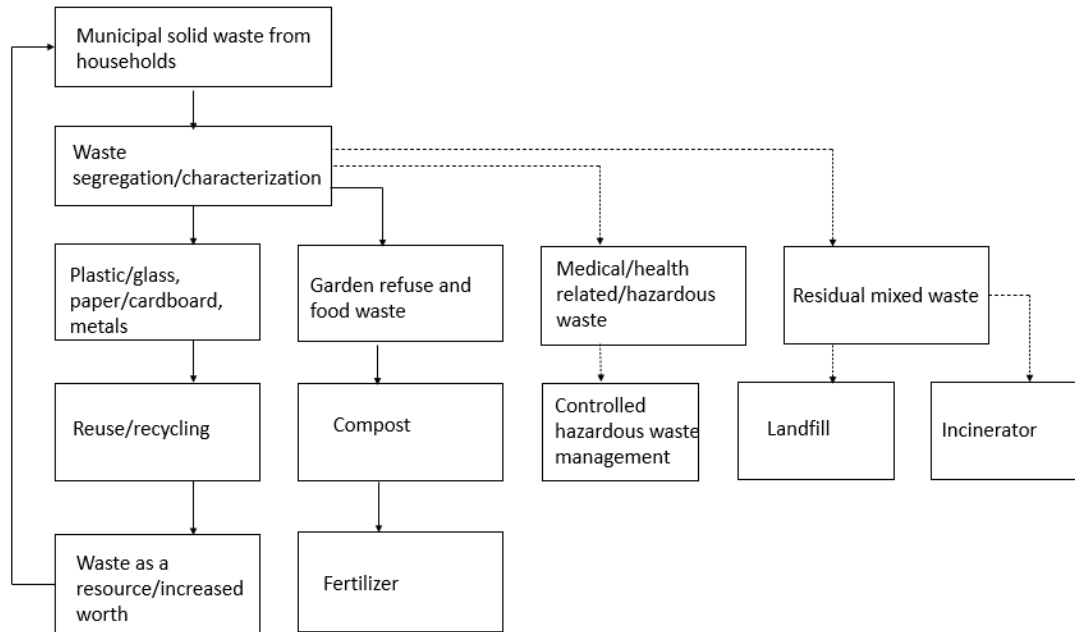


Figure 3.1: A path for managing household municipal waste as a resource (Adapted from Oteng-Ababio, 2014: 5)

The concept of disposal of hazardous waste at the household level has become a very important topic in light of the COVID-19 pandemic, which has resulted in the excess generation of medical-related waste. Therefore, how this waste stream is disposed of at this level is crucial. Waste as a resource is economically driven by the manipulation of the full capacity of waste materials (DEFF, 2020). In this regard, Oteng-Ababio (2014) states that when waste is handled efficiently, it is able to generate satisfactory business for the user.

3.2.1 Waste generation

Research shows that the generation of solid waste around the world is increasing quicker than urbanization rates (Chan et al., 2022; DEFF, 2011; Khan et al., 2022; Nukusheva et al., 2023; Tassie and Endalew, 2020; Suthar and Singh, 2015). Adipah and Kwame (2019), Boateng et al. (2016), Dugbazah et al. (2021), Handayani et al. (2018), Haywood et al. (2021), Kaza et al. (2018), Kebaili et al. (2022), Khan et al., (2022), Kumar et al. (2017) and Raab et al. (2021)

add that this is an attribute of population growth coupled with increased consumption patterns as well as development initiatives around the world. In terms of consumption rates, people now have a wider spectrum of products to choose from, which have also been found to have shorter life spans and are largely only used once before disposal (Malinauskaite et al., 2017). Additionally, this consumerism is largely related to the linear culture of buy-use-dispose (Chan et al., 2022). Thus, waste generation has increased consistently with preliminary projection figures (Kaza et al., 2018).

According to Haywood et al. (2021) and Iuga (2016), the type of buildings people live in, their living conditions, and their overall consumption levels, as well as industries and commercial spaces, have a great influence on waste generation and management patterns. Haywood et al. (2021) and Saseanu et al. (2019) reaffirm that waste generation and management in a specific area are further affected by rates of socio-economic advancement as well as the environmental policies in place. For instance, Vetter-Gindele et al. (2019) state that in cities specifically, high rates of consumption of environmental goods and services have been recorded. In this regard, Khan et al. (2022) and Vetter-Gindele et al. (2019) show that the consumption of goods in relation to things like convenience and shopping material, electronics and plastic, as well as food and beverages packaging, is exceeding environmental limits.

Developing countries such as those in Africa are no exception to this increase in waste generation rates (Aryampa et al., 2019; Chan et al., 2022; DEFF, 2011; DEA, 2019; Lazo and Gasparatos, 2022; Orhororo and Oghoghorie, 2019; Picard, 2020). In this regard, Godfrey et al. (2019) show that these trends will result in an exponential increase in waste generation. This will subsequently magnify the issue of waste management in these regions (Aryampa et al., 2019). Abubakar et al. (2022) and Kaza et al. (2018) state that high waste quantities, compositions and management practices present significant implications for the environment.

Kaza et al. (2018) state that 5% of the world's greenhouse gas emissions are attributed to waste management, specifically, poor waste management strategies. For instance, Kaza et al. (2018) show that in 2016 approximately 1.6 billion tons of carbon dioxide (CO₂) was emitted from solid waste treatment and disposal mainly from open dumps and landfill sites, which do not have gas capture techniques. In light of the COVID-19 pandemic, Adler (2021) shows that although CO₂ emissions decreased in 2020 as a result of a decline in economic activity, emissions increased in 2021. Specifically, CO₂ emitted in 2021 was a 5% increase (about 36.4

billion metric tons) from the 2020 emissions and an approximated 0.8% decrease from 2019 figures (Adler, 2021). Kaza et al. (2018) add that these emissions are expected to have increased by 1 billion tons per year by 2050, lest efficient strides are taken to improve this sector.

Hoornweg and Bhada-Tata (2012), Muzenda (2014) and Orhorhoro and Oghoghorie (2019) assert that when societies become more modern and people have access to more money, their consumption rates increase, especially when considering inorganic items like paper and plastic. In this regard, Aryampa et al. (2019) and Edmond (2019) stress that it is within those countries with the least ability to deal with exponential increases in waste where waste is generated most rapidly. This leaves areas already battling to manage waste efficiently more vulnerable (Aryampa et al., 2019). El-Ramady et al. (2021) state that this is a result of the lack of or not enough waste management regulations in place guarding waste management practices.

According to Zhang et al. (2022), resource extraction in the world increased from 7 to 89 gross tonnage from 1900 to 2015. Hoornweg and Bhada-Tata (2012), Orhorhoro and Oghoghorie (2019) and Tassie and Endalew (2020) add that cities globally produced approximately 1.3 billion tons of solid waste per year in 2012, which means that each individual generated about 1.2 kg of waste per day. Edmond (2019) and the World Bank (2019) add that in 2016, approximately 2.01 billion tons of solid waste were produced by cities around the world, which consolidated to a footprint of 0.74 kg per individual per day. Given the above figures, waste generation per person per day is estimated to range from 0.11-4.54 kg, at a mean of approximately 0.74 kg (Kaza et al., 2018).

The volume of solid waste generation is anticipated to hike to approximately 2.2 billion tons by 2025 (Hoornweg and Bhada-Tata, 2012; Orhorhoro and Oghoghorie, 2019). However, the World Bank (2022) reports that an estimated 2.24 billion tons of solid waste were foreseen to be generated in 2020, which is equivalent to a footprint of 0.79 kg per person per day. Additionally, a global yearly waste generation of about 2.59 billion tons is anticipated by 2030 and approximately 3.40 to 3.88 billion tons by 2050 (Kaza et al., 2018; World Bank, 2019; 2022). Explicitly, the rate of waste generation, in light of population growth and urbanization, is anticipated to have increased by about 70-73% by 2050, while the world's population is anticipated to increase by approximately less than 35% (World Bank, 2022; Wahba et al., 2019).

Kaza et al. (2018) reiterate that approximately 34% of the globe's waste is accounted for by high-income countries, which make up only 16% of the world's population. For instance, Jacobsen et al. (2022) show that developed countries account for the most plastic and packaging waste generated. Furthermore, the daily per capita waste generation is expected to increase by 19% by 2050 in high-income countries, while low- and middle-income countries are expected to see an increase of about 40% more than the increase in high-income countries (Kaza et al., 2018). On a lower scale, in a study conducted within a city in Ethiopia across groups of socio-economic standing, Zia et al. (2017) found that high-income groups generated the most waste, with low-income groups accounting for the least amount of waste.

Specifically, Zia et al. (2017) report that high-, middle- and low-income groups generated about 0.890, 0.612 and 0.346 kg of waste per capita per day, respectively. In a similar study in Botswana, Dikole and Letshwenyo (2020) conclude that, on weekends, the waste generation rate for low-income households was about 0.038 kg per capita per day, whereas for high-income households, the rate was 0.36 kg per capita per day. Although low-income households recorded higher waste generation rates during weekdays when compared to their middle- and high-income counterparts, middle- and high-income households generated more waste during weekends (Dikole and Letshwenyo, 2020). Dikole and Letshwenyo (2020) emphasize that establishing this information is vital as it may influence waste management system planning.

3.2.1.1 African and South African context

Ayeleru et al. (2020) state that in 2019 Sub-Saharan Africa had a population of approximately 1 billion people. With such a high population, it is inevitable that countries within this region still experience issues when it comes to waste generation and in turn, waste management (Orhorhoro and Oghoghorie, 2019). According to Aryampa et al. (2019), population growth is one of the main attributes to waste generation in various African countries. With increasing income levels, economic growth is also a vital contributor to waste generation in Africa (Aryampa et al., 2019).

Health and environmental issues related to the rise in unregulated dumps still present challenges in Africa (Picard, 2020). Specifically, about 62 million tons of waste are generated annually within Sub-Saharan Africa (Hoornweg and Bhada-Tata, 2012; Orhorhoro and Oghoghorie, 2019). When considering individual generation, Hoornweg and Bhada-Tata (2012) and Orhorhoro and Oghoghorie (2019) show that people generate approximately 0.09

to 3.0 kg of waste per day, averaging about 0.65 kg per capita per day. These challenges in waste generation have led to detrimental land, water, air and health outcomes (Siddiqi et al., 2020).

Dugbazah et al. (2021) stress that Africa is experiencing a crisis of an increase in inefficient waste management sites, which has resulted in waste pollution within these sites. To this end, research shows that in Africa, and particularly the Sub-Saharan region, the exponential growth in waste generation is foreseen to be so substantial that it will overshadow the decreases in waste generation in other regions of the world (Godfrey et al., 2019). According to Kaza et al. (2018), in 2016, Sub-Saharan Africa produced approximately 174 million tons of waste, which is about 0.46 kg per capita per day, which was the lowest in the world. This is based on projections that estimate that the current waste generation rates in regions in Sub-Saharan Africa will triple by the year 2050 (Edmond, 2019).

According to Stubbs (2021a), the South African population produces about 122 million tons of waste a year. In monetary terms, this equates to approximately R25.2 billion worth of waste; however, around 90% of this waste goes to landfills (Statistics South Africa (Stats SA), 2018a; Stubbs, 2021a; Stubbs, 2021b). The annual figure of 122 million tons is an increase from an approximated 108 million tons of waste reported in 2011 (DEA, 2012a). Regarding domestic waste specifically, based on income-specific waste generation rates, Rodseth et al. (2020) add that approximately 12.7 million tons of domestic waste are generated per year. This is equivalent to about 0.63 kg per capita per day of domestic waste generated in the country. Stubbs (2021b) reiterates that these waste generation figures speak to a possible waste management problem needing immediate attention in the country.

Adipah and Kwame (2019) stress that more waste disposal space is required as more waste is being generated. Waste disposal space is running out in South Africa as a result of the exponentially increasing solid waste generation and not enough appropriate land for disposal (Githathu, 2019; Stats SA, 2018a). For instance, Thusi (2020) states that landfills in Johannesburg are left with less than five years' worth of disposal space. This does not seem to be unique to South Africa, as similar findings have been reported from other countries, specifically within the developing world (Youjin, 2019). In particular, Youjin (2019) reports that an important landfill site in Singapore, the Semakau landfill, is expected to run out of space by 2035.

Kaza et al. (2018) state that it is pivotal to comprehend the quantities and varieties of waste generated. Thus, reliable waste generation data that considers fundamental attributes such as household income and settlement type information is essential for the development of waste policy and planning as well as for waste modeling and management (Rodseth et al., 2020). This further reiterates the importance of ascertaining material use, consumption as well as subsequent waste management practices of households of varying socio-economic standings. Kaza et al. (2018) add that this is vital for the adoption of fitting waste management methods and to prepare for future initiatives. Specifically, Kaza et al. (2018) stress that this information allows local authorities to assign sufficient money and land, partner with parties in the private or non-government sectors for services, and employ appropriate technologies.

As alluded to in previous discussions, research maintains that more solid waste is generated within societies with advanced economic development and greater urbanization rates (Edmond, 2019; Hoornweg and Bhada-Tata, 2012; Kaza et al., 2018; Nukusheva et al., 2023). Specifically, high-income levels are positively correlated to high living standards and, thus, higher consumption and waste generation rates (Hoornweg and Bhada-Tata, 2012). For instance, Wahba et al. (2019) show that high-income countries produce about 1.6 kg of waste per person per day on average. Moreover, more (approximately twice as much) waste is generated within urban households when compared to their rural counterparts (Hoornweg and Bhada-Tata, 2012; Kawai and Tasaki, 2016; Khan et al., 2021).

However, Kaza et al. (2018) and Zia et al. (2017) argue that rates of waste generation have been found to increase quicker within low- and lower-middle-income households and regions, with incremental income changes, when compared to high-income households. Sub-Saharan Africa and South Asia are particularly anticipated to produce three times and twice as much waste, respectively, in the next 30 years, given rates of economic growth and urbanization within these regions (Kaza et al., 2018; Nukusheva et al., 2023; Wahba et al., 2019).

According to Dikole and Letshwenyo (2020) and Herianto et al. (2019), and as already briefly discussed, waste generation and the rate thereof may be influenced by factors such as the location of the household as well as the size and income of the household. Another important contributing factor to waste generation at the household level is family size (Arumugam et al., 2021). Specifically, Arumugam et al. (2021) found that family size is correlated to the per capita daily waste generation within households. In this regard, Arumugam et al. (2021) found

that bigger families generate less per capita waste, whereas smaller families generate more per capita waste.

Fadhullah et al. (2022) and Herianto et al. (2019) state that waste generation at the household level is the main contributor to municipal waste management. For example, in the study conducted by Getahun et al. (2012) in Ethiopia, it was reported that the majority (87%) of waste generated was from households. Waste generation at the household or municipal level is usually through various sources as a result of human activities or interactions (Abdel-Shafy and Mansour, 2018; Hoornweg and Bhada-Tata, 2012). Thus, making household waste management practices an important attribute of municipal solid waste management systems (Lazo and Gasparatos, 2022).

According to Viljoen et al. (2021) and Septiningtiyas et al. (2018), waste at the household level may be produced through domestic activities like cleaning, cooking, burning fuel and gardening. Gutberlet (2018) reaffirms that urban lifestyles also have a hand in waste generation in these areas. Therefore, the household level is the initial stage of waste management; thus, the practices adopted at this level are crucial (Handayani et al., 2018).

3.2.1.2 Use/ consumption of various materials

It is expected that the use or consumption of materials and the patterns thereof influence waste generation patterns within households. Specifically, this study intended to establish household profiles in relation to their use or consumption patterns of energy sources, water and sanitation services and waste disposal facilities or services. Additionally, the study considered the generation and management of solid and organic waste. Thus, this section reviews literature related to how the use of these materials influences waste generation and management within households.

3.2.1.2.1 Energy

As the population size and, thus, the standard of living increase, so does the consumption of goods and energy (Malinauskaite et al., 2017; OECD, 2020; Yang et al., 2023). Malinauskaite et al. (2017) and Yang et al. (2023) add that the upsurge in energy consumption rates has led to an increase in waste generation. For instance, Uhunamure et al. (2021) show that e-waste has been exponentially increasing in countries like South Africa. Uhunamure et al. (2021), Yang et al. (2023) and Zhou and Yang (2016) add that, in turn, household use of energy and

electronic products has resulted in detrimental environmental issues. Bohlmann and Inglesi-Lotz (2018) and Uhunamure et al. (2021) further indicate that it is thus of essence to gauge households' energy use patterns considering the great role households play in energy consumption and, therefore, the generation of related waste materials.

To enhance energy effectiveness while also encouraging the conservation of energy at the household level, it is vital to comprehend household energy use patterns (Zhou and Yang, 2016). According to Irfan et al. (2021), Roser (2021) and the World Health Organization (WHO, 2021), approximately 2.6 to 3 billion people globally (most of which are poor in low- and middle-income countries) use open fires, wood, coal, animal dung and crop waste. These energy sources largely lead to air pollution, which in turn leads to non-communicable diseases (Buthelezi et al., 2019; Irfan et al., 2021; Roser, 2021; WHO, 2021). Similarly, Bardus and Massoud (2022) provide examples of improper waste management practices in many low- and middle-income countries that include open dumping and burning of waste that result in soil, water and air pollution, which have social, health and environmental impacts.

Buthelezi et al. (2019) state that even though low-income communities mainly rely on electricity for activities such as lighting and entertainment, they still use traditional fuels such as coal, paraffin and wood for activities like cooking and heating. Lianwei and Wen (2021) find similar trends in China, where most rural areas still depend on burning coal, firewood and straw to fulfill activities like cooking. Additionally, it is mainly women who fulfill tasks such as cooking and also taking care of children (Smith and Pillarisetti, 2018). Women and children are, therefore, usually close to equipment such as stoves as they burn, thus, these groups are generally more exposed to household air pollution (Smith and Pillarisetti, 2018).

Insufficient access to modern and efficient energy sources has been found to be detrimental to the health of many individuals globally (WHO, 2021). The WHO (2021) stresses that the air pollution from these conventional energy sources is much worse in poorly ventilated spaces, resulting in health issues. Specifically, about 3.8 million people end up dying hastily as a result of diseases like pneumonia, chronic obstructive pulmonary disease, stroke, ischemic heart disease and lung cancer, which are aggravated by air pollution within the household (Smith and Pillarisetti, 2018; WHO, 2021).

The WHO (2021) stresses that many unsustainable fuels and the inefficient use thereof lead to pollutants that contribute to climate change. Thus, Perera (2018) elaborates that the by-products from the burning of fossil fuels are detrimental to health and are considered the main factors in environmental injustices and disparities in the world. Particularly, Smith and Pillarisetti (2018) show that household air pollution, as a result of biomass use, is a great threat to human health. Environmental injustices and societal inequalities are more prevalent within low-income communities, where the effects of pollution and climate change from fossil fuels are exacerbated (Khine and Langkulsen, 2023; Perera, 2018). Additionally, Khine and Langkulsen (2023) and Perera (2018) highlight that climate change impacts such as droughts and flooding usually disproportionately affect the poorest in societies who have to live in areas susceptible to these disasters.

According to Lianwei and Wen (2021), the rate of household end-use energy consumption around the world is approximately 35%. Mutumbi et al. (2021) reinforce that households consume a considerable amount of energy, and specifically in relation to electricity. This is because, at this level, a significant amount of electricity is consumed (Mutumbi et al., 2021). As Lianwei and Wen (2021) reiterate, urbanization and economic development have meant an increase in household energy use demand. For instance, Narmilan et al. (2020) state that households in developing countries are increasingly using more appliances like washing machines and dishwashers. Uhunamure et al. (2021) add that the use of electrical and electronic devices has gained favor among households, and this has subsequently led to a drastic increase in the use of appliances in South African homes. This is attributed to an increase in the number of households connected to the main electricity supply in the country (Stats SA, 2019a).

The energy use decision-making for different households is impacted by several factors; for this reason, there are high variances in energy use patterns of different households (Yalcintas and Kaya, 2017; Zhou and Yang, 2016). Specifically, Bohlmann and Inglesi-Lotz (2018) and Lianwei and Wen (2021) state that some of the attributes influencing household energy use include energy process, per capita income, urbanization, access to energy, purchasing power, the energy efficiency of appliances used, climatic conditions as well as other characteristics of the residence.

It is imperative that these patterns are investigated to gauge consumption and, thus, waste generation in the energy sector. Moreover, Bayudan-Dacuycuy and Dacuycuy (2018),

Bohlmann and Inglesi-Lotz (2018), Shahi et al. (2019) and Soltani et al. (2019) state household characteristics, including attributes like age, sex, income and education levels, household size, location and access to electricity have a significant influence on the household's option of cleaner energy for activities like cooking, heating and lighting. For instance, Bayudan-Dacuycuy and Dacuycuy (2018) and Soltani et al. (2019) show that there is a positive correlation between household income and household electricity use. That is, high energy consumption positively correlates stronger with high-income households as opposed to middle- and lower-income households (Soltani et al., 2019), although electricity consumption has been found to be negatively correlated to increases in electricity prices (Yalcintas and Kaya, 2017). Furthermore, Yalcintas and Kaya (2017) show that there is a positive correlation between electricity consumption and household size.

The demand for energy at the residential level in different countries has extensively increased in the past few decades (Shahi et al., 2019). For instance, according to Bohlmann and Inglesi-Lotz (2018), various electrification initiatives and alterations in consumer preferences among South African households have resulted in increased energy consumption within these households. However, although South Africa's high access to and expenditure on electricity has been recorded among households in the country, about 70% of households in the country are still spending money on alternative sources of energy (Bohlmann and Inglesi-Lotz; 2018).

Bohlmann and Inglesi-Lotz (2018) state that the majority of the total energy consumption (about 85-90%) in South African households is towards space heating and cooking, while the remaining 5-10% goes to lighting. Bohlmann and Inglesi-Lotz (2018) add that a significant proportion of low-income households in South Africa largely rely on conventional energy sources like paraffin and wood to meet their energy needs. These results are in accordance with the energy ladder, whereby higher-income households tend not to use traditional fuels while lower-income households rely more on these fuels (Lianwei and Wen, 2021; Soltani et al., 2019).

Specifically, Lianwei and Wen (2021) explain that the energy ladder concept shows how low-income households (such as those in rural areas) mainly rely on traditional fuels (such as fuelwood and dung). This changes as household income increases and households progressively move up the energy ladder to use more modern energy sources such as electricity (Lianwei and Wen, 2021). However, patterns noted in a study conducted within a city in Iran

by Soltani et al. (2019) contradict this, as here it was found that high-income households relied on both traditional and modern energy sources. According to Haywood et al. (2021), those households relying on non-electric fuel sources for heating or cooking often dispose of their waste on the street, in their yards, or by burying it.

In South Africa, loadshedding has resulted in further energy challenges because households have had to complement electrical appliances and products with non-electric energy sources and/ or technology, such as inverters and generators, to generate electricity when power cuts occur (De Jonghe, 2022; De Lange, 2022; Goodall, 2022; Mosepele, 2022; Ramela, 2023). Specifically, loadshedding is defined by Garrison (2023) as the planned temporary blackouts aimed at relieving pressure from the power grid. However, Matiwane (2022), Ramela (2023) and Swart (2022) show that households cannot afford non-electric energy sources and/ or technology on sources such as gas, candles and paraffin.

3.2.1.2.2 Water and sanitation facilities

According to Ramulongo et al. (2017), the swift growth in urbanization, population numbers, and industrialization have also resulted in notable hikes in water consumption. With regards to access to piped or tap water in South Africa, Stats SA (2019a) shows that households have seen an increase of 3.8% either within their dwellings, off-site, or on-site between 2002 and 2019. For instance, within eThekweni Municipality, approximately 60.2% of households had access to piped water inside their dwelling in 2011 and about 97.3% of households had access to piped/ tap water within their dwelling, off-site or on-site in 2019 (Stats SA 2011; 2019a). Ramulongo et al. (2017) proceed to state that the water supply/ demand is expected to have increased by approximately 20% in 2027. Jacobs-Mata et al. (2018) reiterate that in South Africa, the water demand is rising exponentially, thus, leaving the country's water supply under immense pressure.

Narmilan et al. (2020), Oskam et al. (2021) and Ramulongo et al. (2017) state that water consumption at the household level is influenced by several attributes, including climatic conditions or seasonality and socio-economic as well as socio-demographic characteristics. To elaborate, Ramulongo et al. (2017) found that household size influences water usage, where bigger families have been noted to use more water. Additionally, high living standards associated with higher income levels have been noted to lead to increased water consumption (Narmilan et al., 2020; Ramulongo et al., 2017). Research further shows that education has a

negative correlation with water consumption (Briand et al., 2009; Narmilan et al., 2020). To this end, the higher the level of education attained by an individual, the less water they use.

Narmilan et al. (2020) show that the number of taps within the household also speaks to the water consumption levels within the household. This is supported by Briand et al. (2009), who assert that piped water networks within the household have an influence on the socio-economic standing of a household and, thus, their water consumption. Specifically, the number of taps the household has access to is positively correlated to the water consumption of the household (Narmilan et al., 2020). Additionally, Briand et al. (2009) and Oskam et al. (2021) show that households with access to more money and those with higher education levels acquired have more access to piped water networks.

In terms of age, Narmilan et al. (2020) state that, in general, younger people use more water when compared to their older counterparts. The time of day, and the day of the week, also influence residential water use (Ramulongo et al., 2017). Mornings and afternoons record higher water consumption as this is the period within which residents are either preparing for school or work as well as baths and meals (Ramulongo et al., 2017). Narmilan et al. (2020) add that households generally use more appliances like washing machines, flushing toilets, dishwashers and showers, which essentially use more water. This further speaks to the observation made by Uhunamure et al. (2021) regarding the excessive use of appliances; and, thus, the generally increased use of materials.

Siddiqi et al. (2020) and Stats SA (2019a) emphasize the importance of environmental hygiene in the prevention of diseases. However, according to Gebremichael et al. (2021), about 40% of the African population lacks access to improved sanitation services. The statistics are worse for rural African populations, where approximately 55% of the people lack access to improved sanitation services (Gebremichael et al., 2021). Thus, it is evident that although the conversation around access to water and sanitation is centered around universal access, it has not proven to be equitable (Mudombi, 2020).

Stats SA (2019a) reinforces the above argument by showing that in South Africa, although access to improved sanitation increased by 20.4% between 2002 and 2019, improved sanitation facilities (flush toilets with a connection to public sewerage systems or septic tanks or pit toilets with a ventilation pipe) were found mainly within the urbanized parts of the country. According

to Stats SA (2019b), 83.0% of South African households had access to improved sanitation in 2018. For instance, Stats SA (2019a) shows an estimate of about 80.9% of households in KwaZulu-Natal with access to a flush toilet connected to a public sewerage system or a septic tank, or a pit toilet with a ventilation pipe in 2019. Provinces such as Limpopo record lower figures (26.5%) of households with access to flush toilets (Stats SA, 2019a). In this province, 37.6% of households were found to use pit latrines without ventilation pipes (Stats SA, 2019a). Additionally, Adzawla et al. (2019) add that, recently, sanitation has become an economy-wide issue, as opposed to just being contained in specific areas such as cities. Inefficient or failure in the design of and the deterioration in sanitation infrastructure puts the health of people at risk.

In terms of specific toilet facilities that households in South Africa have access to, Stats SA (2019a) shows that the majority (59.9%) of households have access to flush toilets that are connected to public sewerage systems. This is followed by 17.9% and 14.3% of households with access to pit latrines with ventilation pipes and those without ventilation pipes, respectively (Stats SA, 2019a). With lower percentages, Stats SA (2019a) shows that 3.8% of households had access to flush toilets with a connection to septic or conservancy tanks, 1.3% with no toilet facility, 0.7% with chemical toilets, 0.4% pour-flush toilets connected to a septic tank or pit and other types of facilities, 0.2% with bucket toilets that the household has to empty and lastly, 0.1% with ecological sanitation systems.

According to Simiyu et al. (2020), people in various low-income regions in Sub-Saharan Africa generally share sanitation facilities. Research shows that when many individuals rely on one toilet, which is not cleaned or maintained properly or often enough, they are exposed to a greater risk of infections (Govender et al., 2011). Govender et al. (2011) show that although water is crucial for human hygiene, it can also be detrimental as a disease vector when it carries pathogens. Govender et al. (2011) found that this is especially true within households with many individuals relying on a few sewage systems.

Lack of access to sufficient and efficient water and sanitation facilities leads to wastewater (from bathing or washing) being disposed of onto open land, into stormwater drains and down the kitchen sink and toilet (Govender et al., 2011). When wastewater gathers outside houses and on roads, it ends up entering stormwater drains and, thus, river systems (Govender et al., 2011). Additionally, Haywood et al. (2021) report that households that lack access to piped

water inside their dwelling, and those without efficient sanitation, often end up disposing of waste on the street, in their yards, or by burying it.

3.2.1.2.3 Use/ consumption of other solid materials

Households use various solid materials during daily activities that end up as waste. In this regard, Dikole and Letshwenyo (2020) and Tsheleza et al. (20220) emphasize that knowing the specific types of waste streams generated at the household level is crucial for efficient solid waste management systems. Specifically, these solid materials may include miscellaneous items such as foodstuffs, packaging, furniture, textiles, stationery and containers (Dikole and Letshwenyo, 2020; Dzawanda and Moyo, 2022; Fadhullah et al., 2022; Kibria et al., 2023; Suthar and Singh, 2015). The use of solid materials within households results in household solid waste, which is one of the main sources of municipal solid waste (Fadhullah et al., 2022; Suthar and Singh, 2015).

Although the household solid waste composition varies based on different factors such as the socio-economic standing of the household, the settlement type and time of the week, several studies have reported similar waste compositions across different communities (Dikole and Letshwenyo, 2020; Fadhullah et al., 2022; Letshwenyo and Kgetseymore, 2020; Suthar and Singh, 2015; Tsheleza et al., 2022; Von Massow et al., 2019). Specifically, food waste has been found to dominate household solid waste compositions of various communities (Dikole and Letshwenyo, 2020; Fadhullah et al., 2022; Suthar and Singh, 2015; Tsheleza et al., 2022).

Güven et al. (2023), Odonkor and Sallar (2021) and Szymkowiak et al. (2022) show that the generation of food waste had a direct and positive correlation with income levels and a negative correlation with age. Additionally, Hermsnussen et al. (2022) state that the quantities of food waste produced by households are positively correlated to the expenditure on food. Specifically, households with more household members generally spend more because they buy more food (Hermsnussen et al., 2022). However, this does not necessarily apply to all large households since household size is among many other variables that impact on purchasing power. Moreover, households buying more food do not necessarily result in a positive correlation with the generation of food waste. Households with fewer members and more purchasing power could purchase more food and in turn, generate more waste. Hermsnussen et al. (2022), Letshwenyo and Kgetseymore (2020) and Szymkowiak et al. (2022) further state that the fast-changing lifestyle and preference of consumers, households' cooking in large

quantities, eating habits and inability to estimate their consumption rates and retailers' strategies of encouraging consumers to buy more foodstuffs are also drivers behind the increase in food waste that is generated within households.

Güven et al. (2023), Hermsnussen et al. (2022) and Vetter-Gindele et al. (2019) caution that the increased consumption of heavily packaged food and drinks, shopping of goods, convenience items, durables and consumables surpass environmental limits. For instance, if the overall global quantity of food waste were to be treated as a country, it would follow China and the United States as the third biggest emitter of greenhouse gases (Szymkowiak et al., 2022). Thus, Szymkowiak et al. (2022) emphasize that the increase in food waste presents a threat to sustainable development and overall human well-being. Food disposal behavior is associated with cultural norms, social backgrounds, phases of life, demographic and socio-economic attributes (Hermsnussen et al., 2022). Furthermore, De Lange (2022) shows that in South Africa, households have been forced to dispose of more food than normal because of loadshedding power cuts.

Moreover, research reveals that food waste is generally followed by waste types such as plastic, paper, cardboard and glass (Dikole and Letshwenyo, 2020; Fadhullah et al., 2022; Letshwenyo and Kgetseymore, 2020; Suthar and Singh, 2015). For instance, in a household solid waste management study, Fadhullah et al. (2022) found that the majority of the households (74.3%) threw away foodstuffs as waste, while 18.3% disposed of plastic products. In a similar study, Suthar and Singh (2015) found similar results whereby food waste accounted for an average of approximately 80% of the household waste generated in the study community. Within the same community, plastic and polythene waste was the second highest (7%) waste stream generated, followed by paper waste at an average of 6% (Suthar and Singh, 2015).

Letshwenyo and Kgetseymore (2020) and Nell et al. (2022b) show that paper and cardboard and plastic materials are generally generated in high quantities within households because they are usually used for packaging. According to Nell et al. (2022b), high- and middle-income households generally generate more paper and cardboard waste as a result of having a higher purchasing power and more involvement in activities that include the use and consumption of paper, such as consuming more pre-packaged food. Moreover, in a study by Letshwenyo and Kgetseymore (2020) it was found that wastes like plastics, glasses and aluminum cans and

paper and cardboard were produced in high quantities, which was a reflection of the poor reuse and recycling culture within households.

Eades et al. (2020) show that garden refuse that is produced by households makes up a large component of biodegradable municipal solid waste. Berge and Von Blottnitz (2022) and Purchase et al. (2022) define construction and demolition waste as materials that are produced as a byproduct of demolition, construction or renovation activities and are no longer useful. This waste is usually discarded into landfills (Purchase et al., 2022). Additionally, Purchase et al. (2022) stress that the amount of construction and demolition waste that is being produced is increasing at alarming rates. Islam et al. (2019) state that this is a result of an increase in construction activities. Although construction and demolition waste is one of the largest waste streams generated, it is not well understood or documented (Berge and Von Blottnitz, 2022).

Post-consumer textile waste is another waste type that has surfaced in recent years as the use and production of clothes has increased (Jacometti, 2019; Horvat and Vendramin, 2021). Post-consumer textile waste includes clothing, packaging, fashion accessories and soft home furnishing materials (Ajila, 2019). Specifically, Jaccometti (2019) adds that clothing and textile waste has become a global concern also based on the severe environmental impact that the sector has. In this regard, the fashion industry is responsible for a large consumption of water, energy and chemicals as well as the production of waste and pollution (Ajila, 2019; Jaccometti, 2019; Tripa and Indrie, 2021). This waste is still largely sent to landfills or is incinerated, therefore, substantial attention is required to the end of life these materials (Jacometti, 2019). The next subsection unpacks the literature on the generation of waste within households in the context of the COVID-19 pandemic.

3.2.1.3 Waste generation in the context of COVID-19

The COVID-19 pandemic had a detrimental impact on the production and composition of municipal solid waste (Peula et al., 2023). For instance, Szymkowiak et al. (2022) show that the pandemic led to people bulk buying which subsequently led to an increase in food waste. Moreover, with the pandemic came social distancing, which meant that consumers were at home more and ordered takeaways as opposed to a sit-in meal at a restaurant (Almulhim et al. 2021; Arumugam et al., 2021; Filho et al., 2021; Kibria et al., 2023; Leal Filho et al., 2021; Oyedotun et al., 2020; Ncube et al., 2021). Subsequently, more single-use food packaging materials, such as plastics, were used for the takeaways (Kibria et al., 2023; Ncube et al., 2021).

Even though the closure of schools and businesses as a means to contain the spread of COVID-19 reduced waste generation in these establishments, a substantial amount of this waste generation was redirected to households (Almulhim et al., 2021; Naughton, 2020). Additionally, Filho et al. (2021) show that garden refuse and glass bottles were other waste streams that increased during the pandemic.

El-Ramady et al. (2021) and Kurniawan et al. (2023) show that COVID-19 has had impacts on various societal problem areas, such as air pollution, medical and municipal solid waste streams and environmental noise. Additionally, this is more the case in developing countries (El-Ramady et al., 2021). For instance, when considering some environmental impacts, emissions of greenhouse gases temporarily declined as the lockdown reduced air pollution from vehicles and industries (Adler, 2021; Almulhim et al., 2021; Ronaghi and Scorsone, 2023).

The pandemic and associated lockdown and regulatory measures aimed to curb the spread of COVID-19 have resulted in a rise in the production and use of household items like masks, thermometers, gloves, cleaning products, foodstuffs, toilet paper and sanitizers (Forlani and Njie, 2022; Jayasinghe et al., 2023; Sarkodie and Owusu, 2021). Additionally, El-Ramady et al. (2021) show that under lockdown, organic solid waste has increased. Thus, although air pollution temporarily decreased, the environmental impact of solid waste materials, which are not biodegradable, such as face masks, has been detrimental (Almulhim et al., 2021; Jayasinghe et al., 2023; Ronaghi and Scorsone, 2023).

Events such as panic shopping, which occurred around the world, also led to the disposal of increased amounts of waste in the form of leftovers and perishable items being thrown away (Filho et al., 2021; Naughton, 2020; Sarkodie and Owusu, 2021). In this regard, El-Ramady et al. (2021) add that the rates of online shopping were amplified by approximately 940%. According to Filho et al. (2021), the world has seen a rise of about 45% and 53% in food waste and plastic packaging, respectively. Additionally, Almulhim et al. (2021) show that due to fear of waste being contaminated, people stopped reusing items like plastics. This has subsequently increased related waste streams significantly (El-Ramady et al., 2021).

These events have thus subsequently led to an increase in waste generation within households during lockdown restrictions (Arumugam et al., 2021; Forlani and Njie, 2022; Filho et al., 2021). Furthermore, Arumugam et al. (2021) and Filho et al. (2021) found an increase in

medical, electric and electronic, garden, metal packaging, glass, plastic, paper and cardboard, non-recyclable and food waste. This goes to show that waste has and will proceed to increase in amounts of disposables on a daily basis (El-Ramady et al., 2021).

The increased use of Personal Protective Equipment (PPE) during this period has also meant an increase in contaminated/ biomedical waste being generated (Arumugam et al., 2021; Naughton, 2020; Thakur et al., 2021). For instance, Benson et al. (2021) state that approximately 12 billion medical and fabric face masks are discarded each month. This is detrimental because waste from COVID-19-infected individuals potentially contains traces of the virus. Moreover, this has meant an unparalleled surplus of plastic waste in the world in the form of plastic-based PPE such as face shields, safety glasses, surgical masks, medical gowns, protective aprons, gloves, sanitizer containers and plastic shoes (Benson et al., 2021). The majority of this single-use PPE is not disposed of properly and consequently ends up polluting atmospheric, aquatic and terrestrial environments (Abedin et al., 2022; Benson et al., 2021).

Medical waste has garnered research attention because of health implications and the necessity of properly handling and disposing of this type of waste (Andeobu et al., 2022; Bucătaru et al., 2021; Jayasinghe et al., 2023; Windfeld and Brooks, 2015; Yoon et al., 2022). In terms of the latter, the need for medical waste legislation is globally recognized and implemented (Windfeld and Brooks, 2015). Windfeld and Brooks (2015) indicate that not properly sorting medical waste results in high levels of incineration as the main disposal method, with higher disposal costs and environmental impacts. Bucătaru et al. (2021: 1) examine aspects related to the sustainable management of general medical waste and the medical waste specific to the COVID-19 pandemic, arguing that:

Medical waste requires special treatment given its impact on the environment and on humanity. The management of activities related to its storage, transport, and destruction is an important point in the sustainable development of mankind, especially in the current context of the pandemic.

Bucătaru et al.'s (2021) scientometric study of the Web of Science database reveals that research in the medical waste field tends to be concentrated on hazardous waste and a national focus on the management of this type of waste. Similarly, Andeobu et al. (2022) examine prior studies from 2019–2021 from various databases to assess the generation of medical waste from

COVID-19, management and disposal methods, current problems/ challenges and environmental and public health impacts in Australia. Their research also reveals inadequate attention to these issues pertaining to medical waste at the household level despite recognizing that there are “enormous risks involved and the significance of appropriate handling and disposal of medical waste from COVID-19” (Andeobu et al., 2022: 1). Although there is attention to sustainable waste management in these studies, there is no mention of managing medical waste at the household level where people are increasingly dealing with this type of waste without proper information and training on how to handle and dispose of medical waste.

3.3 Waste management

Waste management is defined by Orhorhoro and Oghoghorie (2019) and Wan et al. (2019) as the steps necessary or taken to manage generated waste properly. Specifically, waste management involves the processes of collection, transportation, treatment, dumping and monitoring of waste material (Adipah and Kwame, 2019; Kaza et al., 2018; Muzenda, 2014; Rasmeni and Madyira, 2019; Wan et al., 2019). According to Khan et al. (2022), the process of waste disposal may include the generator either breaking the waste down into basic components or dumping the waste in a container. Subsequently, the waste is collected by a formal or informal actor and then transported to an area for processing or reusing (Khan et al., 2022).

Kaza et al. (2018) elaborate that waste is typically collected from generation points (such as households and commercial spaces) and is then taken to transfer stations or collection locations, and lastly, the waste is taken to treatment or disposal sites. According to Muzenda (2014), waste collection and transportation processes need to be accommodative to changing and increasing populations and urbanization. Additionally, waste management should account for the enhancement of service delivery and community health (Muzenda, 2014).

According to Adipah and Kwame (2019), municipal solid waste management authorities encompass organizations or stakeholders who are concerned with waste management. Specifically, these authorities are mainly responsible for establishing efficient legislation, regulation and policies, while also initiating strategic plans for adequate waste management procedures (Adipah and Kwame, 2019; Elsaid and Aghezzaf, 2015). Therefore, stakeholders play a crucial role in the performance of waste management systems (Elsaid and Aghezzaf, 2015). Malinauskaite et al. (2017) and Nukusheva et al. (2023) state that waste management

encompasses government intervention at all stages whereby the central government will often set strategies and national policies, thereafter regional and local governments will design and implement these policies while also putting measures in place for the collection, treatment and disposal of waste. Thus, it is essential that these authorities collect accurate information on waste types and quantities that are being generated (Adipah and Kwame, 2019).

Kaza et al. (2018) state that local authorities generally oversee approximately 70% of waste management services. Moreover, approximately half of waste management services (including collection, treatment and disposal) are handled by public authorities, while one-third is by public-private affiliations. According to Elsheekh et al. (2021) and Iuga (2016), the prime goals here are to guard the environment and public health, ensure sustainable waste management to conserve the environment and keep public spaces clean.

There currently exist various issues as far as waste management is concerned (Lazo and Gasparatos, 2022; Selvakumaran and Wahid, 2022). According to Getahun et al. (2012), Kaza et al. (2018), Muzenda (2014) and Vetter-Gindele et al. (2019), detrimental impacts of urban growth on the environment are perpetuated when there is a lack of efficient policies and approaches for the execution of sustainable solutions to the issue of waste generation and management. Currently, the majority of the world's waste is being disposed of in landfill sites (Kaza et al., 2018). Specifically, Kaza et al. (2018) state that a substantial amount of waste (approximately 37%) ends up in a type of landfill site where about 8% goes into sanitary landfills which use landfill gas collection systems. Moreover, approximately 33% of waste is disposed of in open dumps, about 19% is recovered through sustainable means such as recycling and composting, and 11% is incinerated for disposal as the final means of management (Kaza et al., 2018).

Godfrey et al. (2019), Gutberlet (2018), Mamady (2016) and Nukusheva et al. (2023) state that the careless disposal of waste is one of the key reasons behind environmental pollution, which results in climate change-related impacts as well as other environmental and related human health issues. For instance, Ijjasz-Vasquez and Kaza (2020) and Parikh et al. (2020) show that waste that has been disposed of improperly culminates as a flooding risk when it ends up in creeks, ditches, riverbanks and canals. Furthermore, Kaza et al. (2018) add that waste that is disposed of carelessly ends up harboring disease vectors, perpetuating respiratory issues

through airborne particles, harming animals, polluting water bodies and weakening tourism prospects.

Waste collection is said to be a vital stage in the waste management process (Kaza et al., 2018; Khan et al., 2022). Haywood et al. (2021) state that this is mainly because improper practices may result due to a lack of proper waste collection services. Nevertheless, waste collection rates have been found to differ greatly according to income levels. According to Kaza et al. (2018), waste collection in low-income countries has improved from approximately 22% to 39%, which signifies improvements in the provision of sufficient waste collection methods in these regions. In South Africa, Stats SA (2019b) shows that in 2018 66.4% of households had access to waste removal services at home.

These improvements in waste collection are said to be in line with the general global enhancements in sustainable waste management initiatives such as recycling and composting (Kaza et al., 2018). However, there still exists great insufficiencies and inequalities in the waste management of various communities in the global South (Gutberlet et al., 2017a). For instance, Kaza et al. (2018) show that only approximately 26% of waste is collected from the outskirts of urban areas within low-income countries, while about 48% of waste is collected in cities within these regions.

Edmond (2019) argues that the world's low-income and, thus, poorer states bear the greatest global burdens of waste generation and management. Explicitly, Khan et al. (2021) and Siddiqi et al. (2020) show that several regions in Africa are experiencing severe challenges in waste management. These challenges are associated with the increasing build-up in waste, waste handling, and the culture of unsustainable waste management (Khan et al., 2021; Siddiqi et al., 2020). In Africa, an average waste collection rate of about 55% of all waste substances has been recorded (Aryampa et al., 2019; Dugbazah et al., 2021). However, lower waste collection rates (approximately 44%) are recorded in Sub-Saharan Africa (Kaza et al., 2018).

According to Kaza et al. (2018), Khan et al. (2021) and the World Bank (2022), approximately 93% of waste generated in low-income countries is disposed of in open/ unregulated dumps or is openly burned and only 2% in high-income states. Kaza et al. (2018) state that upper-middle-income countries of the world lead in terms of waste going into landfills with 54%, this is followed by 39% for high-income-countries which divert 35% of waste through recycling and

composting and takes about 22% to incineration. Specifically, Dugbazah et al. (2021) and Godfrey et al. (2019) elaborate that over 90% of waste generated in Africa is dumped carelessly in unmonitored dumpsites and landfills and ends up being burned; although approximately 80-90% of municipal solid waste that is generated in the continent is recyclable (Godfrey et al., 2019). Getahun et al. (2012) found that in Jimma City, Ethiopia, 51% of the households used individually chosen sites to dispose of waste, 25% relied on community containers for landfilling, 22% resorted to burning the waste, and 2% used private waste collectors.

In Sub-Saharan Africa, several cities depend on a dual system for waste management (Kaza et al., 2018). In particular, waste is initially collected in households, door-to-door; alternatively, the waste is collected from a communal central point where waste is discarded (Kaza et al., 2018; Kurniawan et al., 2023). Kaza et al. (2018) show that about 69% of waste in this region is disposed of in open dumps or burned, approximately 24% is dumped in landfills, and lastly, 7% is recycled or recovered.

Although the number of sanitary landfills has increased, waste volumes are increasing exponentially and so these new facilities are not meeting the required space (Kaza et al., 2018). For instance, Orhorhoro and Oghoghorie (2019) found that in Nigeria, waste has been found to be disposed of unsustainably around buildings, in drainage systems, roadsides, unused land, etc. Moreover, it has been noted that sustainable waste management initiatives such as recycling are usually reserved for tourism destination cities in the region (Kaza et al., 2018).

In the context of South Africa, the DEFF (2011) and Viljoen et al. (2021) explain that the main waste management issues in the country include the increasing population and economy, which leads to an increase in waste generation; multifaceted waste streams due to urbanization and industrialization; unequal access to waste management services especially in informal urban areas as well as tribal and rural formal areas; lack of efficient and reliable waste data, which fuels the lack of understanding of waste flows and balance in the country; policies and legislation that do not fully support the waste management hierarchy; lack of and outdated efficient waste management infrastructure; high costs associated with sustainable waste management; and not enough sustainable landfills.

Needless to say, waste management is a significant socio-economic and environmental concern in Africa (Godfrey et al., 2019). Waste management is particularly important as it has a great

effect on the quality of life (Arumugam et al., 2021). Furthermore, out of the 50 largest dumpsites in the world, 19 are located in Africa, mainly within Sub-Saharan Africa (Dugbazah et al., 2021). Despite this fact, Dugbazah et al. (2021) and Orhorhoro and Oghoghorie (2019) stress that within many countries in Sub-Saharan Africa, solid waste is littered in areas including vacant land, drainage systems, buildings and roadsides.

Orhorhoro and Oghoghorie (2019) and the World Bank (2022) further state that in several developing countries and cities, and specifically in the majority of the urban areas within Sub-Saharan Africa, approximately 20-50% of environmental budgets are allocated to solid waste management, however, only an approximated 20-80% of the solid waste generated is collected. This may largely be attributed to inefficient waste management policies and frail structures dealing with waste management strategies and institutions, which have made waste management a significant hurdle in Sub-Saharan Africa and Africa in general (Dugbazah et al., 2021; Orhorhoro and Oghoghorie, 2019).

Dugbazah et al. (2021), Godfrey et al. (2019), Hoornweg and Bhada-Tata (2012), Malinauskaite et al. (2017), Nukusheva et al. (2023) and Picard (2020) reiterate that waste that is not managed properly adds to pollution, public health and other environmental issues. Additionally, waste that is not properly managed promotes the spread of mosquitoes in nearby residential areas (Picard, 2020). As already discussed, more waste is being generated in recent years than ever before. Thus, minimizing waste while moving away from the conventional use of landfills is critical (Gutberlet, 2018). Amasuomo and Baird (2016) stress that waste management has become a more prominent concept recently, unlike in prehistoric times due to population growth, which has meant that waste now is not just simply a source of annoyance as it was before.

For example, Amasuomo and Baird (2016) and Ogbu and Ezeodili (2021) state that the increased migration of people into cities led to spikes in waste of different compositions due to increased incidents of improper waste management. Unfortunately, littering and illegal dumping, which correlate with detrimental impacts on human health and dignity, are still largely evident in communities that lack efficient waste management services (DEFF, 2020; Rasmeni and Madyira, 2019; Vinti et al., 2023). This improper waste management subsequently leads to risks to public health as these dumps end up becoming breeding sites for things like rats, mosquitoes and vermin (Amasuomo and Baird, 2016; Picard, 2020; Word

Bank, 2022; Vinti et al., 2023). The DEFF (2020) elaborates that illegal dumping and littering present substantial public costs when considering that government has various other competing demands depending on already limited resources.

To reiterate, waste presents as a great developmental, safety, health and environmental challenge (Gutberlet, 2018; World Bank, 2019; Vinti et al., 2023). Specifically, improperly managed waste may leak into the environment and thus creates methane; it may end up being a breeding ground for vectors of infection; and may encourage urban violence (Godfrey et al., 2019; Hoornweg and Bhada-Tata, 2012; Odonkor et al., 2020; Picard, 2020; World Bank, 2019; 2022). When waste in open dumps degrades, methane is emitted, which is a gas that is a high probable contributor to the phenomenon of global warming (Picard, 2020).

Mihai and Taherzadeh (2017) stress the perpetuation of issues related to sanitation and waste management services within urban areas due to rapid migration, which has led to the development of slums. Additionally, Santoso and Farizal (2019) show that this increase in waste in these areas is not complemented by efficient waste management at the community level. Residents of developing countries, especially poor people residing in urban areas, experience the worst effects of unsustainable waste management (Kaza et al., 2018; The World Bank, 2019). Moreover, Adzawla et al. (2019) caution that waste generation and its associated costs are projected to increase drastically in developing countries. This increase also includes the waste footprint and waste management costs (Adzawla et al., 2019). Mihai and Taherzadeh (2017) add that dumps are widely used across the world, especially in peri-urban and rural areas, regardless of these not being environmentally sustainable. According to Kaza et al. (2018), low- and middle-income countries struggle more to attain sustainable waste management as a result of issues in planning, operation and finances. As already alluded to, research shows that more than 90% of waste in low-income countries, such as those in Africa, is discarded in illegal dumping sites or is openly burned (Godfrey et al., 2019; Kurniawan et al., 2023; World Bank, 2019; Vinti et al., 2023).

In South Africa, the collection of illegally discarded waste and the measures taken to prevent illegal dumping is approximately 100 times higher than managing waste that has been dumped properly/ through formal waste management channels (DEA, 2012b). For instance, the eThekweni Municipality (2016a) and Ndebele and Du Plessis (2018) show that the Durban Solid Waste (DSW) spends approximately R180 000 000 per annum for the removal and

treatment of illegal dumping sites in the Municipality. Thus, proper solid waste management has been a major issue, more so within areas with high population density (Kumar et al., 2017).

Waste management is the responsibility of various actors, including households, waste pickers, door-to-door collectors and managers, as well as government officials and bodies, engineers, consultants, the private sector, scientists, journalists and activists (DEA, 2019; Elsaid and Aghezzaf, 2015; Gutberlet, 2018; Kurniawan et al., 2023; Nukusheva et al., 2023). For instance, Hoornweg and Bhada-Tata (2012) show that over two million informal waste pickers are involved in the recycling sector globally. Elsaid and Aghezzaf (2015) and Parikh et al. (2020) add that waste pickers search through public bins for recyclable materials to sell to recycling facilities. Waste pickers are usually made up of vulnerable groups, including women, children, the unemployed, the elderly and migrants (Kaza et al., 2018). These groups are usually associated with unhealthy working conditions with no social security or health insurance (Kaza et al., 2018). Additionally, Dugbazah et al. (2021) point out that informal waste pickers engage in the recovery of material at lower costs when compared to municipalities and private organizations.

According to Khan et al. (2021) and Siddiqi et al. (2020), developing and low-income countries are faced with hurdles of inadequate environmental policies coupled with the perceived high costs associated with efficient waste collection, treatment and disposal. Pertinent issues of waste collection are also largely influenced by the accessibility of the location of waste and the ease of access to it (Aryampa et al., 2019). In Africa, recycling has been associated with poverty, unemployment and socio-economic circumstances (DEA, 2019; Dugbazah et al., 2021). Specifically, this is in relation to informal waste pickers who recover recyclables, the lack of sufficient recycling and the widespread improper waste management in the continent (Dugbazah et al., 2021).

Relationships between waste pickers and the public and private sectors are usually negative and homeowners have been found not to trust waste pickers (DEFF, 2020). There is usually a social stigma associated with waste pickers. When these negative relationships are overcome, Edmond (2019) and Fadhillah et al. (2022) show that waste picking offers employment and, thus, income for many individuals engaged in this activity (who are made up largely of urban dwellers of the world). However, this employment is often accompanied by fluctuations in the

price of recyclable items and an absence of prospects for training and education (Kaza et al., 2018).

The DEA (2019) and the DEFF (2020) show that in South Africa, waste picking is associated with unsafe working conditions, low-income and unregulated conditions. The DEA (2019) adds that poor, black citizens in South Africa are mainly the ones involved in waste picking and function under unhealthy conditions due to illegal dumping and littering. Additionally, waste pickers usually deal with unsorted contaminated waste that may be mixed with organic and hazardous materials (Elsaid and Aghezzaf, 2015). Godfrey et al. (2019) highlight another scenario where women and children are the two most vulnerable groups involved in the recycling of waste electrical and electronic equipment in Africa.

Gutberlet (2018) stresses the positive contribution to democracy achieved through comprehensive and inclusive waste management. To this end, Gutberlet (2018) proposes that efficient waste government consists of various components (Figure 3.2). As depicted in Figure 3.2, waste is viewed as an interconnected and complex socio-environmental-technical subject as opposed to just a technical concern (Gutberlet, 2018; Viljoen et al., 2021). These constituents include multi-stakeholder participation, which encourages the incorporation of knowledge from all involved stakeholders (DEA, 2019; Gutberlet, 2018; Viljoen et al., 2021).

Secondly, Figure 3.2 depicts that through the incorporation of an inter-institutional approach, the issue of waste treatment may be tackled from an interdisciplinary viewpoint as opposed to the current engineering perspective; and lastly, public policies which consider the components of sustainable development (social, economic and environmental) (DEA, 2019; Gutberlet, 2018). Gutberlet (2018) and Malinauskaite et al. (2017) stress the importance of public policies in tackling waste management challenges and enhancing grassroots development.

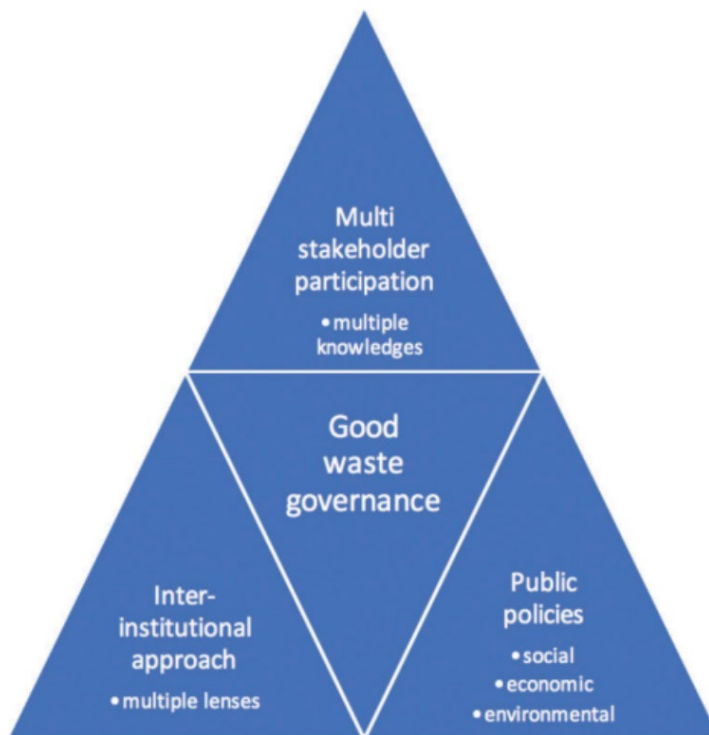


Figure 3.2: The constituents of efficient waste governance (Gutberlet, 2018: 201)

3.3.1 Waste management practices at the municipality, community and household levels

According to Hoornweg and Bhada-Tata (2012) and Rodseth et al. (2020), waste collection rates have been reported to be influenced by income levels, whereby higher income means higher collection rates. Furthermore, Ijjasz-Vasquez and Kaza (2020) and Kaza et al. (2018) show that approximately 50%, 10% and 4% of municipal budgets in low-, middle- and high-income countries, respectively, are allocated to solid waste management. Kaza et al. (2018) emphasize that for many regions within low-income countries, waste management is the highest budget item, making up about 20% of municipal budgets. Specifically, Hoornweg and Bhada-Tata (2012) state that the majority of the municipality's solid waste management budget within low-income countries is dedicated to collection services. Although this budget may go up to 80-90%, low-income countries still record low waste collection rates, which leads to low waste collection frequency (Hoornweg and Bhada-Tata, 2012). Waste in these regions is generally managed by households where they dump, burn, and sometimes compost their waste (Kaza et al., 2018; Vinti et al., 2023). The opposite is evident for high-income countries where the municipalities' budget is less (about 10%) for waste collection, but they still record greater

rates of waste collection (approximately 90%) and a more efficient waste collection system (Hoornweg and Bhada-Tata, 2012).

At a lower scale, the DEA (2012b) and Godfrey et al. (2019) show that, generally, efficient waste collection services are reserved for city centers of African countries, leaving suburbs and peri-urban areas less catered for while rural areas have no service at all. The DEFF (2020) asserts that in South Africa, historical disparities have been echoed in the backlogs in waste management service delivery in the country. To elaborate, the DEA (2012b; 2012c), DEFF (2020) and Kurniawan et al. (2023) show that issues of proper waste infrastructure and management systems and practices differ between densely and sparsely populated rural areas, which also differ significantly between middle-income urban areas and informal settlements. In this regard, Rodseth et al. (2020) show that about 31% of households in South Africa lack access to formal waste management services.

The DEFF (2020) reports that in South Africa, several issues have been noted with respect to waste management. These challenges include illegal dumping and littering in communities; people not separating waste at source; lack of recycling culture and infrastructure; inadequacies and discrepancies in the delivery of waste management services; open burning of waste; failure to honor permit conditions; lack of awareness and in turn support and cooperation for waste management service providers; and failure to prioritize the waste sector in certain parts of the country (DEFF, 2020; Haywood et al., 2021; Kurniawan et al., 2023; Viljoen et al., 2021; Vinti et al., 2023).

As discussed under the ISWM approach section, proper waste management is an important service and thus needs sustainable, efficient and socially accepted integrated systems (World Bank, 2019). However, the practice of sustainable waste management is an expensive one and remains a great challenge within developing countries (World Bank, 2019). For instance, Hoornweg and Bhada-Tata (2012) show that activities like segregating waste at source and collecting separate waste streams increase the costs of waste management. Due to a lack of understanding of the costs associated with waste management, these services are usually not sufficiently budgeted for (DEA, 2012c; Parliamentary Monitoring Group (PMG), 2022). The DEA (2012b) and PMG (2022) add that underpriced waste services give waste generators a false impression of waste management being cheap, thus discouraging waste minimization.

According to Taelman et al. (2018), additional costs are incurred for waste management activities, such as collection spending, when waste is handled ineffectively. This, in turn, not only places increased pressure on municipal budgets but also imposes harm on people and the environment (Taelman et al., 2018). Hoornweg and Bhada-Tata (2012) predict that the cost of solid waste management will increase to about \$375.5 billion per year in 2025 (from an annual cost of \$205.4 billion in 2012). This drastic increase will evidently be more detrimental to low-income and middle-income communities of the world (Hoornweg and Bhada-Tata, 2012).

For instance, Mutungwe et al. (2014) show that community members in an urban community in Zimbabwe end up burning certain waste materials to avoid making too many trips to dumping sites. In the same study, a significant number of residents indicated that they dug rubbish pits in their yards to dump solid waste; when pits fill up, subsequent ones are dug near the initial pit (Mutungwe et al., 2014). Hoornweg and Bhada-Tata (2012) emphasize that although municipal waste collection budgets are generally high, they are still low, especially when budgets for other items increase.

Kaza et al. (2018) echo that the most common waste management service afforded to communities at the municipal level is the collection of waste. According to Hoornweg and Bhada-Tata (2012) and Kaza et al. (2018), municipal solid waste is collected from the source to the point of treatment or disposal through the following means:

- **House-to-house:** waste is collected by waste collectors from within each household. This service is usually paid for by the household. Here waste is collected using trucks, small vehicles, hand carts, or donkeys.
- **Community bins:** individuals/ households drop off their waste at a fixed point within the community where the bins have been placed. This garbage is then collected from this point by the municipality.
- **Curbside pick-ups:** The household leaves their waste outside their house on scheduled days. These collection schedules are usually decided by the municipality.
- **Self-delivered:** Waste disposal sites or transfer stations are available within the community for households to drop off their waste.
- **Contracted or delegated service:** firms or municipal facilities are hired by businesses to schedule waste collection. Here, municipalities may also hire private companies to collect waste in different areas.

Hoornweg and Bhada-Tata (2012) state that an important part of waste collection is containerization. Containerization ensures that waste is not interfered with by vermin, does not get burnt, and does not get water-logged as it sits for collection. Most countries in Sub-Saharan Africa rely on communal container collection systems where these communal waste bins are placed at specific points in the community for households to drop off their waste (Odonkor et al., 2020). This waste is then emptied by waste collection trucks (Odonkor et al., 2020). When municipal waste is not collected or controlled effectively, it ends up being dumped in an unrestrained manner or burnt, which in turn leads to pollution or threats to public health (Eshete et al., 2023; Kurniawan et al., 2023; Mihai and Taherzadeh, 2017; Vinti et al., 2023).

Municipalities are generally in charge of community waste management (Abdel-Shafy and Mansour, 2018; DEA, 2019; Kaza et al., 2018; Rodseth et al., 2020). Here the local government is generally responsible for waste management infrastructure such as public bins and services like street sweeping as well as waste collection and disposal (DEA, 2019; DEFF, 2020; Nukusheva et al., 2023). Kaza et al. (2018) elaborate that institutional bodies have been initiated in almost 70% of the countries worldwide to establish policies and regulations in the waste sector.

Kaza et al. (2018) and Viljoen et al. (2021) add that there are usually not enough resources and insufficient capacity for planning, development, operation and management of waste management at the local level. In this regard, Haywood et al. (2021) and Kaza et al. (2018) stress that challenges in relation to sustainable waste management arise as a result and thus, negatively impacting the economy and the vulnerable groups in society. Specifically, the majority of the low- and middle-income countries in the world disproportionately suffer as a result of poor waste management (Kaza et al., 2018). This is especially true in instances where waste is disposed of close to the homes of the poor and not managed properly (Amasuomo and Baird, 2016; Kaza et al., 2018; Picard, 2020).

Cheng et al. (2022), Hoornweg and Bhada-Tata (2012) and Saleh and Koller (2019) add that municipal solid waste includes not only domestic waste but also commercial, industrial, construction and demolition, and institutional waste. Municipal solid waste initiatives differ from one municipality or country to another based on factors like the economic climate, lifestyle, waste management policies or regulations in place and industrial composition (Abdel-Shafy and Mansour, 2018; Nukusheva et al., 2023). Local municipality regulations generally

dictate whether or not waste needs to be separated or mixed at the household level (Hoornweg and Bhada-Tata, 2012). To this end, households may have to segregate waste at the point of generation into different types (Hoornweg and Bhada-Tata, 2012). These different types may be dry or recyclable waste or wet waste, which includes food and/ or organic material and may be harmful or harmless (Hoornweg and Bhada-Tata, 2012; Saleh and Koller, 2019).

There have been great inconsistencies in waste removal services between rural and urban areas, as well as between urban and metropolitan areas in South Africa (Stats SA, 2019a). Specifically, Dlamini et al. (2017) and Stats SA (2019a) found that rural households were less likely to have their waste removed or have sufficient waste management information when compared to urban areas. Additionally, rural areas are most likely to depend on their own waste dumps, unlike urban areas with access to municipal services (Nukusheva et al., 2023; Stats SA, 2019a).

Abdel-Shafy and Mansour (2018) elaborate that municipal solid waste initiatives are required to be socially and legally adequate, environmentally and financially sustainable as well as technically practical. These attributes, coupled with an absence of understanding of various factors, which are essential actors in the whole handling system, have made solid waste management a severe issue for authorities (Abdel-Shafy and Mansour, 2018). The main reason behind unsuccessful waste management initiatives, especially within developing countries, is the lack of sufficient resources necessary for efficient waste management (Abdel-Shafy and Mansour, 2018; Kaza et al., 2018; Viljoen et al., 2021). As already discussed, waste management at the household level is largely influenced and determined by waste management services provided at the municipality level. In this regard, the next subsection unpacks this relationship by discussing waste management practices at the household level.

3.3.2 Waste management practices at the household level

As previously discussed, the main household waste management practices are determined by the households' socio-economic as well as demographic attributes (Haywood et al., 2021; Saseanu et al., 2019). These practices range from burning and burying waste; using dustbins within the household; separating waste streams for recycling, reusing and composting; using community bins; illegally dumping waste around the community and using local waste drop-off centers (eThekweni Municipality, 2016a; Gutberlet, 2018; Haywood et al., 2021; Hoornweg and Bhada-Tata, 2012; Kaza et al., 2018; Kurniawan et al., 2023; Lee, 2020; Rodseth et al.,

2020; Sarfo-Mensah et al., 2019; Silva et al., 2017). Household waste generally forms part of municipal waste (Fadhullah et al., 2022; Herianto et al., 2019). In this regard, DEA (2012a), DEA (2019), DEFF (2020), Haywood et al. (2021) and Nukusheva et al. (2023) reiterate that household waste is then collected from households and drop-off centers for further management.

According to the findings from Haywood et al. (2021), waste bins provided to low-income households in cities such as Johannesburg by municipalities are usually not enough to manage the waste being generated in these areas. To elaborate, the study shows that this is usually because low-income houses in such areas generally have informal shacks in their backyards (Haywood et al., 2021). Not being able to rely solely on formal waste collection subsequently results in the need for alternative waste management methods (Haywood et al., 2021).

In studies conducted by Haywood et al. (2021) and Ndebele and Du Plessis (2018), it was found that although South African households residing in low-income settlements had their solid waste removed by municipalities on a weekly basis, a substantial number of these households still disposed of waste on the street, their yard and through burying or burning. Specifically, Haywood et al. (2021) found that about 10% of households engaged in these improper waste management practices, while Ndebele and Du Plessis (2018) report that approximately 25% of residents bury waste or participate in other practices as opposed to waiting for the municipality to remove the waste for them. To explain the reasoning behind the above, Haywood et al. (2021) state that bins get stolen, especially if there are nearby areas that do not receive waste collection services or only get black bags. Additionally, informal housing settlements, such as shacks, do not get allocated bins (Haywood et al., 2021). In Ntuzuma township, located within the eThekweni Municipality, Ndebele and Du Plessis (2018) found that regardless of the functional municipality waste collection service, residents still insist on participating in improper waste management practices. Additionally, Ndebele and Du Plessis (2018) report that only 51% of the residents acknowledged that the Municipality offered sufficient and cost-efficient waste management services.

The DEA (2012b), the eThekweni Municipality (2016a) and Parikh et al. (2020) show that regarding household waste collection within the Municipality, the DSW department collects waste from households once a week. Specifically, eThekweni Municipality (2016a; 2023) and Stats SA (2011) show an approximated 86.1% rate of weekly household waste collection in the

Municipality. Additionally, weekly curbside waste collection services by the DSW are offered in formal residential areas (eThekweni Municipality, 2016a; Parikh et al., 2020). The household waste is put inside black bags, which have been provided to households by the DSW, and thereafter placed on the curb on a specified day by the household (eThekweni Municipality, 2016a). Some communities get orange and clear recycling plastic bags provided by the DSW (eThekweni Municipality, 2016a; Parikh et al., 2020). The eThekweni Municipality (2016a) adds that these different bags with recyclables are then collected separately by private waste collection operators and dropped off at recycling facilities.

Regarding households located in low-income or high-density areas within the eThekweni Municipality, the Community Based Contractor (CBC) is commissioned by DSW to collect waste in these areas (DEA, 2012b; eThekweni Municipality, 2016a). The CBCs are usually familiar with the areas within which they are contracted to work, which aids in the creation of employment within these communities (DEA, 2012b; eThekweni Municipality, 2016a). The waste collected by the CBCs is collected by their own transport and thereafter taken to the closest transfer station or landfill site (eThekweni Municipality, 2016a).

For rural areas, the DSW or CBCs collect the waste, where possible, but these areas are usually not easily accessible and sometimes are not provided with waste collection plastic bags (eThekweni Municipality, 2016a). As carried out by the DSW, the residential collection of recyclables in South Africa may be done at the household level or communal points around the community and through the use of drop-off centers (DEA, 2012b). Drop-off centers are areas where consumers drop off recyclable materials without monetary compensation (DEA, 2012c). Additionally, residential garden waste may be fetched by the municipality or dropped off at local garden refuse transfer station centers (DEA, 2012b).

The DEA (2012b) and Haywood et al. (2021) highlight that another common waste collection service in South Africa is residential communal collection, where skips are placed around the community and are emptied regularly. In such instances, households are required to take their waste to these locations, which is expected to discourage the use of these communal skips as they may sometimes be far away (Aryampa et al., 2019; Haywood et al., 2021). According to Aryampa et al. (2019), when people are discouraged from taking waste to collection points, waste ends up being improperly discarded.

As already alluded to, the collection and disposal of municipal solid waste are serious issues within many urban environments in many countries globally (Abdel-Shafy and Mansour, 2018; Nukusheva et al., 2023). Stats SA (2017) shows that in eThekweni Municipality, South Africa, 53.6% of residents reported that waste removal and littering were a challenge in the Municipality. For instance, Mthembu (2021a) and Mthembu (2021b) show that the Bluff area has seen some difficulties in waste management due to issues such as those attributed to the DSW refuse collection services staff problems, irregular waste pickup schedule, COVID-19 lockdown restrictions and a frequent breakdown in waste pickup trucks. Specifically, residents were found to dispose of waste outside a drop-off zone even after its closing hours (Mthembu, 2021a). These issues were worsened by COVID-19 and associated restrictions and regulations. Additionally, Mthembu (2021b) shows that the unavailability of fixed bins on the streets has led to excessive littering and illegal dumping in Bluff.

Mamady (2016) affirms that households have a significant role to play in waste management. According to Adzawla et al. (2019), urban households were more likely to engage in proper waste management practices. Specifically, the more income a household makes and the higher the level of education completed, the less likely the household is to rely on conventional and unsustainable waste management methods like open or backyard dumping (Getahun et al., 2012). Getahun et al. (2012) found that in an Ethiopian community, households relied more on private and municipal waste collection services.

Funding for proper waste management (within households) generally has to compete with other important services such as water, education and health care provision (Kaza et al., 2018). Additionally, Adzawla et al. (2019) report that government funding for household/ community waste management is generally mostly directed at urban areas as opposed to rural areas. To substantiate this, Adzawla et al. (2019) and Rodseth et al. (2020) state that urban areas have access to communal waste bins while rural areas rely on open waste dumping. Adzawla et al. (2019) state that household size also plays a crucial role in how waste is managed in the household. Specifically, bigger families are found to engage more in unsustainable waste management practices such as burning and burying waste (Adzawla et al., 2019).

3.3.3 Disposal facilities/ services methods

Solid waste disposal is a pressing challenge in many urban and rural areas across the globe (Abdel-Shafy and Mansour, 2018; Nukusheva et al., 2023). According to Gutberlet (2018),

Kurniawan et al. (2023), Mihai and Taherzadeh (2017), Nyika et al. (2020) and Vinti et al. (2023), the burning of waste is still quite common, especially within informal settlements and rural areas. Rodseth et al. (2020) add that it is commonly households that do not have access to regular waste management services that end up relying on private or open dumps, which are neither engineered nor controlled.

Activities like illegal dumping were found to be most prominent within households in metro areas (Rodseth et al., 2020). Moreover, Haywood et al. (2021) found that households residing in shacks often dumped waste in the street. Gutberlet (2018) adds that within informal settlements, the already limited resources are directed at removing waste as opposed to directing resources to sustainable waste management infrastructure.

The role that individuals and communities play in waste generation, management and its impacts on communities have presented waste as both a social challenge and responsibility (Lebleu, 2020; Otumawu-Apreku, 2020). This social aspect of waste has gained interest among policy-makers as they are increasingly learning from past experiences that neglecting this important aspect results in detrimental impacts on the implementation of policy goals (Gutberlet, 2018; Tsai and Lin, 2021). Gutberlet (2018) and Tsai and Lin (2021) elaborate that detrimental impacts on the implementation of policy goals subsequently lead to negative and expensive social issues, which mainly affect vulnerable groups in society. To validate earlier discussions, the DEA (2019), Godfrey et al. (2019) and Mihai and Taherzadeh (2017) reinforce that in developing countries, the informal sector is a crucial actor in the provision of waste collection services by rerouting recyclable materials from waste disposal.

Considering the global South specifically, Dugbazah et al. (2021) and Gutberlet (2018) state that people are widely engaged in the informal collection of recyclable and reusable waste and that the majority of these materials do get recovered. These initiatives include collecting, separating, redirecting and recycling materials (Gutberlet, 2018). However, Gutberlet (2018) elaborates that formal recycling initiatives are still scarce and do not recover a significant amount of material.

According to Adipah and Kwame (2019), the specific principles of waste management include waste minimization (through reducing waste generation) and maximizing reusing and recycling waste. For instance, Kurniawan et al. (2023) and Schoeman and Rampedi (2022) add that waste

minimization is able to reduce municipal solid waste, which ends up in landfills. This, in turn, speaks to the circular economy approach. Specifically, Schoeman and Rampedi (2022) state that waste minimization protects natural resources through repurposing material and putting it back into the economic cycle. As depicted in Figure 3.3 and briefly discussed in chapters one and three, research shows that the waste hierarchy essentially guides the waste management process (DEA, 2012b; Hoornweg and Bhada-Tata, 2012; Khan et al., 2022; Nyika et al., 2020).

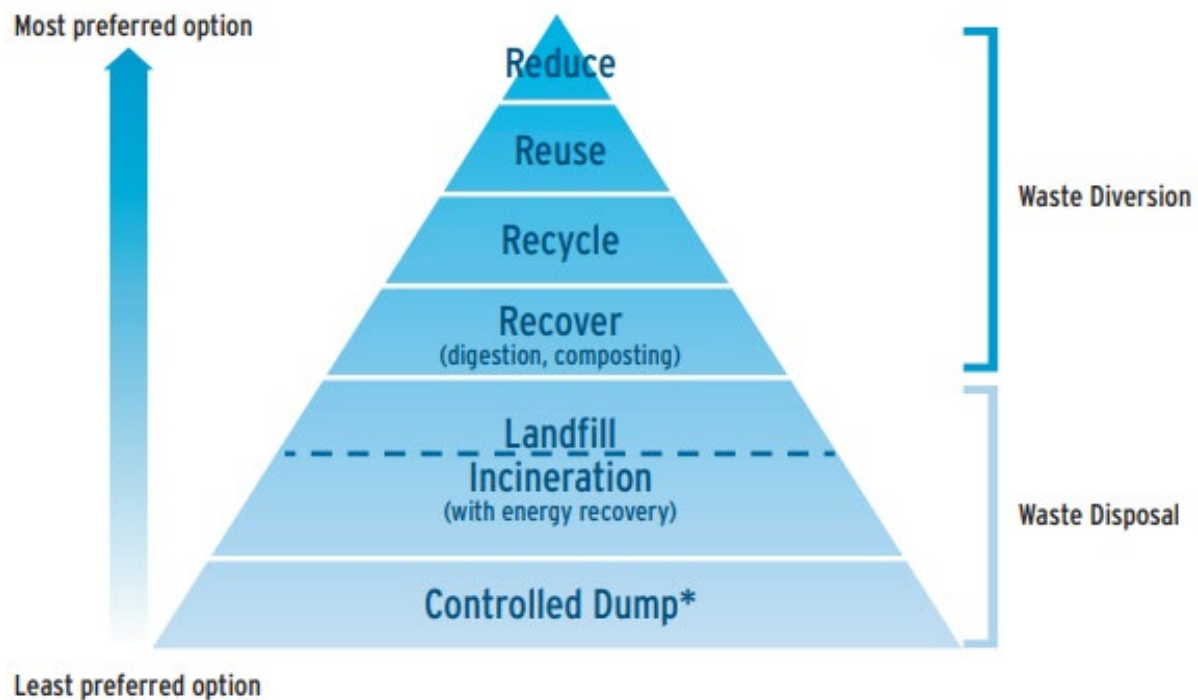


Figure 3.3: The waste hierarchy (Hoornweg and Bhada-Tata, 2012: 27)

According to the DEFF (2011) and the DEA (2012b), and as shown in Figure 3.3, the waste management hierarchy depicts methods that may be employed for waste management during the waste lifecycle. Evidently, the hierarchy looks at the most to the least preferred waste management options (Smith, 2020). Specifically, from the base of the hierarchy depicted in Figure 3.3, the least preferred methods are outlined where waste is disposed of, and as the hierarchy narrows or moves upwards, the most preferred methods are outlined, which speak to waste diversion (Hoornweg and Bhada-Tata, 2012; Smith, 2020).

As the least preferred waste management method and part of the ‘waste disposal’ part of the waste management hierarchy, Hoornweg and Bhada-Tata (2012) and Nyika et al. (2020) highlight controlled dumping or disposal, which incorporates selecting dumping sites,

controlling access into the site and sometimes compacting the waste. Although this method is the least preferred method, it is still a vital part of the waste management process (Leblanc, 2019b). Landfills are the main approach for waste disposal, and here energy recovery may also start to take place when methane gas is captured for this purpose (Leblanc, 2019b). Orhorhoro and Oghoghorie (2019) add that if the waste diversion methods of the waste management hierarchy are adopted, generated waste can be channeled through environmentally friendly methods, such as the generation of renewable energy for the benefit of the greater society.

Muzenda (2014) states that in South Africa, the dominant waste management method is the 'end of pipe', where landfilling is the most common channel of disposal. Hoornweg and Bhada-Tata (2012), Leblanc (2019b), Malinauskaite et al. (2017) and Muzenda (2014) explain that landfill sites are engineered for the purpose of waste disposal but may have little or no pre-treatment. These spaces are different from dump sites in that dump sites are not specifically designed or constructed, and the disposal of waste in these sites is not controlled (Muzenda, 2014). On the other hand, Leblanc (2019b) shows that landfills need to be designed, constructed, operated and regulated by rigorous end-of-life measures. According to Muzenda (2014), landfills may be problematic in that they may be affiliated with vector rodents, insects and birds; debris blown by the wind; contamination of ground and surface water; repellent odors; as well as uninhibited combustion hazards.

Landfills are necessary for the disposal of waste residue that has been left over from other waste management methods (Hoornweg and Bhada-Tata, 2012; Leblanc, 2019b; eThekweni Municipality, 2016a). Thus, eThekweni Municipality (2016a), Gutberlet (2018) and Orhorhoro and Oghoghorie (2019) emphasize that landfill sites are still required in waste management. Therefore, landfills still remain a common means of waste disposal (Abdel-Shafy and Mansour, 2018). However, when these land sites are not properly controlled, they result in negative impacts on soil, water and air (Gutberlet, 2018).

There is a pressing need for landfill sites to be properly designed to avoid issues for those in operation and for these sites to be closely monitored once closed (Gutberlet, 2018; Leblanc, 2019b; Orhorhoro and Oghoghorie, 2019). These measures are critical for the conservation of the environment and for guarding public health (Hoornweg and Bhada-Tata, 2012). However, Hoornweg and Bhada-Tata (2012) and Malinauskaite et al. (2017) stress that efficient landfilling is uncommon, more so within developing or poorer nations. Hoornweg and Bhada-

Tata (2012) further outline the various stages through which landfilling advances, starting from open-dumping to controlled dumping and, finally, sanitary landfilling.

The second least preferred method highlighted in the waste management hierarchy is incineration. Wani et al. (2018) explain that incineration is a process of burning solid waste under high temperatures and controlled conditions. A supporting sanitary landfill is needed to dispose of bottom ash, by-passed waste and non-combustible materials (Hoornweg and Bhada-Tata, 2012). Hoornweg and Bhada-Tata (2012) outline that incineration has the potential to reduce the disposal of waste with a lot of plastic, paper, cardboard, packaging materials and horticultural waste. Incineration with energy recovery is seen as the better method over direct landfilling as it helps extract essential energy from waste materials before the waste is disposed of (Hoornweg and Bhada-Tata, 2012; Muzenda, 2014).

The incineration method is only preferred if the necessary pollution mitigation measures are considered and when the related cost implications are addressed sufficiently (Hoornweg and Bhada-Tata, 2012). Although expensive, large-scale incineration is advantageous in that it is able to redirect waste from landfills; it may prevent the spread of diseases; and it has potential as an energy source (Muzenda, 2014). On the contrary, El-Ramady et al. (2021) report that this method is largely shunned in several regions. This is mainly due to the high costs associated with having to abide by sustainable atmospheric emission standards and having to incessantly treat the ash produced (El-Ramady et al., 2021). The waste diversion methods highlighted in Figure 3.3 will be unpacked under the sustainable waste management practices section.

3.3.4 Awareness and willingness-to-adopt and pay for waste management practices

Adipah and Kwame (2019), Bautista (2019), Handayani et al. (2018), Kurniawan et al. (2023) and Selvakumaran and Wahid (2022) confirm that awareness, knowledge and understanding of waste management play a significant role in waste management practices; whereby poor knowledge and the lack of awareness lead to improper waste management (Mamady, 2016; Vinti et al., 2023). Selvakumaran and Wahid (2022) assert that individuals who have an understanding of waste management practices, such as segregation, show interest in engaging in these practices. Adipah and Kwame (2019) further show that willingness and waste management behavior may influence decisions such as sustainable waste practice policies and waste management establishments.

Selvakumaran and Wahid (2022) show that attitudes towards such waste management practices are largely motivated by high knowledge. This resonates with the TPB discussed in chapter two, where it was revealed that the level of awareness has a considerable impact on waste management behaviors and the intentions thereof. Specifically, Herdiansyah et al. (2021) and Wu et al. (2022) add that personal norms, perceived behavioral control and environmental concern are all attributes of environmental knowledge that may influence waste management behavior.

The lack of or insufficient knowledge about crucial information, such as waste collection points, negatively affects proper waste management behavior (Islam et al., 2022). According to the DEA (2012c), Fadhullah et al. (2022), Islam et al. (2022) and Vinti et al. (2023), education and awareness campaigns are thus crucial for the successful implementation of waste reduction initiatives. Islam et al. (2022) and Vinti et al. (2023) state that these awareness improvement initiatives are crucial to improving waste recovery rates. Kumar et al. (2017) add that the lack of environmental awareness hinders the adoption of innovative technologies and means and thus shifts to sustainable waste management. Therefore, public awareness is imperative for compliance with a civic waste management responsibility (DEFF, 2020; Kurniawan et al., 2023). The DEA (2012b), Fadhullah et al. (2022) and Vinti et al. (2023) emphasize that it is vital to educate people about waste reduction and the benefits thereof, to change their attitudes and improve awareness. Specifically, in a study looking at awareness and practice of solid waste management among college students, Bautista (2019) concluded that although the students were aware of waste management practices, to a certain extent, they were not aware of the role they could play in these practices as students. However, the students were, to a large extent practicing proper solid waste management practices when looking at recycling, reusing and disposing of waste properly, and to a less extent in segregation and reduction (Bautista, 2019).

In a similar study, Mutungwe et al. (2014) state that although residents of Chinhoyi, Zimbabwe, knew the detriment of improper waste management and were aware of the importance of proper waste management strategies, they were not aware of the sustainable practices of recycling, reusing, reducing and rethinking in waste management. Similarly, Bautista (2019) and Islam et al. (2022) found that respondents were aware that sustainable waste management practices are essential for the protection and conservation of the environment. Regardless of this level of

awareness, the majority of the respondents were still not mindful of their specific roles in proper waste management (Bautista, 2019).

Islam et al. (2022), Kurniawan et al. (2023) and Vinti et al. (2023) show that the respondents' awareness of the impacts of improper waste disposal has not been evident in how they disposed of waste items such as batteries. Additionally, household awareness is seen to be higher within households with fewer members, older members and a higher income (Islam et al., 2022). The opposite was also deduced by Islam et al. (2022), where larger households with younger members and lower incomes did not have sufficient knowledge.

Boateng et al. (2016) affirm that for efficient waste management, it is essential for service providers, including local government, to have access to trustworthy sources of funding for waste management services. On this note, Boateng et al. (2016) point out that the willingness of community members to pay for better waste management services also determines the sustainability of funding aimed at waste management (Boateng et al., 2016). In a case study conducted in Ethiopian urban households of Bahir Dar city, Tassie and Endalew (2020) found that the majority of the households were willing to pay for better solid waste management services. Research shows that some factors that affect willingness are the household's size, educational level, sex and age distribution, monthly income, residential area, access to waste management services as well as the distance from municipal dumpsites, amount of waste produced weekly and the role played by the respondent in the management of waste (Al-Khateeb et al., 2017; Balasubramanian, 2019; Boateng et al., 2016; Chikowore, 2021; Han et al., 2019; Handayani et al., 2018; Islam et al., 2022; Kurniawan et al., 2023; Mamady, 2016; Miner et al., 2020; Saseanu et al., 2019; Tassie and Endalew, 2020; Viljoen et al., 2021; Whitmarsh et al., 2018).

Regarding the amount of waste produced by a household per week, Tassie and Endalew (2020) show that those households that generate the most waste were more willing to pay for better solid waste management services. Al-Khateeb et al. (2017) found that place of residence, level of education, sex and awareness have an impact on willingness-to-pay for proper waste management services. Attributes such as the sex of the head of household and the number of children in the household were found to have a less significant role on willingness-to-pay for waste management services (Tassie and Endalew, 2020).

Handayani et al. (2018) and Whitmarsh et al. (2018) state that women, older individuals, those who are wealthy and those individuals who have completed higher levels of formal education generally participate more in sustainable waste management. In terms of age, Adzawla et al. (2019) found that households with older household heads were more likely to use public dumping sites and bins for municipal disposal as opposed to burning or burying waste, whereas households with younger household heads disposed of waste in open places like gutters.

In general, females are considered to be more environmentally responsible and better at managing waste than their male counterparts within households (Adzawla et al., 2019; Boateng et al., 2016; Handayani et al., 2018; Tassie and Endalew, 2020). Adzawla et al. (2019) similarly found that female-headed households managed their waste more efficiently than those headed by men. Specifically, the study concluded that female-headed households used bins or public waste disposal sites to discard waste instead of burning or burying the waste, while the male-headed households discarded waste on the streets, into gutters and in water bodies (Adzawla et al., 2019).

Handayani et al. (2018) and Tassie and Endalew (2020) state that this may be attributed to the fact that females have historically been more responsible for activities like cleaning, washing, cooking and refuse disposal, which speaks to their role in household hygiene. To this end, Awunyo-Vitor et al. (2013) and Tassie and Endalew (2020) found that females were more willing to pay for improved solid waste management services than males. However, studies like those conducted by Han et al. (2019) and Islam et al. (2022) show that in certain instances, men are more willing to take on the responsibility of paying for waste management in the household. Similarly, those households who perceived themselves to play a significant role in solid waste management and were already environmentally responsible were also more willing to pay for improved waste management services (Tassie and Endalew, 2020).

Regarding the amount of waste produced by a household per week, Tassie and Endalew (2020) show that those households that generate the most waste were more willing to pay for better solid waste management services. Moreover, the amount of money that people are willing to pay was found to be significant and positively correlated with the volume of waste generated (Awunyo-Vitor et al., 2013). Bhattarai (2015) further reveals that those households who have already received waste management services are more willing to pay for improved services when compared to those that do not have access to these services.

With regards to education, Boateng et al. (2016), Fadhullah et al. (2022), Islam et al. (2022), Saseanu et al. (2019) and Tassie and Endalew (2020) state that this plays a vital role in establishing willingness-to-pay for as well as engage in waste management practices and services. Similarly, Adzawla et al. (2019), Han et al. (2019), Islam et al. (2022) and Tassie and Endalew (2020) add that the highest level of education acquired is significantly correlated with the willingness-to-adopt and pay for sustainable waste management. Specifically, education is seen as an important factor and is positively correlated to awareness, understanding and perception of waste management services and environmental issues (Adzawla et al., 2019; Han et al., 2019; Islam et al., 2022; Tassie and Endalew, 2020).

Similarly, Boateng et al. (2016) found that individuals with tertiary education were significantly more willing to pay for proper waste management services when compared to those with no formal education. The prime reason behind this is that those with tertiary education were employed and could afford to pay for these services, unlike individuals with no formal education (Boateng et al., 2016). However, in a study conducted by Fadhullah et al. (2022), it was found that respondents who had attained lower higher education levels were more willing to participate in waste segregation as opposed to those with higher education levels attained. Fadhullah et al. (2022) suggest that this is based on individuals with higher levels of education attained spending most of their time at work than at home.

The affordability or ability of households to pay for waste management services influences their willingness-to-pay (Awunyo-Vitor et al., 2013; Tassie and Endalew, 2020). Whereby willingness-to-pay often decreases with increased associated costs (Han et al., 2019). In this regard, Han et al. (2019), Islam et al. (2022) and Tassie and Endalew (2020) found that willingness-to-pay for these services was mainly among higher-income households, middle-income groups followed, and low-income households were the lowest in terms of willingness-to-pay.

When those households who were not willing to pay anything for better solid waste management services were probed for reasons for this response, the majority indicated insufficient income to pay, followed by a lack of trust in government waste management initiatives (stating that they do not believe that these services will be reliable) (Bhattarai, 2015; Tassie and Endalew, 2020). Having access to free waste disposal practices, such as digging deep holes for waste, was another reason why respondents were not willing to pay for improved

waste management services. Furthermore, these respondents claimed that waste management was the sole responsibility of the state and that the taxes they pay should cover the cost of the improvement of services, and that improved waste management services were not sufficiently important to pay for (Bhattarai, 2015; Tassie and Endalew, 2020).

3.3.5 Waste management in the context of COVID-19

Waste management is one of the main aspects that has been severely affected by COVID-19 around the world (El-Ramady et al., 2021; Forlani and Njie, 2022). According to Fadhullah et al. (2022), COVID-19 has had detrimental impacts on household waste management. For instance, Dzawanda and Moyo (2022) and El-Ramady et al. (2021) state that the generation of healthcare waste, which may be considered communicable and bio-hazardous, has increased. This is one aspect that makes waste management especially a pressing topic in light of the COVID-19 pandemic (Sarkodie and Owusu, 2021). This is mainly due to the increase in overall waste generation, especially contaminated medical waste, which threatens to perpetuate the spread of COVID-19 and, thus, worsening the associated health risks (Acharya et al., 2021; Dzawanda and Moyo, 2022; Jayasinghe et al., 2023; Oyedotun et al., 2020; Sarkodie and Owusu, 2021). Additionally, Dzawanda and Moyo (2022) and Zhou et al. (2020) show that there is also a concern pertaining to household waste being a contamination and transmission source. Thakur et al. (2021) emphasize that with individuals being treated for COVID-19 from home comes contaminated biomedical waste. Filho et al. (2021) report that packaging waste and health waste were found to be the highest (45%) waste types generated by households in the light of the pandemic.

The main challenges found by Filho et al. (2021) in household waste management during the pandemic included an increase in food waste (about 33%), having to establish waste segregation methods (about 25%), an increase in the frequency of waste collection (21%) and a decrease in the frequency of waste collection (15%). Additionally, Acharya et al. (2021) report that waste management services, including collection, segregation, recycling and disposal, have been disrupted by the perpetuation of COVID-19. The study found that households end up mixing all waste types together instead of separating the waste (Acharya et al., 2021). When probed, the respondents indicated that they do not separate waste streams due to a lack of space within households (Acharya et al., 2021). However, in a similar study, Selvakumaran and Wahid (2022) found that respondents argued for the importance of waste segregation citing the critical role played by proper hygiene in combating the pandemic.

Acharya et al. (2021), El-Ramady et al. (2021) and Jayasinghe et al. (2023) found that due to its contagious properties when contaminated PPE is discarded carelessly, it causes a magnitude of issues for the environment and people. To reiterate, Sarkodie and Owusu (2021) provide the example of Hong Kong, where PPE such as face masks have been inappropriately disposed of and have thus accumulated at beaches and nature trails. Efforts aimed at reducing waste pollution, such as that associated with plastic, have been negatively impacted by COVID-19 because PPE, such as plastic-based disposable masks and gloves, are currently very important and extensively produced and used (Sarkodie and Owusu, 2021).

According to El-Ramady et al. (2021), developed countries are at an advantage as far as the risk of the spread of COVID-19 through rising volumes of domestic waste is concerned. Specifically, this may be attributed to the fact that developed nations, for the most part, already have sustainable waste management structures in place (El-Ramady et al., 2021). For instance, Khan et al. (2021) stress that waste management personnel in developing countries have been exposed to contracting COVID-19 due to inefficient or lack of access to sufficient funds as well as protective equipment to use while working.

Additionally, waste management personnel stopped working in some countries during the lockdown (El-Ramady et al., 2021; Ijjasz-Vasquez and Kaza, 2020). Specifically, Ijjasz-Vasquez and Kaza (2020) stress that several challenges have been exacerbated as a result of the COVID-19 pandemic. This includes an effect on sustainable waste management sectors where workers suffering from chronic illnesses stay at home (El-Ramady et al., 2021). El-Ramady et al. (2021) emphasize that this subsequently negatively impacts sustainable practices such as recycling.

The inability to manage waste properly at the household level presents the risk of perpetuating the spread of COVID-19 through secondary transmissions (Singh et al., 2022; Smith, 2020). Additionally, with COVID-19, a lot of local sustainable waste management initiatives were canceled, which in turn led to local waste issues (Smith, 2020). Due to the pandemic and lockdown measures, households saw vast adjustments to things like consumption patterns, which in turn, changed waste management behavior (Smith, 2020). This has introduced new issues for solid waste management systems (Smith, 2020). It thus goes without saying that the pandemic has resulted in scenarios that have increased pressure on waste management systems globally (Filho et al., 2021).

It is thus evident that efficient waste management is essential in combatting the spread of COVID-19 (El-Ramady et al., 2021). Sarkodie and Owusu (2021) and Singh et al. (2022) propose that the current waste management scene presents valuable lessons for a post-COVID-19 scenario. To avoid going back to how waste was managed prior to the pandemic, structural modifications need to be established to highlight the importance of shifting to a circular economy from a linear one (Mapani et al., 2022; Sarkodie and Owusu, 2021). Diprose et al. (2022) and Mapani et al. (2022) reiterate the importance of a circular economy in waste reduction. Additionally, this approach will position societies to better cope with future health disruptions and disasters (including extreme climate events such as floods) that can generate new and different forms of waste at the household level.

In this context, a culture of minimal waste generation and economic development centered around the notions of zero-waste and zero-carbon are promoted (Mapani et al., 2022; Sarkodie and Owusu, 2021). To this end, Khan et al. (2022) and Kurniawan et al. (2023) highlight the significant role of an ISWM approach in waste management. As discussed in chapter two, ISWM is a comprehensive waste management strategy that considers all waste streams produced (liquid, solid and gas emissions) and, in turn, strives to reduce the generation of these (Khan et al., 2022). This is done using a holistic and participatory lens where the social, political and different waste management practices are considered (Korneliussen, 2021; Leblanc, 2019a). In this regard, the following section unpacks various sustainable waste management practices.

3.4 Sustainable waste management practices

As evidenced in previous discussions, there are several issues in waste management systems within many developing countries (Smith, 2020). These are often related to inadequate waste collection services and inappropriate final disposal sites (Smith, 2020). To this end, households end up burning waste, throwing it away on vacant land and/ or the waste ends up in landfills (Kurniawan et al., 2023; Smith, 2020; Vinti et al., 2023). Thus, reducing the amount of waste going into landfills is crucial (Vetter-Gindele et al., 2019). Specifically, waste from residential areas is one of the main sources of municipal solid waste (Fadhullah et al., 2022); therefore, households play a crucial role in sustainable waste management.

Sustainable solid waste management is necessary for efficient solid waste management systems to be successful (Fadhullah et al., 2022). Research highlights that leaning more toward waste

management practices like reusing, recycling and recovery as opposed to the conventional dumpsites and landfills enhances livelihoods through job creation and business opportunities (DEA, 2012c; Edmond, 2019; Godfrey et al., 2019; Gusti, 2016; Stubbs, 2021a; Stubbs, 2021b). Specifically, Gusti (2016) defines practices such as reusing, reducing, recycling and waste-to-energy conversion practices as sustainable waste management behavior. As discussed under the circular economy approach, sustainable waste management decreases the environmental impacts of waste on the economy and, thus, fosters sustainable economic growth (Edmond, 2019; Stubbs, 2021a; Stubbs, 2021b). However, sustainability has been an issue facing communities globally and embracing it has proven to be a social issue that is embedded in international, national and local policies as well as the planning and implementation associated with these (Bautista, 2019; Fadhillah et al., 2022).

According to the DEFF (2011) and Muzenda (2014), the avoidance, reduction, recycling and recovery of waste form the basis of cradle-to-cradle waste management. For instance, this approach ensures that cleaner alternatives are enforced in product design and packaging (Muzenda, 2014). This means that items are repurposed or recycled when it comes to the end of their life span and help feed into new products and materials (as opposed to discarding them as waste) (DEFF, 2011; Muzenda, 2014). This cycle continues until, eventually, as little as possible waste (from the original products) enters the recovery stage of the waste management hierarchy (DEFF, 2011; Muzenda, 2014). This promotes waste minimization by closing loops in a material's lifecycle (Kaza et al., 2018; Stahel, 2016), thus, promoting a circular economy. Materials are then finally entered into the least preferred option of the waste management hierarchy to be either disposed of or treated (DEFF, 2011; Muzenda, 2014).

Godfrey et al. (2019) show that significant socio-economic prospects are created through the diversion of waste away from dumpsites. Through proper governance, which engages the public/ community and considers environmental as well as economic attributes, sustainable development is made possible (Bautista, 2019). In South Africa specifically, sustainable development is seen as a critical part of environmental conservation and is directed at establishing a balance for socio-economic issues of societies that are different and are still developing (DEFF, 2011; Smith, 2020).

Smith (2020), Viljoen et al. (2021) and Whitmarsh et al. (2018) explain that efficient waste management includes waste reduction (which is achieved best by first preventing or avoiding

the generation of waste); this is then followed by reusing items instead of disposing of them, composting and lastly recycling. Bardus and Massoud (2022) assert that understanding what motivates citizens to sort waste at home is key to designing effective, efficient, and equitable waste management interventions. Kurniawan et al. (2023), Viljoen et al. (2021) and Vinti et al. (2023) add that waste separation and sorting at the household level is crucial in order to achieve proper waste handling. According to the DEFF (2020), the implementation of proper waste collection and disposal methods is critical to taking advantage of the economic value of waste. In this regard, proper and innovative means of waste collection and disposal are critical to reap the economic value of waste (DEA, 2019).

It is acknowledged that municipalities/ governments have a vital role to play in waste reduction or the sustainable management of waste; however, it also goes without saying that everyone who uses or consumes materials, which inevitably become waste, plays a significant role in this process (DEFF, 2011; Whitmarsh et al. 2018). In this regard, DEFF (2011) and DEFF (2020) add that all stakeholders, including municipalities as well as private and informal players, ought to work closely together to manage waste. Additionally, being one of the main municipal waste generators (Fadhullah et al., 2022), residential areas also play a crucial role in sustainable waste management.

Considering and also holding all waste generators accountable in the waste management process is crucial, particularly due to the escalating rates of population growth and industrialization (Makgae, 2011; Menyuka et al., 2020; Miner et al., 2020; Omole et al., 2016). As already discussed, households are key players in waste management; and should therefore be involved in decision-making for waste management attributes, including equipment, infrastructure and technology, so that they know more about these resources and so use them more and effectively (Adipah and Kwame, 2019). In this regard, waste management initiatives at the household level are the essence of sustainable waste management research (Viljoen et al., 2021). The next subsections take a closer look at waste diversion, the most preferred attribute of the waste management process, as highlighted in the waste hierarchy (Figure 3.3).

3.4.1 Prevention

Waste prevention is related to decreasing the quantity of waste that is produced by individuals, households and businesses (Rasmeni and Madyira, 2019; Smith, 2020). The logic of this concept is that if individuals only bought items in the quantities they need, reducing their

purchases, less waste would be generated (DEFF, 2020; Smith, 2020). Additionally, the DEA (2019), the DEFF (2020) and Nyika et al. (2020) emphasize that waste prevention speaks largely to evading and minimizing waste before products become waste. They further assert that this is achieved by paying more attention to product design and packing.

In waste prevention, choosing to avoid the excessive expenditure of goods and services, and especially the consumption of virgin materials is promoted (Leblanc, 2019b). Specifically, the environmental impacts of products are established during the product design stage, where manufacturers use a circularity pattern at this stage to eradicate the linear ‘take-make-use-dispose’ (DEA, 2019; DEFF, 2020). Economically, waste prevention is seen as a means of preventing costs associated with waste collection and disposal incurred by businesses and the public sector (DEA, 2019; DEFF, 2020).

The eThekweni Municipality (2016a), the DEA (2019), the DEFF (2020), Nukusheva et al. (2023) and Nyika et al. (2020) reinforce that waste prevention should be the first method considered and applied to any waste stream. Thus, this method is considered one of the two strategic entry points of the waste sector into minimizing waste and into the circular economy (the other being waste as a resource) (DEFF, 2020). Most importantly, this is the most preferred waste management practice and, thus, will/ should be the first method to be applied (DEFF, 2020).

In South Africa, the DEA (2019) and the DEFF (2020) state that some barriers to waste prevention are the perceived convenience of landfilling with its associated low costs, insufficient data on different waste streams; consumers believing that products with reused or recycled materials are of lower quality; manufacturers not getting incentives to motivate better action; and shortened innovation and product development cycles. According to the OECD (2020), reuse, eco-design, repair, refurbishment, extended producer responsibility schemes and re-manufacturing are some means that may be used to support waste prevention.

3.4.2 Separation

Waste separation/ segregation at source is a prominent aspect of sustainable waste management because it allows for value extraction and recycling (DEA, 2012c; Kumar et al., 2017; Kurniawan et al., 2023; Selvakumaran and Wahid, 2022). For example, Vinti et al. (2023) and Zhou et al. (2022) state that separating household waste is a contemporary and improved waste

management strategy. This method involves categorizing similar waste streams by using different bin services, curbside collections, or delivery drop-off centers for specific waste streams (DEA, 2019; DEFF, 2020; Kurniawan et al., 2023). According to Selvakumaran and Wahid (2022), unsegregated waste, which ends up in landfills, presents detrimental environmental problems.

Hoornweg and Bhada-Tata (2012) and Kumar et al. (2017) add that segregating dry or inorganic waste materials from wet or biodegradable ones is important for efficient waste management and should, ideally, be the responsibility of households or other producers of waste. The quantity and quality of recycled materials are determined by the degree to which the waste is separated at source (Hoornweg and Bhada-Tata, 2012). For instance, Selvakumaran and Wahid (2022) add that segregation plays a significant role in decreasing pollution by ensuring that hazardous waste is treated separately.

The term ‘separation’ may be misleading to a certain degree because this concept describes putting different waste streams in separate containers as opposed to separating waste that was first mixed together, as the term insinuates (Hoornweg and Bhada-Tata, 2012). The process of segregation is an issue, especially in developing countries where waste disposal happens largely without enough planning (Smith, 2020). Waste separation does bear ample benefits, for instance, the DEA (2019) and DEFF (2020) state that these benefits include assisting in the diversion of waste away from landfills, decreasing waste stream contamination, increasing the value of waste, and affording improved resource recovery. To reap these benefits, there needs to be a high willingness and good practices by individuals/ households/ communities (DEA, 2019). Moreover, residents need to be open to new technologies, which are associated with waste management facilities, as well as infrastructure and related benefits.

The DEA (2019) further stresses the importance of the acceptance of waste separation markets by all relevant stakeholders. In a study conducted by Filho et al. (2021), it was revealed that nearly half of the respondents did not separate their waste streams. Specifically, only 32% of the respondents revealed that they had increased efforts toward waste segregation since the COVID-19 lockdown (Filho et al., 2021). This speaks to the urgent need for waste generators to embrace sustainable waste management practices.

3.4.3 Reduce

Reducing waste aims to decrease resource use while also monitoring consumption levels in order to reduce waste volumes at source (Hoornweg and Bhada-Tata, 2012; Muniandy et al., 2021; Orhorhoro and Oghoghorie, 2019). This is achieved through controlling the use and encouraging the conservation of resources in order to reduce waste (Muniandy et al., 2021). Waste reduction is especially applicable for those waste streams where methods including recycling, recovery, treatment and disposal may not be efficient (Muzenda, 2014).

The DEFF (2011) and Orhorhoro and Oghoghorie (2019) state that reducing waste incorporates design and manufacture and the use and disposal of those products with low material and toxic content and those with an extended useful life. Specifically, this mainly includes decreasing product packaging, transporting goods in more fuel-efficient vehicles, and investing in energy-efficient production and services (Leblanc, 2019b). Kaza et al. (2018) show that technology plays a crucial role in waste reduction and has been utilized extensively around the world to decrease waste, and to alter production processes for the purpose of reduction (including reducing the use of virgin materials) or to promote subsequent sustainable waste management practices.

Factors including competitive pressures, producer accountability and economic incentives encourage waste minimization (Muzenda, 2014). Muzenda (2014) elaborates that these incentives include initiatives such as the plastic bag levy by the South African government. As portrayed in Figure 3.3, waste minimization is the most preferred means of waste management (DEFF, 2011; Muzenda, 2014). Waste minimization incorporates the promotion of sustainable waste management strategies like reuse, recycling and resource recovery, averting and decreasing waste generation at source, and enhancing the standard of the waste being generated (Oteng-Ababio, 2014; Ugwu et al., 2021). Hoornweg and Bhada-Tata (2012), Muzenda (2014) and Ugwu et al. (2021) add that waste or source reduction may also incorporate measures including minimization, reuse and prevention.

According to DEFF (2020) and Edmond (2019), waste pickers play a crucial role in waste minimization. Specifically, waste pickers are the first in the system to remove reusable and recyclable materials from waste, which initiates the process of resource recovery (DEFF, 2020). Explicitly, Naidoo (2021) emphasizes the important role played by these individuals who pick through waste looking for recyclables which they then clean and sell. Needless to

say, through this profession, tons of valuable materials are diverted from landfills (Naidoo, 2021). Thus, waste pickers have the potential to enhance recycling processes while also decreasing costs in waste management and enhancing livelihoods (Dugbazah et al., 2021; Siddiqi et al., 2020).

3.4.4 Repurpose

The DEFF (2011) states that when an item is reused or repurposed, it is removed from the waste stream and used again for another purpose without having to alter its form or properties. Specifically, the item is used again for the same or different purposes (Oteng-Ababio, 2014). Reusing or repurposing encourages looking at used or old items as resources as opposed to waste (Smith, 2020). The eThekwini Municipality (2016a) states that this includes practices such as households reusing empty plastic bags and glasses, businesses using refillable printer ink cartridges and rechargeable batteries, and the government enforcing levies on plastic shopping bags.

Smith (2020) states that the notion of repurposing is to discourage the general perception that items that are old, empty, broken, or worn out are worthless and should be disposed of without consideration. Additionally, Mihai and Taherzadeh (2017) state that reusing items prevent the unrestrained generation and disposal of waste at the household level. Thus, this method helps evade waste generation (eThekwini Municipality, 2016a). According to Nyika et al. (2020), repurposing is similar to recycling and recovery since they involve reclaiming materials that are viewed as waste in order to minimize waste streams going to landfills.

3.4.5 Recycling

Recycling includes isolating materials from a waste stream, thereafter, processing them as goods or raw materials (DEFF, 2011; Rasmeni and Madyira, 2019). Hoornweg and Bhada-Tata (2012) and Orhorhoro and Oghoghorie (2019) add that recycling deals with the recovery of materials, which deals with changing waste to reusable/ useful products. According to Nyika et al. (2020), waste needs to be taken through restoration, repairing and cleaning processes before being recycled. The methods of recovery and recycling serve to decrease the amount of waste that is disposed of and also to feed materials back into the economy (eThekwini Municipality, 2016a; Hoornweg and Bhada-Tata, 2012).

Stats SA (2018a) stresses that recycling is an essential sustainable waste management strategy as it plays a vital role in the reduction of pollution, conservation of energy and the conservation of natural resources. Therefore, Schoeman and Rampedi (2022) reiterate that recycling is able to contribute positively to reducing the consumption of natural resources while subsequently enhancing material reuse, which resonates with the circular economy approach. More people are now participating in recycling initiatives; this process has been made simpler and more convenient over the years, especially with the expansion of recycling facilities (Whitmarsh et al., 2018). According to Muzenda (2014), recycling programs in South Africa are largely voluntary projects, which are motivated by initiatives that are driven by private corporations' donations through Non-Profit Organizations (NPOs), which handle the recycling or recovery activities and facilities within which this is done.

In Africa, only an estimated 4% of the 80-90% of recyclable waste is actually being recycled, mainly by informal waste reclaimers (Godfrey et al., 2019). According to Stats SA (2018a; 2019a), the majority of households in South Africa do not recycle their waste. The DEA (2012a) and Stubbs (2021b) show that in 2011 only 10% of waste generated in the country was recycled. Additionally, Stats SA (2019a) states that only 6.1% of South African households recycle household waste. Specifically, Stats SA (2018a) shows that approximately 75.8% of households that did not participate in segregating waste for the purpose of recycling claim that these steps were not essential as waste could simply be discarded in bins for refuse collection. A study conducted by Ndebele and Du Plessis (2018) revealed that only 16% of the participants recycled waste. Recycling trends in the country were most common among households headed by adults aged 65 years and older (Stats SA, 2018a). This behavior is also influenced by the sufficient provision of the necessary resources (refuse and recycling services) by municipalities that usually do not have adequate infrastructure and capacity (Stats SA, 2018a).

The eThekweni Municipality (2016a) states that the DSW has the orange bag curbside collection system as the Municipality's flagship recycling and waste minimization project. Households are provided with orange bags to separate cardboard, paper and plastic for recycling (eThekweni Municipality, 2016a). Although there had been challenges (related to inconsistencies with the delivery and collection of the bags) with the orange bag recycling program, the eThekweni Municipality is working on addressing these issues and reconfiguring the program (Magubane, 2023). As previously stated, these recyclable materials are then collected on a specific day (eThekweni Municipality, 2016a). Clear bags are also provided for

the separation and, thus, the collection of glass bottles and cans (eThekwini Municipality, 2016a).

The eThekwini Municipality (2016a) adds that there are also drop-off centers within communities in the Municipality where people can take paper, cardboard, plastic, glass bottles, metal and used oil. Additionally, buyback centers have been established across the Municipality by the DSW (eThekwini Municipality, 2016a). These centers are drop-off facilities where individuals drop off recyclable materials, which are weighed to determine the value and, thus, how much the individual will earn from it (DEA, 2012c; eThekwini Municipality, 2016a). The DEA (2012c) adds that the recyclable materials are then bought from buyback centers by recycling companies.

3.4.6 Composting

The eThekwini Municipality (2016a) and Leblanc (2019b) define composting as the monitored biological breakdown of organic matter. Gupta et al. (2015) add that organic matter is decomposed by microorganisms in warm and moist environments under aerobic and anaerobic conditions. This organic matter may include food and plant matter which is turned into humus. Furthermore, composting involves the decomposition of organic waste by burying the waste in the ground (Adzawla et al., 2019; Khan, 2021; Oteng-Ababio, 2014). This process then helps to enhance soil fertility while also combatting any adverse effect that waste has on the environment (Adzawla et al., 2019).

Waste composting may be achieved at the household, community and municipality levels (Viljoen et al., 2021). This practice may be inclusive of biowaste sources such as municipal, sewage and agricultural, and is able to reroute wastes from different sources from ending up in open dumps or from being burnt (Mihai and Taherzadeh, 2017; Vinti et al., 2023). As previously discussed, diverting waste from landfills helps in curbing greenhouse gas emissions (Leblanc, 2019b). Additionally, composting is also beneficial in that it replenishes the soil with nutrients, thus improving soil fertility for food production (Reetsch et al., 2020).

Godfrey et al. (2019) state that more than 57% of the municipal solid waste in Africa is considered biodegradable, organic and wet waste. Komakech et al. (2015) substantiate this by adding that most of the waste that is collected within cities in Sub-Saharan Africa is biodegradable. This waste includes food and garden waste, which may be easily handled and

turned into useful products like biogas and compost (Godfrey et al., 2019). However, biodegradable waste is still largely under-explored as a useful resource in the continent (Godfrey et al., 2019). Specifically, this waste is still largely disposed of in landfill sites (Komakech et al., 2015).

3.4.7 Energy recovery

Siddiqi et al. (2020) state that municipal solid waste is utilized in waste-to-energy processes to generate energy. The process of energy recovery includes the conversion of waste that is non-recyclable into heat, fuel, or electrical energy through processes such as combustion, pyrolysis and gasification for the production of energy and controlling waste (Abebe, 2018; DEFF, 2011; Orhorhoro and Oghoghorie, 2019; Siddiqi et al., 2020). When these systems use improved technologies instead of conventional incineration, waste is sustainably managed (Siddiqi et al., 2020). According to Abebe (2018) and Picard (2020), turning waste into energy is ideal and presents great potential for tackling the challenges of waste management and access to energy through waste reduction.

Abebe (2018) shows that waste-to-energy is a viable means of mitigating climate change through the reduction of greenhouse gases being formed and emitted to the environment. However, waste-to-energy initiatives are said to be more expensive than using landfills; are usually established in low- and middle-income regions; and depend on socio-economic, environmental and location attributes (Khan, 2021; Siddiqi et al., 2020). Siddiqi et al. (2020) argue that the costs of technologies are progressively decreasing, and coupled with enhancements in these technologies, waste-to-energy initiatives become more feasible. Thus, it goes without saying that although waste-to-energy systems are not comparable to green energy sources such as solar, they are still vital in redirecting waste from landfills (Siddiqi et al., 2020).

For instance, renewable energy is being generated by landfills in eThekweni Municipality (World Bank, 2015; United Nations Environmental Program (UNEP), 2018). The eThekweni Municipality project is said to be the first of its kind in Africa to be registered under the Clean Development Mechanism in Africa (World Bank, 2015). Specifically, the Durban Landfill Gas-to-electricity project, funded by the World Bank, was established in 2004 (UNEP, 2018). For example, methane gas from the Marianhill landfill is utilized to power electricity-producing generators for the local grid (UNEP, 2018). This project is being executed by the DSW and is

estimated to provide about three megawatts of electricity that is sold to the Electricity Department of the eThekweni Municipality (World Bank, 2015; UNEP, 2018). According to UNEP (2018), this is advantageous in that it not only offers cleaner energy but also decreases the impact of methane on the environment. Although the Bisasar landfill site was scheduled to close in 2015, it was projected to be able to still be able to produce gas and therefore generate electricity until around 2030 (Pather-Elias et al., nd). Additionally, the project has enhanced the overall state of landfills and has thus combated the generation of liquid runoff, which contaminates groundwater systems and has further averted the breeding of disease-harboring vectors (UNEP, 2018).

The project has also helped in the operation of other landfills in South Africa (World Bank, 2015). Specifically, since the inception of this project, gas observations and regular reporting of soil gas concentrations being more than 1% are minimum requirements for waste disposal at landfills (World Bank, 2015). Even though the collection or flaring of gas and use of methane for renewable energy is not an obligation by the law, if methane concentrations in the air are more than 5%, permanent venting systems are required (World Bank, 2015). The next subsection discusses some of the other sustainable waste management initiatives that have been reported on the African continent.

3.4.8 Sustainable waste management initiatives in Africa

The issues of waste disposal have called for alternate means of waste management (Abebe, 2018). Efficient waste management practices are vital for the reduction of pollution (Nukusheva et al., 2023). Hence, sustainable waste management initiatives have increased based on social needs and resource demand (Nyika et al., 2020). This is especially true for developing countries within which improper waste management perpetuates issues related to the already feeble quality of life (Dugbazah et al., 2021; Vinti et al., 2023). The quality of life in continents such as Africa may be improved by leveraging waste management practices and technologies such as energy conversion technologies and recycling initiatives (Dugbazah et al., 2021).

Research shows that great strides have been made in Africa regarding adopting sustainable waste management practices (Dugbazah et al., 2021; Godfrey, 2019). Dugbazah et al. (2021) and Godfrey et al. (2019) add that digital technologies and social innovations have been adopted by several African countries not only for specific waste management initiatives such

as recycling but also for technologies aimed at curbing unsustainable waste management. Although these initiatives possess great potential for sustainable waste management, it is still crucial to note the existence of challenges, such as insufficient resources, which have made it difficult for developing countries to adopt greener initiatives (Ahen and Amankwah-Amoah, 2021).

Picard (2020) and Shaban (2018) present the waste-to-energy plant in Addis Ababa as the first of its kind in Africa as an example of such initiatives. This initiative is by the Ethiopian government in partnership with an association of international cooperations, which include Singapore-based Cambridge Industries Limited, a Danish engineering firm and the Chinese-based National Electric Engineering and Ramboll (Shaban, 2018). Here, Ethiopia hosts Africa's Reppie project, a waste-to-energy facility on the continent (Shaban, 2018). According to Shaban (2018), this innovation was established on the Koshe landfill site and was intended to absorb approximately 80% of waste generated in Addis Ababa and subsequently provide the households of the city with 30% of electricity.

Godfrey et al. (2019) show that in Nigeria and South Africa, the Wecyclers and the Packa-Ching waste collection models have been innovated, respectively. These models encourage communities to recycle by rewarding them for their recyclable waste material (Godfrey et al., 2019). Specifically, residents are rewarded through access to conveniently located collection systems, especially within areas with no or inefficient municipal waste collection systems. Additionally, Thusi (2020) adds that in similar waste separation and recycling initiatives in South Africa, households are given plastic bags for recyclable materials, which are then collected. In Johannesburg, this initiative has been made compulsory within certain communities (Thusi, 2020).

With the Packa-Ching initiative, Dlamini (2021) and Sasol (2020) elaborate that people across South Africa have been able to earn an income through the sale of their recyclable packaging. Specifically, this initiative is a mobile recycling service that encourages waste separation at source. Sasol (2020) states that Packa-Ching collects recyclable packaging from various community collection points weekly using a truck and trailer. In 2020 there were four Packa-Ching business units in South Africa with the aim of reaching a further 25 units by 2025 (Sasol, 2020).

As one of the key sponsors of the Packa-Ching program, Sasol has introduced an initiative aimed at reducing plastic waste in the country (Sasol, 2020). Furthermore, Sasol funds many Packa-Ching units across South Africa while also sponsoring fuel for Packa-Ching business owners who manage these units and operate the mobile collection trucks and trailers (Sasol, 2020). Through this initiative, over 1 400 tons of recyclable packaging waste have been sustainably managed since 2017 and more than R1 million has been given back to community members (Sasol, 2020). As indicated, these figures are expected to increase by 2025 with an addition of more units. With regard to waste recycling, about 70 000 tons of recyclables are expected to be collected (Sasol, 2020). Approximately 75 new employment opportunities will be introduced, and an estimated R50 million will be paid to communities (Sasol, 2020).

The Greymont Upcycle Zero-Waste to Landfill is a repurposing and recycling store in Johannesburg, South Africa (Feris, 2021; Moduka, 2020). The goal of the store is to encourage sustainable waste management as opposed to sending items to landfills, portraying a circular economy (Feris, 2021; Moduka, 2020). Specifically, Feris (2021) states that this store stocks unused or unsold corporate items, which would have otherwise gone to landfills for various reasons, such as issues with company branding, surplus stock or businesses ceasing to operate. Branding is then removed from these items (stationery, clothing items, furniture, etc.) before being sold at low prices (Feris, 2021). Moduka (2020) adds that the removal of branding is done by local communities and then sold in the store for money that is then used to fund subsequent initiatives as well as the training and support initiatives for the communities in question (Moduka, 2020).

In instances where the removal of branding will not suffice, items are upcycled into other products (Moduka, 2020). Furthermore, Greymont Upcycle passes these upcycle entrepreneurial skills on to other members of society, especially the unemployed so that they are able to use these repurposing skills to earn an income (Feris, 2021; Moduka, 2021). Feris (2021) shows that Upcycle also partners with international corporations to attain funds for the establishment of upcycling centers.

3.5 Other factors influencing waste management behavior

According to Kurniawan et al. (2023) and Sunarti et al. (2021), to address the issue of waste management properly, the participation of households is indispensable. Thus, Al-Khateeb et al. (2017) reiterate that to enhance waste management, factors influencing participation in

sustainable/ waste management need to be properly understood. In this regard, this section unpacks some predictors that have been found to influence overall waste management behavior.

3.5.1 Level understanding

Knowledge, awareness and understanding of waste management play a crucial role in waste management behavior (Bautista, 2019; Handayani et al., 2018; Kurniawan et al., 2023; Selvakumaran and Wahid, 2022; Strydom, 2018b; Vinti et al., 2023). According to Whitmarsh et al. (2018), understanding the means through which sustainable waste management behaviors may be encouraged is crucial but still presents itself as a major challenge. Schoeman and Rampedi (2022) reiterate that for as long as there is a lack of understanding among various stakeholders in societies, fulfilling sustainable waste management behavior goals such as reduction and prevention remains impractical. Therefore, in order to establish the proper encouragement measures necessary for households to participate in sustainable waste management practices, understanding factors such as current household behavior is essential (Ariyani and Ririh, 2020).

In a study that assessed waste segregation behavior and knowledge, Selvakumaran and Wahid (2022) found that most respondents understood what waste segregation meant, how it is done and what its purpose is. However, Russell et al. (2017) emphasize that there is still a lot of work necessary to increase understanding of waste behavior. For instance, in terms of food waste, more understanding at the household level would encourage efforts toward waste reduction (Russell et al., 2017). In another example, Jacobsen et al. (2022) state that understanding the functions, qualities, and impacts of various packaging materials means that consumers are able to engage in the proper reduction of the related waste materials.

3.5.2 Current waste management practices

According to Fadhullah et al. (2022), moving towards sustainable practices requires the knowledge of current waste management practices to aid in making an accurate decision. Wu et al. (2022) state that waste management behavior is influenced by perceived behavioral control. For instance, households are less likely to engage in proper waste management practices when they are not satisfied with or do not have easy access to waste management services and infrastructure (Lazo and Gasparatos, 2022).

As stated by Ariyani and Ririh (2020), understanding current household behavior is crucial to establishing the relevant encouragement measures needed for households to engage in sustainable waste management practices. Additionally, Sunarti et al. (2021) show that when information about existing waste management behavior is collated and shared, positive behavior toward waste management may be intensified based on the social norms that are encouraged through this information.

3.5.3 Availability of resources

Waste management behavior may be influenced by the availability of the necessary resources, such as disposal facilities (Nuraini and Pertiwi, 2019). According to Raghu and Rodrigues (2020), the lack of and access to the necessary waste management resources may have a negative impact on an individual's will to participate in waste management practices. Additionally, Nuraini and Pertiwi (2019) and Srun and Kurisu (2019) show that inadequate facilities lead to uncontrolled waste, which is disposed of improperly. Moreover, a lack of sufficient waste management systems, which may include a lack of containers, inconsistent waste collection and poor cleaning services, also leads to improper waste management practices (Nuraini and Pertiwi, 2019; Srun and Kurisu, 2019). For instance, Nuraini and Pertiwi (2019) found that the insufficient access to infrastructure and waste transportation facilities in the village of study discouraged proper waste management behavior among respondents. Thus, these respondents opt to either burn or throw their waste into the river (Nuraini and Pertiwi, 2019).

According to Kaza et al. (2018) and Viljoen et al. (2021), there are generally not enough waste management resources at the local level; this is usually coupled with insufficient capacity for planning, development, operation and management of waste management systems. Additionally, issues related to sustainable waste management arise as a result, thus, negatively influencing the economy and vulnerable groups in society (Haywood et al., 2021; Kaza et al., 2018). Specifically, Kurniawan et al. (2023) and Lazo and Gasparatos (2022) report that when households are located far from waste management infrastructure or struggle to access such services, improper practices are used instead.

Fadhullah et al. (2022), Nuraini and Pertiwi (2019), Omotayo et al. (2020) and Saseanu et al. (2019) show that financial resources are also crucial in determining waste management behavior. In particular, Ferreira and Santana (2021) show that money is a crucial challenge

affecting the ability of low-income households to participate in sustainable behavior. Results from a study conducted by Omotayo et al. (2020) indicate that those households with access to social grants were more likely to participate in recycling and paying for waste management when compared to those households without access to these resources.

It is evident that households are more likely to pay for better waste management services if they have access to increased income (Omotayo et al., 2020). This is in relation to being able to afford to perform such behavior, based on the price of these products or services (Ferreira and Santana, 2021). However, Fadhullah et al. (2022) argue that it is those respondents with low incomes who are more involved in waste segregation. This is associated with waste picking activities which are mainly done by poorer individuals as a means of securing an income (Fadhullah et al., 2022).

3.5.4 Attitudes and perceived advantages/ rewards

In light of increasing rates of waste generation coupled with improper waste management practices, determining attitudes toward waste practices is crucial (Sunarti et al., 2021; Smith, 2020). Specifically, Lazo and Gasparatos (2022) and Smith (2020) show that this includes attitudes toward mitigation efforts like recycling and reducing waste. Attitudes are considered to be one of the most important aspects affecting behavior (Muniandy et al., 2021; Nuraini and Pertiwi, 2019). As an attribute of the TPB, attitudes speak to negative or positive feelings toward behaviors (Muniandy et al., 2021).

According to Al-Khateeb et al. (2017) and Smith (2020), attitudes towards sustainable waste management behaviors like separation at source and recycling have been found to be vastly influenced by factors such as the place of residence and socio-economic characteristics of the household. Positive attitudes toward sustainable behaviors are largely associated with positive behavior (Lazo and Gasparatos, 2022; Muniandy et al., 2021). Additionally, Nuraini and Pertiwi (2019), Selvakumaran and Wahid (2022) and Smith (2020) found that awareness and knowledge had a significant impact on attitudes toward participation in proper waste management.

For instance, Santoso and Farizal (2019) found the attitude attribute of the TPB to be the most important one in determining an individual's intentions and behavior in separating waste streams. Specifically, a lack of awareness has more influence on an individual's attitude and

behavior than an absence of concern for the environment (Smith, 2020). However, subjective norms, perceived behavioral control, and demographics do not seem to have as much of an impact on waste separation (Santoso and Farizal, 2019).

According to Sunarti et al. (2021) and Wu et al. (2022), when an individual expects a behavior to reap favorable consequences, their intentions to participate are increased, which also increases the probability of them actually participating. In a study conducted by Schoeman and Rampedi (2022), it was found that recycling benefits were an influencing factor in engaging in this behavior among households in Johannesburg, South Africa. Omotayo et al. (2020) show that waste may present economic advantages for households when opportunities, such as those related to recycling, are explored. However, according to Knickmeyer (2020), participation in municipal sustainable waste management activities is generally on a voluntary basis, therefore, a lack of economic reward.

Jacobsen et al. (2022) reiterate the crucial role played by personal resources that an individual has access to in waste management. These include and are largely reflective of the socio-economic standing of the individual (Jacobsen et al., 2022). For example, Fadhillah et al. (2022) show that waste pickers, who are generally poor individuals operating within the informal sector, have used this as a means of livelihood generation and obtaining extra income.

3.5.5 Perceived time and convenience/ effort considerations

According to Islam et al. (2022), convenience (for instance, when considering the location of waste collection points) was found to be an important determinant of inappropriate waste disposal behavior. Specifically, Kurniawan et al. (2023) and Lazo and Gasparatos (2022) found that when households are located far from waste management services and infrastructure, they tend to engage in practices such as burning and illegal dumping. Knickmeyer (2020) states that the inconvenience associated with the perceived difficulty of engaging in waste management practices such as waste separation discourages engagement. Therefore, in order to encourage the development of new sustainable waste management habits, the related infrastructure, services and systems need to be convenient for consumers to use (Jacobsen et al., 2022).

Moreover, positive attitudes, as well as sustainable waste management behavior, were found to be mainly determined by the practice being cost-effective, not time-consuming and convenient (Smith, 2020). Specifically, Strydom (2018a) found that the intention to participate

in sustainable waste management behavior was overridden by the behavior being practical to engage in. Thus, reaffirming that convenience is a requirement for engagement in proper waste management behavior such as waste reduction (Jacobsen et al., 2022; Strydom, 2018b). For instance, Jacobsen et al. (2022) and Strydom (2018b) show that the success of waste management systems and facilities is dependent on how convenient their use is for consumers.

In terms of time considerations, Fadhullah et al. (2022) found that individuals with lower levels of education attained were more willing to separate their waste streams at home. This is based on the fact that individuals with higher levels of education attained spend most of their time at work (Fadhullah et al., 2022); thus, they have less time to dedicate to such household activities. Additionally, Nuraini and Pertiwi (2019) add that employment has been associated with low waste management behavior. Specifically, Strydom (2018b) found that respondents who were employed full-time and part-time indicated not having time to participate in recycling.

Yadav et al. (2023) also identified similar barriers (divided into causal, potential causal and effective categories) that impede the adoption of smart and sustainable waste management practices in developing countries that undermine the circular economy:

- Causal barriers
 - Lack of strict government regulatory policies
 - Lack of proper financial planning
 - Lack of benchmarking processes
- Potential causal barriers
 - Difficulty in implementing innovative technologies
 - Absence of dynamic scheduling and routing
- Effect barriers
 - Lack of awareness among the community
 - Lack of source segregation and recycling commitment
 - Lack of service provider

Yadav et al. (2023) note that identifying and understanding barriers/ challenges in relation to sustainable waste management practices are central to assisting policy-makers and stakeholders to advance a sustainable circular economy agenda and develop policies, programs, campaigns, and other measures to achieve a zero-waste economy.

3.6 Waste management policy in South Africa

Godfrey et al. (2019) show that there are several international, continental and regional policies that have been established to tackle waste and pollution in Africa. These regulations are essential for the development of modern and efficient systems that are needed to transition into a green economy while also ensuring that public and environmental health are catered for (Siddiqi et al., 2020). Additionally, Kaza et al. (2018) state that approximately two-thirds of countries in the world have targeted legislation and regulations in place and are in line with the management of solid waste. However, the implementation and the progress that has been made in line with the objectives of many of these policies vary drastically and are not clear (Godfrey et al., 2019; Kaza et al., 2018). According to Kaza et al. (2018), five-to-ten-year national strategies are sometimes conceptualized by national governments. These policies are said to outline the country's waste position while also speaking to waste sector goals pertaining to critical aspects of sustainable waste management, including recycling, financing, awareness, advocating for a green economy, and decreasing the emission of greenhouse gases while also reintegrating contaminated waste management sites (Kaza et al., 2018).

The DEFF (2020) reports that waste management has been a challenge, especially when considering issues around landfills in South Africa. Specifically, landfill space is running out in the country (DEFF, 2020). According to Aryampa et al. (2019), when these spaces are used beyond their threshold, they end up portraying settings similar to open dumps. This poses a threat to the environment, explicitly to soil and water and, in turn, human health (Aryampa et al., 2019). Moreover, using landfill space beyond its carrying capacity also poses issues for human settlements, agricultural land and safe water resources when spaces meant for these purposes are used for waste disposal (Aryampa et al., 2019). Running and closing down landfills lawfully have been significant challenges in South Africa as far as licensing conditions of these landfills are concerned (DEFF, 2020). The DEFF (2020) elaborates that in terms of operational issues, there are great costs associated with this practice at local government, and communities close to possible landfill sites are usually opposed to having these sites nearby. It is thus of utmost importance that South Africa's waste management strategies speak to the diversion of waste from landfills (DEFF, 2020; Gutberlet, 2018).

Essentially, the aim is to divert waste from landfills by relying more on sustainable waste management strategies guided by the waste management hierarchy (DEA, 2012b). As already highlighted, the DEA (2012b) emphasizes that waste management should focus on waste

minimization as opposed to waste collection and disposal. According to the DEFF (2020), establishing a secondary resource economy based on waste being a benefit, and thus, part of the circular economy, is the basis of South Africa's strategy for relying less on landfills and more on sustainable waste management.

3.6.1 The National Waste Management Strategy (NWMS)

The NWMS 2011 and 2020, executed in line with National Environmental Management Act (NEMA) and the Waste Act, outline the South African government's policy and strategies for waste management in the country (DEA, 2019; DEFF, 2011; DEFF, 2020). Specifically, the NWMS stipulates measures to be taken to tackle the waste management issues faced by the country (DEFF, 2011). Municipalities in the country are expected to ensure that their ISWM plans align with the NWMS of the country (Umhlathuze, 2021). Additionally, the DEFF (2011) shows that the NWMS looks to find common ground between waste management stakeholders for enhanced waste management in the country. This is to be achieved through the adoption of the waste management hierarchy (Khan et al., 2022; Nyika et al., 2020).

The NWMS 2011 (the first NWMS in the country) was conceptualized under the National Environmental Management: Waste Act of 2008 (NEM: WA) to guard human health and well-being and the environment by applying the waste management hierarchy for sustainable waste management, while also remedying historical waste management inequalities in the country (DEFF, 2011). The objectives of this strategy were to encourage the implementation of the waste management hierarchy; enhance the delivery of waste management services; enhance the role of waste in the green economy; improve awareness of the effects of waste on human health and well-being as well as to the environment; strive towards efficient planning for integrated waste management; safeguard sustainable financing of waste management services; implement remediation methods for contaminated land; and ensure that the Waste Act is adhered to (DEFF, 2011). Here, a context is provided and outlines the roles and responsibilities of the various stakeholders, including those in government, private and public organizations, labor unions and communities (DEFF, 2011).

The NWMS 2011 was guided by eight goals. The DEFF (2011: 7) and the DEA (2019: 12) outline these goals as:

- Goal 1 - Promote waste minimization, reuse, recycling and recovery of waste

- Goal 2 - Ensure the effective and efficient delivery of waste services
- Goal 3 - Grow the contribution of the waste sector to the green economy
- Goal 4 - Ensure that people are aware of the impact of waste on their health, well-being and the environment
- Goal 5 - Achieve integrated waste management planning
- Goal 6 - Ensure sound budgeting and financial management for waste services
- Goal 7 - Provide measures to remediate contaminated lands
- Goal 8 - Establish effective compliance with and enforcement of the Waste Act.

Although the NWMS 2011 made great strides in enhancing waste management services, there is still evidence of backlogs in waste management service provision in certain areas (DEA, 2012b; DEA, 2019). This is specifically evident in informal settlements and rural or peri-urban communities (DEA, 2012b; DEA, 2019; Nukusheva et al., 2023). Additionally, and as previously stated, the NWMS 2011 was informed by the waste management hierarchy; however, there has only been restricted progress in preventing waste from going into landfills (DEA, 2019).

An important lesson learned from the NWMS 2011 is the requirement for proper provincial planning, organization and supervision of integrated planning for waste management infrastructure (DEA, 2019). One of the imperative objectives when revising the NWMS was to integrate important waste management stakeholders, including those in the informal sector, into municipal waste management services. The updated version of the NWMS 2011 is the NWMS 2020, which concentrates on avoiding the generation of waste and decreasing the amount of waste going to landfills (Umhlathuze, 2021).

The main principles that reinforce the NWMS 2020 include waste minimization, waste prevention, waste as a resource, sustainable strategic partnerships as well as environmentally sound socio-economic growth and development (Table 3.1). It is thus evident that this 2020 update focuses more on the waste diversion attributes of the waste hierarchy. Additionally, the specific expected outcomes of the successful implementation of the NWMS 2020 as outlined by the DEFF (2020: 23) are:

- Prevent waste, and where waste cannot be prevented, ensure - 40% of waste is diverted from landfill within 5 years; 55% within 10 years; and at least 70% within 15 years, leading to zero-waste going to landfills;
- All South Africans live in clean communities with waste services that are well managed and financially sustainable; and
- Mainstreaming of waste awareness and a culture of compliance resulting in zero tolerance of pollution, litter and illegal dumping.

The DEA (2019) and the DEFF (2020) state that the NWMS 2020 has been conceptualized based on the notion that waste is an essential industry that is influenced by technology and innovation to establish a secondary resource, despite waste being an environmental concern. The importance of adapting policies is particularly crucial for fully embracing a circular economy (Knickmeyer, 2020), as previously highlighted.

Table 3.1: The main principles reinforcing the NWMS 2020 (DEFF, 2020: 22 and 23)

Principle	Explanation
Waste minimization	This refers to avoiding the amount and toxicity of waste that is generated and, in the event that waste is generated, the reduction of the amount and toxicity of the waste that is disposed of.
Waste prevention	This refers to avoiding the generation of waste and avoiding toxicity in waste.
Waste as a resource	This refers to beneficiating waste through reuse, recycling, treatment and recovery to reduce the amount and the toxicity of waste disposed of.
Sustainable strategic partnerships	This refers to the government establishing and sustaining collaborative working relationships with non-government role-players involved in the management of waste, that is, the private sector, academia, civil society organizations and other development funding institutions.
Environmentally sound socio-economic growth and development	This refers to ensuring that the intent and commitments of the SDGs and NDP are continuously integrated and aligned to all environmental protection considerations and that environmental protection programs contribute to improving the socio-economic lives of people.

The NWMS 2020 is based on three pillars which are an update of the eight goals of the NWMS 2011 (DEA, 2019; DEFF, 2020; Schoeman and Rampedi, 2022; Umhlathuze, 2021). The DEA (2019) adds that these goals are aimed at communicating the main objectives of the Waste Act, which are waste minimization, effective and sustainable waste services, and compliance, enforcement and awareness; discussed next.

a. Waste minimization

According to DEFF (2020), waste minimization as a pillar focuses on reducing waste that goes into the coasts, rivers, wetlands and human settlements through initiatives that involve diverting waste away from landfills. The focus here is to enhance a secondary resources economy founded on waste as a resource to accomplish a circular economy (DEA, 2019). The second strategic thrust of this pillar is to enhance reuse, recycling, recovery and other proper waste treatments; lastly, it aims at improving the part played by the waste sector in the circular economy (DEFF, 2020).

Waste minimization relies on a successful and consistent partnership between the public and private sectors (DEFF, 2020; Sabri et al., 2013). It is expected that through this pillar, no waste will be going into landfill sites through short, medium and long-term goals (DEFF, 2020). To emphasize, as noted earlier, the 5-year target aims at achieving a 40% reduction in waste being taken to landfills; the 10-year target aims at reducing waste going into landfills by 55%; in 15 years the reduction would have reached 70% and eventually, zero-waste will be going to landfill (DEFF, 2020).

Figure 3.4 highlights the two entry points of waste minimization: waste prevention and waste as a resource (DEA, 2019; DEFF, 2020). Waste prevention was discussed in detail earlier. The DEA (2019) explains that waste as a resource incorporates measures aimed at enhancing a secondary resource economy using waste materials for recycling as well as material and energy recovery. This is seen as an economically viable strategy as it takes advantage of the commercial value of waste (DEA, 2019). Waste prevention and waste as a resource are important not only for the reduction of waste but also for the incorporation of waste into the circular economy to assist in minimizing the demand for virgin materials and to reduce the amount of waste going to landfills (DEA, 2019).

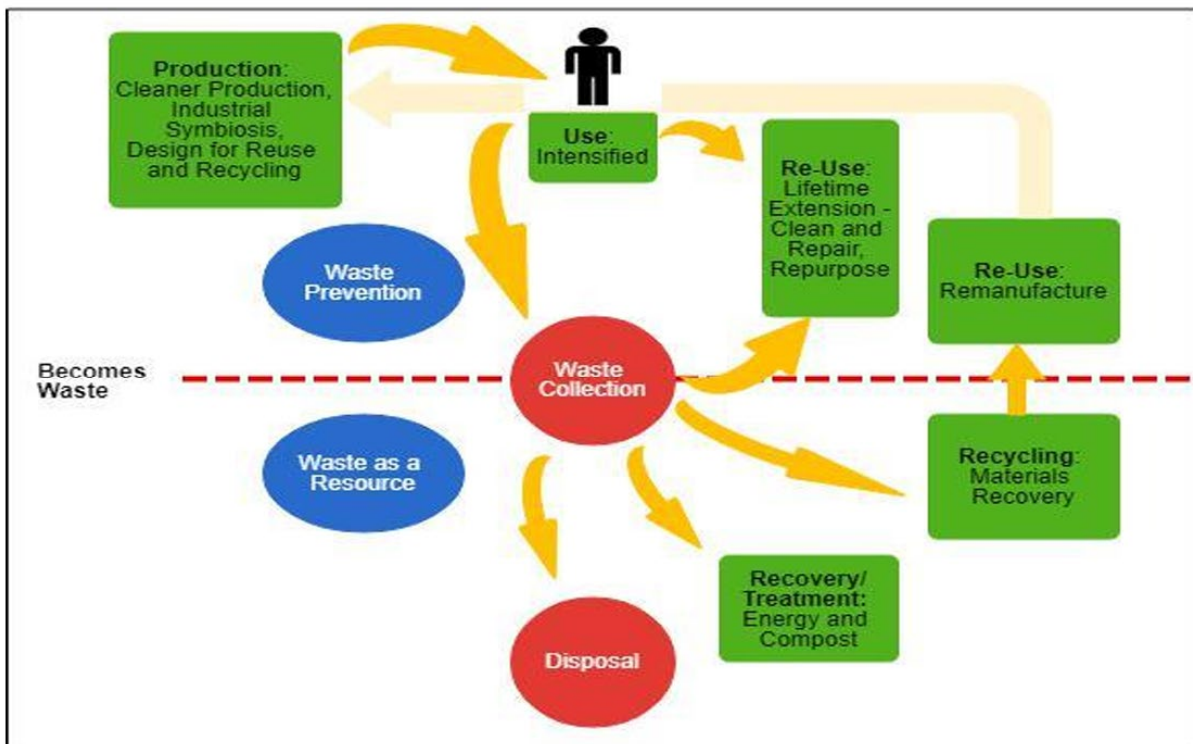


Figure 3.4: Depiction of the waste minimization activities (DEFF, 2020: 34)

b. Effective and sustainable waste services

This pillar aims to identify and deal with the varying circumstances and waste management issues that are evident across local government establishments (DEFF, 2020). The emphasis here is on the local government making sure that citizens have access to efficient waste management services and that sustainable development is supported through the delivery of waste management services (DEA, 2019). Secondly, the DEFF (2020) states that this pillar aims to establish flexible strategies for service delivery that will incorporate the informal sector while tackling the needs of communities. The third strategic thrust of this pillar is to lead public investment and relationships with private parties in waste management initiatives (DEFF, 2020). Lastly, here the intention is to ensure that sustainable development is enhanced through access to the delivery of waste management services (DEFF, 2020). It is envisaged that through this pillar, every citizen in South Africa will live in a clean community with proper access to waste management services (DEFF, 2020).

c. Compliance, enforcement and awareness

The emphasis of this goal is to alter attitudes and behaviors which influence a culture of compliance with local as well as international standards embedded among the general public, businesses and the government (DEA, 2019). The DEA (2019) states that this is to help manage the effect that waste has on the environment while also mitigating pollution. Here the strategic thrusts are to alleviate and avoid damages to the environment and society as a result of waste non-compliance; enhance compliance to legislation and standards at local, provincial, national and international levels; alleviate and avoid pollution, illegal dumping and littering; and ensuring that socio-economic and environmental benefits of compliance and proper waste management are visible (DEFF, 2020). The DEFF (2020) shows that through this pillar, it is expected that the awareness of every individual would be enhanced and that there would be a culture of zero pollution, littering and dumping tolerance which would lead to compliance.

3.6.2 eThekweni Municipality: Waste removal by-law, 2016

In addition to the NWMS and the various waste management strategies employed by the eThekweni Municipality (as discussed under Section 3.3), the Municipality further outlines the waste removal by-law (eThekweni Municipality, 2016b). In relation to household waste, this document highlights various aspects linked to the removal/ management of domestic waste, garden refuse, special domestic waste, bulky waste and building waste. Moreover, the document further reiterates the discussions in this Chapter around waste management plans/ strategies, disposal sites, enforcement and offences in the municipality.

In relation to waste removal services, the by-law states that it is the Municipality's responsibility to either collect and remove domestic waste or appoint an authorized waste removal contractor to collect waste on a day specified by the Municipality. Moreover, it is the household's responsibility to cater for the temporary storage for the waste generated in this home (eThekweni Municipality, 2016b). The Municipality may also use its discretion to provide bulk waste skips (this may be at a tariff charge) to households in instances where the bins being used are not suitable. In such circumstances, the municipal bins should only be used for temporarily storing household waste. Specifically, this waste must be stored in waste bins (that are kept in good condition and clean) until it is collected and removed by the Municipality. Waste generators are also permitted to sell recyclable waste, dispose of it themselves and use appropriate waste as compost within the premises within which the compost is generated.

All waste for collection must be placed immediately outside the home before 7 o'clock in the morning of the stipulated collection day. The bins and disposal bags need to be properly closed and not cause any obstruction (eThekweni Municipality, 2016b). Moreover, hot ash, unwrapped glass pieces, materials (such as liquids) that may make the bins strenuous to handle and any other material which may injure the municipal employee or may damage the bin or waste removal truck and any object that is not domestic waste (such as metal, timber rests, soil and rocks) are not to be discarded in waste bins (eThekweni Municipality, 2016b). Non-compliance may result in the waste in the bin not being collected or a fine being issued to the household.

The by-law further outlines that the Municipality must supply households with refuse bags at intervals determined appropriate. In this regard, households are obligated to line their bins with the bags provided as opposed to discarding of waste directly into the bin. Moreover, the by-law states that households are liable for a tariff charge for waste collection, removal and disposal. The Municipality does not collect garden refuse, special domestic waste, bulky waste and building waste (eThekweni Municipality, 2016b). The household must make arrangements to drop this waste off at a disposal site (at no charge) or use the garden refuse as compost on the premises. The Municipality does provide a special service upon request and at a payment to collect these waste materials from any premises. In terms of building waste, it needs to be stored adequately that it does not cause any pollution or nuisance and is not unsightly.

3.7 Sustainable/ waste management implementation challenges in developing countries and households

Issues around solid waste management include those dealing with economic, technological, institutional, socio-cultural and environmental attributes (Aryampa et al., 2019; Nyika et al., 2022). For instance, Dugbazah et al. (2021) and Kumar et al. (2017) state that issues such as the unavailability of skilled waste management professionals and the absence of sufficient training in efficient waste management are barriers to efficient waste management. Furthermore, Rodseth et al. (2020) show that the scarcity of consistent and reliable waste data, which incorporates informal sector contributions, poses great limitations to efficient waste management. Aryampa et al. (2019) show that when waste is unaccounted for, it creates gaps in waste generation approximations.

According to Aryampa et al. (2019) and Rodseth et al. (2020), waste management initiatives reported in waste data sources for countries like South Africa are sometimes misrepresented.

This is largely because significant contributions in data management, such as those from informal players, are often omitted or not accounted for correctly as a result of inequalities in access to formal waste management services across households of varying socio-economic standings (Rodseth et al., 2020). Needless to say, when not all waste management practices are represented in data, the effects of unregulated practices (those that happen outside of or are detached from formal waste systems) on societies and the environment are not considered, and so may result in adverse impacts when mitigation actions are not identified (Rodseth et al., 2020). Additionally, Aryampa et al. (2019) show that these gaps in waste data present boundaries in valuations of waste generation and management attributes.

As briefly discussed previously, several issues have been reported globally as far as finances in waste management are concerned (DEFF, 2020; Kaza et al., 2018; Godfrey et al., 2019; Nyika et al., 2020). According to Kaza et al. (2018), financing and operating waste management initiatives under public-private affiliations are not always successful, and so these partnerships are not always feasible. Moreover, since the operational costs of waste management need to be considered at the initial stages of waste management, it is often a great hurdle to finance these activities; this is more so the case for ongoing operational costs (Kaza et al., 2018).

For low-income countries, Kaza et al. (2018) report that operating expenses (including collection, transportation, treatment and disposal) come up to an estimated minimum of \$35 per ton as opposed to an estimated minimum of \$100 per ton for high-income countries. Additionally, costs such as those for waste management labor and transportation are generally high. Kaza et al. (2018) report an estimated average of \$20-50 per ton of waste for transportation. These financial barriers have also been recorded as constraints in the waste sector in Africa (Godfrey et al., 2019).

According to Babayemi et al. (2019), financing waste management in Africa has been a great constraint, especially in the adoption of proper waste management initiatives. Davis (2019) further highlights that the lack of advanced waste management systems in continents such as Africa hinders the financing, and establishment and delivery of waste management initiatives. For instance, Godfrey et al. (2019) show that the waste management sector in Africa needs investment finance, which has been a challenge since agencies, and the government who deal

with waste management and the logistics thereof, do not always fully understand project costing and cost recovery.

The DEFF (2020) elaborates that in South Africa, the financial capacity of the majority of waste management (especially sustainable waste management) of the local governments has been a great obstacle. As a result, operational costs such as employee salaries, capital expenditure, fuel and upkeep have been challenging to meet (Nyika et al., 2020). In turn, municipalities opt for the cheapest waste collection and disposal methods and struggle to implement sustainable waste management systems (DEFF, 2020).

Ineffective waste management policies coupled with insufficient municipal budgets allocated to waste management constrain the shift to efficient waste collection, storage, treatment and disposal (Dugbazah et al., 2021; Godfrey et al., 2019; Kumar et al., 2017; Orhorhoro and Oghoghorie, 2019). Aryampa et al. (2019) found that inconsistencies in transport availability, and inefficiencies in government authorities, have been found to impede waste collection. Aryampa et al. (2019) add that the enhancement of the ability of waste management authorities to manage waste is improving much slower compared to waste generation rates. For example, in terms of limited waste transportation, Aryampa et al. (2019) conclude that waste ends up being collected based on available vehicles as opposed to the amount of waste that needs collection.

The incapacity of many authorities to recognize waste as a resource is a challenge for the waste management sector as it means that sustainable practices are not taken into consideration or are not carried out efficiently (Oteng-Ababio, 2014). Additionally, the lack of understanding and misinterpretation of legislation, guidelines and policies have resulted in issues in waste management (Nyika et al., 2020). In line with this, when these policies are not coordinated and rolled out efficiently at the national, provincial and local levels, the execution of efficient waste management decisions and strategies is hindered (Nukusheva et al., 2023; Nyika et al., 2020).

Dugbazah et al. (2021), Kumar et al. (2017) and Smith (2020) outline the low motivation and general attitudes to waste management, as well as corruption, lack of planning, conflict and lack of political will as some of the hindering factors to innovative shifts to efficient waste management strategies and technologies. Godfrey et al. (2019) stress that the greatest of these concerns is a failure in governance. A study conducted by Wee et al. (2017) in Malaysia found

that some governance issues in waste management include inadequate expertise among staff members, insufficient funds and policy execution system vagueness.

3.8 Conclusion

This chapter has outlined an extensive overview of what constitutes waste, and waste management in relation to initiatives and practices. Additionally, in-depth discussions and arguments on sustainable waste management, specifically in a developing world context, are outlined, paying close attention to initiatives on the African continent and policy in South Africa. The next chapter provides an outline of the study area description, as well as the research design and methodological approaches and data analysis utilized in the acquisition and analysis of the research data for this study.

CHAPTER FOUR

DESCRIPTION OF STUDY AREA AND RESEARCH METHODOLOGY

4.1 Introduction

This chapter outlines the research methodology adopted for this case study research approach which focused on the Bluff area, within the SDB. Specifically, the chapter starts by describing the study area. Thereafter, the research design is outlined and discussed, followed by a discussion of the data collection tools; and processes employed as well as the data analysis.

4.2 Description of the study area

Bob et al. (2016) state that in South Africa and in many areas globally, housing areas and conditions provide an excellent indicator of social positions and relations in society. The SDB in eThekweni Municipality was purposively chosen as the case study as noted in the introductory chapter. The value of adopting a case study approach is elaborated on in the next section. The eThekweni Municipality is located in the KwaZulu-Natal province (Figure 4.1) on the east coast of South Africa (eThekweni Municipality, 2019; 2023; Stats SA, 2011). Bob et al. (2016) indicate that the SDB is located on the East coast of South Africa, where the largest and busiest port city on the African continent is situated. They further note that the SDB is in a low-lying flat basin that extends from the harbor to the Isipingo-Amanzimtoti area, which is in the south, asserting that the relatively flat coastal plain rises to the west and has a steep ridgeline to the south with a high coastal dune system to the east. Bob et al. (2016) further state that the area is bounded on the sea-ward side by the low Bluff ridge and on the north-west by the Bluff ridge.

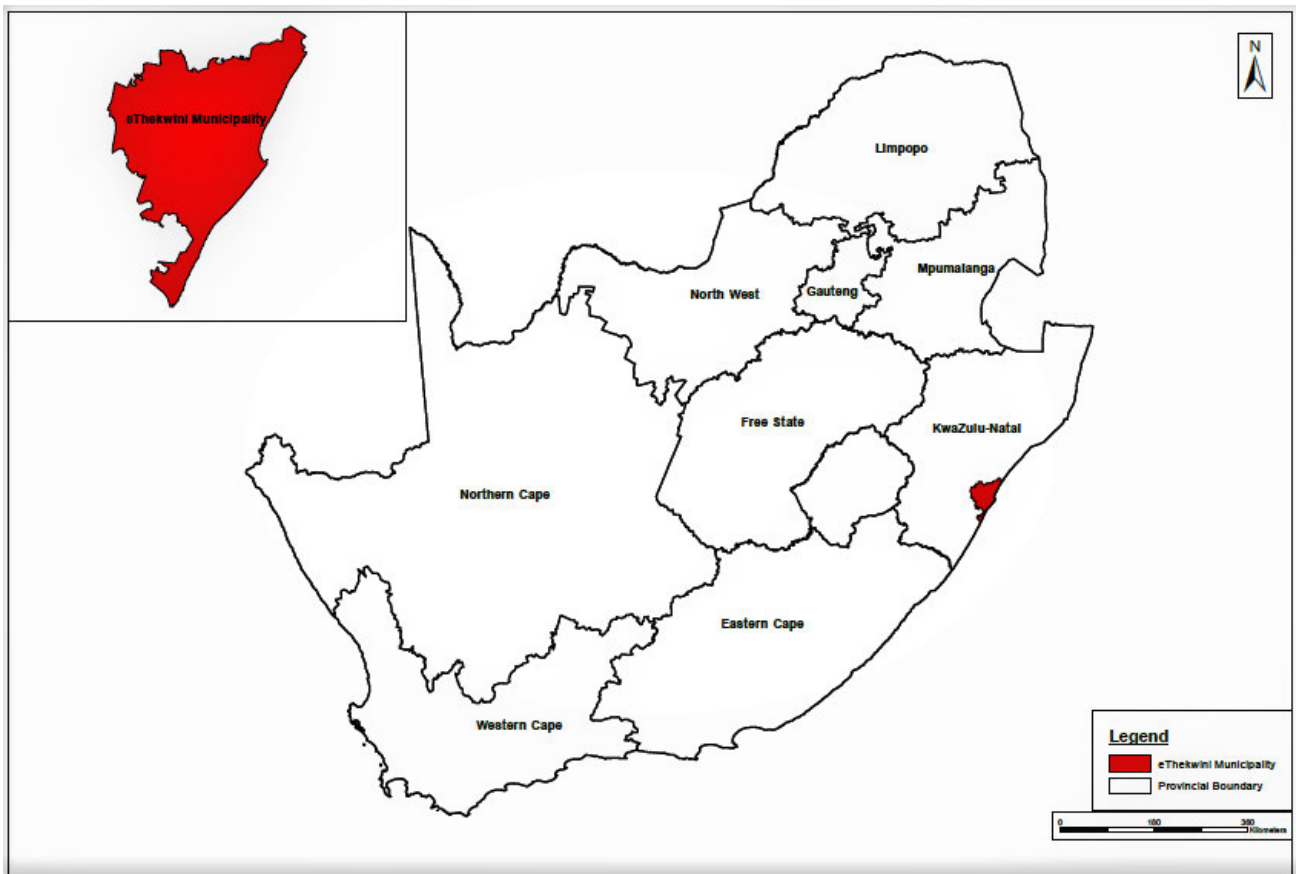


Figure 4.1: A map outlining provincial boundaries in South Africa and the eThekweni Municipality, located in the KwaZulu-Natal province (Author, 2022)

According to the eThekweni Municipality (2019; 2023) and Stats SA (2011), the eThekweni Municipality (Figure 4.2) covers an area of about 2 555 kilometers squares (km^2) and in 2016, was home to approximately 3.5-3.6 million people. Furthermore, the Municipality is home to approximately 956 713 households with an average household size of about 3.4 to 3.5 (eThekweni Municipality, 2023; Stats SA, 2011). Additionally, eThekweni Municipality accommodates a diverse society that is faced with a plethora of socio-economic, environmental and governance issues (eThekweni Municipality, 2019; 2023; Stats SA, 2011).



Figure 4.2: A map depicting the eThekweni Municipality within which Bluff, the study area, is situated (Author, 2022)

Adebayo et al. (2013), Bob et al. (2016), Jaggernath (2010) and the KwaZulu-Natal Gaming and Betting Board (KZNGBB, 2019) state that the SDB is located in the Southern eThekweni region, south of the Durban harbor and is a mixture of residential and industrial land use as well as key transport routes. Adebayo et al. (2013) indicate that the SDB was established by the apartheid government in the 1970s. The reason behind the establishment of the SDB was to create employment through advancements in industrial and economic productivity (Adebayo et al., 2013). Karmakar and Chetty (2023: 4) assert that the SDB is “the industrial powerhouse of the Durban metropolis, and the city’s continued development have been accompanied by an increase in environmental problems that adversely impact the standard of living of neighboring communities”. They further argue that residents in the SDB are subjected to slow violence having to endure “the stench of carcinogenic air inhaled daily by people of color in liminal zones like the SDB is a stinging reminder of the area’s escalating slow violence” (Karmakar and Chetty, 2023: 6).

With residential areas positioned in close proximity to industries, the SDB has seen a variety of issues associated with environmental pollution (Adebayo et al., 2013; Bob et al., 2016; Firmin, 2019; Jaggernath, 2010; Karmakar and Chetty, 2023). Thus, atmospheric pollution as a result of chemicals like sulphur dioxide (SO₂) from petrochemical companies has been the biggest challenge faced by residents within the SDB (Adebayo et al., 2013; Firmin, 2019; Jaggernath, 2010). It is evident that this area is still largely subjected to the impacts of the apartheid era, which culminates in the current social and environmental injustices prevalent in the area (Firmin, 2019). Karmakar and Chetty (2023) state that the SDB is an example of environmental injustice in South Africa, specifically where industrialization practices and policies implemented during the apartheid era led to environmental degradation that disproportionately impacts Black people. Therefore, as also seen in the greater eThekweni Municipality, the residents of these communities have to live in detrimental socio-economic and environmental settings (Jaggernath, 2010). Karmakar and Chetty (2023) further note that the policies of apartheid industrialization led to unhygienic and hazardous working conditions for black people and that racially segregated residential neighborhoods, clearly evident in the SDB, were frequently located in close proximity to and downwind of heavy industry. These areas also exposed mainly Black people to environmental hazards (such as chemical factories) and waste disposal sites, degrading natural ecosystems in the area and undermining human health and well-being.

The Bluff area (Figure 4.3) is situated within the SDB, in the Southern region of the eThekweni Municipality (KZNGBB, 2019). The Bluff area includes the communities of Grosvenor, Kings Rest, Brighton Beach, Ocean View, Treasure Beach, Fynnland, Merebank, Wentworth and Merewent (KZNGBB, 2019). The communities of Cave Rock, Van Riebeeck Park, Austerville and Stanvac also fall under the Bluff area. The KZNGBB (2019) and Frith (2011) report that the Bluff covers a land area of 21.68 km² and is home to an approximated population of between 62 124 to 68 124 people and 18 331 households.

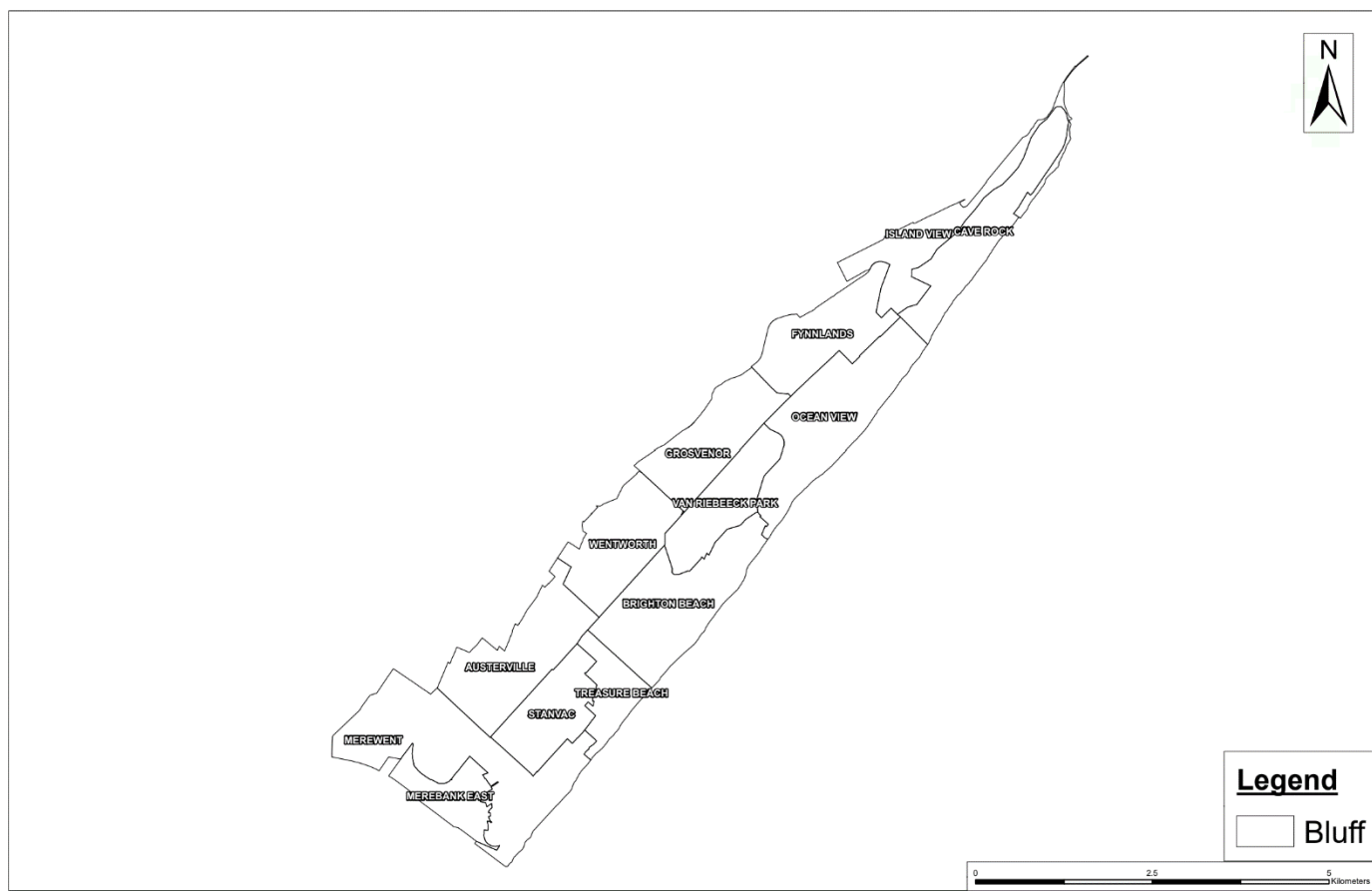


Figure 4.3: A map depicting the Bluff area and the communities located within the area (Author, 2023)

Frith (2011) states that the Bluff is composed of about 52% females and 48% males. In terms of racial composition (historical population group), the community is made up of about 37% Colored, 30% Indian/ Asian, 17% White and 16% Black African (KZNGBB, 2019; Frith, 2011). The dominant first language is English (80%), followed by isiZulu and Afrikaans at 8% and 7%, respectively (Frith, 2011). When looking at socio-economic standing, the KZNGBB (2019) shows that the majority (63%) of households fall under middle-income, 22% of households in the low-income and 1% are in the high-income categories.

In terms of waste management, the eThekweni Municipality (2019) reiterates that landfilling is the main solid waste disposal within this Municipality. According to Walford (2019), the DSW provides domestic refuse bags to residents and subsequently collects residential waste weekly. The DSW also cleans the streets and also removes and disposes of garden refuse (Walford, 2019). Additionally, the eThekweni Municipality (2019) states that the DSW has been tasked

with guaranteeing that through the waste sector, initiatives that aid in recovering materials and decreasing carbon emissions are implemented. For instance, as noted earlier, two landfills within this Municipality are sites of the first landfill gas-to-electricity projects in Africa (eThekweni Municipality, 2019). However, Ndebele and Du Plessis (2018) argue that eThekweni has been faced with improper waste management challenges, which have resulted in inefficient practices. Some of these waste management issues include the lack of waste segregation and illegal dumping (Menyuka et al., 2020; Ndebele and Du Plessis, 2018). The lack of proper waste management practices ends up costing the Municipality a lot of money (approximately R180 000 000 per year) to remove waste and rehabilitate sites of improper disposal (Ndebele and Du Plessis, 2018).

As discussed previously, Majola (2021) and Ndebele and Du Plessis (2018) also reiterate that the Municipality is responsible for most of the community waste removal, which is done weekly. Majola (2021) and Mthembu (2021a) add that regardless of this service, illegal dumping and littering are still largely problematic. This is more so the case within informal settlements in the eThekweni Municipality (Majola, 2021). For instance, Majola (2021) finds that residents in the informal settlement of Redhill end up dumping waste illegally because they have to buy refuse bags, as opposed to these being given for free by the Municipality. Additionally, in the Bluff area, Mthembu (2021b) shows that littering and illegal dumping have been perpetuated by the lack of inaccessibility to sufficient fixed bins on the streets.

Reports in other communities within the Municipality show that residents have complained about waste not being consistently collected in certain streets (Majola, 2021). For instance, similar reports were made by Mthembu (2021a) regarding waste collection and improper dumping issues in the Bluff area. Moreover, Majola (2021) finds that when animals such as dogs have torn through refuse bags of uncollected waste, these bags are left behind when collection does take place. Majola (2021) and Mthembu (2021a) further report that the eThekweni Municipality has noted this issue to be exacerbated by an influx of people into informal settlements as well as COVID-19 restrictions and regulations.

4.3 Research design

4.3.1 Methodology

According to Sileyew (2019), research methodology is the route taken to conduct research. Goundar (2012) states that research methodology is an account of the methods undertaken to

conduct a study. Specifically, this is the pathway used to devise research issues and objectives, as well as data collection and the presentation of results (Sileyew, 2019). Additionally, methodology incorporates researching specific techniques that will be appropriate for the particular study (Goundar, 2012). Thus, research methodology is an umbrella term for the organized procedures adopted to undertake a study (Goundar, 2012). Methods, on the other hand, are the specific plans of action that are adopted in the research study (Goundar, 2012). The following section outlines and discusses the reasons behind the philosophy, approach and methods adopted to fulfill the aim and objectives of the study.

4.3.2 Research philosophy and approach

This study adopts the pragmatism research philosophy. According to Cordeiro and Kelly (2019), pragmatism is a research approach utilized for the assessment and interrogation of thoughts and opinions concerning their empirical functioning. Specifically, Saunders et al. (2019) explain the pragmatic approach from an ontology perspective that reality is multifaceted, abundant and exists externally as a result of fluctuating processes, ideas, experiences and procedures. Here, Saunders et al. (2019) note that various methods of analyzing the world and doing research exist and that considering several perspectives is essential.

Dawadi et al. (2021) and Takahashi and Araujo (2020) explain that a research paradigm includes the researchers' epistemology and ontology assumptions that lead the research procedure. In the lens of epistemology, the assumptions are based on what admissible knowledge is made up of (Saunders et al., 2019). In relation to pragmatic research, epistemology speaks to the empirical sense of knowledge from a specific perspective (Saunders et al., 2019); in the context of this study, this refers to the practical meaning of waste management at the household level. Additionally, epistemology states that 'true' knowledge and philosophies in pragmatism are those that allow for lucrative action (Cordeiro and Kelly, 2019; Saunders et al., 2019).

Pragmatism utilizes various methods to recognize a challenge and offer empirical solutions to guide future practice (Dawadi et al., 2021; Saunders et al., 2019). Thus, allowing for the provision of a wider platform to tackle dynamic and complex research issues to produce varied outcomes (Cordeiro and Kelly, 2019). Specifically, Dawadi et al. (2021) add that the specific research problems steer the methods used in the study. Additionally, subjective and objective

types of knowledge are equally important to meet the objectives of the study (Dawadi et al., 2021). Therefore, the study utilizes mixed methods, specifically the triangulation methodology approach.

4.3.2.1 Mixed methods

Thattamparambil (2020) defines mixed methods as data collection instruments that embrace both numerical quantifications and in-depth examination. Specifically, the choice of the mixed method includes gathering, evaluating, explaining and reporting on qualitative and quantitative data (Dawadi et al., 2021). In this design, the quantitative methods obtain the study results using research strategies like surveys, whereas qualitative methods derive results through strategies like interviews (Dawadi et al., 2021). Undertaking research relying on mixed methods is advantageous in that both the quantitative and qualitative approaches present vital elements that enhance the overall results of the study. Dawadi et al. (2021) stress that because quantitative research allows for the collection of large sample sizes, more reliable generalizations may be made for a wider population. With qualitative approaches, the participant's perspectives are honored through the in-depth understanding of research issues afforded by the strategies used (Dawadi et al., 2021). Thus, Dawadi et al. (2021) and Tenny et al. (2017) reiterate that qualitative data offers depth to a study while quantitative data presents breadth.

It is therefore evident that both qualitative and quantitative methods are valuable, and although different, may complement each other, thus using both concurrently is advantageous in that it provides better insights on issues that cannot be holistically comprehended by only one research strategy (Dawadi et al., 2021). Combining both approaches also means eliminating the weaknesses of the individual methods while capitalizing on their respective strengths to draw more precise conclusions (Dawadi et al., 2021). Thus, ideally, integrating both qualitative and quantitative methods is preferred for research to be considered comprehensive (Goundar, 2012).

4.3.2.2 Quantitative and qualitative methods

Apuke (2017) defines quantitative research methods as those that acquire results through the quantification and analysis of variables. Apuke (2017) adds that statistical analyses are conducted when phenomena are brought to quantitative values. Specifically, Gupta and Gupta (2022), Tenny et al. (2017) and Thattamparambil (2020) show that in quantitative studies,

numerical data points are collected, hypotheses are tested, or treatments are introduced. Explicitly, quantitative research, as the term suggests, is embedded in quantifying or measuring subjects (Goundar, 2012). Questions such as how many or how much as well as who, where, when, and what are answered through the use and analysis of numerical data using statistical techniques (Apuke, 2017; Tenny et al., 2017). Quantitative research generally tests hypotheses, makes forecasts and analyzes cause-and-effect relationships (Apuke, 2017).

Contrary to quantitative methods, qualitative research is mainly descriptive, relying on words and the application of reason as opposed to being numerical (Goundar, 2012). According to Apuke (2017), Gupta and Gupta (2022), Teherani et al. (2015) and Thattamparambil (2020), qualitative research aims to comprehend and interpret interactivities in society. These phenomena may include how people or individuals behave, interact, and how they shape relationships as well as how people encounter and perceive various characteristics of their lives, which may be difficult to ascertain quantitatively (Teherani et al., 2015; Tenny et al., 2017). The goal here is to explain using descriptions, find meaning and ascertain feelings or relationships (Goundar, 2012). Apuke (2017) states that non-numerical data is gathered for the purpose of qualitative research. In these research methodologies, questions such as why and how are answered (Busetto et al., 2020; Tenny et al., 2017).

Several recent studies on waste management specifically have been conducted in the last four years using the mixed methods approach that reflects the importance and relevance of adopting this methodological approach. For example, Esmaeilizadeh et al. (2020) embraced a mixed methods approach (specifically a scoping review adopting a quantitative design and Delphi technique drawing on key informant interviews as the qualitative aspect) to assess perspectives on the challenges of municipal solid waste management in Iran. Yadav et al. (2022) used qualitative (semi-structured interviews) and quantitative (structured survey) methods to understand individuals' motivators and barriers to e-waste recycling. Similarly, Nisha et al. (2022) conducted qualitative (semi-structured interviews with eight selected consumers) and quantitative (structured survey with 350 participants) methods to examine consumer awareness and perceptions about e-waste management. Yadav et al. (2023) examine challenges to smart waste management for a sustainable circular economy in developing countries by adopting a mixed methods approach and undertaking a comparative analysis. Specifically, they used a qualitative component of the research entailed using an extensive literature review and discussion with selected experts to identify barriers to the adoption of smart waste

management. The quantitative analysis used by Yadav et al. (2023) included using the Fuzzy Decision-Making Trial and Evaluation Laboratory method on selected barriers to prioritize the most significant causal barrier by separating them into the cause-effect group.

4.3.2.3 Triangulation

Triangulation is essentially the use of both qualitative and quantitative approaches, which strengthens the study methodology and results (Dawadi et al., 2021). Ndanu and Syombua (2015) state that the term triangulation may be used interchangeably with mixed methods. This is mainly because triangulation essentially means mixing different methodologies to study one thing; the results here may overlap, complement each other or contradict each other (Ndanu and Syombua, 2015). Dawadi et al. (2021) add that using the quantitative and qualitative approaches simultaneously yields triangulated results. In this sense, triangulation eliminates the risks that may be associated with relying on one method relating to generating data, intrinsic bias or methodological strategies, which may negatively impact data analysis (Joslin and Müller, 2016).

The present study adopts methodological (also called mixed) triangulation, whereby quantitative and qualitative methods are adopted concurrently. Specifically, this type of triangulation uses more than one method to conduct the research (Joslin and Müller, 2016; Ndanu and Syombua, 2015). Specifically, Ndanu and Syombua (2015) state that methodological triangulation encompasses the use of several quantitative and/ or qualitative methods to conduct research. The between- or across-method triangulation, using both qualitative and quantitative methods, is specifically used in the context of this study. As previously discussed, Ndanu and Syombua (2015) reiterate that individual research methods possess positive and negative attributes, thus, using more than one method is preferred in the context of triangulation as it enhances the validity of the results.

4.3.2.4 Case study

Crowe et al. (2011), Harrison et al. (2017), Ramchander (2018) and Thattamparambil (2020) define a case study approach as one that researchers utilize to get deeper and more comprehensive insights into a multi-faceted topic in a specific real-world context. This research design is used widely in several fields, specifically within the social sciences (Crowe et al., 2011; Harrison et al., 2017). Additionally, Crowe et al. (2011) and Lucas et al. (2018) elaborate that there are three prime case study types. The first, which is employed in this study, is the

instrumental case study which employs a specific case to obtain a wider perspective of a particular phenomenon (Crowe et al., 2011). In contrast, the intrinsic case study is used to gain more knowledge on a distinctive case; here, the distinctiveness of the phenomenon needs to be clearly defined (Crowe et al., 2011; Lucas et al., 2018). The third case study discussed by Crowe et al. (2011) and Lucas et al. (2018) is the collective case study, which is used to examine several cases at the same time or consecutively in order to gain a wider perspective of a certain phenomenon by inquiring variabilities within and between these cases.

Since case studies investigate specific cases, they are able to gain information by answering questions related to how, why and what of a particular issue (Crowe et al., 2011; Lucas et al., 2018). Thus, by offering a variety of perspectives, this approach is able to gain complex perspectives to help bridge gaps in a specific topic (Crowe et al., 2011; Lucas et al., 2018). Moreover, this approach allows for flexibility and thus can speak to several research questions while also emulating the adaptability of different contexts (Lucas et al., 2018). Researchers are further able to learn from the research participants through a case study as participants are offered the opportunity to explain and outline their experiences (Lucas et al., 2018).

4.4 Research questions

The aim of this study, as outlined in chapter one, was to undertake a comprehensive examination of household waste management practices in the Bluff area to assess sustainability considerations and inform future intervention strategies. To fulfill the aim and objectives of the study, the research utilized the research philosophy, approaches as well as data collection tools, processes and data analysis methods outlined in the current chapter. Specifically, the following research questions were addressed:

- What are the socio-economic profiles of the households within the Bluff area?
- Which waste management practices do households engage in and how are the practices used influenced by socio-demographic variables in the Bluff area?
- What are the household profiles in relation to the use/ consumption patterns of energy?
- What are the household profiles in relation to the use/ consumption patterns of water and sanitation facilities?
- What are the household profiles in relation to the use/ consumption patterns of waste disposal facilities or services?
- What are the current household waste management practices in relation to solid waste?

- What are the current household waste management practices in relation to water and sanitation?
- What are the current household waste management practices in relation to organic/ refuse waste?
- What are the current household waste management practices in relation to e-waste/ energy?
- What are the respondents' levels of awareness and understanding of sustainable waste management practices and the benefits thereof?
- To what extent are residents using sustainable/ green/ environmentally responsible waste management practices?
- How willing are residents to adopt/ use sustainable waste management practices?
- How willing are residents to pay for sustainable waste management practices and, if so, how much are they willing to pay?
- What are the challenges experienced in residential areas that constrain the shift to embracing more sustainable waste management practices?

4.5 Data collection tools and processes

As already discussed, both qualitative and quantitative methods were used to obtain the primary data for this study. Additionally, secondary data was acquired through the use of literature and secondary data sources. Specifically, peer-reviewed literature was used from journal articles, books, and other relevant proceedings, websites, reports, documents relating to waste generation, waste management (and in particular waste management practices), waste management policy in South Africa, as well as problems that constrain the use of sustainable/ waste management in developing countries and households. The following section outlines the primary data collection tools and processes followed for the purpose of the study.

4.5.1 Questionnaire surveys

Thattamparambil (2020) defines surveys as methods of data collection generally encompassing multiple choice and/ or rating questions. The goal of a survey is to analyze a population sample to make conclusions about a population (Gupta and Gupta, 2022; Young, 2015). Roopa and Rani (2012) and Young (2015) state that survey methodologies that rely on questionnaires are commonly used in quantitative social sciences and offer copious quantities of data that may be analyzed with ease.

Roopa and Rani (2012) emphasize that questionnaires are the pillar of every survey. Farnsworth (2021) and Roopa and Rani (2012) define a questionnaire as questions outlined with the aim of collecting specific information pertaining to encounters, behaviors and opinions of individuals for the purpose of acquiring statistically useful information. Additionally, Roopa and Rani (2012) state that questionnaires are crucial as, through them, accounts may be drawn about specific entities or groups.

Farnsworth (2021) adds that questions on a questionnaire instrument need to be probed in varying levels of detail and asked in a particular manner. Additionally, for the survey to adequately imitate the perspectives and opinions of participants, it is essential that the applicable questions are asked, that these questions are arranged precisely, and that correct scaling is used (Brace, 2018; Roopa and Rani, 2012; Taherdoost, 2022). Brace (2018) and Roopa and Rani (2012) show that questionnaires allow for the gathering of quantitative data in a manner that is consistent and articulate for analysis. For instance, questionnaires allow for the processing and analysis of data comparatively easier than data that has to be recorded and transcribed first and then analyzed (Young, 2015).

For this study, a household waste management questionnaire was administered (Appendix 1). In this regard, the questionnaire was designed to encompass both closed- and open-ended questions; these were included under the following sections:

- Socio-economic and demographic profile of respondents
- Profile of water and sanitation, energy and selected solid material of the households
- Respondents' awareness and perceptions of sustainable waste management practices
- General questions

The questionnaire comprised of different sections to ensure that enough information was captured about the respondents' socio-economic and demographic profile, that is, their household size, age, categories, the highest level of formal education attained, and employment status of members of the households. Additionally, the household's monthly source of income and who the decision-maker/s in the household is/ are were probed. Section B probed into the households' water and sanitation, energy and selected solid material generation profiles. This section aimed to examine the households' sources of water, sanitation facilities and energy; to understand the frequency of generation of and disposal facilities or services or methods used

for specific waste types; and how the COVID-19 pandemic has affected the generation of specific waste types in the households. Additionally, the section investigated whether or not households engaged in specific sustainable practices and, if not, reasons for non-engagement were examined.

The respondents' awareness and perceptions of sustainable waste management practices were outlined in Section C. Specifically, this section examined respondents' awareness of sustainable waste management practices and facilities or methods, and their perceptions of these; previous and current engagement in specific practices, and reasons for disengagement; as well as costs related to the use of such practices and future willingness-to-use and pay for specific practices.

Lastly, Section D asked for any comments or issues the respondents had in relation to waste management practices in the household and in the community. This was important in order to gauge any further information that may not have emanated from the close-ended questions in the previous sections, thus, gaining a further understanding of household waste management issues in the Bluff area. Details on the aforementioned topics were critical for proper data analysis.

4.5.2 Key informant interviews

According to Thattamparambil (2020), interviews are data collection instruments that include asking respondents open-ended questions. Taylor and Blake (2015) define key informant interviews as comprehensive conversations, best guided by specific questions, with individuals deemed to possess unique knowledge on a subject matter. Additionally, these interviews provide a comprehensive lens on a certain topic using experts with varying perspectives (Taylor and Blake, 2015).

According to Lokot (2021), key informant interviews are an integral instrument of qualitative research as they hold and enhance vital expertise and value. Additionally, Lokot (2021) shows that this knowledge is produced due to the position and proficiency of the key informant, which suggests that the individual has a sound grasp of the subject matter and so can represent their communities. Specifically, Cossham and Johanson (2019) state that key informants are individuals who provide a specific outlook on a phenomenon that they are knowledgeable

about. Although they are not necessarily the study participants or subjects, they help enhance the researcher's insights and thus help decrease possible bias (Cossham and Johanson, 2019).

Key informant interviews allow for the collection of thorough and detailed data, which may be done in an adaptable manner that permits questions to be left out or extended (Taylor and Blake, 2015). Additionally, Cossham and Johanson (2019) state that this research tool offers a qualitative view of a phenomenon. In particular, the information offered through these interviews helps supplement information about the subject matter or from participants where these participants are not able to contribute the full perspective (Cossham and Johanson, 2019). Thus, key informant interviews are frequently used to enhance other research tools, such as surveys (Lokot, 2021).

For this study, six key informant interviews were conducted. Specifically, two of these were with eThekweni Municipality waste management officials (who were familiar with the strategies developed by the municipality and the challenges associated with waste management in the city) (Appendix 2), two with non-government and civil society organizations in the SDB (as noted earlier, the SDB is associated with high levels of environmental activism and these individuals are well positioned to provide insights on waste management practices in the area) (Appendix 3), and lastly, two with researchers (who had undertaken environmental sustainability research in the SDB) (Appendix 4). As stated in chapter one, these interviews were used to unpack some of the policy and application dynamics related to household waste service provision in the SDB and specifically, the communities within the Bluff area.

4.5.3 Sampling framework

According to Tuovila (2020), sampling is an important element of statistical analysis that is used to determine a certain number of subjects chosen from a population. For this study, a multi-stage sampling framework was adopted to select a sample of 400 households, deemed to be statistically significant in relation to the number of households, from the Bluff population for the quantitative portion of the study. Specifically, these households were randomly selected using spatially based random sampling through the GISGME tool. The GISGME tool was used to generate points that were randomly selected on a map of Bluff, and the nearest house to the chosen point was then approached. This method was adopted to ensure a geographical spread that included households from diverse locations and socio-economic groups, thereby reducing bias. If a consenting adult (18 years of age and older) was available, then a survey was

administered. In households where an adult was not available or did not consent to participate, the nearest neighbor was approached. Additionally, six key informants were purposely selected for the qualitative portion of the data collection for reasons indicated earlier.

The Bluff and the broader SDB were purposefully selected given the perceived vulnerability of the community and specifically, households within the community. The Bluff area represents a typical community in South Africa. Additionally, these households encompass high-, middle- and low-income and informal residents, which allows for comparisons of the intra-community heterogeneity to be conducted. Moreover, as discussed in chapter one, limited research has been carried out to reflect on comprehensive waste management practices in this area. For the most part, studies tend to focus on specific waste streams instead of analyzing the main residential waste streams in their entirety. Furthermore, when looking at sustainability considerations, the focus is hardly on households of different socio-economic standing, and it often considers air pollution and related issues in the SDB as it is an industrial hub.

According to Middleton (2019), the caliber of a research study is assessed using validity and reliability. Goundar (2012) and Middleton (2019) explain that validity is a means of confirming that research methods have been conducted following accurate procedures. Additionally, reliability essentially looks at whether the methodology is of acceptable quality and allows for precision and repeatability (Goundar, 2012); thus, ensuring the consistency of the methods adopted (Middleton, 2019). According to Smith and Noble (2014), bias affects the validity and reliability of a study. Specifically, bias may impact the result and interpretation of data (Smith and Noble, 2014). Therefore, eliminating bias is crucial because it means that study conclusions may be drawn without the researcher's personal interests to either purposefully focus or obscure something (Goundar, 2012).

Given the above information, bias needed to be eliminated to ensure validity and reliability in the data collected. In particular, questionnaires were completed by 10 trained fieldworkers during the day, some on weekdays and others on weekends to cover the whole spectrum of the socio-economic variables within the communities as per the survey. The fieldworkers were trained to ensure that they were familiar with the questionnaire. Additionally, they were proficient in English and isiZulu to accommodate the main languages used in the area. Thus, there were no communication issues. This strategy was also to minimize any bias in the responses obtained. Furthermore, given the fact that Bluff has 18 331 households, the sample

size of 400 households was deemed statistically significant at the 95% confidence level with a 5% margin of error.

4.6 Data analysis

The data for the quantitative portion of the study was captured, coded and analyzed using the SPSS version 27. Data was discussed thematically in relation to the study objectives and research questions, where open-ended responses were also coded into different themes for ease of capturing and analysis. Thematic analyses are also aligned with the approaches adopted by Nisha et al. (2022) and Yadav et al. (2022; 2023), who also used mixed methods research designs. Descriptive and inferential statistics were utilized for the analysis of the data. Inferential statistics were used to compare and measure differences and deduce whether or not there were any statistically significant associations between the waste management practices employed by the households of different socio-economic standing within the Bluff area.

The data for this study was predominantly categorical, thus, the non-parametric Pearson's chi-square test of independence was used to examine differences across variable categories. Data was presented as cross-tabulations which were then subjected to Pearson chi-square tests to highlight column proportions that were significantly different. Independent variables such as gender, age, and income were used to disaggregate various categories of perception and behavior concerning ISWM at the household level. Furthermore, descriptive statistics were used to depict the analyzed data trends and associations on graphs and tables.

4.7 Ethical consideration

Ethical clearance for the study was granted by the University of KwaZulu-Natal (UKZN) Human Social Science Research Ethics Committee (HSSREC – approval protocol number: HSSREC/00002709/2021) (Appendix 5) and, thus, abided by all guidelines related to the conduction of research that deals with human subjects. Respondents and key informants gave consent to participate in the research after they were made aware of the details of the study, the role they play through their participation and that all the information they provided will be used for research purposes only. Furthermore, the participants were informed that their anonymity and confidentiality would be ensured at all times and that their participation was voluntary and they had the right to choose not to participate at any given point of the survey or interview.

4.8 Study limitations

Due to time, resource and cost limitations, the study was limited to one area and one province. Therefore, the research findings when generalized to the rest of the communities and provinces in a country, such as South Africa, with varying demographic and socio-economic details, historic contexts, waste generation issues, waste management facilities and opportunities need to be done with caution. However, the study does shed light on comprehensive waste management practices at the household level, while also considering the main residential waste streams in their entirety and intra-community heterogeneity.

Although there was a comprehensive examination of household waste streams, the study did not extend to quantifying the amount of waste generated, as this was beyond the scope of the study. Additionally, the study relied on self-reporting surveys and interviews, thus, the researcher did not assess the quality of the infrastructure in terms of energy supply, water and sanitation and waste disposal facilities. As in the case of many household studies, the socio-demographic profiles of the respondents (who respond on behalf of the household) are used as a proxy for perceptions linked to responses (especially when examining differences in categories using P values as described earlier), given that this is a self-reported study. As noted above, the responses were not validated by observation or any other methodology. Undertaking 400 surveys to improve statistical significance also contributes to the validity of the results, addressing the limitation.

4.9 Conclusion

The chapter outlined a description of the SDB and, in particular, the Bluff area. Moreover, the study methodology and data analysis adopted were outlined. Specifically, the various approaches using both qualitative and quantitative methods were extensively discussed in relation to their relevance in this study. The next chapter provides an analysis and discussion of the data used for this study.

CHAPTER FIVE

DATA DESCRIPTION AND ANALYSIS

5.1 Introduction

This chapter outlines the results obtained from the analyses of the data collected for the study. Moreover, these results are discussed extensively in relation to current and relevant literature. The aim of the study was to undertake a comprehensive examination of household waste management practices in the Bluff area (eThekweni Municipality, South Africa) to assess sustainability considerations and inform future intervention strategies. To achieve this and the objectives of the study, a mixed methods triangulation approach was assumed. The results and discussion are explored under different themes. Specifically, the first broad theme is the socio-economic and demographic profile of respondents and households. This is followed by the profiles of water and sanitation, energy as well as selected material use among the households. Lastly, data on the respondents' awareness and perceptions of sustainable waste management practices are analyzed and discussed.

In terms of data analysis, frequency tables were generated and cross-tabulations using chi-square tests were used where applicable to compare column proportions of the same categories and to ascertain any significant differences in categories between appropriate variables. As discussed previously, data from questionnaire surveys and key informant interviews were used to obtain the results of this study. Specifically, 400 face-to-face interviews were completed in different communities within the Bluff area. Additionally, 6 key informant interviews were conducted for the qualitative aspect of the study. The data analysis for the quantitative and qualitative components was conducted thematically in its entirety. Thus, the qualitative responses are presented simultaneously with the quantitative results.

5.2 Socio-economic and demographic profile of respondents and households

As highlighted in the literature review, socio-economic and demographic characteristics of individuals and households may have an influence on awareness, perceptions and attitudes as well as behaviors. In this regard, this section unpacks the socio-economic and demographic results related to the respondents. Similarly, the household size, sex and age distribution, the highest level of formal education acquired by members of different sexes in the household and their employment status are also unpacked in this section. Moreover, data on the household sources and amount of income as well as the decision-maker in the household are analyzed and

discussed. For the purpose of this study, profiling socio-economic and demographic characteristics aid in understanding the factors that lead to the respondents' and households' waste management behavior and their awareness and perceptions of sustainable waste management practices.

5.2.1 Socio-economic and demographic profile of respondents

Research shows that attributes such as sex, education levels and income influence an individual's choice, use and consumption of various materials such as energy, water and sanitation facilities as well as waste disposal facilities or services (Bayudan-Dacuycuy and Dacuycuy, 2018; Bohlmann and Inglesi-Lotz, 2018; Briand et al., 2009; Narmilan et al., 2020; Shahi et al., 2019; Soltani et al., 2019). In this regard, the following subsection provides the respondents' socio-economic and demographic characteristics profile.

Table 5.1: Respondents' age category (n=400, in %)

Age cohorts	Percentages
18-25	18.75
26-35	26.25
36-45	18
46-55	14.5
56-65	12
66-75	7.75
76-85	2.75
Total	100
Average	41.59

The results depicted in Table 5.1 reveal that the average respondents' age was 42.59 years. Specifically, the respondent's ages ranged between the ages of 18-85 years, whereby the 26-35 years age cohort had the highest proportion of respondents (26.25%) and the 18-25 years age cohort followed by 18.75%. Additionally, the 36-45 years and 46-55 years age cohorts followed closely, accounting for 18% and 14.5% of respondents, respectively. Moreover, a smaller proportion of the respondents were within the 56-65-year age cohort, accounting for 12%. Even fewer respondents belonged to the 66-75- and 76-85 years age cohorts, accounting for 7.75% and 2.75%, respectively.

It is thus evident that almost half (45%) of the respondents were members of the youth category, while another 44.5% of the respondents were between the ages of 36-65 and a few (10.5%) of the respondents were older than 66 years. Thus, the respondents for this study were fairly youthful and comprised mainly of economically active individuals. This is in line with the

results of the 2011 census data where it was reported that individuals of working age (15 to 64 years) made up approximately 70% of the total population size of the eThekwin Municipality (Stats SA, 2011).

In relation to the sex distribution, it was found in this study that slightly more respondents were male (52.25%) compared to females, who accounted for 47.75% of the overall respondents. The results differ slightly from the South African statistics as per the community survey of 2016 where it was found that the country was made up of approximately 51% females and 49% males (Stats SA, 2016). Moreover, the sex distribution in the Bluff, as noted by Frith (2011), was composed of about 52% females and 48% males, which also differs from the findings of the study. Gender considerations are important since studies indicate that there are differences in the way males and females consume products as well as generate and manage waste (Adzawla et al., 2019; Awunyo-Vitor et al., 2013; Boateng et al., 2016; Handayani et al., 2018; Tassie and Endalew, 2020). These studies also suggest that there are differences in willingness to embrace and/ or pay for sustainable waste management practices.

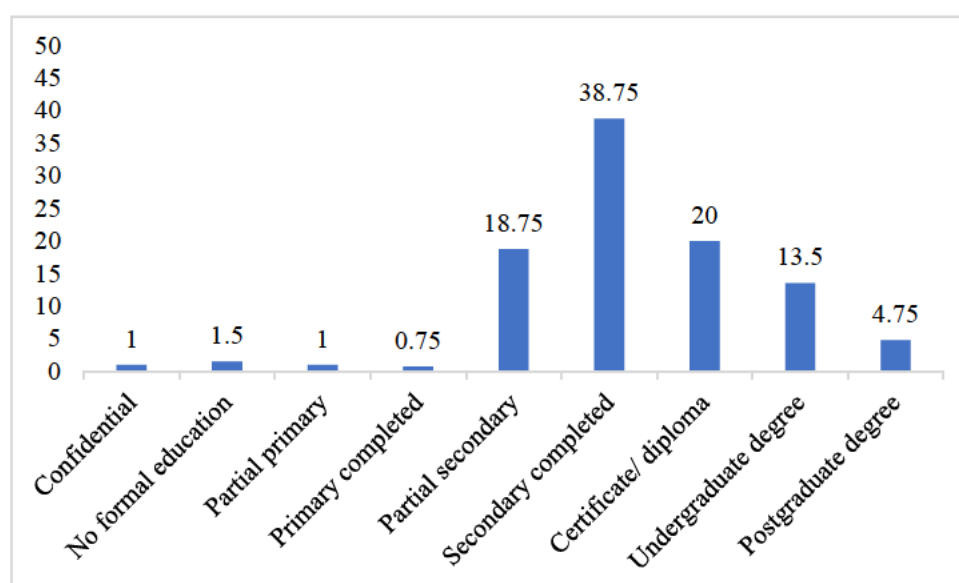


Figure 5.1: Highest level of formal education attained by respondents (n=400, in %)

Regarding formal education, most (38.75%) of the respondents had only completed secondary school (Figure 5.1). Moreover, although 38.25% of the respondents had received a post-matric qualification, close to a fifth of the respondents (18.75%) had only attained a partial secondary education. Specifically, 20% of the respondents had attained a certificate or diploma, 13.5%

had undergraduate degrees and a smaller proportion (4.75%) had attained postgraduate degrees. Moreover, even fewer proportions had no formal education (1.5%), partial primary (1%) and completed primary (0.75%).

Research indicates that education plays a crucial role in waste management behavior (Boateng et al., 2016; Fadhullah et al., 2022; Islam et al., 2022; Saseanu et al., 2019; Tassie and Endalew, 2020). Adzawla et al. (2019), Boateng et al. (2016), Fadhullah et al. (2022), Han et al. (2019), Islam et al. (2022), Saseanu et al. (2019) and Tassie and Endalew (2020) show that education has been highlighted as an important determinant of attributes like willingness-to-adopt and willingness-to-pay for as well as engage in sustainable waste management practices and services. Moreover, education is seen as an important factor and is positively correlated to awareness, understanding and perceptions of waste management services and environmental issues (Adzawla et al., 2019; Han et al., 2019; Islam et al., 2022; Tassie and Endalew, 2020).

Table 5.2: Employment status of respondents (n=400, in %)

Employment status	Percentages
Confidential	0.5
Employed	45.75
Part-time employed	5.25
Unemployed	13.75
Self-employed	10.5
Retired	14.5
Medically boarded	0.5
Student	9.25
Total	100

The employment status of respondents is particularly a crucial aspect to probe as a major part of sustainable waste management is the willingness-to-pay to embrace these practices. The results in Table 5.2 indicate that most of the respondents (45.75%) were employed. Smaller proportions of the respondents had retired (14.5%), were unemployed (13.75%), self-employed (10.5%), students (9.25%), part-time employed (5.25%) and medically boarded (two respondents). Similar to education, the employment status of individuals and households is an important determinant of waste management behavior (Boateng et al., 2016). Awunyo-Vitor et al. (2013) and Tassie and Endalew, 2020 show that this is mainly in relation to affordability or the ability of households to pay for waste management services, which in turn influences their willingness-to-pay for these services. Han et al. (2019) show that willingness-to-pay for such services declines with increasing costs. Specifically, studies by Han et al. (2019), Islam et al. (2022) and Tassie and Endalew (2020) report that willingness-to-pay for waste management

services was mainly among higher-income households and middle-income groups, whereby low-income households portrayed the lowest willingness-to-pay.

5.2.2 Socio-economic and demographic profile of households

Households play a crucial role in waste management (Mamady, 2016). Additionally, various household characteristics such as household size, sex and age distribution, highest levels of education attained, employment status, and decision-making within the household influence the choice, use and consumption of various materials, waste generation as well as waste management behavior (Awunyo-Vitor et al., 2013; Adzawla et al., 2019; Kaza et al., 2018; Tassie and Endalew, 2020). Thus, to enable a comparative analysis of waste management practices in relation to the socio-demographic variables, it was essential to establish the socio-economic profiles of the households and not only the respondents.

Table 5.3: Sex distribution in relation to household size (n=400, in %)

	Males in household	Females in household	Total household size proportion
None	9.25	14.5	-
1	40.75	28.25	12.75
2	25.75	28.25	17.75
3	14.5	15	19
4	6.75	8.25	21
5	2.25	2.75	13.5
6	0.75	2	6
7	-	0.5	4
8	-	0.25	3.25
9	-	-	1.25
10	-	0.25	0.5
11	-	-	0.25
12	-	-	0.75
Total	100	100	100
Average	1.8	2	3.75
Range	6	10	11

The total number of members within the households is indicative of the waste generation habits of the household. Specifically, Arumugam et al. (2021), Dikole and Letshwenyo (2020) and Herianto et al. (2019) show that waste generation and the rate of generation are influenced by household size. This figure is also reflective of whether the families are nuclear or extended. Specifically, nuclear families are those comprised of just couples or one or more parents with children, while extended families are those with couples, one or more parents with children as well as other family members (Stats SA, 2021). The overall average household size within the Bluff area was 3.75, with a range of 11 (from 1 to 12 household members) and a sum of 1 499

residents. This is unsurprising as it is almost the same as the average household size of about 3.4 to 3.5 reported within the eThekweni Municipality, within which the Bluff area is located (eThekweni Municipality, 2023; Stats SA, 2011). The average number of males and females was more or less the same, where it was 2 for males and 1.8 for females, with a total of 714 males and 786 females. Additionally, the range for males was 6 (ranging from no males to 6) and 10 for females (ranging from no females to 10). Moreover, the majority of the households (84%) consisted of between 1-5 members, indicating the dominance of nuclear families within the Bluff area. This is a representation of a typical household structure in South Africa, where Stats SA (2022a) reports that 41.5% of households in the country are nuclear families.

Twenty-one percent of the households were made up of 4 members, 19% of 3 members, 17.75% of 2 members, 13.5% of 5 members and 12.75% of 1 member. Subsequently, fewer proportions accounted for bigger household sizes, whereby 6%, 4% and 3.25% were made up of 6, 7 and 8 household members, respectively. Even smaller proportions are evident as household sizes increase, specifically three, two and one of the households were accounted for by 12, 10 and 11 members, respectively. Moreover, 12.5% of households had more males residing alone when compared to females and 5.25% more households did not have female members. Specifically, the majority of the households consisted of 1 male (40.75%), 2 males (25.75%) and 3 males (14.5%). Moreover, 9.25% of the households had no male figures, while 6.75% had 4 males. A smaller proportion of the households had 5 (2.25%) and 6 (0.75%) males. It is also depicted in Table 5.3 that the majority (28.25%) of the households consisted of both 1 and 2 females alike. Additionally, 15% of the households had 3 females, 15.5% of the households had no females within households and 8.25% had 4 females. Fewer proportions of households consisted of 5 (2.75%), 6 (2%) and 7 (two households), where only one household each consisted of 8 and 10 females.

To emphasize, Islam et al. (2022) show that household size has an influence on awareness and knowledge of various waste management practices, where smaller households are more aware. This was further reiterated by one of the researcher key informants who stated: *“households with fewer members generally know more about different sustainable household practices”* and further noted that awareness levels seem lower in larger households, although these households generate higher amounts of waste. The relationship between household size and energy consumption patterns was shown by Bohlmann and Inglesi-Lotz (2018), Bayudan-Dacuycuy and Dacuycuy (2018), Shahi et al. (2019), Soltani et al. (2019) and Yalcintas and Kaya (2017)

while Ramulongo et al. (2017) found that larger households consumed more water. Adzawla et al. (2019) argue that bigger families engage more in unsustainable waste management practices such as burning and burying waste.

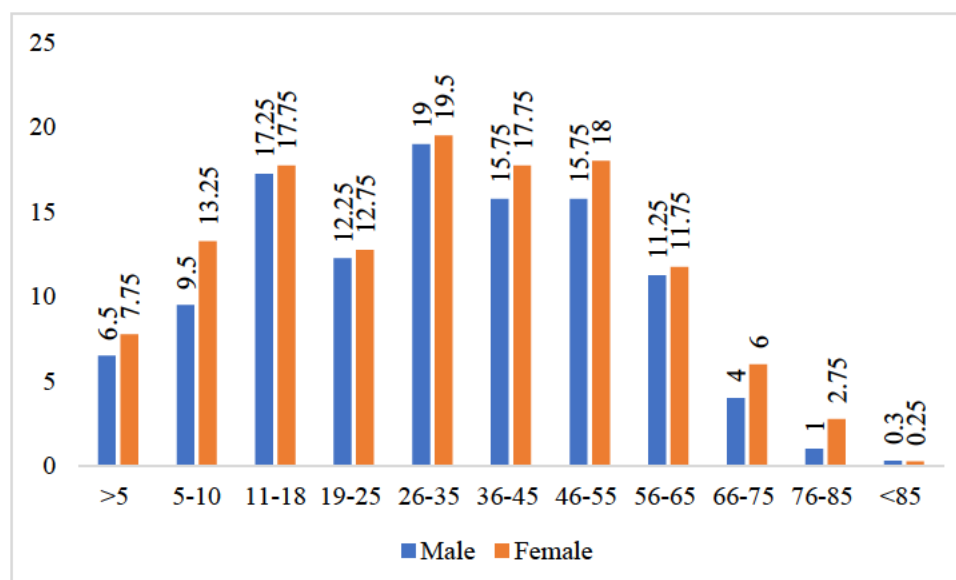


Figure 5.2: Household age cohorts according to sex distribution (n=400, in %)

Research shows that sex and age have an impact on the waste management habits adopted within households (Bohlmann and Inglesi-Lotz, 2018; Bayudan-Dacuyucuy and Dacuyucuy, 2018; Shahi et al., 2019; Soltani et al., 2019). Additionally, Islam et al. (2022) show that the age distribution of the household influences household awareness and knowledge of various waste management practices, whereas households with older members are more aware. These aspects are discussed later. Moreover, Adzawla et al. (2019), Handayani et al. (2018) and Whitmarsh et al. (2018) show that households with older household heads or older individuals are less likely to engage in improper and more proper waste management practices. In this regard, the age cohorts within households were analyzed in relation to the household sex distribution. Arguably, however, as stated by one of the researcher key informants, increasingly the younger generation in the context of climate change are becoming more conscious of environmental issues which are influencing their behaviors and practices, elaborated on later.

The results show that the household sex distribution in the respective age categories is vastly similar. Specifically, Figure 5.2 depicts that almost half (48.5%) of the males within the households were between the ages of 11-35 years and 42.75% between 36-65 years. Specifically, 19% of the males within households were within the 26-35 age cohort, 17.25%

within the 11-18 cohort, 15.75% within the 36-45 and 46-55 age cohorts and 11.25% between 56-65 years. Additionally, it is evident that 16% of the males were young children (10 years and younger), and lastly, 5.25% comprised males who were 66 years and older. Therefore, the majority of the male household members were within the youth and working age groups.

With regards to the female members within households, Figure 5.2 shows that half of the females were between the ages of 11 to 35 years (which comprises the majority of members of youth), whereby 19.5% of females were between 26-35 years, 17.75% within the 11-18 age cohort and 12.75% within the 19-25 years age cohort. Moreover, 47.5% of the females in the households were between the ages of 36-65 years and are specifically comprised of 18% of female members between 46-55 years, 17.75 between 36-45 years and 11.75% within the 56-65 age cohort. Young female children made up 21% of the females in the households and only 9% of the females were older than 66 years. The majority of the females were also made up of mainly those within the youth and the working age group.

Table 5.4: Household highest level of education attained according to sex distribution (n=400, in %)

Highest level of education attained	Males	Females
Confidential	0.5	0.75
No formal education	7.75	11.25
Partial primary	10.5	16.75
Primary completed	4.5	5.25
Partial secondary	19.5	17.5
Secondary completed	35.75	35.25
Certificate/ diploma	15.25	16.5
Undergraduate degree	7.75	7
Postgraduate degree	3.5	2.5
ABET	0.5	0.25
Special school	-	0.25

The highest level of formal education attained by an individual or within a household is said to influence the waste management options preferred or adopted by the household. For instance, Handayani et al. (2018) and Whitmarsh et al. (2018) found that those who have completed higher levels of formal education participate more in sustainable waste management practices. In this regard, ascertaining this information at the household level, while also considering this using sex distribution was deemed vital for this study.

Specifically, the cross-tabulation between the highest level of education attained within households and the sex distribution portrays a similar distribution in terms of the highest level

of education attained between the sexes within the households. With similar proportions in terms of members who completed secondary school, those who obtained partial secondary schooling and those who attained post-secondary school qualifications. Explicitly, the results show that a significant proportion (70.5%) of the males within the households had either completed secondary school (35.75%), attained partial secondary education (19.5%) and possessed a certificate or diploma (15.25%). Similarly, the majority of the females (69.25%) had completed secondary school (35.25%), attained a partial secondary education (17.5%) and possessed certificates or diplomas (16.5%). Additionally, 10.5% of the males had attained partial primary education, 7.75% had undergraduate degrees and no formal education, 3.5% possessed postgraduate degrees and two had Adult Basic Education and Training (ABET). Moreover, 16.75% of the females had obtained partial primary education, 11.25% had no formal education and 5.25% had completed primary school. Seven percent of the females in the household had attained undergraduate degrees, 2.5% had postgraduate degrees and only one female had either ABET or special school education.

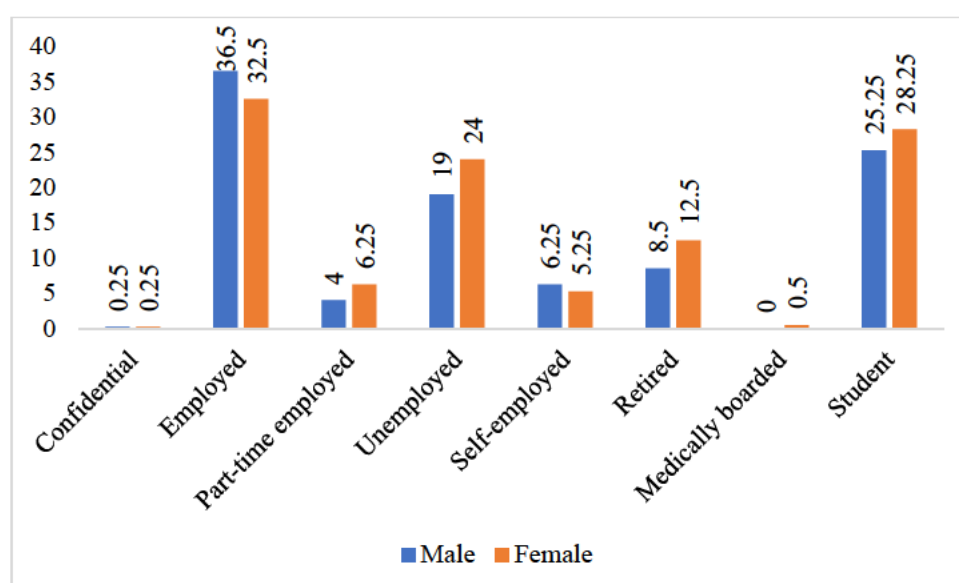


Figure 5.3: Household employment status according to sex distribution (n=400, in %)

Figure 5.3 provides a cross-tabulation between the employment status in the households and the sex distribution within the sample households. The results show that 36.5% of the male households were employed, whereas 32.5% of the females were employed. More female members (28.25%) were students when compared to their male counterparts (25.25%). Evidently, more females (24%) were unemployed compared to 19% of the male household members. Similarly, the results indicate that 12.5% of the females and 8.5% of the males were

retired. Additionally, 6.25% of males and 5.25% of females were self-employed. Lastly, 6.25% of the females were part-time employed while two were medically boarded, while 4% of the male members were part-time employed. Overall, the results show that employment rates are higher than unemployment rates in this sample household population which comprises mainly working-age individuals.

Table 5.5: Monthly household income derived for sources of income (n=400)

Household income source	Households participating in income source (in %: multiple responses)	Average monthly income (in Rands)
Employment	64.5	R20 358.72
Other sources	11.75	R11 600
Sale of agricultural produce	0.5	R6 250
Remittances	3.25	R5 753.85
Old age pension	18.75	R3 992.53
Disability grant	2.25	R1 863.33
Child grant	9.5	R814.58
Average total monthly household income	-	R19 750.29

Based on the results presented in Table 5.5, it is evident that the average household income of the sampled households is R19 750.29. Specifically, the majority of the average monthly income (R20 358.72) was from among those who received income from employment, while R11 600 was attained from those receiving income through other sources. Average monthly income from those receiving income through the sale of agricultural produce accounted for R6 250 of the average monthly household income, income from those receiving remittances for R5 753.85 and state welfare for a combined R6 670.44. Explicitly, those receiving old age pensions contributed R3 992.53, those receiving disability grants for R1 863.33 and child grants for R814.58.

The results for the main source of household income align with those by Stats SA (2022a), where it was found that the majority of South African and KwaZulu-Natal households (59.4% and 60%, respectively) rely mainly on salaries. These results further align with assertions by one of the researcher key informants who reported: *“our results revealed that the majority of households in the SDB rely mainly on employment for income”*. As already highlighted, income is crucial in determining waste management behavior within a household. Specifically, Handayani et al. (2018), Islam et al. (2022) and Whitmarsh et al. (2018) also show that households with higher incomes generally have more awareness of sustainable waste management practices and are subsequently more likely to participate in these.

Table 5.6: Main person/s responsible for household decision-making (n=400, in %)

Responses	Percentages
No response	0.25
It is personal	0.25
Adult male	28
Adult female	34.75
Adult male and female jointly	33.75
Adult males jointly	0.5
Adult females jointly	0.5
Everyone	1.5
Each individual	0.5
Total	100

Decision-making is a crucial determinant of household behavior, and specifically, waste management behavior (Uma et al., 2020). Thus, this study needed to establish which member/s within the household make the decisions. The results depict that household decisions were mainly made by an adult female (34.75%), adult male and female jointly (33.75%) as well as adult male (28%). Only 1.5% of the households had their decisions made by everyone and two households each by adult males jointly, adult females jointly and each individual alike. These results are different from assertions by a researcher interviewed and Uma et al. (2020), where it was indicated that male figures dominated household decision-making positions. One of the researcher key informants specifically stated that “*decisions within households were found to be made mainly by adult male figures*”.

5.3 Water and sanitation, energy and selected solid material profiles of the households

This section presents the results and discussion related to the households’ sources and frequency of use of water, sanitation facilities and energy. Moreover, the household profiles of selected materials are examined. Specifically, the results for the frequency of generation of various waste types, the disposal facilities/ services/ methods currently used, changes in amounts of waste generated during the COVID-19 pandemic and lessons learned, waste separation habits, and engagement in specific practices are outlined. As highlighted in the theoretical and conceptual framework for this study, current habits and practices do forecast behavior and also speak to sustainability considerations (Gardner, 2015; Omotayo et al., 2020). For instance, one of the eThekweni Municipality waste management key informants reiterated the detrimental impact that COVID-19 had on waste management among households: “*COVID-19 resulted in changes in how waste was generated and managed in the homes, where households were spending more time at home*”. Moreover, Khan et al. (2022) stress that the ISWM highlights the importance of considering all waste streams produced in the household

for comprehensive waste management. Thus, profiling the use of these resources and materials is crucial for the purpose of establishing the households' waste management practices to assess sustainability considerations.

5.3.1 Water and sanitation profiles of the households

Water consumption has increased in light of enhancements in industrialization, population growth and urbanization (Ramulongo et al., 2017; Stats SA, 2022a). South Africa is no exception to this increase in water consumption as household access to piped or tap water either within dwellings, off-site or on-site has increased by about 3.8% between 2002-2019 (Stats SA, 2019a). The water demand in the country is continuing to increase exponentially, which in turn leaves the water supply in the country under severe pressure (Jacobs-Mata et al., 2018).

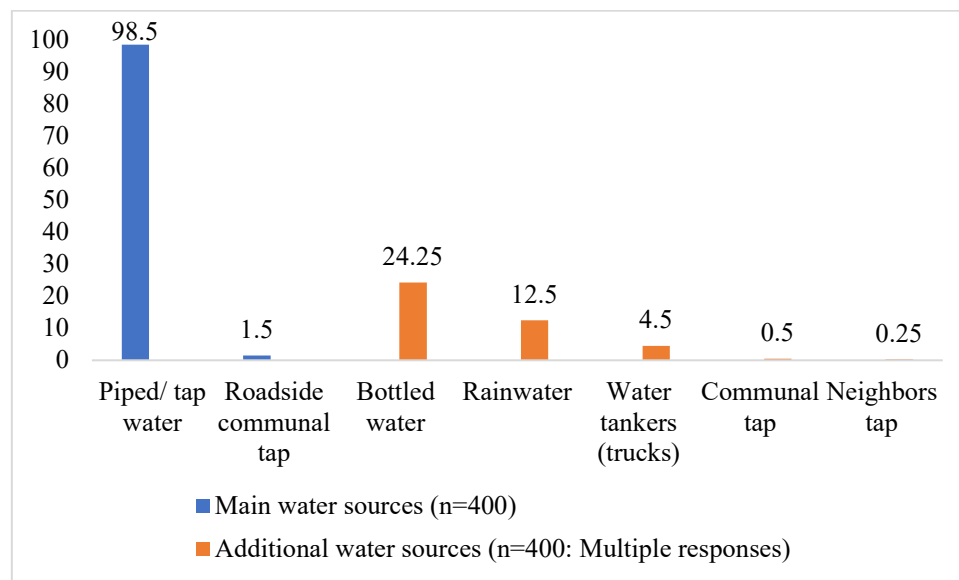


Figure 5.4: Main and additional water sources currently used by households (n=400, in %)

The households evidently (Figure 5.4) rely mainly on piped/ tap water (98.5%) as the main water source, followed by 1.5% of the households relying on a roadside communal tap as the main water source. This high access to piped/ tap water may be attributed to the policy aimed at providing services including water, electricity as well as sewerage and sanitation for free or at considerably subsidized rates to indigent households in the country that was adopted in 2001 by the South African government (South African Government, nd; Stats SA, 2018b). Specifically, approximately 6 000 liters of water is provided to each household per month (South African Government, nd).

The proportion of households relying mainly on piped/ tap water is higher than the 60.2% of households with piped water inside their dwelling that was recorded within the eThekweni Municipality in the 2011 census data (Stats SA, 2011). Although the eThekweni Municipality records an increase in the proportion of households with access to piped or tap water in their dwellings, off-site or on-site (97.7%), it is still one of the lowest among the metros in the country (Stats SA, 2022a). The results further reveal the additional water sources that are used by households, whereby the main additional water source was bottled water (24.25%), which was then followed by rainwater at 12.5%. A smaller proportion of the households used water tankers (4.5%), two households used communal taps and one household used a neighbor's tap as additional water sources. The use of bottled water also contributes to other forms of waste, such as plastic waste. One of the researcher key informants states that the use of bottled water (almost exclusively for drinking purposes) can be attributed to *“concerns over the quality of tap water for drinking purposes, which is particularly of concern in the SDB given the high levels of pollutants which influence people’s perceptions”*.

Table 5.7: Main and additional sanitation facilities currently used by households (in %)

Sanitation facilities	Main sanitation facilities (n=400)	Additional sanitation facilities (n=400: yes responses only)
Flush toilet	98.75	-
Pit latrine	0.75	1.5
Bucket toilet	0.25	0.5
Flush toilet with controlled/ reduced water levels	0.25	-

In line with households relying mainly on piped/ tap water, the results reveal that households relied on flush toilets (98.75%) as the main sanitation facilities. It is evident that the Bluff area residents had a higher proportion of residents with access to flush toilets connected to public sewerage or a septic or conservancy tanks when compared to the figures (64.8% and 63.4%) recorded within South Africa in general and within the eThekweni Municipality, respectively (Stats SA, 2011; 2022a). Additionally, this figure is also higher than the 83% recorded for households with access to improved sanitation in South Africa and the 59.9% of households with access to flush toilets connected to public sewerage systems (Stats SA, 2019a; 2019b).

Based on the above results, Bluff portrays an urban community where improved sanitation facilities (flush toilets with a connection to public sewerage systems or septic tanks or pit toilets with a ventilation pipe) are mainly found in South Africa (Stats SA, 2019b). In this regard, the South African Government (nd) states that sewerage and sanitation are fully subsidized to poor

households, in line with the policy on access to free basic municipal services. This was also highlighted by one of the researcher key informants as an achievement for the Municipality: “*most households in the city having flush toilets is a major achievement in eThekwin Municipality*”. This high reliance on flush toilets further speaks to the likelihood of sanitation-related waste being generated. Moreover, the responses are dissimilar to the results reported by Stats SA (2022a), where it was found that 34% of households in KwaZulu-Natal rely on pit toilets with ventilation pipes; the results indicate that only 0.75% of households use pit latrines and one household relying on buckets and flush toilets with controlled/ reduced water levels alike, as their main sanitation facilities. Pit latrines (1.5%) and bucket toilets (two households) were the only additional sanitation facilities used by households.

5.3.2 Energy profiles of the households

Research shows that with an increase in population size and the standard of living, the consumption of energy has also increased (Malinauskaite et al., 2017; OECD, 2020). In turn, this increase in energy consumption rates has resulted in an increase in waste generation (Malinauskaite et al., 2017). It is thus essential to understand households’ energy use patterns granted the role played by households in energy consumption and, in turn, the generation of associated waste materials (Bohlmann and Inglesi-Lotz, 2018; Uhunamure et al., 2021). Loadshedding in the South African context specifically poses several additional challenges since households complement electrical appliances and products with non-electric energy sources and/ or technology such as inverters and generators to generate electricity when loadshedding occurs (De Jonghe, 2022; Goodall, 2022; Mosepele, 2022). These responses to deal with the energy crisis in South Africa have resulted in new and different types of e-waste being generated, as noted by one of the researcher key informants.

Table 5.8: Main and additional energy sources currently used by households (in %)

Energy sources	Main energy sources (n=400)	Additional energy sources (n=400: multiple responses)
Electricity	98	0.75
Gas	1.25	31.25
Paraffin	0.5	2
Fuelwood	0.25	0.25
Candles	-	46.25
Solar	-	4.75
Rechargeable lights	-	1.25
Torch	-	0.75
Energy saving lightbulbs	-	0.5
Emergency lights	-	0.5
Flashlight	-	0.25
Lamp with batteries	-	0.25
LED emergency lights	-	0.25
Gas light	-	0.25

In relation to the main energy sources used by households in Bluff, households relied mainly on electricity (98%) as the main energy source. This is in line with the high electricity use recorded within the eThekweni Municipality. Specifically, eThekweni Municipality (2023) reports that 97% of the households within the municipality have electricity. Additionally, Stats SA (2011) shows that 89.9% of households within the Municipality rely on electricity for lighting. Moreover, these results concur with those by Lianwei and Wen (2021), where it is highlighted that as household income increases, households move up the energy ladder. Specifically, more modern energy sources, such as electricity, are used as opposed to relying on traditional fuels (Lianwei and Wen, 2021). The policy on free access to basic services to poor households has also driven access to grid electricity in the country. Specifically, the South African Government (nd) states that 50 kWh of electricity for a grid-energy system is provided for each household per month.

In agreement with the above results, Uhunamure et al. (2021) concur that South African homes are increasingly using electronic and electric devices and appliances; which largely rely on power from electricity to run and/or charge. This high dependence on electricity has implications for the generation of e-waste, which is currently a major concern. Specifically, Uhunamure et al. (2021) state that South Africa has seen an exponential increase in the generation of e-waste. More so since not a lot of attention is placed on e-waste and no specialized removal is available (Mintz et al., 2019). Subsequent main energy sources used by households included gas (1.25%) and paraffin (two households), with only one household relying on fuelwood.

Moreover, 46.25% and 31.25% of the households used candles and gas, respectively, as additional energy sources. This shows that a substantial proportion of households still largely rely on traditional energy sources. Soltani et al. (2019) support these results as it was found within a city in Iran that high-income households still relied on both traditional and modern energy sources. This is unsurprising within Bluff, a residential area in South Africa, where loadshedding has forced households to substitute electricity for alternative power sources (De Jonghe, 2022; Goodall, 2022; Mosepele, 2022), as noted earlier. In instances where households cannot afford equipment such as inverters and generators, they rely on sources such as candles (Matiwane, 2022; Swart, 2022). This was also reiterated by one of the researcher key informants who indicated: *“power outages as a result of loadshedding in the country have forced households, especially low-income ones, to climb back down on the energy ladder and rely more on conventional sources such as candles during outages”*.

According to Haywood et al. (2021), those households relying on non-electric fuel sources for heating or cooking often dispose of their waste on the street, in their yards, or by burying it. Fewer proportions of respondents in this study used solar (4.75%), paraffin (2%), rechargeable lights (1.25%) and torch and electricity (both 0.75%) as additional energy sources. Additionally, even fewer households (two) reported using energy-saving light bulbs and emergency lights. One household each used fuelwood, flashlight, lamp with batteries, LED emergency lights and gas lights as additional energy sources. Energy sources such as candles and paraffin have severe health impacts as well, with additional safety concerns since these sources can cause fires, as noted by one of the researcher key informants. It is also important to note that the current reliance on energy in South Africa is not linked to sustainable and renewable energy sources. As De Jonghe (2022) substantiates, the energy sector in South Africa largely relies on non-renewable energy sources, with sustainable energy sources accounting for only 13.7% of the country's energy.

One of the key issues of sustainable waste management is what energy source the household uses. The results of the study in relation to energy sources used show that there is very little practice linked to the use of renewable energy sources. Furthermore, one of the non-government/ civil society organization key informants stated: *“as far as I know, renewable energy is unfortunately not widely used by households or industries in the SDB”*. This, as stated by one of the researcher key informants was linked to *“high start-up costs of using renewable energy such as solar energy”*. Thus, these current practices tell us that households are

contributing massively to the carbon footprint, especially in a country like South Africa, where electricity is still largely coal-fed (De Jonghe, 2022; Qu et al., 2023). In this regard, Qu et al. (2023) show that in 2019, the energy sector in the country made up approximately 86% of the greenhouse gas emissions, which further speaks to the carbon-intensive generation of electricity.

Table 5.9: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and the main sources of water, sanitation and energy in the households

Socio-economic and demographic variables	Water	Sanitation	Energy
Age of respondent	0.234	0.912	0.373
Sex of respondent	0.471	0.412	0.240
Highest level of education attained by respondent	0.483	0.702	0.619
Employment status of respondent	0.486	0.534	0.831
Total household size	0.702	0.994	0.976
Household decision-maker	0.692	0.999	0.998
Monthly household income	0.639	0.951	0.984

The chi-square results show that there were no statistically significant differences detected in terms of the key socio-economic and demographic attributes that were analyzed against the main household sources for water, sanitation and energy. These results show respondents' and households' backgrounds and socio-economic standing have no significant influence on the main water, sanitation and energy sources used. This affirms the previous results of the study as well as reports by the eThekweni Municipality (2023), Stats SA (2011; 2019a; 2019b; 2022a) and Uhunamure et al. (2021) that the majority of the households in South Africa, and specifically within the eThekweni Municipality rely on the same water, sanitation and energy sources, regardless of the socio-economic and demographic profiles. The importance of locality-sensitive research in understanding the main sources of water, sanitation and energy sources at the household level is reinforced. The results from this study differ from the assumptions and conclusions in the literature (Bayudan-Dacuycuy and Dacuycuy, 2018; Bohlmann and Inglesi-Lotz, 2018; Buthelezi et al., 2019; Narmilan et al., 2020; Oskam et al., 2021; Ramulongo et al., 2017; Shahi et al., 2019; Smith and Pillarisetti, 2018; Soltani et al., 2019) that suggest that these variables influence water, sanitation and energy use at the household level. It indicates that although there are socio-economic differences within communities, the formality and the context of South Africa (that is, the provision of free basic services by the municipality) could explain the lack of differences. However, the Bluff area is

largely a formal settlement. A comparative analysis between different types of communities (such as formal and informal settlements) may detect differences.

5.3.3 Selected waste material profiles of the households

The consumption of materials such as electronics, plastic, convenience and shopping supplies as well as food and beverages packaging is exceeding environmental limits (Khan et al., 2022; Vetter-Gindele et al., 2019). Specifically, Aryampa et al. (2019) and Godfrey et al. (2019) show that the increase in waste generation magnifies the challenges of waste management in continents such as Africa. Therefore, it is crucial to understand the quantities and types of waste generated (Kaza et al., 2018).

Godfrey et al. (2019) state that it is foreseen that the exponential growth in waste generation in Sub-Saharan Africa will eventually overshadow the decrease in waste generation in other regions of the world. Additionally, Rodseth et al. (2020) show that South African households generate approximately 12.7 million tons of waste per year. This is equivalent to 0.63 kg per capita per day, which speak to a possible waste management challenge in the country (Stubbs, 2021b). To this end, the respondents were further asked to indicate how frequently the household generates various waste streams.

Table 5.10: Frequency of household generation of various waste streams (in %)

Frequency of generation	Waste stream percentages								
	Paper and cardboard waste	Plastic waste	Aluminum can and glass waste	Food waste	e-waste	Wastewater	Garden refuse	PPE waste	Construction and demolishing
Never	1	0.75	12.5	9.5	30.75	8	53.5	0.5	85.25
Rarely	17.5	11.25	38	23.25	54.25	8.75	24.25	37.5	12.75
Sometimes	29.25	29.75	28.5	17.75	5.5	7.75	17.75	14	1
Often	33.5	33.5	15.75	16.75	1.5	9.25	3.5	27.25	0.75
Always	18.75	24.75	5.25	32.75	8	66.25	1	20.75	0.25
Total	100	100	100	100	100	100	100	100	100

The results for paper and cardboard waste indicate that this household waste was mainly generated often (33.5%) and sometimes (29.25%), followed by always (18.75%) and rarely (17.5%) with only 1% of the respondents indicating that paper and cardboard waste is never generated in the household. The results for plastic waste are similar to those of paper and cardboard waste. Specifically, 33.5%, 29.75% and 24.75% of the respondents reported that households generated plastic waste often, sometimes and always, respectively. Subsequently,

11.25% and 0.75% of the respondents indicated that plastic waste was either rarely or never generated, respectively. It is evident that aluminum can and glass waste were mainly rarely (38%) and sometimes (28.5%) generated. Additionally, in terms of this waste stream, 15.75%, 12.5% and 5.25% of the respondents reported that it was generated often, never and always, respectively.

Table 5.10 shows that 32.75% of the respondents indicated that food waste was always generated within households; this was followed by 23.25% who indicated that food waste was rarely generated, 17.75% and 16.75% reported that food waste is only generated sometimes and often, respectively, as well as 9.5% stating that households never generate food waste. The majority (54.25%) of the respondents reported that e-waste was rarely generated within households, followed by 30.75% indicating that this waste stream is never generated. Eight percent of the respondents indicated that e-waste was always generated within households, 5.5% stated that this waste was only generated sometimes and 1.5% stated that the waste was generated often. Sixty-six percent of the respondents reported that households always generate wastewater, 9.25%, 8.75%, 8% and 7.75% reported that wastewater was generated often, rarely, never and sometimes, respectively. The results further reveal that, for the most part, garden refuse was either never, rarely and only sometimes generated with 53.50%, 24.25% and 17.75%, respectively. Fewer proportions reported that the garden refuse was often (3.5%) and always (1%) generated.

Surprisingly with PPE waste, 37.5% of the respondents reported that households rarely generated this waste, while 27.25% and 20.75% reported that this waste was generated often and always, respectively. Fourteen percent of the respondents stated that PPE waste was only generated sometimes, while a fewer (households) proportion reported that PPE waste was never generated in the household. Lastly, 85.25% of the respondents reported that households never generated construction and demolishing waste, while fewer proportions of the respondents (12.75%, 1% and 0.75%) stated that households generated construction and demolishing waste on rare occasions, only sometimes and often, respectively, while one respondent indicated to always generating this waste.

Contrary to the respondents' results that indicate that the majority of the waste types are largely never, rarely or sometimes generated, the eThekweni Municipality waste management key informants stress that waste streams like e-waste, PPE and food waste make up a significant

proportion of waste that is generated within the SDB. Specifically, one of the official key informants stressed: *“a lot of waste that is collected from households is a mixture of various household waste types. Households mix things like paper, bottles, electronics, food scraps and even garden refuse together for collection”*. Moreover, in relation to COVID-19-related waste, another eThekweni Municipality waste management key informant stated: *“since the COVID-19 pandemic, household waste now also includes a lot of masks, gloves, sanitizer and cleaning detergent containers which makes it harder to separate/ remove once it contaminates general waste”*.

It is evident that there is a certain level of a lack of understanding at the household level of what different waste streams are. It is of great concern that households do not see the items they routinely discard as waste. For instance, when looking at the high proportion of households that indicated either rarely and/ or never generate e-waste, aluminum can and glass waste, PPE and food waste; it is evident that they do not understand what constitutes these types of waste. In this regard, household surveys are crucial to help understand that households do not understand what waste is or what waste streams are, as it is evident that waste is generally associated with solid waste types like paper, cardboard and plastic. Moreover, this information is crucial because households that generate the most have been found to be more willing to pay for better solid waste management services (Tassie and Endalew, 2020).

Table 5.11: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and how often households generate various waste streams

Waste types	Age of respondent	Sex of respondent	Highest level of education attained by respondent	Employment status of respondent	Total household size	Household decision-maker	Monthly household income
Paper and cardboard waste	0.000	0.233	0.242	0.198	0.813	0.198	0.002
Plastic waste	0.000	0.297	0.100	0.047	0.466	0.130	0.001
Aluminum cans and glasses	0.523	0.008	0.204	0.097	0.009	0.106	0.017
Food waste	0.058	0.002	0.006	0.121	0.684	0.029	0.009
e-waste	0.029	0.074	0.423	0.041	0.009	0.004	0.011
Wastewater	0.000	0.006	0.026	0.004	0.171	0.717	0.000
Garden refuse	0.204	0.073	0.030	0.094	0.095	0.000	0.000
PPE	0.002	0.842	0.199	0.599	0.326	0.009	0.004
Construction and demolishing waste	0.037	0.434	0.965	0.831	0.802	0.305	0.020

As already alluded to and discussed by Arumugam et al. (2021), Dikole and Letshwenyo (2020), Herianto et al. (2019), Orhorhoro and Oghoghorie (2019) and Rodseth et al. (2020), individual and household demographic and socio-economic factors are correlated to the per capita household daily waste generation. Specifically, waste generation and, in turn, the rate of generation is associated with attributes such as household size, household income (Arumugam et al., 2021; Dikole and Letshwenyo, 2020; Herianto et al., 2019; Hoornweg and Bhada-Tata, 2012). In this regard, a chi-square test was conducted to establish the differences between the main socio-economic and demographic attributes of respondents and households and how often various waste streams are generated within households.

The results indicate that there are significant differences across monthly household income categories and the generation of all waste types. Specifically, Table 5.11 shows that the frequency of generation of wastewater ($p < 0.001$), garden refuse ($p < 0.001$), plastic waste ($p = 0.001$), paper and cardboard waste ($p = 0.002$), PPE ($p = 0.004$), food waste ($p = 0.009$), e-waste ($p = 0.011$), aluminum cans and glasses ($p = 0.017$) and construction and demolishing waste ($p = 0.020$) are significantly different across monthly household income categories. Additionally, the results show that the generation of paper and cardboard waste ($p < 0.001$), plastic waste ($p < 0.001$), wastewater ($p < 0.001$), PPE ($p = 0.002$), e-waste ($p = 0.029$) and construction and demolishing waste ($p = 0.037$) differed significantly across respondent age cohorts (Table 5.11). The generation of aluminum cans and glasses ($p = 0.008$), food waste ($p = 0.002$) and wastewater ($p = 0.006$) differed significantly across the sex of the respondent categories. The generation of food waste ($p = 0.006$), wastewater ($p = 0.026$) and garden refuse ($p = 0.030$) differed significantly across the highest level of education attained cohorts. The generation of plastic waste ($p = 0.047$), e-waste ($p = 0.041$) and wastewater ($p = 0.004$) differed significantly across the employment status of the respondent categories. The generation of aluminum cans and glasses ($p = 0.009$) and e-waste ($p = 0.009$) differed significantly across total household size categories. The generation of food waste ($p = 0.029$), e-waste ($p = 0.004$), garden refuse ($p < 0.001$) and PPE ($p = 0.009$) differed significantly across household decision-make cohorts.

The results correspond to those found by Novriadhy et al. (2021) and Soysa et al. (2022). Specifically, Novriadhy et al. (2021) and Sysa et al. (2022) found that household net income, family size and age had a significant relationship with the generation of waste. For instance, Nell et al. (2022b) show that high- and middle-income households commonly generate more

paper and cardboard waste because they have a higher purchasing power and are more involved in activities that include using and consuming paper, for instance, consuming more pre-packaged food. However, some of the results oppose those by Machate (2021) and Novriadhy et al. (2021). In terms of food waste, Machate (2021) found that the age of respondents as well as family size had a significant correlation with the amount of this waste type that is generated, while the highest level of education attained did not.

Table 5.12: Main and additional household disposal methods for various waste streams (n=400, in %)

Disposal method	Waste stream percentages															
	Paper and cardboard waste		Plastic waste		Aluminum can and glass waste		Food waste		e-waste		Wastewater		Garden refuse		Construction and demolishing waste	
	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional
Do not generate*	1	-	0.75	-	12	-	9.75	-	31.5	-	6.5	-	57	-	87.25	-
Dustbin	86.25	4.75	87	-	76.25	2	77.25	2.5	61	0.5	-	0.25	23.5	1.25	3.5	0.5
Segregation	6.5	4	4.5	3	4.5	3	1	0.75	2.75	0.5	-	-	2.75	0.25	0.75	-
Repurpose	0.5	5.5	2.5	15.25	0.5	6.75	3	2.75	0.5	0.5	5	18.75	1	0.5	0.75	0.25
Reducing	-	1.75	0.25	2.25	0.25	2.5	1.25	0.75	0.25	-	-	1	-	-	0.25	0.25
Recycling	4.5	12.75	4	7.5	4.5	7.25	0.25	0.25	2.5	2	-	-	0.5	0.25	0.5	0.25
Burying	0.5	0.5	0.5	-	0.5	-	0.5	0.25	-	-	-	-	0.25	0.25	0.25	-
Burning	0.75	1.75	0.5	0.75	0.25	-	0.25	-	0.25	-	-	-	1	0.5	-	-
Illegal dumping	-	1.25	-	1	0.75	0.5	-	0.25	0.5	0.25	-	-	0.25	0.25	0.25	-
Composting	-	-	-	-	-	-	6.75	6.75	-	-	-	0.25	3.75	1.25	-	-
Local drop-off	-	3.75	-	2	0.5	2.5	-	0.5	0.75	1.5	-	-	10	1.75	6.5	1.5
Down the drain	-	-	-	-	-	-	-	0.5	-	-	88.5	2.5	-	-	-	-
Give to people	-	-	-	-	-	-	0.25	-	-	-	-	-	-	-	-	-

*Those households that do not engage in the specific disposal methods because they indicated they do not generate the indicated waste stream

Handayani et al. (2018) reiterate that the household level is the primary stage of waste management, therefore, the practices adopted at this level are important. Thus, respondents were asked to provide the main and additional waste disposal methods for waste streams generated within households and it was revealed that the dustbins (and thereby collection to landfill sites) is the main waste disposal method for the majority of the waste streams generated in the households. Additionally, an eThekweni Municipality waste management key informant affirmed the above by stating: *“waste is not separated, which is why refuse collectors pick up every waste disposed of by residents irrespective of waste category”*. This was deemed as a crucial component of this study because research shows that waste that is improperly disposed of or done so to landfills is one of the most pertinent causes of environmental pollution (Godfrey et al., 2019; Gutberlet, 2018; Mamady, 2016; Vinti et al., 2023). There are very low levels of waste separation at source evident in this study, which is viewed as the first step to promote sustainable waste management practices within a circular economy framework.

One of the eThekweni Municipality waste management key informants interviewed indicated that there is a multi-purpose drop-off site within the Bluff community:

This specific site specifically offers services for garden refuse drop-off for the community members. We also accept recyclables like plastics, steel, oil, boxes, paper, newspapers and glass. These waste types are separated into different skips for drop-off at relevant recycling companies (for example, Mondi for paper and scrap yards for steel).

Additionally, in relation to electric and electronic waste, the eThekweni Municipality waste management official specified: *“we recycle these. We take the material to different recycling sites after separating it”*.

Regardless of the above, for the majority of the solid waste streams generated within households, the dustbin is the main source of disposal. Specifically, it is evident that most households (86.25%) used dustbins as the main disposal method for paper and cardboard waste. Additionally, only 6.5% of the households segregated their paper and cardboard waste, 4.5% recycled this waste while 0.75% burned this waste and two households each repurpose and bury this waste. One percent did not generate this waste. Additional disposal methods for paper and cardboard waste include recycling (12.75%), repurposing (5.5%), dustbins (4.75%),

segregation (4%), local drop-off sites (3.75%), reducing (1.75%), burning (1.75%), illegal dumping (1.25%) and burying (two households). Similarly, 87% of the households relied mainly on dustbins to dispose of plastic waste. Smaller proportions used segregation (4.5%), recycling (4%), repurposing (2.25%), burying (two households), burning (two households) and reducing (one household) as the main plastic waste disposal methods, whereby 0.75% claimed not to generate plastic waste. Additional plastic waste disposal methods included repurposing (15.25%), recycling (7.5%), segregation (3%), reducing (2.25%), local drop-off sites (2%), illegal dumping (1%) and burning (0.75%).

In relation to aluminum cans and glass waste, 76.25% of the households used dustbins as the main disposal method and 12% claimed not to generate this waste. Moreover, 4.5% of the households segregated and recycled aluminum cans and glass waste. Other main disposal methods for this waste stream are illegal dumping (0.75%), repurposing (two households), burying (two households), local drop-off sites (two households), reducing (one household) and burying (one household). With regard to additional disposal methods for aluminum can and glass waste, the results show that households used recycling (7.25%), repurposing (6.75%), segregation (3%), reducing (2.5%), local drop-off sites (2.5%), dustbins (2%) and illegal dumping (two households).

A large proportion (77.25%) of households dispose of food waste in dustbins as the main disposal method and 9.75% indicated not generating this waste type. Moreover, composting (6.75%), repurposing (3%), reducing (1.25%), segregation (1%), burying (two households), recycling (one household), burning (one household) and giving leftover food to people (one household) were the other main disposal methods for food waste in the Bluff area. Additional disposal methods for food waste in households were composting (6.75%), repurposing (2.75%), dustbins (2.5%), segregation (0.75%) and reducing (0.75%). Two households reported using local drop-off and down the drain, as well as one household each reporting to use recycling, burying and illegal dumping.

Sixty one percent of the households mainly disposed of e-waste in dustbins, while a substantial 31.5% did not generate this waste stream. Fewer households relied on segregation (2.75%), recycling (2.5%), local drop-off sites (0.75%), repurposing (two households), illegal dumping (two households), reducing (one household) and burning (one household) as the main disposal method for e-waste. The results show that there were a few additional disposal methods used

by a small proportion of households for e-waste. Specifically, 2% of the households used recycling, 1.5% used local drop-off sites, two households each used dustbins, segregation and repurposing, as well as one household used illegal dumping as additional means of discarding e-waste.

In relation to wastewater, the main disposal methods were down the drain (88.5%) and repurposing (5%), while 6.5% of the respondents reported that the households did not generate wastewater. Some households indicating that they do not believe that they generate waste water speaks to a lack of understanding of what this waste stream is. As for additional wastewater disposal methods, the results show that repurposing was the most preferred at 18.75%, followed by down the drain with 2.5%, reducing at 1% and one household each using a dustbin and composting as an additional disposal method. The majority of the households (57%) did not generate garden refuse. Among those who did generate this waste type, 23.5% claimed to use dustbins as the main disposal method. Moreover, 10% of the households used local drop-off sites as the main disposal method for garden refuse, while 3.75% relied on composting, 2.75% on segregation, 1% on repurposing and burning, two households on recycling and one household each on burying and illegal dumping. The additional disposal methods used by households for garden refuse were local drop-off sites at 1.75% and dustbins and composting, both accounting for 1.25%. Two households each used repurposing and burning as well as one household each for segregation, recycling, burning and illegal dumping.

Similar to garden refuse, the majority of the households (87.25%) did not generate construction and demolishing waste. The main disposal methods for construction and demolishing waste were local drop-off sites (6.5%), dustbins (3.5%), segregation (0.75%) and repurposing (0.75%). Two households used recycling as a main disposal method for construction and demolishing waste, with one household each using reducing, burying and illegal dumping. Additional disposal methods for the construction and demolishing waste within the households were local drop-off sites (1.5%), dustbins (two households) and one household each using repurposing, reducing and recycling.

The above results are not surprising for a community located within a municipality within which weekly waste removal is at 86.1% (eThekweni Municipality, 2016a; Stats SA, 2011), which is higher than the weekly national removal of 60.3% but the same as the weekly removal recorded in urban KwaZulu-Natal. Irrespective of the eThekweni Municipality (2016a)

indicating that households are provided with orange and clear bags for waste separation for recycling purposes and community drop-off centers, the Municipality is still largely responsible for waste management through weekly waste collections. Additionally, these results concur with those by Parikh et al. (2020) in a study conducted in an informal settlement in Durban, where it was found that only 18% and 20% of respondents recycled and segregated their waste, respectively.

Some of the key informant interviewees further reiterate that households in the area are provided with these waste separation bags. Specifically, one of the researcher key informants stated:

The eThekwin Municipality has a waste separation program where it utilizes different color bags for different types of waste to be separated. Blue bags are used for garden refuse, orange bags for recyclables such as paper and cardboard, while clear bags are used for glass bottles and cans.

This was supported by one of the non-government/ civil society organization key informants who indicated that “the Durban solid waste separation into different color bags (for recyclables and none recyclables) households leave these out for collection once a week the recyclables are then cleaned before recycling”. Additionally, an eThekwin Municipality waste management key informant further substantiates that community members in the Bluff area do receive these services from the city: “we try to give them different colored plastic bags for waste separation at home. Community members are expected to collect these from this site”.

Irrespective of the above, households mainly just dispose of waste in the bin in preparation for collection as opposed to separating materials like paper, cardboard, plastic, glass and metal, and dropping them off for recycling. It was further reiterated by two key informant interviewees that the eThekwin Municipality is mainly responsible for waste management in communities. Specifically, one of the eThekwin Municipality waste management key informants stated:

The DSW collects waste once a week from residents as per the Council by-laws and disposed-off at any landfill site. Twenty-six packs (plastic garbage bags) are issued to residents which last for 3 months.

In terms of waste management and landfilling in the eThekweni Municipality, one of the researcher key informants indicated:

Landfill sites are permitted to manage municipal solid waste comprising of domestic waste, office waste, street sweeping waste, market waste (vegetables and fruits), garden refuse, sand/ soil and builders' rubble. The eThekweni Municipality collects and processes all types of general solid refuse, including household refuse, business refuse, etc.

Table 5.13: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and main household waste disposal methods for various waste streams

Waste type	Age of respondent	Sex of respondent	Highest level of education attained by respondent	Employment status of respondent	Total household size	Household decision-maker	Monthly household income
Paper and cardboard waste	0.657	0.682	0.356	0.628	0.982	0.994	0.162
Plastic waste	0.612	0.006	0.779	0.906	0.935	1.000	0.040
Aluminum can and glass waste	0.800	0.199	0.893	0.465	0.986	0.999	0.665
Food waste	0.255	0.081	0.549	0.760	0.976	0.882	0.817
e-waste	0.513	0.550	0.977	0.967	0.902	0.988	0.583
Wastewater	0.000	0.020	0.208	0.000	0.195	0.498	0.006
Garden refuse	0.039	0.364	0.081	0.706	0.938	0.017	0.000
Construction and demolishing waste	0.167	0.290	0.986	0.858	1.000	0.994	0.047

Research shows that the demographic and socio-economic attributes of individuals and households influence the waste disposal method that is used (Gutberlet, 2018; Haywood et al., 2021; Kaza et al., 2018; Mutungwe et al., 2014; Rodseth et al., 2020). For instance, Adzawla et al. (2019), Gutberlet (2018), Han et al. (2019), Haywood et al. (2021), Islam et al. (2022), Kaza et al. (2018), Rodseth et al. (2020) and Tassie and Endalew (2020) show that attributes such as settlement type and location, income levels and family size impacts the waste management practices at the household level. Specifically, analyses of the differences between households' and respondents' main socio-economic and demographic attributes and the main household waste disposal methods for various waste streams were conducted. The results of these analyses reveal significant differences across the households' monthly income categories and the disposal method for garden refuse ($p < 0.001$), wastewater ($p = 0.006$), plastic waste ($p = 0.040$) and construction and demolishing waste ($p = 0.047$). The respondents' age categories were significantly associated with the disposal methods for wastewater ($p < 0.001$) and garden refuse ($p = 0.039$). Furthermore, significant differences were found between the respondents' sex cohorts and plastic waste ($p = 0.006$) and wastewater ($p = 0.020$). The respondents' employment status categories were significantly associated with the disposal method used for wastewater ($p < 0.001$). Lastly, household decision-making categories were found to significantly differ in relation to the generation of garden refuse ($p = 0.017$).

The results correspond to those of Kalonde et al. (2023), Fadhullah et al. (2022) and Viljoen et al. (2021). For instance, Fadhullah et al. (2022) concluded that education level and household size did not have a significant relationship with waste segregation. Moreover, Viljoen et al. (2021) also found that household income influenced waste management practices. Additionally, the results from the study by Viljoen et al. (2021) show that lower-income households were less concerned about dumping waste improperly. Kalonde et al. (2023) also found a significant relationship between sex and the disposal method adopted by households, while no significant association was found between household size and the waste management method chosen by the household. However, contrary to the findings of this study, Fadhullah et al. (2022) found that sex, monthly income and occupation did not significantly correlate with the practice of waste segregation. Moreover, unlike the findings of the current study, Kalonde et al. (2023) report that education influenced the waste management practice that households engaged in. Kalonde et al. (2023) found that households that engaged in improper waste management methods had attained lower levels of education. In terms of age, Kalonde et al.

(2023) found no significant relationship between this attribute and households' waste disposal choices.

5.3.4 PPE/ COVID-19-related waste profiles of the households

The COVID-19 pandemic has had impacts on various aspects of day-to-day life, including the generation and management of waste (El-Ramady et al., 2021; Kurniawan et al., 2023). Specifically, El-Ramady et al. (2021) and Sarkodie and Owusu (2021) show that the pandemic and the associated measures aimed at curbing its spread led to an increase in the generation and use of household products such as masks, cleaning products, foodstuffs, sanitizers and toilet paper. In turn, waste from perishable items and leftovers as well as medical, e-waste, garden, metal packaging, plastic, glass, paper and cardboard and non-recyclables being disposed of increased (Arumugam et al., 2021; Benson et al., 2021; El-Ramady et al., 2021; Filho et al., 2021; Naughton, 2020; Sarkodie and Owusu, 2021). Moreover, due to the fear of waste getting contaminated, people discontinued sustainable waste management practices such as the reuse of items like plastics (Almulhim et al., 2021). In essence, these events led to an increase in waste being generated within households, especially during the lockdown restrictions (Arumugam et al., 2021; Filho et al., 2021).

In light of the COVID-19 pandemic, it was crucial that the study probed on waste management practices that households have adopted to manage COVID-19-related waste. El-Ramady et al. (2021) and Kurniawan et al. (2023) show that waste management was one of the main aspects that were severely impacted by COVID-19. Waste management in the Bluff community was no exception to the detrimental impacts of COVID-19. For instance, an eThekwin Municipality waste management key informant reiterated difficulties faced by the waste management sector during this period by stating that *“during hard lockdown we had to close the site, during this period people would drop off waste at the gate/ entrance and so we were forced to open because we offer an essential service”*. The previous results show that the frequency of household generation of various waste streams that PPE was not recognized as waste. This reinforces earlier claims that the understanding of what constitutes specific waste streams by households is limited. However, when waste items are disintegrated, there is a higher level of response. As depicted in Table 5.13, when households are further probed about the various individual PPE waste streams they do recognize them as waste.

Table 5.14: Main and additional household disposal method for PPE/ COVID-19-related waste (n=400, in %)

Disposal method	Waste stream percentages																	
	Disposable masks		Reusable masks		Sanitizer container		Cleaning detergent container		Cleaning cloths		Disinfectant wipes		Gloves		Tissue paper		Waste by infected member	
	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional	Main	Additional
Do not generate*	6	-	11.75	-	3	-	3	-	5.5	-	15	-	13.25	-	5.23	-	56	-
Dustbin	91.5	0.5	61	3.75	77	4.25	83.25	3.25	77	3.5	82.75	-	83.5	0.25	85.25	6.5	38	1.75
Segregation	0.25	0.5	0.5	0.25	0.25	0.25	0.25	0.5	0.25	0.25	0.5	0.25	-	0.25	-	0.25	1.75	3.5
Sealing	0.25	0.25	0.25	-	-	0.25	-	-	16.25	0.25	1	0.25	0.5	0.25	-	0.25	3.5	-
Repurpose	1	0.25	25.25	5.25	18.75	5.5	12.25	3.25	-	3.75	-	-	1.75	-	-	-	0.25	-
Reducing	-	-	0.25	3.09	-	2	-	0.25	-	1.75	-	-	-	-	0.25	-	-	-
Recycling	0.25	0.25	0.5	-	0.25	0.75	0.25	0.5	0.25	-	-	-	-	-	0.25	-	-	-
Burying	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	-	-
Burning	0.25	-	-	-	0.25	-	0.25	-	0.25	0.5	0.25	-	0.25	0.25	0.25	0.25	0.5	0.25
Illegal dumping	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-	-	-
Local drop-off	-	0.5	-	0.25	-	-	-	0.5	-	0.5	-	0.5	-	0.25	-	0.25	-	0.25
Down the drain	-	-	-	-	-	-	-	-	-	-	-	-	0.25	-	8.25	4	-	-

*Those households that do not engage in the specific disposal methods because they indicated they do not generate the indicated waste stream

Evidently and similar to the previous discussion on disposal methods for the main household waste streams, for the most part, the main disposal method for PPE/ COVID-19-related waste was through dustbins. Ninety-two percent of the households used dustbins as the main means to discard disposal masks, while 6% did not generate this waste. One percent of the households repurposed disposable masks, while segregation, sealing, recycling, burying, burning and legal dumping were used by one household each as the main disposal methods for disposal masks. Additional means of disposing of disposal masks that were used by two households each were dustbins, segregation and local drop-off sites, while sealing, repurposing and recycling were used by one household each.

Sixty-one percent of the households used dustbins as the main disposal method for reusable masks, while 11.75% did not generate this waste. A substantial proportion (25.25%) of the households repurposed reusable masks, while two households each relied on segregation and recycling, as well as one household each on sealing, reducing, burying and illegal dumping. The results further illustrate that fewer proportions relied on additional disposal methods for reusable masks; these were repurposing (5.25%), dustbins (3.75%), reducing (3.09%) and only one household each using segregation and local drop-off sites.

Seventy-seven percent of the households discarded sanitizer containers in bins, while 18.75% repurposed these as the main disposal methods. Three percent of the households did not generate sanitizer containers, while one household each used segregation, recycling, burying, burning and illegal dumping as the main disposal methods. For the additional disposal methods of sanitizer containers, the results show that 5.5% of the households repurposed, 4.25% used dustbins, 2% reduced, 0.75% recycled and one household each segregated and sealed sanitizer containers. In relation to the main disposal methods of cleaning detergent containers, it is further revealed that 83.25% of the households used dustbins to dispose of these while only 12.25% repurposes them. Three percent of the respondents reported that their households did not generate cleaning detergent container waste, while one household each segregated, recycled, buried, burned and dumped this waste illegally as the main means of disposal. The few households that adopted additional disposal methods for cleaning detergent containers used dustbins (3.25%) and repurposing (3.25%), while two households each used segregation, recycling and local drop-off sites, and one household reduced this waste.

Regarding the main disposal method for cleaning cloths, 77% of the households used dustbins and 16.25% sealed these materials. Six percent of the household did not generate cleaning cloth waste, while one household each segregated, recycled, buried, burned and illegally dumped cleaning cloths as the main modes of disposal. The additional disposal methods for cleaning cloths were repurposing (3.75%), dustbins (3.5%), reducing (1.75%), burning (two households), local drop-off sites (two households), segregation (one household) and sealing (one household). Although 15% of households claimed not to generate disinfectant wipes, those who did generate mainly discarded them in dustbins (82.75%). The additional disposal methods for disinfectant wipes were local drop-off sites (two households) and one household each using segregation and sealing. In relation to gloves as waste, 13.25% of the households did not generate them.

The main disposal methods for those who did generate glove waste were 82.75% for dustbins, and 1.75% repurposing, while two households used sealing and one household each used burying, burning, illegal dumping and down the drain. The additional disposal methods for gloves were dustbins, segregation, sealing, burning and local drop-off sites being used by one household each. Tissue paper was also mainly discarded in dustbins (85.25%), while 8.25% disposed of this material down the drain. Additionally, one household each used reducing, recycling, burying, burning and illegal dumping as the main means of disposing of tissue paper, while 13.25% of the respondents stated that households did not generate this waste. The additional means of tissue paper disposal were dustbins (6.5%), down the drain (4%) as well as one household each relying on segregation, sealing, burning and local drop-off sites. Lastly, 56% of the respondents reported that households did not generate waste by infected members. Thirty-eight percent of the households used dustbins as the main disposal method for waste by infected members, 3.5% mainly sealed this waste, 1.75% segregated this waste, two households burned this waste and one household repurposed this waste. Additional disposal methods for waste by infected members were segregation (3.5%) and dustbins (1.75%), while one household each used burying and local drop-off sites.

Table 5.15: P values of chi-square test ratio results analyzing the association between socio-economic and demographic attributes of the respondents and households and PPE/ COVID-19-related household waste disposal method

Waste type	Age of respondent	Sex of respondent	Highest level of education attained by respondent	Employment status of respondent	Total household size	Household decision-maker	Monthly household income
Disposable masks waste	0.895	0.391	0.762	0.956	0.998	1.000	0.950
Reusable masks waste	0.891	0.104	0.846	0.987	0.961	0.382	0.768
Sanitizer containers waste	0.854	0.279	0.645	0.981	0.984	0.997	0.955
Cleaning detergent containers waste	0.722	0.433	0.813	0.954	0.995	1.000	0.818
Cleaning cloths waste	0.716	0.327	0.735	0.833	0.992	0.997	0.994
Disinfectant wipes waste	0.839	0.132	0.946	0.370	0.987	0.988	0.838
Gloves waste	0.941	0.222	0.991	0.893	1.000	0.991	0.927
Tissue paper waste	0.962	0.272	0.743	0.944	0.988	1.000	0.938
Waste generated by infected family members	0.110	0.233	0.824	0.257	0.920	0.525	0.184

The chi-square results show that there are no significant differences detected in terms of the key socio-economic and demographic attributes that were analyzed against the PPE/ COVID-19-related household waste disposal method. These results show that irrespective of the respondents' and households' backgrounds and socio-economic positions, there is no significant influence on the disposal method of PPE/ COVID-19-related waste that is generated within the household. This could be attributed to the disruptions that COVID-19 had on the waste management sector (Acharya et al., 2021; El-Ramady et al., 2021; Ijjasz-Vasquez and Kaza, 2020). For instance, Acharya et al. (2021) found that households did not separate waste due to a lack of space during the peak of the pandemic. Additionally, Smith (2020) reports that various waste management initiatives were canceled as a result of COVID-19. Furthermore, Filho et al. (2021) stress that COVID-19 resulted in increased pressure on waste management systems worldwide; thus, households of all demographic and socio-economic backgrounds were negatively impacted.

Research indicates that COVID-19 had detrimental implications on household waste management (El-Ramady et al., 2021; Fadhulah et al., 2022; Kurniawan et al., 2023). For instance, El-Ramady et al. (2021) state that this includes an effect on sustainable waste management sectors where workers suffering from chronic illnesses stayed at home, which subsequently negatively impacts sustainable practices such as recycling. The Bluff area was no exception to these detrimental impacts as an eThekweni Municipality waste management official and non-government/ civil society organization key informants reported waste management issues and concerns within the Municipality. Specifically, the eThekweni Municipality waste management key informant highlighted the issues that transpired when waste depot staff members fell ill with COVID-19:

There were cases found which led to the depot being shut down, however, collection continued with the help from other regions. The challenge was that they (employees) were not familiar with the area, which led to more complaints being attended to by our staff when we resumed service delivery.

Additionally, one of the non-government/ civil society organization key informants commented on the detrimental impacts of COVID-19 on the marine environment by stating:

The concern is the impact that it (COVID-19) has on the environment by looking at disposable masks. At the moment, the terrestrial and aquatic ecosystems are highly affected due to the mismanagement of disposable masks and this adds to what (waste) has been there. This causes more stress on the environment and results in biodiversity loss in the marine, fresh water and forest ecosystems.

Moreover, with regard to whether they were aware of the impacts of COVID-19 on domestic waste management, the key informant indicated:

No, organizations that deal with things like recycling were and are still open. But people are now more aware or careful of how they handle their waste because they know that waste is now more contaminated.

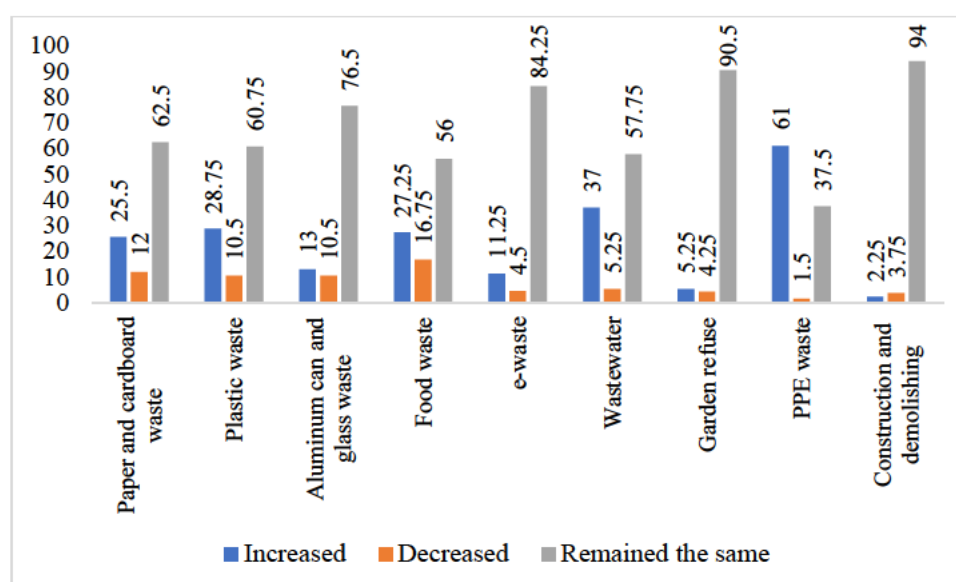


Figure 5.5: Changes in household waste generation since the COVID-19 pandemic (n=400, in %)

The respondents were further probed about how the frequency of the generation of various waste streams has changed since the COVID-19 pandemic (Figure 5.5). Generally, the dominantly positive response was that the generation of the various waste streams (except for PPE) had remained the same. Specifically, 94%, 90.5%, 84.25%, 76.5%, 62.5%, 60.75%, 57.75%, 56% and 37.5% of the respondents reported that construction and demolishing waste, garden refuse, e-waste, aluminum can and glass waste, paper and cardboard waste, plastic

waste, wastewater, food waste and PPE waste, respectively, had remained the same since the pandemic.

Sixty-one percent of the respondents stated that PPE waste had increased since the pandemic. In terms of the other waste streams, 37%, 28.75%, 27.25% and 25.5% of the respondents reported that wastewater, plastic waste, food waste, and paper and cardboard waste, respectively, had increased. Fewer proportions were noted in relation to the increase of aluminum can and glass waste (13%), e-waste (11.25%), garden refuse (5.25%) and construction and demolishing waste (2.25%). Concerning waste streams that were noted to have decreased since the COVID-19 pandemic, the results show that 16.75% of the respondents noted a decrease in food waste, 12% noted a decrease in paper and cardboard waste and 10.5% noted a decrease in plastic and aluminum can and glass waste streams alike. A fewer proportion of respondents noted a decrease in wastewater (5.25%), e-waste (4.5%), garden refuse (4.25%), construction and demolishing waste (3.75%) and PPE waste (1.5%). Except for PPE waste, the above results oppose those by Acharya et al. (2021), Oyedotun et al. (2020) and Sarkodie and Owusu (2021) where it was shown that COVID-19 came with an increase in the generation of various waste streams, especially contaminated medical waste.

The COVID-19 pandemic brought to the fore the generation of medical waste at the household level. Prior to the pandemic, medical waste research was confined to studies located generally in medical waste facilities such as hospitals and clinics, focusing mainly on waste associated with infectious diseases (Andeobu et al., 2022; Bucătaru et al., 2021; Windfeld and Brooks, 2015; Yoon et al., 2022). While the generation of COVID-19-related medical waste has subsided with the infection rates and protocol requirements (such as the use of masks and sanitizers) declining, from a household sustainable waste management perspective, examining medical waste generation patterns and behaviors at this level should be an important focus of waste research since there is increasing self-medication trends and care-giving of ailing persons within households that generate waste which is currently not being properly disposed of. Medical waste at the household level is not adequately covered in existing research and legislation as noted in the literature review chapter.

Table 5.16: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and changes in household waste generation since the COVID-19 pandemic

Waste type	Age of respondent	Sex of respondent	Highest level of education attained by respondent	Employment status of respondent	Total household size	Household decision-maker	Monthly household income
Paper and cardboard waste	0.049	0.933	0.135	0.016	0.003	0.256	0.000
Plastic waste	0.023	0.749	0.091	0.100	0.003	0.399	0.004
Aluminum can and glass waste	0.982	0.215	0.560	0.206	0.255	0.196	0.378
Food waste	0.335	0.216	0.048	0.041	0.002	0.009	0.000
e-waste	0.020	0.566	0.305	0.014	0.015	0.056	0.520
Wastewater	0.056	0.412	0.067	0.003	0.000	0.017	0.000
Garden refuse	0.472	0.327	0.111	0.021	0.342	0.103	0.362
PPE	0.043	0.582	0.030	0.236	0.126	0.016	0.032
Construction and demolishing	0.425	0.891	0.322	0.167	0.956	0.101	0.000

Research shows that the COVID-19 pandemic presented detrimental impacts on waste management systems (Filho et al., 2021; Naughton, 2020; Kibria et al., 2023; Peula et al., 2023; Sarkodie and Owusu, 2021). Specifically, Peula et al. (2023) indicate that the production and composition of municipal solid waste were negatively affected by the pandemic. In this regard, Table 5.16 depicts the chi-square test P value results of the differences between selected socio-economic and demographic attributes of the respondents and households and the changes in the frequency of generation of various waste types since the COVID-19 pandemic.

Regarding monthly household income categories, the results show significant differences between the generation of paper and cardboard waste ($p < 0.001$), food waste ($p < 0.001$), wastewater ($p < 0.001$), construction and demolishing waste ($p < 0.001$), plastic waste ($p = 0.004$) and PPE ($p = 0.032$). Moreover, in relation to total household size cohorts, the results show significant differences with changes in the generation of wastewater ($p < 0.001$), food waste ($p = 0.002$), paper and cardboard waste ($p = 0.003$), plastic waste ($p = 0.003$) and e-waste ($p = 0.015$). Significant associations were found between the employment status of respondent categories and wastewater ($p = 0.003$), e-waste ($p = 0.014$), paper and cardboard waste ($p = 0.016$), garden refuse ($p = 0.021$) and food waste ($p = 0.041$). The chi-square tests between the age of respondent categories and changes in the generation of waste since the pandemic reveal significant associations with the generation of e-waste ($p = 0.020$), plastic waste ($p = 0.023$), PPE ($p = 0.043$) and paper and cardboard waste ($p = 0.049$). Furthermore, significant differences were found between the household decision-maker categories and the change in the generation of food waste ($p = 0.009$), PPE ($p = 0.016$) and wastewater ($p = 0.017$). Lastly, the analyses between the highest level of education attained by respondent cohorts and changes in waste generation revealed significant differences in the generation of PPE ($p = 0.030$) and food waste ($p = 0.048$).

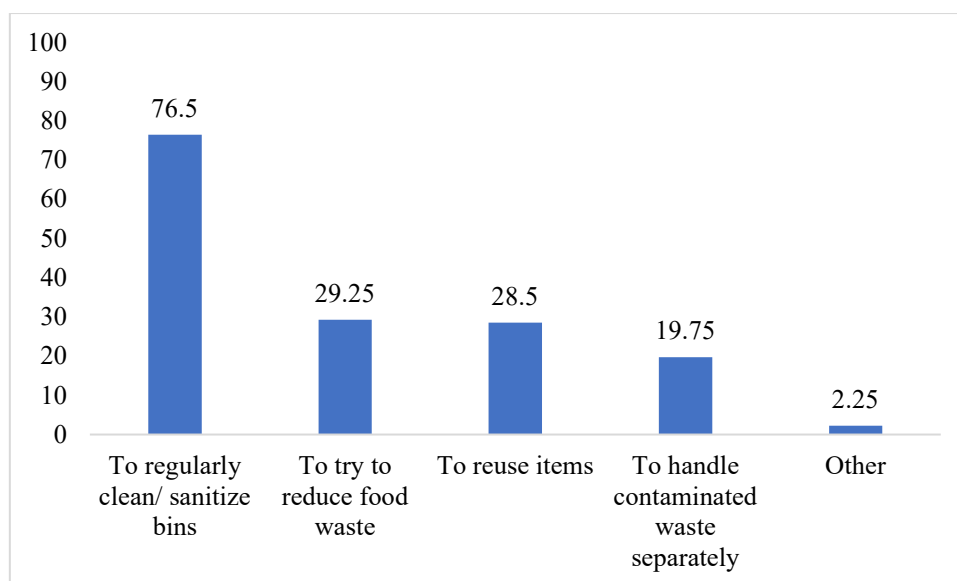


Figure 5.6: Lessons respondent learned from COVID-19 on how to manage household waste (n=400, in %): Multiple responses

As depicted on Figure 5.6, with managing household waste in the context of COVID-19, respondents reported that they have mainly learned to regularly clean or sanitize bins (76.5%), to try to reduce food waste (29.25%), to reuse items (28.5%) and to handle contaminated waste materials separately (19.75%). It is not surprising that households felt the need to regularly clean/ sanitize bins as COVID-19 was associated with a general concern related to household waste being a contamination and transmission source for the pandemic (Zhou et al., 2020). Additionally, as Filho et al. (2021) found, food waste increased by approximately 33% during the pandemic, thus, a significant proportion of households trying to reduce food waste is in line with this report. Households learning to handle contaminated waste materials separately is similar to the findings by Fihlo et al. (2021) and Selvakumaran and Wahid (2022), where it was reported that households have had to establish waste segregation methods in light of the pandemic. Additionally, Filho et al. (2021) found that 32% of the respondents in the study indicated to have increased efforts toward separating waste as a result of the COVID-19 lockdown. The results show that the COVID-19 pandemic has triggered increased awareness among some households about managing different waste streams. The other lessons (2.5%) included to keep your distance, to be more cautious and to disinfect, to keep your mask on, to handle money better, to maximize hygiene and to be clean and cautious about waste.

Interestingly, it is also worth noting that waste management officials have also had to learn to handle waste differently/ more carefully due to COVID-19-related medical waste streams being

included in general domestic waste. Explicitly, one of the eThekweni Municipality waste management key informant mentioned: *“because households do not separate waste streams, we have had to now also segregate this waste which is usually contaminated with things like tissue and disposable face masks”*. Moreover, the key informant added: *“this has been a scary time because of the high chance of getting sick from handling this waste, especially without the proper training to deal with hazardous waste”*. As noted earlier, it is imperative that as the COVID-19 virus ceases to be a health threat, the focus on medical waste at the household level should not decline and receive attention since homes are places where medication is consumed and sick people are treated, which results in waste being generated.

5.3.5 Waste separation trends within households

Waste separation is an important attribute of sustainable waste management (DEA, 2012c; Khanal et al., 2023; Kumar et al., 2017; Selvakumaran and Wahid, 2022; Vinti et al., 2023). Specifically, Khanal et al. (2023) and Selvakumaran and Wahid (2022) state that waste streams that are left unsegregated end up in landfills and so present adverse environmental issues. Thus, it is crucial that waste generators, such as households, separate their waste streams at source (Kurniawan et al., 2023). In instances where households are not engaging in such practices, it is equally important to establish why they do not engage.

The data analysis revealed that the majority (74%) of the households reported not separating different waste streams. One of the researcher key informants who has undertaken environmental sustainability research in the SDB observed similar findings and stated: *“separation at source still poses a challenge in these communities”*. The researcher added: *“the major challenge comes with waste separation at source, to help with this issue, the (municipal) unit has an education wing that makes an effort to educate and inform the communities about separating waste”*. Additionally, one of the non-government/ civil society organization key informants showed that COVID-19 has posed a greater risk in light of waste not being separated: *“with COVID-19 people’s lives are at greater risk because households do not separate waste”*. Moreover, the second non-government/ civil society organization key informant commented on the negative impacts associated with not separating waste on waste pickers: *“individuals (especially the poor) go through people’s waste to see what they can salvage. This is of concern because people do not separate waste, so this waste is contaminated. This is very sad to see”*.

These findings concur with the reports which confirm that South Africa faces several issues with waste management, which include people failing to separate waste at source (DEFF, 2020; Haywood et al., 2021; Viljoen et al., 2021). Additionally, these results are similar to those from studies conducted by Filho et al. (2021) and Parikh et al. (2020), where it was found that almost half of the respondents did not segregate waste streams and that only 20% of the respondents segregated waste. The results differ from a study by Khanal et al. (2023), where it was found that 80.3% of the respondents (which were youths) indicated that they separated the waste generated within their households. Additionally, Khanal et al. (2023) show that the majority of Nepalese households (the study area) have access to separate dustbins to segregate and store various waste streams. Khanal et al. (2023) further found a statistically significant influence of gender on waste separation at source whereby females were more involved in waste separation of household waste when compared to their male counterparts.

Table 5.17: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and household separation of different waste streams

Socio-economic and demographic attributes	Waste separation
Age of respondent	0.404
Sex of respondent	0.322
Highest level of education attained by respondent	0.002
Employment status of respondent	0.111
Total household size	0.042
Household decision-maker	0.190
Monthly household income	0.003

Further analyses using a chi-square test on the associations between the respondent and household socio-economic and demographic attributes and household separation of various waste streams were undertaken. The results in Table 5.17 show that there were significant differences between waste separation and the highest level of education attained by respondents ($p=0.002$), monthly household income ($p=0.003$) and total household size ($p=0.042$) categories. Various research studies (Adzawla et al., 2019; Han et al., 2019; Islam et al., 2022; Tassie and Endalew, 2020) concur that education plays a pivotal role in engaging in sustainable waste management practices. Further analyses of the cross-tabulations reveal that the majority of those within both the secondary completed and undergraduate degree categories did not separate various waste streams. These results are verified by those of Fadhillah et al. (2022), where it was concluded that respondents who had attained lower levels of higher education

were more willing to participate in waste separation when compared to those who had attained higher levels of education. The results contradict those by Getahun et al. (2012), Handayani et al. (2018) and Whitmarsh et al. (2018), which substantiate that the higher the level of education attained, the less likely the household is to rely on unsustainable waste management practices. Although Adzawla et al. (2019), Han et al. (2019), Islam et al. (2022) and Tassie and Endalew (2020) show that education is seen as a crucial influence and is positively associated with awareness, understanding and perceptions of waste management services and environmental issues; the results of the current study show that the highest level of education attained by respondents did not influence waste separation as the majority of the respondents of all education levels did not separate waste.

With regards to monthly household income, Hoornweg and Bhada-Tata (2012) and the World Bank (2019) emphasize that one of the greatest challenges of sustainable behaviors such as waste segregation is the high costs associated with this practice. The results indicate that significant differences were found between waste separation and monthly household income ($p=0.003$) categories. Specifically, the cross-tabulations reveal that those households with the least income do not separate different waste streams, while those with the most income separate the different waste streams generated. Awunyo-Vitor et al. (2013) and Tassie and Endalew (2020) substantiate these results by stating that the ability of households to pay for waste management services influences their willingness-to-pay for these services. Specifically, Han et al. (2019), Islam et al. (2022) and Tassie and Endalew (2020) also found that it is higher-income households that are more willing to pay for improved waste management services.

In relation to household size, Adzawla et al. (2019) state that this attribute also plays a vital role in how households manage waste. Significant differences were noted in relation to waste separation and household size ($p=0.042$) categories. Specifically, the majority of those households with one household member (88.23%) did not separate different waste streams. These findings oppose those by Fadhullah et al. (2022), whereby households with fewer household members were found to be more likely to segregate waste within the household. In this regard, Adzawla et al. (2019) found that bigger families are found to engage more in unsustainable waste management practices.

Table 5.18: Waste streams that households separate (n=104, in %): Multiple responses

Waste streams	Percentages
Paper and cardboard waste	47.11
Garden waste	45.19
Plastic waste	38.46
Food waste	36.53
Aluminum can and glass waste	34.61
e-waste	16.34
Construction and demolishing waste	14.42
PPE waste	12.5

According to Khanal et al. (2023), Viljoen et al. (2021) and Vinti et al. (2023), waste separation and sorting of various waste streams are very important at the household level for the efficient handling of these waste materials. Additionally, the DEA (2019) and Kurniawan et al. (2023) emphasize that to reap the benefits of sustainable waste management practices such as separation, there needs to be a high willingness coupled with good practices by waste generators. Thus, it was essential that those households that separate different waste streams were further probed to reveal the specific waste streams that they separate.

It was evident that paper and cardboard waste as well as garden waste were the main waste streams that the households separated, with 47.11% and 45.19%, respectively. Additionally, 38.46%, 36.53% and 34.61% of the households separated plastic, food and aluminum cans and glass waste, respectively. Lastly, fewer households indicated separating e-waste (16.34%), construction and demolishing waste (14.42%) and PPE waste (12.5%). These results align with the emphasis on the importance of waste generators separating dry or inorganic waste materials from wet biodegradable ones (Hoorweg and Bhada-Tata, 2012; Kumar et al., 2017). This is particularly important since the degree of waste segregation at source determines the quantity and quality of recycled materials, waste diverted from landfills, reduced waste stream contamination, the increased value of waste and improved resource recovery (DEA, 2019; DEFF 2020; Hoorweg and Bhada-Tata, 2012). The relatively low levels of waste separation at the source indicate that there is substantial potential to encourage behavior change to transition to sustainable waste management practices.

Table 5.19: Reasons for households not separating waste streams (n=296, in %): Multiple responses

Reasons	Percentages
Do not have access to the necessary facilities	44.26
It is time-consuming	29.39
Do not see the need to separate	25.68
No response	14.86
Not sure where to take the waste once separated	12.5
Do not know how to do it	10.81
Old age	0.68
The caretaker does it	0.34
It is costly	0.34
I forget	0.34
I just do not do it	0.34
There are no orange bags anymore	0.34
We do not get given different bags	0.34
Not well informed	0.34
Plastic bags are expensive	0.34
It is strenuous	0.34
To avoid monkeys	0.34

Smith (2020) states that the separation of waste streams has been a great concern, especially in developing countries where waste management is generally conducted without sufficient planning. Thus, it is evident in the Bluff case study that several issues have hindered participation in waste segregation. Those households that did not separate the waste streams they generated (which are more than those that did separate) stated that they mainly were not able to do this because they did not have access to the necessary facilities (44.26%). This suggests that there is a willingness to separate if these households had access to facilities that made it easier to separate the waste at the household level. Moreover, 29.39% and 25.68% stated that separating waste was time-consuming and that they did not see the need to separate, respectively. Thirteen percent of the respondents claimed that their households did not separate their waste because they were not sure where to take the waste once separated, while 10.81% shared that they did not know how to separate waste. Other responses by one of two of the respondents related to being too old or separating being physically strenuous, opting not to separate, access to or cost of bags, lack of information, and dealing with monkeys. It was observed during the fieldwork that waste bags were often opened by monkeys in the area. This was also affirmed by one of the researcher key informants who stated that “*monkeys in the area, and the mess they make when bins and bags are left outside, dissuades households to separate the waste or even bother to take time to dispose of waste properly*”.

The results pertaining to why most of those households did not separate the waste generated were similar to findings by Islam et al. (2022), Nuraini and Pertiwi (2019), Raghu and Rodrigues (2020) and Srun and Kurisu (2019). Specifically, access to and the availability of the necessary resources, such as disposal facilities, was also found by Nuraini and Pertiwi (2019) to influence waste management behavior. For instance, a study by Khanal et al. (2023) revealed that 53% of respondents were satisfied with the waste management service provider in the area. Moreover, Raghu and Rodrigues (2020) affirm that an individual's willingness to participate in sustainable waste management practices may be negatively affected by the lack of access to the necessary waste management resources. Islam et al. (2022) further report that convenience is an important determinant of engagement in proper waste management behavior.

5.3.6 Waste generation and management practices

Embracing comprehensive and sustainable waste management practices is more likely to occur among individuals and households who internalize better environmentally responsible practices. Therefore, this study examined engagement in specific practices that are related to the generation and management of various materials.

Table 5.20: Engagement in practices at the household level (n=400, in %): Multiple responses

Practice	Percentage
Closing taps	99
Using fresh water to flush the toilet after every use	98.75
Using energy-saving lightbulbs	57.75
Repurposing reusable materials	42.5
Reporting or fixing communal taps if being used and if they are leaking or not working properly	29.75
Recycling	23.75
Separating different waste streams	23.25
Composting food	16.5
Reusing dish- and/ or bathwater in the garden	16
Using drop-off facilities for recyclables and e-waste	16
Reusing dish- and/ or bathwater to flush the toilet	12.25
Collecting and using rainwater	5
Using renewable energy	4.75
Using ecological toilet	0.5

Table 5.20 shows that the majority of the respondents indicated that household members close taps after use (99%) and use fresh water to flush the toilet after every use (98.75%). Almost all the households use fresh water to flush the toilet and considering that the toilet is flushed after each use speaks to the high-water consumption within this community. These results coincide with those by Narmilan et al. (2020), which show that households within developing countries

are increasingly using more appliances that need more water, like flushing toilets. This is a great concern, especially in a country like South Africa, where the water demand is increasing exponentially, which in turn puts the water supply in the country under severe pressure (Jacobs-Mata et al., 2018).

A significant proportion of the respondents use energy-saving lightbulbs (57.75%) and repurpose reusable materials (42.5%). Additionally, 23.75% and 23.25% of the respondents reported recycling and separating various waste streams, respectively. In a study by Ndebele and Du Plessis (2018), similar but lower recycling results were found, whereby only 16% of the respondents in a South African community recycled. Stats SA (2018a) found that the majority (75.8%) of households that did not engage in waste separation and recycling cited that these steps were not necessary because they could easily throw waste in bins for refuse collection by the Municipality. Additionally, results obtained by Filho et al. (2021) are similar to these, where it is revealed that almost 50% of the respondents did not separate various waste streams and only 32% of the respondents have increased their segregation efforts since the COVID-19 lockdown.

Table 5.20 shows that 16.5% of the respondents composted food, 16% reused dish- and/ or bathwater in the garden and used drop-off facilities for recyclables and e-waste, while 12.25% reused dish- and/ or bathwater to flush the toilet. Smaller proportions reported collecting and using rainwater (12.25%), using renewable energy (4.75%) and using ecological toilets (two households). That such an insignificant proportion of the respondents utilize drop-off facilities is concerning since the SDB has several municipal facilities. In this regard, one of the non-government/ civil society organization key informants stated: *“there are drop-off sites for garden waste like the Tara Road tip/ garden site in Bluff”*. Additionally, one of the eThekweni Municipality waste management key informants confirmed this by adding:

This site (Tara Road tip/ garden site) is one such drop-off site for recycling and separation. This site caters to the whole of Bluff. There are other drop-off sites for the same purpose within the South Durban Basin in areas like Montclair and Merebank.

In terms of energy use, although a significant proportion of households use energy-saving lightbulbs, only a few households use renewable energy, which may speak to the high costs associated with acquiring renewable energy sources (Goodall, 2022). Results presented in

previous sections show that a small proportion of the households indicated repurposing waste materials as an additional method and even smaller proportions used repurposing. Similarly, to manage COVID-19-related waste, only a small proportion of households used repurposing as the main method for managing reusable masks as well as sanitizer and cleaning detergent containers, which are mainly made of plastic materials. Although over 40% of households indicated repurposing reusable materials, this figure may not be a true reflection of pre-COVID-19 practices as far as reusing is concerned. Specifically, Almulhim et al. (2021) found that people stopped reusing certain items like plastics when the pandemic spread in fear of waste contamination. As indicated by Leblanc (2019a) and Schröder et al. (2021), repurposing items such as reusable packaging is crucial to reduce waste at source, which is also one of the most preferred options in a circular economy.

5.4 Respondents' awareness and perceptions of sustainable waste management practices

The adjustment to the TPB, which is one of the frameworks that guided this study, highlights that awareness and perceptions correlate positively to the willingness-to-participate in as well as adoption of sustainable waste management practices (Bautista, 2019; Bhawal Mukherji et al., 2016; Han et al., 2019; Kurniawan et al., 2023; Miner et al., 2020; Vinti et al., 2023; Whitmarsh et al., 2018). Thus, the respondents' awareness of sustainable waste management, information sources, previous engagement in sustainable waste management practices and reasons for discontinuation are explored in this section. The conceptual framework further highlighted the importance of ascertaining the challenges that have constrained the shift to using sustainable waste management, as these speak to waste management behavior (Yukalang et al., 2017). In this regard, this section further analyses the respondents' perceptions on various statements regarding household waste management practices, their knowledge of issues and benefits associated with the use of sustainable waste management, current use of sustainable waste management practices and desired future access. The results of the associated current and future costs of sustainable waste management practices, reasons for not wanting to use these practices in the future as well as challenges experienced that have constrained the shift to using sustainable waste management practices are presented and discussed.

5.4.1 Awareness of sustainable waste management

Smith (2020) stresses that awareness has an impact on attitudes, whereby a lack of awareness about sustainable waste management practices has a significant effect on people's attitudes and behaviors. Therefore, understanding awareness and the impacts thereof is crucial when trying

to gauge household waste management behavioral choices. The following subsection looks specifically at the awareness as well as the socio-economic and demographic attributes that influence awareness of sustainable waste management.

The results show that 69% of the respondents were not aware of sustainable waste management. The results indicate some inconsistencies in terms of awareness of concepts (in this case sustainable waste management and actual practices households engage in. Only 31% of the respondents were aware of sustainable waste management, however, as earlier results reveal, more respondents were engaging in sustainable waste management practices such as using energy-saving light bulbs (57.75%) and repurposing reusable materials (42.5%). This suggests that there is a limited understanding of the circular economy from consumption to disposable and waste management across the value change that includes reducing use and recycling. Greater attention should be paid to raising awareness of sustainable waste management in relation to these aspects by adopting a comprehensive and circular economy approach.

The low level of awareness of sustainable waste management is nevertheless worrying as research indicates that the level of awareness and understanding play a crucial role in the intentions of participating and engagement in waste management behavior (Bautista, 2019; Kurniawan et al., 2023; Mamady, 2016; Whitmarsh et al., 2018; Vinti et al., 2023). Specifically, Mamady (2016) emphasizes that more knowledge and understanding are associated with positive attitudes toward behaviors and, in turn, engagement in the behavior. In this regard, one of the non-government/ civil society organization key informants stresses the need for government to enhance knowledge of and access to information about sustainable waste management practices within the community and the Municipality in the SBD:

There need to be more awareness drives. The government should share information about initiatives and drop-off sites with organizations like us and others in the community. These organizations deal with people on a daily basis so this will ensure that information reaches the people.

Furthermore, one of the non-government/ civil society organization key informants indicated that various efforts had been made to improve community members' awareness and understanding of sustainable waste management practices. Explicitly, one of the eThekweni Municipality waste management key informants indicated:

We give people that come to the site pamphlets which explain what they can do at home in terms of waste separation before bringing it to us. We also provide information on radio through the Department of Education and through word of mouth.

Moreover, one of the eThekweni Municipality waste management key informants further spoke to other education initiatives conducted by an education unit by stating:

The DSW has an education section that educates the community and schools on waste management strategies. This includes recycling, reusing, composting and promoting clean-ups. The benefits are that they receive money by selling recyclables which at the same time cleans the environment. The Adopt-A-Spot program allows the community to take care of areas that have been dumping areas by planting flowers/ making gardens that will bear food for them.

Cleanup and school education initiatives were further reiterated by one of the non-government/ civil society organization key informants: “*education in schools and cleanup campaigns have been conducted*”.

Non-government/ civil society organizations also host educational workshops, where they invite government representatives. One of the non-government/ civil society organization key informants stated: “*we host student workshops and invite the Municipality to present here. Depending on the specific project, we believe in involving the government as a stakeholder*”. This indicates the willingness of the government and the non-government sectors to work together to promote sustainable waste management practices. This, as articulated by one of the key informant researchers, is critical for effective communication and awareness about waste management:

Promoting sustainable waste practices requires all stakeholders, from individuals to community organizations to government departments, to work together to raise awareness, and provide communities and businesses (including big industry) to have the necessary knowledge of how to manage waste properly and reuse and recycle as much as possible. This, in itself, is not enough without proper facilities and services being provided to support efforts to promote sustainable waste practices.

The latter comment regarding the provision of facilities and services aligns with earlier assertions that ease to use or convenience is one of the main contributing factors that influence responsible and sustainable waste management practices.

Studies such as those conducted by Mutungwe et al. (2014) caution that although people may be aware of acceptable behavior, it is not enough if they lack understanding and are not willing to participate. Therefore, although such a high proportion of a lack of awareness may influence participation in sustainable waste management practices negatively, understanding and willingness are also crucial attributes that affect behavior (Kurniawan et al., 2023). Additionally, Bautusta (2019) and Islam et al. (2022) found that although individuals are aware of sustainable waste management practices, the majority of the respondents were not aware of their specific roles in proper waste management.

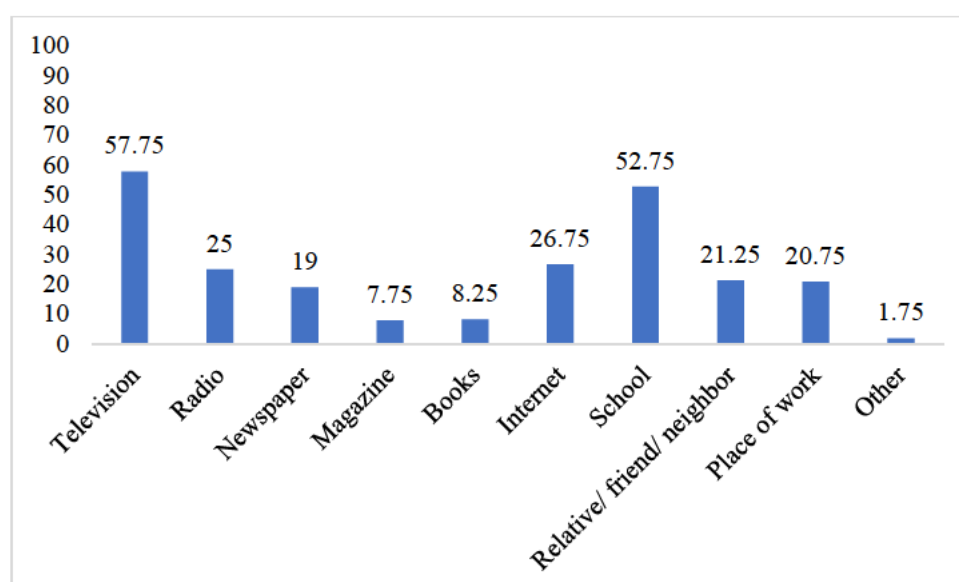


Figure 5.7: Sources of information about sustainable waste management practices (n=124, in %): Multiple responses

In relation to the above findings (Figure 5.7), respondents who were aware were further asked where they received information about sustainable waste management practices from. D'Amato et al. (2019) show that environmental information plays an essential role in promoting sustainable behavior. Moreover, the source from which this information is attained is just as important and also plays a role in determining sustainable waste management behavior (D'Amato et al., 2019). Explicitly, Li et al. (2021) state that the trust level in the information source has a significant influence on an individual's preference and sustainable behavior. In

this regard, it is evident that most of those who were aware of what sustainable waste management practices were received information from television (57.75%) and school (52.75%). Moreover, 26.75%, 25%, 21.25%, 20.75% and 19% of the respondents who were aware received information from the internet, radio, relative/ friend/ neighbor, place of work and newspaper, respectively. In support of these results, Lakshmikantha and Mulur (2014) reinforce that media channels are powerful disseminators of valuable information related to sustainable waste management awareness. Specifically, the study by Lakshmikantha and Mulur (2014) also found newspapers, internet and new media, magazines and other print media, television and radio to be the main information sources. Although the order of information sources differs between the two studies, the findings largely highlight the importance of the same information sources. The other sources of information (1.75%) included age and experience, community campaign, general knowledge, Mondri, municipality, granddaughter and own understanding

Table 5.21: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and awareness of sustainable waste management

	Awareness
Age of respondent	0.360
Sex of respondent	0.142
Highest level of education attained by respondent	0.000
Employment status of respondent	0.141
Total household size	0.925
Household decision-maker	0.252
Monthly household income	0.000

The results of a chi-square test that was conducted to analyze the associations between selected socio-economic and demographic attributes of the respondents and households and the awareness of sustainable waste management practices reveal significant differences between the highest level of education attained by respondents ($p < 0.001$) and monthly household income ($p < 0.001$) categories. Adzawla et al. (2019), Han et al. (2019), Islam et al. (2022) and Tassie and Endalew (2020) show that education is a crucial attribute for and is positively correlated to awareness, understanding and perceptions of waste management services and environmental challenges. The cross-tabulations between the respondent's highest level of education attained and their awareness of sustainable waste management depict significant differences within the partial secondary, secondary completed, certificate/ diploma and undergraduate degree categories. Based on the results, it is evident that awareness was not

influenced by the highest level of education attained by the respondents, as most of those who were not aware belonged to all educational levels. These results speak to the importance of education and awareness campaigns in waste management for the successful execution of sustainable waste management practices (DEA, 2012c; Fadhullah et al., 2022; Islam et al., 2022; Vinti et al., 2023).

The cross-tabulation between the household's income categories and the respondent's awareness of sustainable waste management show significant differences within the no response, R1-R5 000, R30 001-R50 000 and R50 001-R70 000 income categories. The results show that it is those households with the highest level of monthly income that were more aware of sustainable waste management. These results concur with those by Islam et al. (2022), whereby it was concluded that household awareness is higher within households with a higher income.

In the context of the SDB, the survey results are interesting, given the high levels of focus on environmental education and awareness in this highly contested community, as noted in relation to the background of the case study and the many environmental organizations that are active in the community. One of the key informant researchers provides a possible reason:

The SDB is known for high levels of environmental activism, especially against polluting industries. However, individuals and households have generally not translated this activism and awareness to changing practices in their own consumption preferences and how they can limit the waste they generate and dispose of it responsibly.

Thus, this study reveals the importance of examining household-level waste management behaviors and practices, which provides more nuanced information on aspects that need attention to ensure that sustainable waste management practices are embraced by all.

Table 5.22: Awareness of selected types of sustainable waste management (n=124, in %):
Multiple responses

Definition	Percentage
Recycling	35.48
Environmentally friendly disposal	32.26
Reducing waste	30.65
Reusing/ repurposing	30.65
Limiting pollution	7.26
Being clean	7.26
To save or preserve	4.03
Dumpsite	3.23
Composting	1.61
Being aware of waste management implications	0.81
Being innovative and resourceful with waste disposal	0.81

Those respondents who were aware of sustainable waste management were further asked to define this term. The results indicate that respondents mainly defined sustainable waste management as recycling (35.48%), environmentally friendly disposal (32.26%), reducing waste (30.65%) and reusing/ repurposing (30.65%). Fewer respondents defined sustainable waste management as limiting pollution (7.26%), being clean (7.26%), saving or preserving (4.03%) and dumpsite (3.23%). Lastly, 1.61% of the respondents said that sustainable waste management was composting, while 0.81% said it was being aware of waste management implications and being innovative and resourceful with waste disposal. Again, the inconsistencies in understanding what sustainable waste management is and engaging in practices are evident, suggesting that there is a disconnect between what people know/ understand and what they do. This is why it is important to adopt the TPB framework that places emphasis on the understanding that human behavior is often embedded in complexity and contradictions.

5.4.2 Previous use and disuse of sustainable waste management practices

Research shows that issues encountered in relation to efficient waste management discourage waste management intentions and behavior (Smith, 2020; Viljoen et al., 2021; Yukalang et al., 2017). In this regard, the following subsection unpacks sustainable waste management practices that the household had previously used but has discontinued as well as the reasons behind the discontinuation.

Table 5.23: Household previous use and discontinuation of sustainable waste management practices (n=400, in %): Multiple responses – yes only

Sustainable waste management practices used previously and discontinued	Percentages
Separate waste types into different streams and put each in a specifically labeled bin: recycling	13.25
Put food waste in the garden: composting	10.5
Buying and using less products: reducing	10
Take products that could be thrown away and use them for other purposes: Repurposing	3.25

The results depicted in Table 5.23 show that only a few households had previously used and discontinued the use of selected sustainable waste management practices. Specifically, the results depict that 13.25% of the households had previously used and discontinued recycling. Additionally, 10.5% and 10% of the households had previously used and discontinued using composting and reducing, respectively. An even smaller proportion of the households (3.25%) had previously used and discontinued using repurposing.

Table 5.24: Reason for discontinuation of sustainable waste management practices (n=400, in %): Multiple responses – yes only

Reasons for discontinuation	Percentage
Not easily available	12
Time-consuming	8
Inconvenient to use	5.5
Do not know	3.25
Too expensive	3.25
Do not know how to use	3.25
Mondi stopped providing bags and collecting	1
COVID-19	0.5
Moved location	0.5
Do not care	0.25
Do not see a need	0.25
No garden	0.25
Not enough information	0.25
The dog eats it	0.25
Too woke for the system	0.25

The main reasons cited for the discontinuation of the use of sustainable waste management included the practice/ facilities not being easily available (12%) and the practice being time-consuming (8%). In terms of the practice/ facility not being easily available, similar findings were cited by Raab et al. (2021), Smith (2020) and Yukalang et al. (2017), where it was concluded that issues such as those related to inadequate waste management facilities and services discouraged efficient waste management practices. Time has also been found to be a constraint in engaging in proper waste management in similar studies such as those conducted

by Fadhullah et al. (2022) and Nuraini and Pertiwi (2019), whereby it was found that individuals with less time to dedicate to proper waste management were less willing to participate in such behavior.

The results show that 5.5% of the respondents stated that these practices were inconvenient to use, while 3.25% each stated that it was too expensive and that they did not know how to use it, while 1% disclosed that Mondi had stopped providing bags and collecting the material. Islam et al. (2022), Jacobsen et al. (2022), Knickmeyer (2020) and Lazo and Gasparatos (2022) found similar results in relation to convenience being a constraint. Specifically, Knickmeyer (2020) shows that inconvenience associated with attributes such as the perceived difficulties of engaging in sustainable waste management practices discouraged participation. Similarly, Lazo and Gasparatos (2022), Smith (2020) and Yukalang et al. (2017) speak to the insufficient access to and inadequate waste management services and facilities as well as the irregular collection of waste materials as some challenges that discourage engagement in sustainable waste management practices whereby households end up engaging in improper waste management practices. Thus, issues pertaining to convenience and costs, as noted earlier, re-emerge as key issues that influence the uptake of sustainable waste management practices.

Perceptions of the costs associated with sustainable waste management practices have also been found to be an important determinant of waste management behavior (Fadhullah et al., 2022; Nuraini and Pertiwi, 2019; Omotayo et al., 2020; Saseanu et al., 2019). Ferreira and Santana (2021) conclude that low-income households, in particular, have reported more financial challenges that hinder their ability to participate in sustainable behavior. Thus, it is those households that can afford to pay for such practices that are mainly able to participate (Ferreira and Santana, 2021; Omotayo et al., 2020). However, opposing conclusions are made by Fadhullah et al. (2022), where it is found that respondents with low incomes were more involved in practices such as waste segregation. Fadhullah et al. (2022) associate this with waste-picking activities, which are usually performed by poorer individuals as a means of earning an income.

5.4.3 Perceptions of waste management practices

Perceptions are an important attribute to consider in environmental action practices such as sustainable waste management at the household level (Scott et al., 2015). As discussed under the TPB, an individual's perception of their capacity to perform a specific behavior influences their control beliefs, which in turn underpin the individual's perceived behavioral control.

5.4.3.1 Convenience of attaining and using household waste management practices

As discussed in the previous section, convenience considerations are important in determining the type of waste management practices that the individual participates in. This subsection reports on the results obtained when the individuals were asked to rate statements related to the convenience of various household waste management practices.

Table 5.25: Rating of statements pertaining to the convenience of household waste management practices (n=400, in %)

Statements	Rating	Dustbin	Repurposing	Reducing	Recycling	Burying	Burning	Illegal dumping	Composting	Local sites	drop-off
Is expensive	Strongly disagree	27.75	23.25	22	16.75	23.5	25.5	20	21.25	15.5	
	Disagree	53.5	57.25	54.25	55.5	55	56.75	58	50.25	53.75	
	Neutral	11.5	15.75	18	14.75	17	13.5	12.25	21.5	23.75	
	Agree	6.5	3.5	5.25	9	4	3.75	6.75	6.5	6.75	
	Strongly agree	0.75	0.25	0.5	4	0.5	0.5	3	0.5	0.25	
Is unreliable	Strongly disagree	22.25	17.5	18.25	21.5	6.25	6.25	5.25	13.5	12.5	
	Disagree	54.75	54.75	53.25	55.5	32.25	29.25	29.25	51.75	45.5	
	Neutral	12.5	20	21.75	16.25	24.25	19.75	16	26.5	26	
	Agree	8.5	7	5.75	5.75	28	30.25	30.75	7.25	12.5	
	Strongly agree	1.75	0.75	1	1	9.25	14.5	18.75	1	3.5	
Is inconvenient to use	Strongly disagree	24.25	20.5	16	20.25	6.5	7	6.25	11.5	8.5	
	Disagree	56.5	43.75	43.75	43.75	30.25	28.5	30.75	45.5	45.5	
	Neutral	12	20.25	21.75	18.5	23.75	21	18.5	25.25	26	
	Agree	5.5	14.5	17	15.5	30	29.5	26.75	15.5	16.25	
	Strongly agree	1.75	1	1.5	2	9.5	14	17.75	2.25	3.8	
Is time-consuming to do	Strongly disagree	0.25	17.5	13.25	10.75	2.5	5.75	12	8	5	
	Disagree	28.75	33.25	37.5	33.5	30.25	37.75	42	36.75	39.75	
	Neutral	50	20.25	20.5	15	26.5	21.75	20.75	21.5	29.75	
	Agree	15.75	24.25	26.25	33	23.75	21.25	14.75	26.75	16.75	
	Strongly agree	4.75	4.75	2.5	7.75	17	13.5	10.5	7	8.75	

For the discussion strongly agree and agree as well as strongly disagree and disagree were combined to indicate support or not for the specific statements under consideration. As depicted in Table 5.25, the majority of the respondents (81.25%) did not think that using dustbins was expensive. Similarly, 77% did not think using bins was unreliable and 80.75% did not think bins were inconvenient to use. Additionally, 80.5%, 72.25%, 64.25% and 50.75% of the respondents thought that repurposing was inexpensive, reliable, convenient to use and not time-consuming to do. Similar results were recorded for the practice of reducing waste, whereby 76.25%, 71.5%, 59.75% and 50.75% of the respondents reported that reducing was not expensive, was reliable, convenient to use and was not time-consuming to do, respectively. In relation to recycling, 72.25% of the respondents thought it was inexpensive, 77% felt it was reliable, 64% indicated that it was convenient to use and 44.25% noted that it was not time-consuming to do. Seventy-nine percent of the respondents also thought that burying was inexpensive, while 82.25% felt the same for burning. Additionally, 44.75% of the respondents thought that burning was unreliable and although 43.5% thought it was inconvenient to use, 43.5% stated that it was not time-consuming to do. Seventy-eight percent of the respondents stated that illegal dumping was inexpensive and 54% said it was not time-consuming to do, while 49.5% and 44.5% thought it was unreliable and inconvenient to use, respectively. Composting was considered to be inexpensive, reliable, convenient and not time-consuming by 71.5%, 65.25%, 54% and 44.75% of respondents, respectively. Lastly, 69.25%, 58%, 54% and 44.75% of the respondents thought that local drop-off sites were inexpensive, reliable, convenient to use and a time-efficient practice to do.

The responses in terms of specific household waste management practices reflect the importance of adopting a TPB approach. For example, there were generally high levels of agreement that sustainable practices such as repurposing, reducing, recycling and composting are inexpensive, convenient, reliable and not time-consuming. Yet, as per earlier responses, substantially lower proportions of respondents' households indicated that households were engaged in these practices. This again denotes that knowledge/ awareness may not translate into environmentally responsible practices. This was also highlighted by one of the key informant researchers who stated that "*many sustainable waste management practices such as recycling and composting are easy to do and not expensive, yet many residents do not embrace these practices*". This key informant also noted that misconceptions could be influencing behavior, indicating that "*composting is viewed by many residents as being an activity that will cause bad smells and attract flies and insects*". However, composting, when done properly,

does not present these types of problems. Furthermore, as noted by Fadhillah et al. (2022), Reetsch et al. (2020) and Wani et al. (2018), composting has additional environmental benefits to reducing waste, such as increasing soil fertility, humus content and moisture-retaining capacity.

Of concern is that unsustainable waste management practices (such as burying, burning and illegal dumping were also deemed to be inexpensive, convenient, reliable and not time-consuming. This makes it attractive to residents, especially if municipal services are limited or unreliable. Composting, together with reduction and recycling, as noted earlier, are key practices associated with ISWM and moving up the waste management hierarchy (Kaza et al., 2018; Kurniawan et al., 2023; Leblanc, 2019a; Smith, 2020; Vinti et al., 2023; Wani et al., 2018). It is critical that these types of practices are encouraged and households are dissuaded from engaging in unsustainable waste management practices.

5.4.3.2 Health impacts of household waste management practices

Research indicates that improper waste management practices present adverse consequences on public health (Kawai and Tasaki, 2016; Leblanc, 2019a; Lima and Paulo, 2018; Siddiqi et al., 2020; Vinti et al., 2023). Additionally, Adipah and Kwame (2019), Gutberlet (2018), Haerani et al. (2019) and the World Bank (2019) show that adopting sustainable waste management guarantees an efficient environment for human health as well as the conservation of resources. Thus, it was essential that respondents were asked to rate the statement related to the health implications associated with the various waste management practices.

Table 5.26: Rating of statements pertaining to the health impacts of household waste management practices (n=400, in %)

Statements	Rating	Dustbin	Repurposing	Reducing	Recycling	Burying	Burning	Illegal dumping	Composting	Local sites	drop-off
Has associated negative health implications	Strongly disagree	21	22	23	25.5	3.75	1	1.75	15.25	9.75	
	Disagree	52.75	57	57.5	56.25	17.75	10.25	18.25	54.25	50.25	
	Neutral	12.75	17.75	17.75	14.5	21.25	13.5	11.5	24.25	24.25	
	Agree	10.5	2.5	1.75	3.5	43.5	40.75	44.5	5.25	12.5	
	Strongly agree	3	0.75	-	0.25	13.75	34.5	24	1	3.25	

When probed about the associated negative health implications of household waste management practices, 73.75% of the respondents stated that dustbins had no negative health implications. Similar findings were recorded for repurposing, reducing, recycling, composting and local drop-off sites where 57%, 79%, 80.5%, 81.75%, 69.5% and 84.75% of the respondents, respectively, did not think that these practices had any associated negative health implications. On the contrary, 57.25%, 75.25% and 68.5% of the respondents reported that burying, burning and illegal dumping, respectively, did have associated negative health implications. It is evident that the respondents were aware that all the sustainable waste management practices did not have any associated negative health implications, while they acknowledged that the improper waste management practices did pose some negative health impacts. For instance, the DEA (2019), DEFF (2020), Mihai and Taherzadeh (2017), Rasmeni and Madyira (2019) and Vinti et al. (2023) emphasize that waste that is disposed of in an uncontrolled manner or is littered, dumped illegally or burnt leads to pollution and threats to public health; and it is evident from these findings that the respondents were aware of these detrimental effects.

5.4.3.3 Environmental impacts of household waste management practices

Conventional waste management practices such as burying, dumping and burning have proven to be unfriendly to the environment (Gutberlet, 2018; Lee, 2020; Sarfo-Mensah et al., 2019; Silva et al., 2017; Vinti et al., 2023). Additionally, Godfrey et al. (2019), Gutberlet (2018), Mamady (2016), Nukusheva et al. (2023) and the World Bank (2019) show that when waste is disposed of carelessly, environmental pollution is triggered, which leads to climate change-related impacts and other environmental and human health challenges.

Table 5.27: Rating of statements pertaining to the environmental impacts of household waste management practices (n=400, in %)

Statements	Rating	Dustbin	Repurposing	Reducing	Recycling	Burying	Burning	Illegal dumping	Composting	Local sites	drop-off
Causes pollution	Strongly disagree	20.75	30.5	29.25	33.25	1.75	0.25	0.75	16	11.25	
	Disagree	43.25	50	51	49	7.5	4	15.5	53.25	42.5	
	Neutral	14	15	16.5	13	19.5	13.5	12.25	23.5	25.5	
	Agree	20	3.75	2.5	3.5	35.75	32.5	28	3.75	12.75	
	Strongly agree	2	0.75	0.75	1.25	35.5	49.75	43.5	3.5	8	
Is an environmentally friendly practice	Strongly disagree	3.5	0.25	0.5	1.3	32.5	47.25	46.75	3.25	6.75	
	Disagree	29	4	5	4.25	34.5	31.25	34.75	16	34	
	Neutral	19.75	16	18.75	12.75	25.25	15.75	14.5	22.75	27	
	Agree	28.25	56.25	51.5	50.75	5.5	3.75	2.5	40.75	25.25	
	Strongly agree	19.5	23.5	24.25	31	2.25	2	1.5	17.25	7	

Table 5.27 shows that 64% of the respondents did not think that dustbins caused pollution, while 47.75% of the respondents claimed that using dustbins was an environmentally friendly practice. Additionally, 80.5%, 80.25%, 82.25%, 69.25% and 53.75% of the respondents thought that repurposing, reducing, recycling, composting and local drop-off sites did not cause pollution, respectively. While 79.75%, 75.75%, 81.75% and 58% of the respondents believed that these practices (repurposing, reducing, recycling and composting) were environmentally friendly. In contrast, 71.25%, 82.25% and 71.5% of the respondents acknowledged burying, burning and illegal dumping, respectively, caused pollution. In line with these findings, 67%, 78.5% and 81.5% of the respondents did not think that burying, burning and illegal dumping, respectively, were environmentally friendly practices. These results indicate that the respondents acknowledge that the sustainable waste management practices were environmentally friendly and did not cause pollution. Similarly, the majority of the respondents agreed that the conventional and improper waste management methods (burying, burning and illegal dumping) were not environmentally friendly and that these practices caused pollution. These results are in line with the conclusions made by Ijjasz-Vasquez, Kaza (2020), Parikh et al. (2020) and Vinti et al. (2023), who state that carelessly disposed of waste leads to issues such as ending up in creeks, riverbanks, canals and ditches and also results in flooding risks. Moreover, improper waste management strategies end up harboring disease vectors, harming animal life, weakening tourism prospects and causing or worsening respiratory infections (Kaza et al., 2018; Vinti et al., 2023). On the contrary, waste practices such as repurposing, reducing and recycling are necessary for competent solid waste management systems to be effective (Fadhullah et al., 2022). Moreover, these sustainable waste management systems are essential for a circular economy as they reduce the environmental effects of the economy and encourage sustainable economic growth (Edmond, 2019; Stubbs, 2021a; Stubbs, 2021b). The challenge, as noted earlier, is to translate knowledge and awareness into practice.

5.4.3.4 Access of household to waste management practices

As discussed under the TPB, access that households have to waste management facilities, the state that these are under and the overall conditions of the surrounding environment are important attributes for perceived behavioral control and the household waste management practices that households engage in (Liu et al., 2019; Omotayo et al., 2020). Access to waste services has been noted as a pertinent influence on waste management practices that households engage in (Aryampa et al., 2019). Specifically, access to waste management services has been found to influence willingness-to-participate in and pay for efficient waste management

practices (Bhattarai, 2015; Lazo and Gasparatos, 2022; Pertiwa, 2019; Raghu and Rodrigues, 2020).

Table 5.28: Rating of statements pertaining to the access of households to waste management practices (n=400, in %)

Statements	Rating	Dustbin	Repurposing	Reducing	Recycling	Burying	Burning	Illegal dumping	Composting	Local sites	drop-off
Is easy to use/ access	Strongly disagree	0.75	4.25	2.25	6.25	11.5	12.5	13.75	4.25	4	
	Disagree	3	6.5	13	17	17.75	15	11.5	16.75	12.25	
	Neutral	8.5	22	26	21	25	22.25	20.5	28	29	
	Agree	59	50.25	46.5	43.75	40.75	41.25	44.5	42.25	48.25	
	Strongly agree	28.75	17	12.25	12	5	9	9.75	8.75	6.5	
Is safe to use/ access	Strongly disagree	2	0.75	1	1	27	37.5	35.75	2.75	6	
	Disagree	3.25	2.75	3.75	4.25	28.75	26	26.75	9.5	9.5	
	Neutral	14	19	19	16.5	26.75	22.75	19.5	25.5	23.75	
	Agree	52.75	57.25	55.75	55	14.5	12.25	17.25	49.5	50	
	Strongly agree	28	20.25	20.5	23.25	3	1.5	0.75	12.75	10.75	

The respondents were further asked to rate statements pertaining to the ease of use and access as well as safety of use and access to household waste management practices. The majority of the respondents (87.75% and 80.75%) indicated that using and accessing dustbins was easy and safe, respectively. These results are unsurprising since Stats SA (2019b) shows that in 2018, the majority of South African households (66.4%) had access to waste removal services at home. This is generally associated with the collection of waste kept in dustbins for municipal collection once a week. As previously highlighted, one of the eThekweni Municipality waste management key informants reiterated the services offered by the Municipality, stating that *“twenty-six black garbage removal plastic packs, as well as guaranteed once a week collection and wheelie bins are provided for communities in the SDB”*.

The results further show that 67.25% and 77.5% of the respondents stated that accessing and using repurposing was easy and safe. Moreover, reducing and recycling results show that 58.75% and 76.25% of the respondents thought that reducing was easy and safe to use and access, respectively, while 55.75% and 78.25% of the respondents also thought that recycling was easy and safe to use and access. These results concur with those by Mintz et al. (2019), where it was found that generally recycling facilities, especially for materials such as paper and plastic, are usually easily accessible as they are generally conveniently located close to or within residential areas.

Forty-six percent of the respondents stated that burying was easy to use and access and 44.75% acknowledged that this practice was not safe to use and access. Additionally, 50.2% of the respondents stated that burning was easy to use and access, while 62.5% reported that this practice was not safe to use and access. The results for illegal dumping were in alignment with those for burying and burning, whereby 54.25% of the respondents claimed that this practice was easy to use and access, while 62.5% did not think that illegal dumping was safe to use and access. For composting, 51% and 62.25% of the respondents stated that this practice was easy and safe to use and access. Similarly, the results for local drop-off sites indicate that 54.75% and 60.75% of the respondents indicated that this practice was easy and safe to use and access, respectively.

5.4.4 Problems associated with and the benefits of sustainable waste management practices

Research shows that sustainable waste management practices offer ample benefits (DEA, 2019; DEFF, 2020; Schoeman and Rampedi, 2022). For instance, DEA (2012c), Edmond (2019), Godfrey et al. (2019), Gusti (2016) and Stubbs (2021a; 2021b) show that relying more on sustainable waste management practices enhances livelihoods, socio-economic prospects and reduces any negative impacts of the economy on the environment. However, the DEFF (2011), Godfrey et al. (2019) and Viljoen et al. (2021) also show that there are various issues associated with waste management in Africa, and South Africa specifically, which have rendered waste management a significant socio-economic and environmental concern. These issues are linked to various attributes, such as inadequate waste collection services and inappropriate final deposit sites (Smith, 2020). According to Yadav et al. (2023), it is essential that issues related to sustainable waste management strategies are identified and understood in order to help waste management policy-makers and stakeholders to enhance waste management through promoting the circular economy. The respondents were asked whether or not they were aware of issues associated with the use of sustainable waste management practices and 61.75% of the respondents indicated that they were not aware of any issues, while the rest of the respondents indicated problems as shown in Figure 5.9

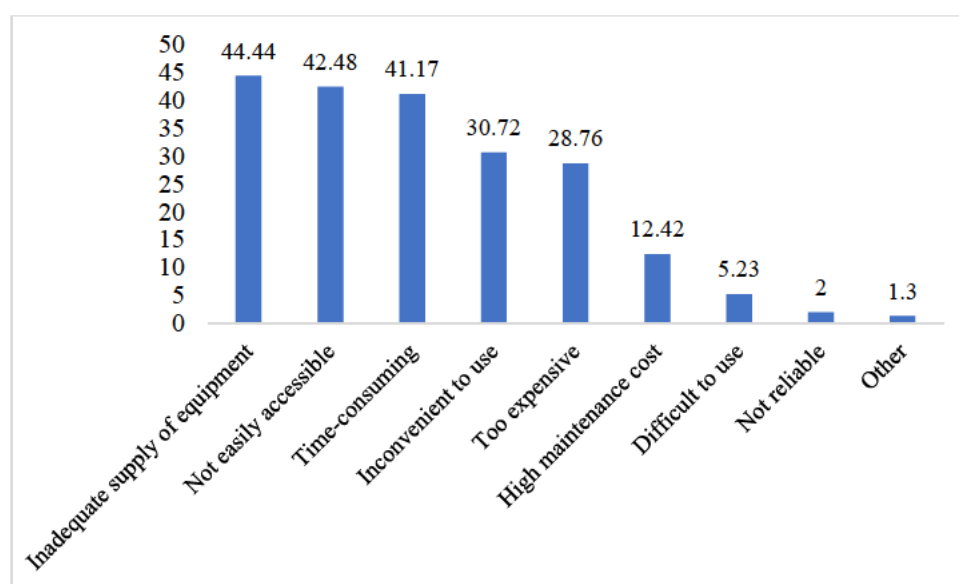


Figure 5.9: Problems associated with the use of sustainable waste management practices (n=153, in %): Multiple responses

The 38.25% of the respondents who indicated that they were aware of problems associated with the use of sustainable waste management practices were further probed to elaborate on

what these issues were. It is evident that some of these problems outlined contradict the results obtained in the previous section looking at perceptions of waste management practices. Specifically, 44.44%, 42.48% and 41.17% of the respondents indicated that there was an inadequate supply of sustainable waste management practices, that these practices are not easily accessible and that they are time-consuming to do, respectively.

The DEFF (2011) and Viljoen et al. (2021) report similar results as those reported above as far as waste management is concerned in South Africa, where it was reported that some of the main issues in this sector include unequal access to waste management services and a lack of and inadequate access to efficient waste management infrastructure. Specifically, Rodseth et al. (2020) add that approximately 31% of the households in the country do not have access to formal waste management services. Lazo and Gasparatos (2022) stress that when households struggle to access efficient waste management services and infrastructure, they resort to disposing of waste improperly. Additionally, Ajzen (2020), Fadhullah et al. (2022) and Omotayo et al. (2020) report that when individuals do not have sufficient time to engage in a behavior, they end up not acting on their intentions to perform a behavior. However, the results about access to sustainable waste management practices contradict those found in the previous subsection, where the majority of the respondents indicated that sustainable waste management practices were easy to access. Additionally, these results oppose those reported by one of the eThekweni Municipality waste management key informants about a community waste disposal site, who indicated:

People do not use the correct bins for specific waste types. For instance, if people put logs in the garden refuse skip the truck that compacts the garden refuse breaks because it does not compact logs. Additionally, people dispose of waste anywhere on site when specific bins are full, so we end up having to clean up after them. When we inform people that we do not take/ accept specific waste, they tell us that they pay rates and so can throw away whatever they want. People use their rights to break the rules and there is nothing we can do about it.

Mthembu (2021a) substantiates the above by affirming that Bluff residents were found to dispose of waste outside a drop-off zone even after its closing hours. Additionally, Mthembu (2021b) states that excessive littering and illegal dumping in the Bluff have further been perpetuated by the unavailability of fixed bins on the streets.

Among the respondents who were aware of problems associated with the use of sustainable waste management practices, 30.72% and 28.76% indicated that sustainable waste management practices were inconvenient to use and too expensive to do, respectively. The high costs associated with sustainable waste management services have also been reported as one of the main challenges associated with these practices in South Africa (DEFF, 2011; Viljoen et al., 2021). A fewer proportion of the respondents indicated that these practices had associated high maintenance costs (12.42%), that they were difficult to use (5.23%) and not reliable (2%). In relation to the results for the difficulty of use, Knickmeyer (2020) asserts that the perceived difficulty of engaging in specific sustainable waste management practices discourages engagement. The other problems associated with the use of sustainable waste management practices (1.3%) 0.65% that were noted were that respondents did not know how to use these practices and that there was not enough information about these practices.

Table 5.29: Benefits of using sustainable waste management practices (n=400, in %)

Benefits noted	Percent
Not applicable	2.5
Do not know	16
Environmentally friendly	71.75
No negative health impacts	27.5
Reliable	13
Cheaper to use	11.75
Easy to use	9.25
Creating income	2
Efficient	0.25
Empowers the unemployed	0.25
Makes soil healthy	0.25
No smell	0.25
Reduces waste	0.25
None	1.75

Smith (2020) indicates that awareness may influence attitudes, where a lack of awareness about sustainable waste management behavior has a substantial effect on people's attitudes and overall waste behavior. Awareness of sustainable waste management practices also includes knowing the benefits associated with the use of these practices. The results indicate that the majority of the respondents (71.75%) indicated that these practices were environmentally friendly. Additionally, it was noted by 27.5% of the respondents that sustainable waste management practices had no negative health impacts. Thirteen percent of the respondents claimed that sustainable waste management practices were reliable, 11.75% indicated that these practices were cheaper to use, while 9.25% thought these practices were easy to use. Smaller proportions indicated that sustainable waste management practices created income (2.25%),

while one respondent each stated that these practices were efficient, empowered the unemployed, made soil healthy, had no smell, reduced waste and helped vegetables grow. It is thus evident that many of the respondents do know some of the main benefits of sustainable waste management practices.

Table 5.30: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and the main benefits of using sustainable waste management practices that were noted by respondents

Main benefits	Age of respondent	Sex of respondent	Highest level of education attained by respondent	Employment status of respondent	Total household size	Household decision-maker	Monthly household income
Environmentally friendly	0.255	0.027	0.000	0.028	0.688	0.206	0.070
No negative health impacts	0.137	0.057	0.084	0.550	0.424	0.617	0.000
Do not know	0.022	0.039	0.003	0.119	0.250	0.295	0.123
Reliable	0.555	0.477	0.809	0.942	0.387	0.719	0.622
Cheaper to use	0.331	0.891	0.064	0.097	0.231	0.654	0.222
Easy to use	0.472	0.818	0.269	0.030	0.256	0.543	0.574

The key benefits associated with sustainable waste management practices were analyzed in relation to the main households' and respondents' socio-economic and demographic attributes to establish any significant differences. Studies such as those conducted by Adzawla et al. (2019), Awunyo-Vitor et al. (2013), Boateng et al. (2016), Fadhullah et al. (2022), Han et al. (2019), Handayani et al. (2018) Islam et al. (2022) and Tassie and Endalew (2020) show that sex, age, education, household size and income play a crucial role in waste management behavior, responsibility as well as willingness-to-participate in and pay for waste management behavior. Additionally, Schoeman and Rampedi (2022) found that knowledge of the benefits of sustainable waste management practices such as recycling influenced engagement in such behavior.

The results in Table 5.30 indicate that there was a significant association between the benefit of sustainable waste management practices not having any negative health impact ($p < 0.001$) and monthly household income categories. Moreover, significant differences were noted between sustainable waste management practices being environmentally friendly and the highest level of education attained by the respondents ($p < 0.001$), sex of the respondents ($p = 0.027$) and employment status of the respondents ($p = 0.028$) categories. With regards to the respondents not knowing any benefits of using sustainable waste management practices, it is evident that there were significant differences with the highest level of education attained by the respondents ($p = 0.003$), age of the respondents ($p = 0.022$) and sex of the respondents ($p = 0.039$) categories. Additionally, there was a significant association between the ease of use of sustainable waste management practices and the employment status of the respondents ($p = 0.030$) categories. It is thus evident that age, sex, highest level of education attained, employment and monthly income considerably influence respondent's awareness of the benefits of sustainable waste management practices. In this regard, the DEA (2012b) and Fadhullah et al. (2022) stress that educating people about sustainable waste management practices and the benefits thereof is crucial to change attitudes and improve awareness. It is also important that these initiatives are directed at people of all demographic and socio-economic groups.

5.4.5 Current use and future willingness-to-use sustainable waste management practices

Gardner (2015) shows that habits may be used to predict specific behavior. In this regard, Bautista (2019) adds that individuals who already engage in specific sustainable waste management behavior are most likely to engage in other sustainable waste management practices. Moreover, Ariyani and Ririh (2020) and Fadhullah et al. (2022) add that having knowledge of current household waste management behavior is important to understand the necessary encouragement steps needed for households to move towards sustainable waste management practices. In relation to willingness, Han et al. (2019) state that willingness-to-engage in and pay for waste management practices are crucial aspects of sustainable domestic waste management practices. In addition to the responses presented earlier in relation to practices at the household level presented in Table 5.23 and sustainable practices previously used but discontinued, respondents were asked whether or not they currently used selected sustainable waste practices, and future-willingness-to-adopt these practices if they did not currently use, tabulated below. This is crucial because practices such as waste reduction, repurposing and recycling are essential components of an ISWM system (Kurniawan et al., 2023; Leblanc, 2019a).

Table 5.31: Current household use of selected sustainable waste management practices and future willingness-to-use If not currently used (n=400, in %): Multiple responses

Sustainable waste management practices	Yes	No	If not used currently, future interest
Take products that could be thrown away and use them for other purposes (repurpose)	56	44	30
Buying and using less products (Reducing)	8.25	91.75	64.75
Separate waste types into different streams and put each in a specifically labelled bin (Recycling)	27	73	52.5
Put food waste in the garden (Composting)	15.75	84.25	51.25

Table 5.31 indicates that of the four sustainable waste management practices, repurposing (56% - higher than the 42.5% reported earlier in Table 5.20) was the most currently used by households. According to the eThekweni Municipality (2016a), repurposing includes households reusing empty plastic bags and glasses. This correlates to the previous results, where respondents indicated mainly reusing plastic waste. AalMulhim et al. (2021) found that when COVID-19 started, people stopped reusing products such as those based on plastic because of a fear of waste being contaminated. The responses indicate that households do repurpose and reuse materials and products. Fewer respondents indicated that households engaged in the other three sustainable waste management practices, specifically recycling (27% - slightly higher than the 23.75% reported earlier in Table 5.20), composting (15.75% - almost the same as the 16.5% reported earlier in Table 5.20) and reducing (8.25% - not covered in Table 5.20). The differences between the previous responses could denote that people understand concepts differently depending on how questions are asked. One of the key informant researchers also referred to this aspect, noting that:

Residents' understanding of waste concepts, including types and practices, differ and can change depending on the context, how questions are posed and even who asks the questions, especially in politically and environmentally contested communities such as the SDB.

The results found for recycling correlate to those by Stats SA (2018a), where it was reported that the majority of South African households do not recycle the waste that they generate. Specifically, Stats SA (2018a) reports that 75.8% of South African households do not segregate waste for recycling purposes because they could simply throw waste in the bin for refuse collection. It is evident that households are the least involved in waste reduction and composting. These results are concerning as Bautista (2019) states that individuals who already practice waste management behavior such as waste reduction are more likely to subsequently engage in other sustainable practices like reusing and recycling. Moreover, source reduction is one of the main components of ISWM (Kurniawan et al., 2023; Leblanc, 2019a). Specifically, waste reduction is the most preferred method through the prevention of waste generation; and waste disposal is the least preferred (Adipah and Kwame, 2019). Additionally, one of the non-government/ civil society organization key informants reiterates this concern when highlighting the aspects that need to be improved by the community and the Municipality by stating:

Recycling, full involvement if beach cleanup, supporting the NGO in improving the environment by keeping it litter free. The Municipality should respond quickly when we report a serious issue in waste management.

These low results for waste reduction may be due to a lack of understanding of what the concept comprises. For instance, Leblanc (2019a) and Wani et al. (2018) show that reduction may include practices like reusing (in which a significant proportion of the households are already engaged). Thus, to reiterate previous discussions, waste education and awareness campaigns are crucial for the effective implementation of waste reduction projects (DEA, 2012c; Fadhullah et al., 2022; Islam et al., 2022; Kurniawan et al., 2023; Vinti et al., 2023). Additionally, educating people about waste reduction and its benefits and methods is important to improve awareness and subsequently change their attitudes (DEA, 2012b; Fadhullah et al., 2022).

In a study conducted by Schoeman and Rampedi (2022), it was found that the household's decision to engage in sustainable waste management practices was influenced by the benefits associated with these practices. More than half of those respondents who were not currently using sustainable waste management practices were willing to participate in reducing (64.75%), recycling (52.5%) and composting (51.25%), while 30% were willing to use repurposing in the future. This indicates a high willingness among the general population to embrace sustainable waste management practices. Al-Khateeb et al. (2017) and Smith (2020) show that attitudes toward sustainable waste management behavior are influenced by various factors, including the socio-economic attributes of the household. Specifically, Uma et al. (2020) show that attributes such as sex, highest level of education attained, employment status and household headship may influence willingness-to-pay for waste management practices. On the contrary, Güven et al. (2023) show that attributes like income, age and highest level of education attained did not influence the willingness of respondents to segregate waste at source.

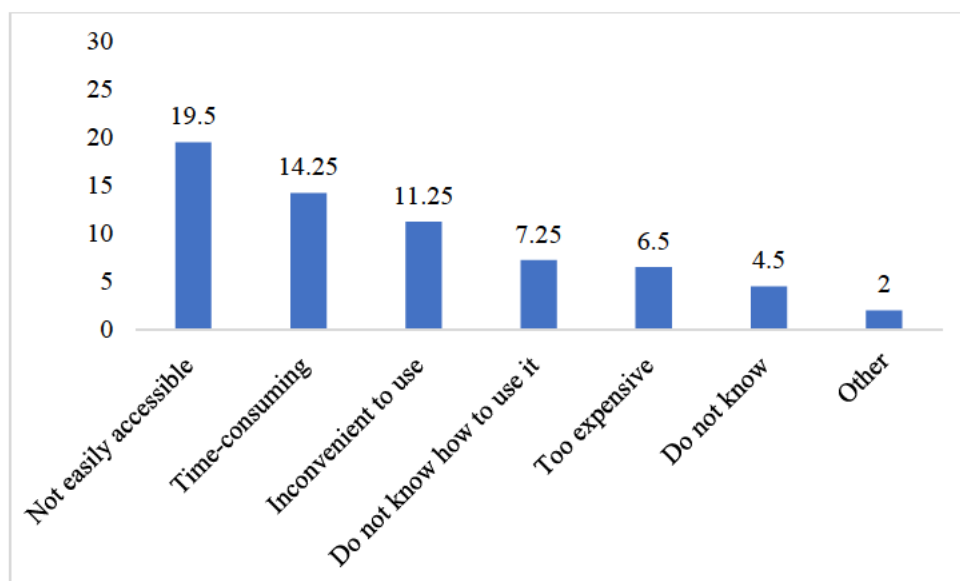


Figure 5.8: Reasons for not currently using sustainable waste management practices (n=400, in %): Multiple responses

Challenges experienced that constrain the use of sustainable waste management practices are usually overlooked when considering household consumption and practices in relation to key domestic waste streams. However, this aspect is crucial when developing waste management strategies and infrastructure within communities. The main reasons cited for not currently using the four selected sustainable waste management practices were that these practices were not easily available (19.5%), were time-consuming to do (14.25%) and were inconvenient to use (11.25%). The reasons resonate with earlier responses presented in Figure 5.8 in relation to reasons why sustainable waste management practices were discontinued. Furthermore, these results concur with the report by Stats SA (2018a), where it was concluded that low participation in sustainable waste management behavior in South African households is largely influenced by inadequate municipal infrastructure and capacity as well as insufficient resources.

A smaller proportion of the respondents stated that they do not know how to use these sustainable practices (7.25%) and that these practices are expensive (6.5%). The other reasons that were cited by the respondents for not currently using sustainable waste management practices included households giving their leftover food to the dog, not seeing a need to adopt sustainable waste management practices, staying on a rented property, having no space to engage in these practices, not being informed about these practices, not being interested and being too old to engage in these practices.

Table 5.32: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and future willingness-to-use sustainable waste management practices if not currently using

	Reducing	Recycling	Composting	Repurposing
Age of respondent	0.031	0.203	0.403	0.095
Sex of respondent	0.069	0.730	0.824	0.555
Highest level of education attained by respondent	0.332	0.747	0.330	0.402
Employment status of respondent	0.520	0.553	0.148	0.720
Total household size	0.343	0.005	0.018	0.021
Household decision-maker	0.031	0.242	0.201	0.251
Monthly household income	0.002	0.120	0.747	0.728

Han et al. (2019) assert that willingness-to-adopt or pay for waste management practices forms part of the foundation of sustainable and effective domestic waste management practices. The DEA (2019) states that this is because there needs to be a high willingness by individuals/ households/ communities to reap the benefits of sustainable waste management practices. However, the aspect of willingness-to-adopt and pay for sustainable waste management practices is usually disregarded when looking at households using and disposing of key domestic waste streams. Considering this aspect is important when establishing waste management intervention strategies and infrastructure. Thus, the future willingness of respondents to use sustainable waste management practices in relation to various socio-economic attributes is analyzed. Additionally, household variables are also included. Specifically, Table 5.32 presents the results of the chi-square tests that were conducted to analyze the differences between selected socio-economic and demographic attribute categories of respondents and households, and future willingness-to-use sustainable waste management practices.

The results show significant differences between age ($p=0.031$), household decision-maker ($p=0.031$) and household monthly income ($p=0.002$) categories and willingness-to-reduce. In relation to recycling, composting and repurposing, significant differences were only noted in relation to the total household size ($p=0.005$, $p=0.018$ and $p=0.021$, respectively) categories. These results reinforce that some of the socio-economic and demographic attributes, especially household size, do influence willingness to engage in sustainable waste management practices. As already discussed previously, socio-economic and demographic variables of individuals and households play a crucial role in determining willingness-to-adopt sustainable waste management practices (Al-Khateeb et al., 2017; Smith, 2020). Specifically, studies such as

those by Adzawla et al. (2019), Fadhullah et al. (2022), Han et al. (2019), Islam et al. (2022) and Tassie and Endalew (2020) substantiate that attributes such as income and educational level influence willingness to engage in sustainable waste management practices. Education and income were generally not found to be influential in this study.

Table 5.33: Reasons why households who do not use sustainable waste management practices are not interested to use in future (n=400, in %): Multiple responses - yes only

Reasons	Percentages
Time-consuming	8.5
Too expensive	7
Inconvenient to use	6.5
Inadequate supply of equipment	6.5
Not easily accessible	4.5
High maintenance cost	2.5
Not reliable	1.5
Difficult to use	1
Old age	0.75
Do not see a need	0.25
Not enough information	0.25
Not interested	0.25
Renting	0.25

The results depicted previously for future interest showed that those respondents who did not currently use sustainable waste management practices were largely interested in using them in the future. Those respondents who stated that their households did not use sustainable waste management practices and were not interested in using these in the future were asked why they were not interested in future use (Table 5.33). In this regard, the highest reasons cited for a lack of future interest to use, albeit a few, were that engaging in sustainable waste management practices was time-consuming (8.5%), these practices are too expensive (7%), that it is inconvenient to use these practices (6.5%) and that there is an inadequate supply of equipment for these practices (6.5%).

Few proportions stated that sustainable waste management practices were not easily accessible (4.5%), that there were high maintenance costs associated with the use of these practices (2.5%), that these practices were not reliable to use (1.5%) and that they were difficult to use (1%). Old age was cited by 0.75% of the respondents, while one respondent each stated that they did not see a need to engage in sustainable waste management practices, that there was not enough information available, they were not interested and that they were renting.

As previously discussed, time has been cited as one of the main reasons behind negative attributes and the discontinuation of the use of sustainable waste management practices. Ajzen (2020) found that insufficient time to engage in sustainable behavior may deter an individual's intentions of participating in a behavior. Additionally, these results concur with those by Knickmeyer (2020), where it was revealed that inconvenience associated with sustainable waste management practices discourages participation. In terms of prices being too expensive, Omotayo et al. (2020) and Ferreira and Santana (2020) reaffirm that it is those households who are able to afford to perform efficient waste management practices through access to extra income and based on the price of these products or services which are more likely to pay for these practices. Moreover, Islam et al. (2022) and Lazo and Gasparatos (2022) found that convenience as well as insufficient access to and supply of waste management infrastructure, deter individuals from engaging in sustainable waste management practices.

Table 5.34: Challenge that has constrained the household's shift to embrace sustainable waste management practice (n=400, in %): Multiple responses

Challenges	Percentages
Do not have equipment	49.75
Time-consuming	31.75
Lack of knowledge	27.5
Too expensive	25.25
No drop-off centers in the community	12.5
None	10.25
Too difficult	7
No space	0.5
Laziness	0.25
Old age	0.25
Sometimes dogs tear the plastics	0.25
Tenant	0.25
Black plastics are not environmentally friendly	0.25

It is evident that a substantial proportion of the respondents who were not currently using sustainable waste management practices were interested in future use. However, there still exist challenges that have constrained the household's shift to engage in these practices. Specifically, Table 5.34 shows that the main constraints were lack of access to the necessary equipment (49.75%) and the practices being time-consuming to engage in (31.75%). One of the key informant researchers who had undertaken environmental sustainability research in the SDB substantiated: *“the placement of the (waste management) facilities for (waste) recovery if too far out will not justify bankability due to high transportation costs”*. In terms of access to the necessary services, equipment and infrastructure, these results are further substantiated by

Kurniawan et al. (2023) and Lazo and Gasparatos (2022), where it was found that when individuals are located far from waste management services and infrastructure, they are discouraged from engaging in sustainable practices. Additionally, and as previously indicated, although the Tara Road tip/ garden site in the Bluff area is for garden refuse, they do accept other waste types. This was confirmed by both eThekwin Municipality waste management key informants. Explicitly, one indicated: *“garden refuse sites in Tara Road and Travencore Drive are always cleared in order to be able to accommodate the continuous waste disposed-off by residents”*.

The second eThekwin Municipality waste management key informant reiterated by stating that waste types accepted at the Tara Road tip/ garden site:

This site specifically offers services for garden refuse drop off for the community members. We also accept recyclables like plastics, steel, oil, boxes, paper, newspapers and glass. These waste types are separated into different skips for drop-off at relevant recycling companies (for example, Mondi for paper and scrap yards for steel).

Time constraints are key in deterring an individual's intentions of engaging in sustainable behavior (Ajzen, 2020; Smith, 2020). Additionally, considering that most of the respondents had completed matric, obtained post-matric qualifications and were employed, it is unsurprising that a significant proportion of the respondents indicated that these practices were time-consuming. This is supported by Fadhullah et al. (2022), where it was concluded that individuals with higher levels of education attained usually spend most of their time at work than at home and so are less willing to participate in efficient waste management practices.

The results in Table depict that 27.5% of the respondents stated that they lacked knowledge about sustainable waste management practices and 25.25% of the respondents indicated that these practices were too expensive. Moreover, one of the key informant researchers outlined similar challenges: *“lack of education and the knowhow for the waste producers to manage such waste without resorting to disposing of it (is a challenge)”*.

In terms of knowledge, Mamady (2016) asserts that the less knowledge and understanding people have, the less positive their attitudes are towards a specific behavior and so the less they are likely to engage in it. Specifically, Bhawal Mukherji et al. (2016), Han et al. (2019),

Herdiansyah et al. (2021), Miner et al. (2020) and Wu et al. (2022) reiterate that willingness-to-engage in sustainable waste management behavior is positively correlated to the environmental knowledge possessed. In terms of cost concerns, the World Bank (2019) concurs that sustainable waste management practices are generally associated with being expensive, which has caused great constraints in engagement in these practices within developing countries.

It is evident that 12.5% of the respondents claimed that the lack of drop-off centers in the community had constrained the embracing of sustainable waste management practices, while 7% of the respondents claimed that these practices were too difficult to engage in. Knickmeyer (2020) found that difficulties associated with engagement in sustainable waste management practices were found to discourage engagement in these practices. Therefore, Jacobsen et al. (2022) and Kurniawan et al. (2023) emphasize the importance of making infrastructure, services and systems convenient for people to use in order to encourage participation in sustainable waste management practices.

5.4.6 Current use and future willingness-to-use sustainable waste management facilities/equipment

As Han et al. (2019) note, willingness-to-use and pay for waste management practices are critical as a foundation for the adoption of sustainable waste management strategies at the household level. Additionally, Adipah and Kwame (2019) assert that willingness-to-use sustainable waste management and waste management behavior influences decisions associated with sustainable waste practice policies and fees for waste management facilities and services. In line with the perceived behavioral control of the TPB, Liu et al. (2019) and Omotayo et al. (2020) further show that it is important to focus on the waste management facilities that households have access to. Thus, the following section looks at the current use of sustainable waste management facilities or equipment and the future willingness-to-use these.

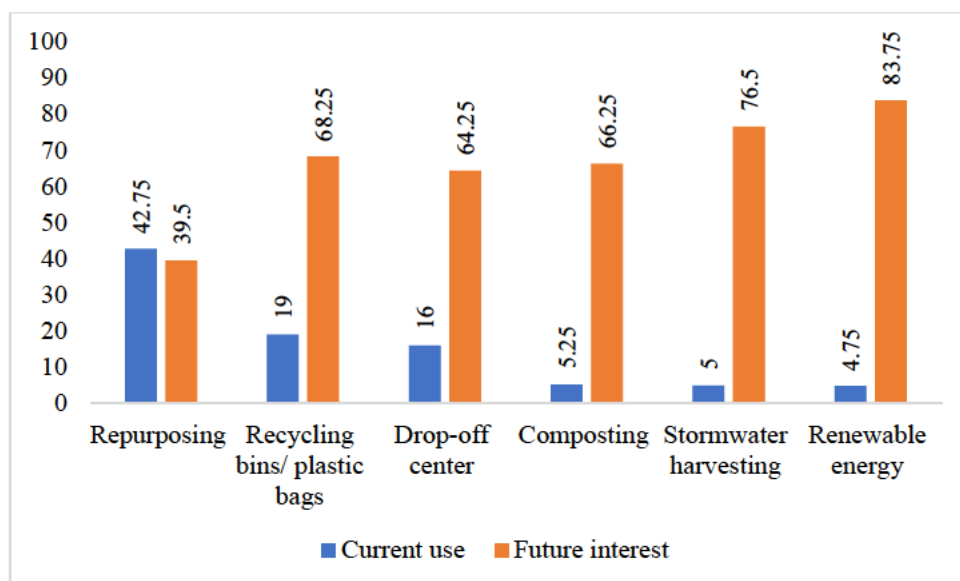


Figure 5.9: Sustainable waste management facilities/ equipment that the household currently have access to as well as the future interest to access sustainable waste management facilities/ equipment if the household currently does not have (n=400, in %): Multiple responses

The results show that the majority of the households (42.75%) with access to sustainable waste management facilities or equipment had access to repurposing facilities or equipment. Additionally, 19% and 16% of the responses with such facilities or equipment had access to recycling bins or plastic bags and drop-off centers, respectively. Fewer proportions of the respondents (5.25%, 5% and 4.75%) had access to composting, stormwater harvesting and renewable energy facilities or equipment, respectively.

When probed about the sustainable waste management facilities or equipment that households would like to have access to in the future, the vast majority of the respondents (83.75%) indicated being interested in having access to renewable energy facilities or equipment. Moreover, 76.5% of the respondents would like future access to stormwater harvesting facilities or equipment, 68.25% would like future access to recycling bins or plastic bags, 66.25% to composting facilities or equipment, 64.25% to drop-off centers and 39.5% to repurposing facilities or equipment. It is evident from these results that it is those households with the least access to specific sustainable waste management facilities or equipment that mostly desire future access to the specific facilities or equipment.

Table 5.35: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and future interest to access sustainable waste management facilities/ equipment

	Repurposing	Recycling bins/ plastic bags	Drop-off center	Composting	Stormwater harvesting	Renewable energy
Age of respondent	0.787	0.020	0.021	0.055	0.053	0.549
Sex of respondent	0.467	0.318	0.371	0.027	0.063	0.003
Highest level of education attained by respondent	0.018	0.632	0.062	0.228	0.190	0.165
Employment status of respondent	0.899	0.660	0.069	0.359	0.024	0.619
Total household size	0.149	0.500	0.749	0.695	0.545	0.142
Household decision-maker	0.350	0.040	0.094	0.263	0.253	0.163
Monthly household income	0.980	0.830	0.158	0.626	0.095	0.324

As previously discussed, a high willingness by individuals/ households/ communities is crucial to reap the benefits of sustainable waste management practices (DEA, 2019). Thus, future interest in acquiring and using sustainable waste management facilities/ equipment is an important aspect to probe in household waste management research. In this regard, Table 5.35 depicts the chi-square test results for the relationship between the main socio-economic and demographic attributes of respondents and households and future interest in accessing sustainable waste management facilities/ equipment. The results show significant associations between future interest in acquiring renewable energy facilities/ equipment and the sex of the respondents ($p=0.003$), repurposing facilities/ equipment and the highest level of education attained by respondents ($p=0.018$) categories. In terms of recycling bins/ plastic bags, significant differences were noted for the age of respondents ($p=0.020$) and household decision-maker ($p=0.040$) categories. For drop-off centers, a significant difference was found in the age of respondents ($p=0.021$) category. Additionally, the results show that stormwater harvesting facilities/ equipment differed significantly across the employment status of respondents ($p=0.024$) and age of respondents ($p=0.053$) categories. For composting, there was a significant difference with the sex of respondent ($p=0.027$) category.

Table 5.36: Sustainable waste management facilities/ equipment/ practices that the household currently have access to were acquired (in %)

Facility/ equipment	How the facility/ equipment was acquired	Acquired percentage
Renewable energy (n=19)	Do not know	15.79
	Purchased	63.15
	Part of the house when purchased/ allocated	21.05
Stormwater harvesting (n=20)	Do not know	10
	Purchased	70
	Part of house when purchased/ allocated	10
	Repurposed	10
Recycling bins/ plastic bags (n=76)	Do not know	1.32
	Purchased	39.47
	Given by friend/ family	2.63
	Donated by government/ municipality	55.26
Composting (n=21)	Do not know	19
	Purchased	52.38
	Part of house when purchased/ allocated	14.29
	Garden tools	4.76
	Repurposed	9.52
Repurposing (n=171)	Do not know	45
	Purchased	36.25
	Given by a friend	0.58
	Part of house when purchased/ allocated	14.62
	Donated by government/ municipality	0.58
	Donated by non-governmental organization	0.58
	Household responsibility	0.58
	Old containers	1.58
	Repurposing	0.58
Drop-off center (n=64)	Do not know	3.13
	Purchased	1.56
	Donated by government/ municipality	89.06
	Donated by non-governmental organization	3.13

Table 5.36 indicates that it is not uncommon for households with access to/ having acquired sustainable waste management facilities or equipment to have acquired these by purchasing them. Specifically, 63.15% of the households purchased renewable energy facilities or equipment, 70% purchased stormwater harvesting facilities or equipment and 52.38% purchased composting facilities or equipment. Although facilities or equipment such as recycling bins or plastic bags (55.26%) and drop-off centers (89.06%) have/ are being donated by the government or municipality, households may still have to supplement facilities or equipment like recycling bins or plastic bags by purchasing them (39.47%).

The results relating to government donations are substantiated by the DEA (2019), DEFF (2020) and eThekweni Municipality (2016a), where it is reported that the local government is usually responsible for waste management infrastructure like public bins and drop-off centers

as well as services including providing plastic bags, waste collection, disposal and street sweeping. Moreover, one of the eThekweni Municipality waste management key informants reiterated: “*the Municipality provides plastic bags, disposal bins around the community, drop-off facilities and weekly waste collections*”.

5.4.7 Money household has spent, currently spends and is willing to spend in the future on sustainable waste management facilities/ equipment

Research shows that money is a crucial determinant of waste management behavior (Fadhullah et al., 2022; Nuraini and Pertiwi, 2019; Omotayo et al., 2020; Saseanu et al., 2019). Moreover, Awunyo-Vitor et al. (2013), Tassie and Endalew (2020) and Uma et al. (2020) stress that the affordability of or ability of households to pay for waste management services plays a substantial role in determining their willingness-to-pay. For instance, Ferreira and Santana (2021) show that financial resources have presented challenges to the ability of low-income households to engage in sustainable behavior. Although, for the most part, households do pay for waste management services through rates, they generally are not aware of these costs. Furthermore, because these costs are not explicitly disclosed and are not related to the amount of waste households generate and dispose of, households remain unaware and are not held accountable for waste generation and management (Matheson, 2022). Al-Khateeb et al. (2017), Balasubramanian (2019), Boateng et al. (2016), Chikowore (2021), Han et al. (2019), Handayani et al. (2018), Islam et al. (2022), Mamady (2016), Miner et al. (2020), Saseanu et al. (2019), Tassie and Endalew (2020), Viljoen et al. (2021) and Whitmarsh et al. (2018) show that willingness-to pay for and adopt sustainable waste management practices is influenced by attributes such as the household’s size, educational level, sex and age distribution, monthly income, residential area, access to waste management services and the distance from municipal dumpsites, amount of waste produced weekly and the role played by the respondent in the management of waste. With the above in mind, the following section presents and discusses results related to money that households paid, are paying and are willing to pay in future for sustainable waste management practices.

Table 5.37: Money household spent as a startup for sustainable waste management practices (n=400, in %)

Money spent as a startup	Percentage
Not applicable	34.75
None	38.5
Do not know	12
R1-R100	5.75
R101-R500	5.25
R501-R900	0.5
R901-R1300	1.5
R1301-R1700	0.5
R1701 and more	1.25
Total	100

The majority of the households (38.5%) with access to sustainable waste management practices did not pay any startup fees for these practices, while 12% did not recall how much they had to pay as startup costs. Additionally, 5.75% and 5.25% of the respondents paid between R1-100 and R101-500, respectively. The fact that the majority of the households that engage in sustainable waste management practices did not pay for these is a reflection of reliance on municipal services and facilities. This is in line with findings by Mutungwe et al. (2014) and Nukusheva et al. (2023) where it was reported that community members largely consider waste management to be the municipality's responsibility. Thus, in the South African context, costs to embrace sustainable waste management practices is not a major constraint.

Table 5.38: Money household spends monthly for sustainable waste management practices (n=400, in %)

Money household spends monthly	Percentage
Not applicable	34.75
None	41.75
Do not know	11.75
R1-R100	7.25
R101-R500	4
R901-R1300	0.25
R1301-R1700	0.25
Total	100

Similar to the results obtained for the money that households spent as startup costs for sustainable waste management practices, it is further apparent that the majority of the households (41.75%) do not spend any money on these practices on a monthly basis. Furthermore, 34.75% of the respondents indicated that monthly spending on sustainable waste management practices was not applicable to their households, while 11.75% did not know how much money they spent monthly. Additionally, 7.25% of the household paid between R1-100 and 4% paid R101-R500 monthly. Only one of the households each paid between R901-R1300 and R1301-R1700 monthly for sustainable waste management practices.

Table 5.39: Money household is willing to spend as startup costs for sustainable waste management practice (n=400, in %)

Money household is willing to spend as a startup	Percentage
Not applicable	3.25
None	24.5
Do not know	19
R1-R500	32.75
R501-R1000	8
R1001-R1500	3.5
R1501-R2000	3.75
R2001-R5000	4.25
R5001-R10000	0.5
R10001-R20000	0.25
R20001 and more	0.25
Total	100

The results show that the range of amounts that households would be willing to spend in the future as startup costs ranged from none to R20 001 and more. Specifically, it is evident that the majority of the households (32.75%) would be willing to spend between R1-R500 as startup costs for sustainable waste management practices, while 24.5% would not be willing to spend any money. Nineteen percent of the respondents indicated that they did not know how much their households would be willing to spend on startup costs. Additionally, 8% of the respondents would be willing to pay between R501-R1 000, while 4.25% stated that they would pay R2 001-R5 000. Fewer respondents (3.75%) would be willing to pay R1 501-R2 000 and 3.5% were willing to pay R1 001-R1 500. Even fewer proportions of the households would be willing to pay R5 001-R10 000 (two households), R10 001-R20 000 (one household) and R20 001 and more (one household).

The results above show that generally, households are only willing to spend the bare minimum for sustainable waste management services. Kaza et al. (2018) explain this by stating that households have other important services such as water, education and health care that they need to finance, which competes with funding efficient waste management at this level. Additionally, the results resonate with those by Chikowore (2021), where it was found that Zimbabwean households were only willing to pay the minimum costs for waste management services.

Table 5.40: Money household is willing to spend monthly for sustainable waste management practices (n=400, in %)

Money household is willing to spend monthly	Percentage
No response	9
Not applicable	4.5
None	27.25
Do not know	18.75
R1-R500	38
R501-R1000	1.25
R1001-R1500	0.5
R1501-R2000	0.75
Total	100

It is evident that 38% of the households would be willing to spend between R1-R500 per month for sustainable waste management practices in the future. These results correlate with those on Table 5.39 for money households are willing to spend as a startup, whereby the majority are only willing to spend the minimum amount options. Additionally, 27.25% of the households would not be willing to spend any money on a monthly basis, while 18.75% do not know how much they would be willing to pay. Smaller proportions of households were willing to pay R501-R1 000 (1.25%), R1 501-R2 000 (0.75%) and R1 001-R1 500 (two households) per month. A significant proportion of respondents would not be willing to pay anything monthly for sustainable waste management practices. Bhattarai (2015) and Tassie and Endalew (2020) found that those households who were not willing to pay anything for better waste management services indicated insufficient income to pay for these services, already having access to free waste disposal practices such as digging holes, waste management being the responsibility of the state, taxes being paid should already cover the cost for improved services as well as a lack of trust in government waste management initiatives.

Table 5.41: P values of chi-square results analyzing the association between socio-economic and demographic attributes of respondents and households and money household spent as a startup/ spends monthly and is willing to spend in future for sustainable waste management practices

	Money household spent as a startup	Money household spends monthly	Money household is willing to spend as a startup	Money household is willing to spend monthly
Age of respondent	0.417	0.941	0.336	0.288
Sex of respondent	0.097	0.498	0.070	0.214
Highest level of education attained by respondent	0.147	0.147	0.154	0.000
Employment status of respondent	0.202	0.372	0.538	0.044
Total household size	0.814	0.509	0.632	0.371
Household decision-maker	0.891	0.945	0.218	0.003
Monthly household income	0.000	0.000	0.035	0.058

As previously discussed, socio-economic and demographic attributes such as level of education and sex influence the money that households spend or are willing to spend on waste management practices and facilities (Al-Khateeb et al., 2017; Fadhullah et al., 2022; Han et al., 2019; Islam et al., 2022; Omotayo et al., 2020; Saseanu et al., 2019). Specifically, willingness-to-pay for waste management practices is an important element for sustainable and effective domestic waste management practices (Han et al., 2019). In this regard, analyses of the associations across the socio-economic and demographic attributes of respondents and households and money that households spent as a startup/ spend monthly and are willing to spend in the future for sustainable waste management practices revealed significant differences between the money that the household spent as a startup as well as monthly on sustainable waste management practices and monthly household income ($p < 0.001$) categories. The same significant p value ($p < 0.001$) was obtained for the difference between money that a household is willing to spend monthly and the highest level of education attained by the respondent category. Moreover, similar findings were obtained for the difference between money that the household is willing to spend monthly and household decision-maker ($p = 0.003$) category. Significant differences were also found between money that the household is willing to spend as a startup and monthly household income ($p = 0.035$) categories as well as money that the household is willing to spend monthly and the employment status of the respondents ($p = 0.044$) categories.

5.4.8 Additional household waste management comments or issues

The respondents were further asked to express any additional comments or issues in relation to waste management within the household or community. This was deemed essential in order to capture any extra details that the respondents may wish to express that were not covered in the survey sections. The responses are analyzed in this section.

Table 5.42: Extra comments or issues in relation to waste management practices in the household (n=400, in %): Multiple responses

Comments or issues	Percentages
Not applicable	84.5
More resources needed by household	5
More personal responsibility	3.25
Lack of municipality or family support	3
Lack of knowledge by family	2.5
More time is needed to engage in sustainable waste management	1.75
Lack of space	0.75
Do not care to practice proper waste management	0.5
Can not afford new waste management practices	0.5
Would like to be more conscious when it comes to using eco-friendly products and buying less/ in bulk	0.25
Happy with current waste management practices	0.25
Water is polluted	0.25

Only a few respondents (15.5%) provided additional comments. Respondents noted that more waste management resources were necessary within households (5%). Furthermore, 3.25% of the respondents stated that more personal responsibility was needed by members of households, while 3% indicated a lack of municipality or family support as an issue. Moreover, 2.5% of the respondents reemphasized that the lack of proper waste management knowledge was still a pertinent issue within households. Two percent of the respondents noted that they needed more time to engage in sustainable waste management, while 0.75% stated that they needed more space. Not caring enough to engage in and not being able to afford sustainable waste management practices were each noted by two of the respondents. Lastly, the results indicate that one respondent each would like to be more conscious about using eco-friendly products and participating in product reduction, that they were happy with their current practices and that their water was polluted.

Table 5.43: Extra comments or issues in relation to waste management practices in the community (n=400, in %): Multiple responses

Comments or issues	Percentages
Not applicable	51.75
Lack of/ need more proper waste management initiatives, facilities and equipment	15.25
There is a lack of municipal waste management services	15
Community members need to take more action in taking care of the community	10.75
Lack of responsibility within the community to engage	9.75
More education is needed in how to manage waste properly	6
The government needs to be more supportive	5.25
Do not care	2
There are issues with the sewer system	1.5
The community is very clean	1
More jobs in sustainable waste management are needed	0.25
Time-consuming	0.25
Encouragement for the community	0.25

Almost half of the respondents (48.25%) provided additional issues and comments about waste management practices within the community. Specifically, 15.25% of the respondents noted that the community needed more waste management initiatives, facilities and equipment. Fifteen percent of the respondents noted that there was a lack of municipal waste management services, while 10.75% stated that community members needed to take more action in taking care of the community. Similarly, 9.75% of the respondents thought that community members lacked responsibility to engage in proper waste management practices, while 6% indicated that more education was necessary on how to manage waste properly. Additionally, 5.25% of the respondents felt that the government needs to be more supportive. A fewer proportion of the respondents indicated that they did not care (2%), there were issues with the sewer system (1.5%) and that the community was very clean (1%). Moreover, one respondent each thought that more jobs in sustainable waste management were needed, that these practices were time-consuming, and that encouragement was needed for the community. The eThekweni Municipality waste management official and a non-government/ civil society organization key informants further expressed challenges. Specifically, one of the eThekweni Municipality waste management key informants stated:

Breakdowns result in numerous complaints of non-collection. Non-collection leads to illegal dumping, which is expensive to get rid of. Illegal dumping, which is caused by irresponsible residents after missing the refuse truck on an actual collection day.

Issues relating to littering and reporting waste mismanagement were identified as a serious challenge by one of the non-government/ civil society organization key informants:

Challenges are with people who turn a blind eye when it comes to waste management, and people who refuse to do the right thing even if they know how the waste should be managed. People refuse to do the simple thing, especially at the parks and at the beach to put litter into the bins. Another problem is when some of the community members report the waste mismanagement to the NGO instead of the Durban Municipality. This becomes hard for the NGO to act as the power is with the DSW and they are doing this because they think the NGO has more power; meanwhile, it all depends on the Municipality's response and/or quick action.

These findings are supported by Stats SA (2017), where statistics indicate that waste removal and littering were a challenge in the eThekweni Municipality. Moreover, Mthembu (2021a; 2021b) shows that within the Bluff area specifically, difficulties in waste management due to issues such as those attributed to the DSW refuse collection services staff problems, irregular waste pickup schedule, COVID-19 lockdown restrictions and a frequent breakdown in waste pickup trucks have been noted.

It is evident that the importance of a circular economy was also noted by the key informant interviewees; they particularly felt strongly about big corporations acknowledging their role in waste management. In this regard, one of the non-government/ civil society organization key informants also noted that waste management should be treated as a priority by the government as well as other key waste material producers by stating:

Waste management is bigger than us and the community. This is a national issue and it has not been taken seriously. For instance, the cradle-to-grave and producer-pay principles should be legislated. This will ensure that producers like Coca-Cola are responsible for buying back their waste (brand) to avoid waste generation and waste that ends up in our oceans.

The other non-government/ civil society organization key informant also noted the key role played by waste pickers in society. Specifically, the interviewee reiterated the need for government to formally incorporate informal waste pickers in waste management initiatives:

Waste pickers are not taken seriously. Waste pickers play an important role in waste separation and formalizing this sector will help us see the positive impacts of waste management. The government is not doing this. Waste pickers are also the eyes and ears for municipalities and the government since they see and know what is happening on the group/ waste management sites like landfills. But no one takes accountability for them.

5.5 Conclusion

This chapter has outlined and discussed the descriptive and inferential statistics results of this study. Specifically, thematic sections were used to discuss the findings from the analysis in relation to literature that was deemed current and relevant. The next chapter provides a summary of the main findings in relation to the study objectives. Moreover, the study provides recommendations made based on the findings as well as concluding remarks.

CHAPTER SIX

SUMMARY OF KEY FINDINGS, RECOMMENDATIONS AND CONCLUDING REMARKS

6.1 Introduction

This study was conducted in KwaZulu-Natal, within communities located in the Bluff area. The Bluff area was deemed ideal for this research because it represents typical residential areas in South Africa. Specifically, Bluff is heterogeneous in nature, including households of informal residents as well as low-income, middle-income and high-income formal dwellers. The variations in socio-economic profiles allow for comparisons to be undertaken, permitting intra-community heterogeneity to be unpacked, which differs from previous studies, which have treated communities as homogenous units and therefore generalizing. Additionally, Bluff is located within the SDB, which is also an industrial hub. Therefore, communities within this area suffer as a result of the environmental pollution caused by the industries in this area. Moreover, various waste disposal and management issues, such as illegal dumping and littering, have been reported within the eThekweni Municipality (within which the SDB is located).

The first chapter of this thesis outlined an introduction to the issue of waste management in South Africa. Specifically, the chapter provided a background, motivation and thus the need for a comprehensive examination of household waste management practices within previously disadvantaged and mixed communities with a heterogeneous socio-economic background, such as the Bluff area. Moreover, the chapter provided the aim and objectives as well as overviews of the theoretical/ conceptual frameworks and research methodology for the study.

The second chapter elaborated on the TPB, which is the theoretical framework that underpinned the study. Furthermore, an adjustment of the TPB, which is the conceptual framework for the study, was also discussed in this chapter. The ISWM and circular economy approaches, which also guided the study as part of the multi-conceptual theoretical framework adopted, were further discussed in chapter two. Chapter three reviewed the literature on various topics that feed into and affect household waste management in a developing country context. Chapter four provided a description, background and conditions of the Bluff area. Additionally, the chapter provided an outline of the data sources, study design and research methodology adopted for the purpose of this

research. Lastly, the study results and the discussion thereof were presented in chapter five of the thesis.

This chapter outlines a summary of the key findings attained during the data analysis of this study. Specifically, the findings are initially summarized in relation to the study's research objectives and then recommendations relating to the aspects examined in the study are forwarded. Thereafter, concluding remarks are outlined.

6.2 Summary of key findings

This section discusses the key findings obtained in relation to the objectives that guided the study. Specifically, the section first outlines the socio-economic profiles of the households in the Bluff area, then results linked to the household profiles concerning the use/ consumption patterns of energy, water and sanitation facilities and waste disposal facilities or services are summarized. Moreover, the current household waste management practices in relation to solid waste, water and sanitation waste, organic/ refuse waste, and e-waste/ energy waste are summarized. Subsequently, the results for the respondents' level of awareness and understanding of sustainable waste management practices and the benefits of these, as well as the extent to which residents are using sustainable waste management practices, are summarized. The willingness-to-adopt and pay for sustainable waste management practices and any challenges experienced in residential areas that have constrained the shift to embracing more sustainable waste management practices are also discussed.

6.2.1 Socio-economic profile of households in the Bluff area

The households had an average household size of 3.75 members, which is similar to the average household size of 3.4 that was reported within the eThekweni Municipality (Stats SA, 2011). Thus, with the majority of the households consisting of between 1-5 members, the Bluff area is made up of mainly nuclear families. Moreover, the households generally had more males than females.

Age cohorts were generally evenly distributed between the sexes. Specifically, the Bluff area is a fairly youthful community, with the majority of the males and females being part of the economically active/ independent age group. Similar to the age cohort, the highest levels of education attained and employment status of household members portrayed comparable

distributions between the sexes, with the majority of the members of households having completed secondary school and being employed.

come, with an average total monthly household income of R19 750.29. This average is lower than the national average monthly income of R24 813 earned by individuals in formal non-agricultural employment recorded in August 2022 (Stats SA, 2022b). In terms of decision-making, it was found that the majority of the households' decision-making was by adult females and adult males and females jointly.

6.2.2 Household profiles in relation to the use/ consumption patterns of energy, water and sanitation facilities as well as waste disposal facilities or services

The results concerning the use and consumption of energy, water and sanitation facilities reflect a dominant reliance on piped/ tap water, flush toilets and electricity. Moreover, it is evident that the demographic and socio-economic attributes of the respondents and households did not affect the main household sources for water, sanitation and energy. This reaffirms that the majority of the households, of all socio-economic and demographic profiles, in the eThekwin Municipality and South Africa in general, use the same water, sanitation and energy sources (eThekwin Municipality, 2023; Stats SA, 2011; 2019a; 2019b; 2022a; Uhunamure et al., 2021). This speaks to the amount of water, sanitation and energy-related waste being generated. For instance, the high dependence on electricity speaks to the exponential increase in e-waste generation in South Africa (Uhunamure et al., 2021). This is highly problematic, especially since not a lot of attention is focused on e-waste, and no specialized removal is available for such waste types (Mintz et al., 2019).

The results indicate that there is a concerning lack of understanding at the household level of different waste streams. It is also evident that households do not recognize the role they play in generating various waste streams, with a significant proportion of the respondents claiming that households only generated paper and cardboard, plastic, aluminum cans and glass, and food waste streams sometimes and rarely. Additionally, although 98% of the households mainly use electricity as the energy source, 54.25% still indicated to only rarely generate e-waste, while 30.75% indicated to never generate this waste stream. Surprisingly, a significant proportion of households also indicated to rarely generate PPE waste. This is evidence that households generally associate

waste with solid waste, such as paper and cardboard. This makes household surveys essential to help show that households do not understand what waste is or what waste streams are.

Significant findings show that the socio-economic and demographic profile of the respondents and households, such as income, age, household decision-maker, sex, highest level of education attained, employment and total household size, had associations with how often households generate various waste streams. Additionally, the main household disposal method chosen for almost all (except for wastewater) generated waste streams was dustbins. This is in line with waste collection and disposal mainly being the responsibility of the Municipality within eThekweni Municipality generally, and specifically in the Bluff community, whereby waste is removed by the DSW weekly. Moreover, the results show that household income, age, sex, employment status and household decision-maker have significant correlations with the main household waste disposal methods for various waste streams. The results further indicated that dustbins were the main household disposal method choice for all the generated PPE/ COVID-19-related waste streams. Although households indicated to have learnt the need for handling contaminated waste separately during the pandemic, they are still largely mixing this waste with other household waste streams. The results further reveal that there are no significant influences of the socio-economic and demographic attributes of the respondents and households on the disposal methods of PPE/ COVID-19-related waste that is generated within the household. Moreover, for the most part (except for PPE waste), households mainly indicated that the generation of various household waste streams stayed the same in light of the COVID-19 pandemic. Additionally, the changes in household waste generation were found to be significantly associated with household income, age, employment status, total household size, household decision-maker and the highest level of education attained.

6.2.3 Current household waste management practices in relation to key domestic waste streams

To validate reports that South Africa faces various waste management issues, including that of a lack of waste separation at source (DEFF, 2020; Haywood et al., 2021; Viljoen et al., 2021), the results show that the vast majority of the households in the study reported not separating the different waste streams. The results show that waste separation is significantly influenced by the highest level of education attained, household income and total household size. Those households that did separate waste indicated that they mainly separated paper and cardboard, garden, plastic,

food, aluminum can and glass waste. The results further reveal that households mainly did not separate waste streams due to a lack of access to the necessary facilities, the practice being time-consuming, and their not seeing the need to separate various waste streams.

Although households had predominantly indicated disposing of almost all waste streams generated in dustbins, a significant proportion also indicated repurposing reusable materials, as well as recycling and separating different waste streams. Specifically, repurposing was used as the main method for managing COVID-19-related waste streams, such as reusable masks and sanitizer and cleaning detergent containers. Additionally, some of the households indicated reusing dish and/ or bathwater in the garden and for flushing the toilet as well as using drop-off facilities for recyclables and e-waste.

6.2.4 Respondents' level of awareness and understanding of sustainable waste management practices and the benefits thereof

The majority of the respondents were not aware of what sustainable waste management is. Moreover, although there was no significant difference between awareness of sustainable waste management and the sex of the respondents, more females were aware than their male counterparts. Opposing the results of Islam et al. (2022), there was no significant relationship between awareness of sustainable waste management and age in this study. On the contrary, there appeared to be a significant relationship between the highest level of education attained by respondents and household income and awareness of sustainable waste management. Explicitly, there was a higher level of awareness amongst those respondents who had completed higher levels of formal education as well as households with higher monthly income. In terms of sources of information about sustainable waste management practices, it was evident that television and school were the highest disseminators, in that order. Moreover, the internet, radio, relatives/ friends, neighbors, places of work, and newspapers were high information sources.

Although respondents were not able to provide a scientific definition of sustainable waste management, they were still able to identify different sustainable waste management practices. Additionally, the respondents knew that sustainable waste management practices were environmentally friendly, did not cause pollution, and had no negative health impacts. In terms of convenience, the majority of the respondents thought that sustainable waste management practices

were inexpensive, reliable, convenient to use and not time-consuming. These results largely contradict those found (within the study) to be the reasons for the discontinuation of sustainable waste management practices as well as the reasons cited as challenges/ issues that have constrained households from shifting to the use of sustainable waste management practices. Moreover, the majority of the respondents thought that sustainable waste management practices were easy and safe to use and access. Although some respondents did not know any benefits of sustainable waste management practices, the main benefits cited by those who did know were that these practices were environmentally friendly, had no negative health impacts, were reliable, were cheaper and easy to use. The main benefits of sustainable waste management that were noted by respondents were further found to be significantly associated with the highest level of education attained, monthly household income, age, sex and employment status.

6.2.5 The extent to which residents are using sustainable/ green/ environmentally responsible waste management practices

Not a significant percentage of respondents had previously used and discontinued using sustainable waste management practices (13.25% for recycling, 10.5% for composting, 10% for reducing and 3.25% for repurposing). The main reasons cited for discontinuation were these practices not being easily available and these being time-consuming to engage in. In terms of the current use of sustainable waste management practices, it was reiterated that repurposing was the vastly used practice. Similar to earlier findings, respondents stressed that sustainable waste management practices were not easily accessible and that they were time-consuming and inconvenient to use; hence they are currently not using these practices.

A great proportion of the households had a future interest in acquiring renewable energy facilities/ equipment, which were also recorded as the least that is currently used by households. These results speak to the high costs associated with renewable energy. Similarly, households were interested in using stormwater harvesting facilities/ equipment in the future. Although households relied substantially on the government/ municipality for facilities/ equipment such as drop-off centers and recycling bins/ plastic bags, it was not uncommon for households to purchase equipment such as those for renewable energy, stormwater harvesting and composting. Moreover, households have also been required to supplement equipment that the government donates, like recycling bins/ plastic bags by purchasing them. The future interest in accessing sustainable waste

management facilities/ equipment was significantly associated with sex, highest level of education attained, age, employment status and household decision-maker. Total household size and monthly income did not have a significant association with this future interest.

In terms of money spent as a startup for sustainable waste management practices, it was found that the majority of the households using these practices did not incur any startup costs for these practices. Parallel results were obtained for money spent monthly on sustainable waste management practices, where it was found that the majority of households did not pay anything on a monthly basis for these practices. It was further revealed that the money paid and that households were willing to pay in the future for sustainable waste management practices was significantly correlated to monthly household income, highest level of education, household decision-maker and employment status.

6.2.6 Willingness-to-adopt/ use and willingness-to-pay for sustainable waste management practices

The majority of the respondents were willing to use reducing, recycling, composting and repurposing in the future. There was a significant correlation between monthly household income, total household size, age and household decision-making and future willingness-to-use sustainable waste management practices. There were no significant differences across categories in relation to sex, education and employment status with future willingness-to-use sustainable waste management practices.

As also affirmed by Chikowore (2021), the majority of the households indicated being willing to pay only the bare minimum for sustainable waste management practices or not pay anything at all. Additionally, the money that households were willing to pay as startup costs for sustainable waste management practices was significantly influenced by households' monthly incomes. According to Kaza et al. (2018), funding efficient waste management at the household level largely competes with various other imperative services that households need to finance.

6.2.7 Challenges experienced in residential areas that constrain the shift to embrace more sustainable waste management practices

The main problems associated with the use of sustainable waste management practices were that there was an inadequate supply of equipment, that these were not easily accessible, they were time-consuming to engage in, inconvenient to use and too expensive. The main reason why households do not use and are not interested in using sustainable waste management in the future is that these practices are time-consuming to use.

In terms of challenges that have constrained the shift of households towards embracing more sustainable waste management practices specifically, it is evident that a lack of access to the necessary equipment is the main issue. Additionally, Ajzen (2020) and Smith (2020) emphasize that time constraints are a major issue that deters an individual's intentions of engaging in sustainable behavior. In agreement with these conclusions, the perception of sustainable waste management practices being time-consuming was cited as a constraint in the Bluff area. Moreover, a lack of knowledge about and high costs associated with sustainable waste management practices are also major constraints to households embracing sustainable waste management practices.

Although only a few of the respondents had additional comments or issues in relation to waste management in the household, those who did stressed the need for more resources. The respondents also acknowledged the need for household members to take more responsibility as well as a lack of municipal and family support. Additionally, in relation to waste management practices in the community, it was mainly highlighted that there needs to be more efficient waste management initiatives, facilities, equipment and municipal waste management services. The need for community members to take more action to take care of the community, and a general lack of responsibility within the community to engage, were further highlighted as issues.

6.3 Recommendations

The following section highlights and expands on some of the key recommendations that have emanated from this research. These recommendations are in line with the study objectives and are guided by the results of the study as well as relevant literature.

6.3.1 Addressing socio-economic and demographic inequalities and challenges

Research shows that it is not uncommon for households to not pay for waste management services (Adeniran et al., 2022). Adeniran et al. (2022) state that this is largely attributed to household income. In this regard, Adeniran et al. (2022) recommend that the South African government needs to strengthen its initiatives aimed at improving the socio-economic status of households, especially those directed at poverty alleviation in the country. Moreover, in light of financial constraints, municipal efforts need to also focus on investigating alternative means of domestic waste management (Viljoen et al., 2021). Viljoen et al. (2021) propose that this may be achieved through collaborations with surrounding areas/ municipalities.

It is recommended that further waste management research and initiatives include children and teenagers (Fadhullah et al., 2022; Herdiansyah et al., 2021), especially in a youthful society such as the Bluff area. Herdiansyah et al. (2021) emphasize that sustainable behaviors formed at an early age provide the ideal foundation for proper waste management. Thus, it is crucial that environmental awareness is instilled as early as possible, specifically in young children (Debrah et al., 2021; Herdiansyah et al., 2021). In this regard, ascertaining awareness, perceptions and knowledge from an early age is needed (Debrah et al., 2021; Herdiansyah et al., 2021). Herdiansyah et al. (2021) show that this allows for the implementation of the necessary improvements or changes through education initiatives early because children are the future and will act for the environment as the next generation of adults. Furthermore, Debrah et al. (2021) reiterate that early childhood education on sustainable practices is essential to bridge the waste management knowledge gap between the youth and older individuals.

6.3.2 Developing strategies in relation to energy, water, waste disposal and sanitation facilities and services to promote increased sustainable use

This study showed that almost all the households used tap/ piped water. However, the quality of the infrastructure was not assessed in this study. Observing the quality of the water source infrastructure is deemed important because of potential issues related to the health and safety impacts of infrastructure that are not of good quality (Parikh et al., 2020; Redman and Redman, 2022). Additionally, the study focused on energy supply and the majority of the households had access to electricity. However, the extent to which energy-efficient appliances/ devices are being used was not detailed in the study because the study was based on self-reporting surveys and

interviews. Thus, there should be an examination of the quality of the infrastructure in terms of energy supply, water and sanitation and waste disposal facilities.

Increased efforts need to be directed toward understanding and catering to the management of waste streams such as e-waste, especially in light of the exponential increase in the generation of such waste streams and the lack of sufficient management facilities/ initiatives in South Africa (Uhunamure et al., 2021; Mintz et al., 2019). Moreover, it is crucial that the use of energy-efficient appliances is promoted (Longe, 2021), given the detrimental environmental impacts of e-waste (Uhunamure et al., 2021; Zhou and Yang, 2016). Households do not appear to understand what constitutes waste, as waste has mainly been largely associated with materials like paper, cardboard and plastic. Moreover, the municipality needs to encourage waste segregation at source (Sinthumule and Mkumbuzi, 2019) for the responsible disposal of waste streams such as e-waste. This will help avoid the mixing of various waste streams. This can be done through the convenient placement of drop-off centers for waste streams like e-waste. Additionally, Viljoen et al. (2021) also show that the implementation of curb-side recyclables collection programs is essential to motivate households to segregate various waste streams. It was found that some of the respondents were not aware of the availability of drop-off centers in the community. Thus, community members should continuously be reminded and informed about these centers and encouraged to utilize them (Viljoen et al., 2021).

6.3.3 Promotion of sustainable waste management practices at the household level

The results of the study, and the literature, have shown that households largely consider waste management to be time-consuming and a municipal responsibility (Adeniran et al., 2022; Kaza et al., 2018; Kurniawan et al., 2023; Viljoen et al., 2021). This is generally based on the community waste management services that municipalities already provide as well as waste management facilities being inconveniently or not located within communities (Adeniran et al., 2022; Haywood et al., 2021; Kaza et al., 2018; Kurniawan et al., 2023). Adeniran et al. (2022), Bhattarai (2015), Mutungwe et al. (2014) and Tassie and Endalew (2020) suggest that this has subsequently led to an unwillingness of residents to pay for waste management services. In this regard, individuals and households must be made aware of the pivotal role they play in waste management (Viljoen et al., 2021). As previously highlighted, households that pay rates and taxes do pay for municipal waste services but do not seem to be aware of this cost. Moreover, households are generally not

held accountable for the amount and types of waste they generate (Matheson, 2022). In this regard, it is recommended that household face disincentives for waste generation and improper waste management (Matheson, 2022). Furthermore, Matheson (2022) adds that households should face the full cost of waste management. It is envisaged that in this way, households will be more conscious of the role they play in waste management and, thus, handle waste better. While this may not be feasible in the South African context since many households do not have sufficient income to cover the full cost of waste management, mechanisms to incentivize sustainable waste management practices and disincentivize problematic waste generation and management practices at the household level should be considered and implemented.

Households should be motivated and encouraged to integrate waste management into their daily routines. That is, do what they can, at their level, to manage waste streams such as food waste. For instance, Fadhullah et al. (2022) assert that simple step-by-step training on basic composting techniques should be incorporated into education campaigns. Moreover, community organic waste composting programs need to be promoted by local waste management authorities (Fadhullah et al., 2022). This is particularly important in the context of the Bluff area, where food waste is significantly produced. Viljoen et al. (2021) show that households not engaging in composting initiatives may be indicative of a lack of information and knowledge. Thus, communities need to be provided with information to encourage them to understand the composting process at the household and community levels (Viljoen et al., 2021).

Fadhullah et al. (2022) emphasize that in order to reduce the environmental and health impacts of waste and the management thereof, policy-makers need to increase waste management initiatives. Specifically, initiatives to educate households on sustainable waste practices such as segregation and composting within households, are vital (Fadhullah et al., 2022; Viljoen et al., 2021). In this regard, Fadhullah et al. (2022) and Redman and Redman (2022) show that these campaigns and marketing initiatives need to emphasize the benefits of proper waste management practices such as segregation. Moreover, these initiatives should highlight the positives of participating in sustainable waste management, as reported by households who are already participating in these practices (Fadhullah et al., 2022). This is particularly important because sustainable and holistic ISWM considers the physical and governance factors of waste management (Elsaid and Aghezzaf, 2015; Korneliussen, 2021; Wilson et al., 2013).

The municipality needs to commit to locating, mapping as well monitoring unrestrained dumpsites (Viljoen et al., 2021). Viljoen et al. (2021) show that communities need to be encouraged to also monitor these dumpsites and report uncontrolled dumping. Specifically, law enforcement is required so that penalties for illegal dumping and improper waste management are in place (Herdiansyah et al., 2021; Viljoen et al., 2021). Moreover, the municipality should ensure that these waste management sites should be regularly managed, emptied and kept tidy to avoid further improper waste disposal within these sites (Viljoen et al., 2021).

According to Leonard and Lidskog (2021), Parikh et al. (2020) and Viljoen et al. (2021), the participation of and collaborative efforts from various stakeholders are crucial for the successful execution of initiatives aimed at uplifting communities. It is encouraged that municipal waste management officials, researchers, community members and NGOs/ civil society organizations forge strong alliances at all levels to promote sustainable socio-economic and environmental behavior (Leonard and Lidskog, 2021; Longe, 2021), which includes finding solutions to waste management issues (Viljoen et al., 2021). For instance, Ahsan et al. (2012) and Singh and Dey (2015) concur that the involvement of non-government and community-based organizations in waste management improves the entire solid waste management process and also encourages community members to manage waste better. Therefore, when waste management officials, community members, researchers and NGOs work together to achieve efficient waste management, they are able to leverage their respective strengths and resources for comprehensive waste management. For instance, Muzvondiwa (2021) shows that NGOs play a significant role in ISWM by providing financial and technical support.

In relation to waste management in light of the COVID-19 pandemic specifically, research shows that the current waste management scene presents valuable lessons for a post-COVID-19 scenario (Sarkodie and Owusu, 2021; Singh et al., 2022). In this regard, Debrah et al. (2022) and Diprose et al. (2022) further highlight the importance of a circular economy in waste reduction. Specifically, Debrah et al. (2022) and Sarkodie and Owusu (2021) elaborate on the need for the establishment of structural modifications to avoid going back to how waste was managed prior to the pandemic and ensuring a shift to a circular economy from a linear one. Additionally, Adeniran et al. (2022) and Debrah et al. (2022) emphasize that, overall, households need to be educated on circularity. Specifically, it is envisaged that in this way, waste recovery, recycling, reusing and

reduction coupled with socio-economic empowerment are achieved (Adeniran et al., 2022). In this regard, it is recommended that government efforts aimed at zero-waste education initiatives are strengthened (Adeniran et al., 2022).

6.3.4 Promoting increased awareness and understanding of sustainable waste management practices

Regarding the findings that alluded to a lack of understanding of waste and waste streams by households, it is evident that a generic awareness of waste is problematic since households do not identify various waste streams and how they (the households) contribute to the generation of these. Therefore, in this manner, households do not seem to understand the importance of managing waste properly and their contribution to sustainable waste management. In this regard, it is important to improve awareness by educating households and communities about sustainable waste management initiatives and their benefits (DEA, 2012b; Fadhullah et al., 2022; Longe, 2021; Sinthumule and Mkumbuzi, 2019; Vinti et al., 2023). Sinthumule and Mkumbuzi (2019) echo that educational programs and initiatives for awareness and responsibility toward sustainable waste management are crucial. In this regard, campaigns could be facilitated through public education through media outlets such as television, radio and leaflets (Sinthumule and Mkumbuzi, 2019). It is further recommended that incentivized initiatives such as school and household competitions, games and quizzes to raise awareness and understanding in a fun and light-hearted manner are implemented within the Bluff community. In a similar study, Muzvondiwa (2021) found that important messages on efficient waste management were easily received through household competitions and school quiz sessions which also brought excitement to children. Moreover, Sinthumule and Mkumbuzi (2019) add that the municipality should run community clean-up competitions where the communities within the area compete against each other and awards are given to the cleanest community.

Longe (2021) highlights the importance of also increasing awareness of the negative impacts of conventional practices that households engage in. In relation to the Bluff area specifically, it is recommended that households are informed about the negative impacts of relying solely/ mainly on facilities like electricity, pipe/ tap water and improper waste management practice. Moreover, the waste associated with these practices needs to be stressed so that households are aware of the risks associated with not transitioning to greener practices. Ramela (2023) further emphasizes that

education on renewable energy alternatives is crucial because most households cannot use or maintain these technologies/ equipment.

As discussed previously, training and education campaigns are crucial to increase understanding of waste streams as well as participation in proper practices (Herdiansyah et al., 2021; Muzvondiwa, 2021; Parikh et al., 2020; Redman and Redman, 2022). In this regard, it is recommended that the relevant stakeholders, such as the government at different levels, rethink the school curriculum to include waste education in schools; in order to teach environmental awareness from an early age (Debrah et al., 2021; Herdiansyah et al., 2021). In the same light, Debrah et al. (2021) emphasize that this formal education needs to include practical components and should also include both basic and higher education students. A substantial number of respondents indicated to have received information about sustainable waste management practices at school. Thus, making schools a crucial point of knowledge dissemination as well as training for efficient waste management at the household level and within communities.

6.3.5 Encouraging the use of sustainable/ green/ environmentally responsible waste management practices

Although access to improved waste management services, infrastructure and systems is crucial to encourage sustainable waste management behaviors (Viljoen et al., 2021), knowledge and social norms still have a pivotal role to play in waste minimization (Herdiansyah et al., 2021; Redman and Redman, 2022; Uma et al., 2020). Thus, more work needs to be done by the Municipality and NGOs/ civil society organizations in the Bluff area to make residents aware of the various sustainable waste management initiatives within the community. This may be achieved through radio and television jingles, posters, and billboards in native languages (Herdiansyah et al., 2021; Longe, 2021; Sinthumule and Mkumbuzi, 2019). Lakshmikantha and Malur (2014) and Sinthumule and Mkumbuzi (2019) further emphasize the importance of media channels in disseminating awareness about proper waste management practices. Thus, spreading information this way is especially important since it is evident, based on the results, that a substantial amount of the respondents found out about sustainable waste management practices through television and radio.

The Bluff area, as noted earlier, displays high levels of awareness of environmental issues linked to residing in locations that have dealt with industrial pollution on a large scale. This community-level awareness of environmental pollution and associated hazards need to be extended and expanded to the household level to focus on sustainable and responsible waste management practices and behaviors. It is notable also, given that the trends in relation to the results of this study generally reflected those in other similar studies, that being in an environmentally contested community with arguably higher levels of environmental awareness and activism does not necessarily translate to sustainable practices at the household level. Thus, focusing on raising awareness and training to promote sustainable waste management practices is important in all communities, including those that display higher levels of environmental awareness of other types of pollution, as in the case of the Bluff community.

As opposed to waiting for individuals to come to them, the Municipality and NGOs/ civil society organizations in the area need to consider deploying representatives to the various communities to engage closer with households. This includes inviting experts to give presentations to community members through meetings and information-sharing sessions (Viljoen et al., 2021). These representatives/ experts will educate community members on various waste streams and how to manage these correctly (Viljoen et al., 2021). These sessions can be held/ taken in areas where various community members frequent; for instance, to encourage male participation, these sessions could be in sporting gatherings and workplaces during lunch breaks (Muzvondiwa, 2021). In this manner, all community members receive information, offer their opinions and make recommendations (Leonard and Lidskog, 2021; Parikh et al., 2020; Viljoen et al., 2021); this will also avoid any misinformation being spread around the community. Moreover, Muzvondiwa (2021) affirms the finding of this study in relation to community members considering waste management the responsibility of the municipality. In this regard, individuals do not value community participation and their role in waste management (Muzvondiwa, 2021). Therefore, it is envisaged that through the recommended meetings and information-sharing sessions, community members will recognize the importance of their role in waste management systems. The active participation of community members in waste management is essential in a circular economy (Knickmeyer, 2020).

Fadhullah et al. (2022) and Redman and Redman (2022) stress that when waste management officials and policy-makers are designing waste management initiatives, they need to understand the specific characteristics of the households within the communities of interest. In this regard, Singh and Dey (2015) show that waste management stakeholders such as NGOs can play a crucial role in waste management policy development. Thus, it is recommended that waste management stakeholders such as NGOs/ civil society organizations (that are already active in the Bluff area and have played a key role in highlighting industrial pollution issues in the communities), researchers and community members be included in policy making. Additionally, the needs and issues of the targeted households should be understood for these initiatives to be successful (Fadhullah et al., 2022). Assessing local needs and circumstances is essential for ISWM because this ensures that the correct waste management solutions are implemented to suit the specific context (Leblanc, 2019a). Furthermore, a circular economy requires the participation of various stakeholders (Knickmeyer, 2020).

This type of community (the Bluff specifically is made up of heterogenous socio-economic groups and is also an industrial hub) can become a best practice case for how environmental practices can be institutionalized within households, industries and government to work together to transition to a more socially, economically and environmentally just society (Leonard and Lidskog, 2021). For example, in conjunction with municipal and household waste management initiatives, Farzadkia et al. (2019) state that industries need to establish and adopt comprehensive waste management plans. Additionally, educational programs should not be limited to only households, instead, industries should also have these programs in relation to the management of the various waste streams they produce (Farzadkia et al., 2019). Moreover, Viljoen et al. (2021) recommend that producers of various recyclable waste streams need to sponsor communities with recycling facilities, awareness drives, educational initiatives and teach community members ways to innovatively manage household waste effectively. In the context of the Bluff area, it was revealed by the waste management key informants that a manufacturing company called Mondi provided communities with drop-off facilities for paper. Additionally, a few respondents noted that their households had stopped engaging in sustainable waste management practices because Mondi stopped providing them with recycling plastic bags and collecting this waste. Thus, local industries play a vital role in community sustainable waste management. Therefore, it is recommended that these organizations are encouraged to get involved in raising awareness and educating the

community on how to sustainably manage the waste that they produce and support efforts by providing the necessary facilities to manage different types of waste.

It is crucial that municipalities such as the eThekweni Municipality, and communities such as the Bluff area, fully embrace a circular economy (Debrah et al., 2022; Mapani et al., 2022). Fiksel et al. (2021) add that circular economy solutions allow for innovative outlets for materials that no longer have use and subsequently eliminating waste that is improperly managed. Specifically, Knickmeyer (2020) shows that to achieve this, there need to be changes in waste management behaviors, and the consumer culture within households. Additionally, current policies and amenities (that guide and cater to waste management) need to be revised (Fadhullah et al., 2022; Mapani et al., 2022; Uma et al., 2020). Fiksel et al. (2021) emphasize that these revisions in policy are necessary to promote technological innovations as well as enhancements in waste management. Therefore, the participation of various stakeholders involved in waste management, especially waste generators, need to be encouraged (Fadhullah et al., 2022; Leonard and Lidskog, 2021; Mapani et al., 2022; Taelman et al., 2018; Viljoen et al., 2021). Gutberlet et al. (2017b) add that waste pickers have been involved in the circular economy for a long time and should also be involved in policy development as well as in the implementation of the circular economy.

It is evident that waste pickers play a pivotal role in waste segregation and recycling at the community level as well as in the circular economy (Gutberlet et al., 2017b; Parikh et al., 2020) and should thus be formally integrated into community waste management (Dias, 2016; Muzvondiwa, 2021; Ntsoane, 2022; Nyika et al., 2020). Thus, for best practice community waste management, it is recommended that waste pickers are integrated as key stakeholders in socio-economic and environmental protection (Dias, 2016) and that their role in sustainable community waste management is highlighted in future research. Specifically, Dias (2016) and Gutberlet et al. (2017b) reiterate that waste pickers protect the environment by allowing for waste products to be reprocessed, reused and recycled and thus, decreasing the amount of waste being disposed of and going to landfills. Muzvondiwa (2021) further suggests that waste picking be formally incorporated into communities as a formal and reputable income source. Gutberlet et al. (2017b) emphasize that waste pickers are more than just waste collectors and classifiers but rather specialized waste management service providers. Thus, when knowledge, attitudes and

perceptions of waste picking are changed, all community members may be motivated to participate in waste picking (Muzvondiwa, 2021).

6.3.6 Supporting and promoting willingness-to-adopt/ use and willingness-to-pay for sustainable waste management practices

Although there are low levels of participation currently in terms of green practices, the study shows that the majority of the respondents have a high interest in embracing these practices. Literature, together with the primary data responses, indicate that there are various reasons that are preventing households from embracing sustainable practices (Herdiansyah et al., 2021; Viljoen et al., 2021). These include a lack of awareness of what can and should be done (Herdiansyah et al., 2021). The issues around cost and economic factors, including incentives, having the proper infrastructure and resources in place, and time constraints, need to be addressed (Viljoen et al., 2021). Thus, it is imperative the eThekweni Municipality responds to the willingness of citizens to transition to greener practices by creating a conducive environment for them to do so.

Herdiansyah et al. (2021), Redman and Redman (2022) and Viljoen et al. (2021) reiterate the findings of this study that inefficient waste management, services, infrastructure and systems have hindered willing households from embracing sustainable waste management practices. Therefore, it is envisaged that households would be more encouraged to participate in proper waste management practices if resources such as infrastructure related to curbside pick-up systems were built/ provided (Herdiansyah et al., 2021; Redman and Redman, 2022; Viljoen et al., 2021). Dias (2016), Herdiansyah et al. (2021) and Viljoen et al. (2021) add that the municipality needs to be more efficient in the services provided to prevent unsustainable waste management practices such as littering. Specifically, empty containers for curbside collection need to be emptied regularly, waste collection needs to be frequent and consistent, and community members need more access to well-kept and serviced drop-off facilities (Viljoen et al., 2021).

The value of adopting the TPB, circular economy and ISWM approaches is reinforced. The study findings resonate with those of other research, such as Bardus and Massoud (2022) and Debrah et al. (2022), that show that influencing sustainable and responsible household waste management practices that focus on future behavioral interventions should build capabilities and create opportunities for behavioral change before expecting normalization to occur. Specifically, for

example, bins and bags for waste separation at the household level should be provided together with accessible and affordable waste recycling facilities. More attention should be paid to raising awareness about sustainable waste management practices that are easy and convenient, which increases behavioral control and entrenches positive perceived social norms that influence current behavior.

6.3.7 Creating an enabling environment to address challenges experienced in residential areas that constrain the shift to embrace more sustainable waste management practices

Efforts should be channeled toward decreasing high tariffs that are associated with sustainable practices. For instance, Akinbami et al. (2021) and Goodall (2022) indicate that there is great potential for the successful use of renewable energy sources in South Africa. However, regardless of the high willingness to use these sources, the high costs associated with renewable energy have discouraged its use. Explicitly, Goodall (2022) and Papathanasiou (2022) stress that the high startup costs of renewable energy have made these sources unaffordable. To restate, in relation to the use of renewable energy, the findings of this study show that a significant proportion of the households did not use renewable energy but had a high future interest in acquiring these facilities/equipment. Thus, it is recommended that, through government and private financing/ investment initiatives, the startup costs of renewable energy sources are kept affordable for households (Papathanasiou, 2022).

In relation to the challenges experienced in relation to the adoption of sustainable waste management practices being time-consuming and inconvenient to engage in, more nuanced incentives are necessary so that households can transition conveniently to more environmentally responsible and green waste management practices. Specifically, Khanal et al. (2023) and Smith (2020) found that respondents would be more encouraged to segregate waste if they received any form of incentives. For instance, it is suggested that resources such as bins for the various waste streams should be provided to households for segregation purposes (Fadhullah et al., 2022; Herdiansyah et al., 2021; Parikh et al., 2020; Viljoen et al., 2021). Khanal et al. (2023) and Sinthumule and Mkumbuzi (2019) show that access to different dustbins encourages the separation of various waste streams. Separating at source is a crucial step for sustainable waste management (Fadhullah et al., 2022; Khanal et al., 2023; Sinthumule and Mkumbuzi, 2019). This further reiterates the importance of embracing a circular economy in waste management as this strategy

has potential to promote sustainable economic growth which not only protects the environment but also creates jobs (Di Vaio et al., 2023; Edmond, 2019; Mapani et al., 2022; Stubbs, 2021a; Stubbs, 2021b). Therefore, it is critical that the government employs efficient waste collection and monitoring structures to ensure that household waste is collected in separated forms at this level (Khanal et al., 2023; Sinthumule and Mkumbuzi, 2019). Specifically, this would tackle the challenge of there being an inadequate supply of equipment and that these equipment/ facilities were not easily accessible.

6.3.8 Other recommendations in relation to waste management practices at the household level

It is evident, based on previous discussions, that the limitations in terms of the scope of the study present opportunities for future research. Thus, further research needs to specifically look at these aspects so as not to rely solely on self-reporting surveys and interviews (Fadhullah et al., 2022). Additionally, further research should also look at under which conditions would households be able to transition to more green appliances, given that these often come with relatively high startup costs, which does not make it easy for lower-income households to embrace.

Considering that the responses of this study are based on survey self-reporting, it is recommended that future research phrases survey questions in the context of a lack of understanding of waste streams in households. For example, it was evident that respondents were more responsive when probed further about disaggregated waste types as opposed to when asked about waste streams within which specific wastes fell. Therefore, survey questions should be as clear and as simple as possible.

6.4 Concluding remarks

Embracing sustainable waste management practices at the household level is crucial to encourage environmentally responsible behavior at this level. Specifically, this study utilized a case study in a community (the SDB) that suffers largely as a result of environmental pollution as well as various waste disposal and management issues. Within this community with a variation in socio-economic profiles, a comprehensive examination of household waste profiles, management practices and perceptions of sustainable waste management practices was conducted to assess any variations as well as commonalities between households. This consideration of the intra-community heterogeneity and the focus on all/ various waste streams allowed for the avoidance of

generalizations within the community while also examining the main household waste streams in their entirety as well as the sustainability considerations among the households. Moreover, research currently generalizes about waste and focuses on ‘umbrella’ waste streams in community and household studies. The current study clearly highlights the value of disaggregating the various waste streams into individual components for more detailed and reliable responses.

This study thus provides a holistic outlook of waste generation and waste management considerations at a domestic level. Specifically, the focus is on sustainable waste management practices of the households within this community, and in turn, contributes to knowledge in the field, which is aligned with strengthening the circular economy in South Africa while also informing future intervention strategies. The results stress an urgent need for initiatives aimed at enhancing people’s knowledge and understanding of sustainable waste management. Additionally, it is important to consider that households of varying socio-economic profiles face different realities as far as knowledge, access, availability and affordability are concerned.

REFERENCES

- Abdel-Shafy, H.I. and Mansour, M.S.M. 2018. Solid waste issues: Sources, composition, disposal, recycling, and valorization. *Egyptian Journal of Petroleum*, 27 (4), 1275-1290.
- Abdulghaffar, N.A. and Williams, I.D. 2021. Development of sustainable waste management in higher institutions. *AIMS Environmental Science*, 8 (3), 238-254.
- Abebe, M.A. 2018. Challenges of waste to energy facility in Reppi (Koshe), Addis Ababa city. *International Research Journal of Pharmacy and Medical Sciences*, 1 (4), 9-16.
- Abedin, M.J., Khandaker, M.U., Uddin, M.R., Karim, M.R., Ahamad, M.S.U., Islam, M.A., Arif, A.M., Sulieman, A. and Idris, A.M. 2022. PPE pollution in the terrestrial and aquatic environment of the Chittagong city area associated with the COVID-19 pandemic and concomitant health implications. *Environmental Science and Pollution Research*, 29 (18), 27521-27533.
- Abubakar, I.R., Maniruzzaman, K.M., Dano, U.L., AlShihri, F.S., AlShammari, M.S., Ahmed, S.M.S., Al-Gehlani, W.A.G. and Alrawaf, T.I. 2022. Environmental sustainability impacts of solid waste management practices in the global South. *International Journal of Environmental Research and Public Health*, 19 (19), 12717.
- Acharya, A., Bastola, G., Modi, B., Marhatta, A., Belbase, S., Lamichhane, G., Gyawali, N. and Dahal, R.K. 2021. The impact of COVID-19 outbreak and perceptions of people towards household waste management chain in Nepal. *Geoenvironmental Disasters*, 8 (14), 1-11.
- Adebayo, A.A., Musvoto, G.G. and Adebayo, P. 2013, September. Towards the creation of healthier city neighbourhoods for marginalised communities in South Africa: a case study of the South Durban industrial basin in the city of Durban. In *Urban Forum* (Vol. 24, No. 3, 343-355). Springer Netherlands.
- Adeniran, A., Motsatsi, L., Mbanga, S., Ayesu-Koranteng, E. and Shakantu, W. 2022. An Investigation of waste management practice in a South African Township: A case study of Ekuphumleni Township, Ndlambe Municipality. In: Raimi, M.O., Sunday, O.A., Sawyerr, H.O.

and Adias, T.C., eds. *Emerging Issues in Environmental Epidemiology and it's Reflection*. IntechOpen Limited, SCIR.

Adipah, S. and Kwame, O.N. 2019. A novel introduction of municipal solid waste management. *Journal of Environmental Science and Public Health*, 3 (2), 147-157.

Adler, K. 2021. Global CO₂ emissions to rise by 4.9% in 2021: Global carbon project. *IHS Markit*. Available at: <https://cleanenergynews.ihsmarkit.com/research-analysis/global-co2-emissions-to-rise-by-49-in-2021-global-carbon-proje.html>. (Accessed on 25 March 2022)

Adom, D., Hussein, E.K. and Agyem, J.A. 2018. Theoretical and conceptual framework: Mandatory ingredients of a quality research. *International Journal of Scientific Research*, 7 (1), 438-441.

Adzawla, W., Tahidu, A., Mustapha, S. and Azumah, S.B. 2019. Do socioeconomic factors influence households' solid waste disposal systems? Evidence from Ghana. *Waste Management and Research*, 37 (1), 51-57.

Agamuthu, P. 2012. Landfilling in developing countries. *Waste Management and Research*, 31 (1), 1-2.

Ahen, F. and Amankwah-Amoah, J. 2021. Sustainable waste management innovations in Africa: New perspectives and research agenda for improving global health. *Sustainability*, 13, 6646.

Ahsan, A., Alamgir, M., Imteaz, M., Daud, N.N. and Islam, R. 2012. Role of NGOs and CBOs in waste management. *Iranian Journal of Public Health*, 41 (6), 27.

Ajila, K.O. 2019. Analysis of post-consumer solid textile waste management among households in Oyo State of Nigeria. *Journal of Environmental Protection*, 10 (11), 1419-1435.

Ajzen, I. 2006. Constructing a theory of planned behavior questionnaire.

Ajzen, I. 2011. The theory of planned behaviour: Reactions and reflections. *Psychology and Health*, 26 (9), 1113-1127.

Ajzen, I. 2020. The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies*, 2 (4), 314-324.

Akinbami, O.M., Oke, S.R. and Bodunrin, M.O. 2021. The state of renewable energy development in South Africa: An overview. *Alexandria Engineering Journal*, 60 (6), 5077-5093.

Albira, I.A., Hamzah, T.A., Yusoff, S.M., Noor, N.M. and Emenike, C.U. 2018. Post-War Waste Composition: Household Waste Management in Misrata City, Libya. *The Arab World Geographer*, 21 (2-3), 114-127.

Al-Khateeb, A.J., Al-Sari, M.I., Al-Khatib, I.A. and Anayah, F. 2017. Factors affecting the sustainability of solid waste management system—the case of Palestine. *Environmental monitoring and assessment*, 189 (2), 1-12.

Almulhim, A.I., Ahmad, I., Sarkar, S. and Chavali, M. 2021. Consequences of COVID-19 pandemic on solid waste management: Scenarios pertaining to developing countries. *Remediation Journal*, 31 (4), 111-121.

Amasuomo, E. and Baird, J. 2016. The concept of waste and waste Management. *Journal of Management and Sustainability*, 6, 88.

Andeobu, L., Wibowo, S. and Grandhi, S. 2022. Medical waste from COVID-19 pandemic—a systematic review of management and environmental impacts in Australia. *International Journal of Environmental Research and Public Health*, 19 (3), 1381.

Apuke, O.D. 2017. Quantitative research methods a synopsis approach. *Arabian Journal of Business and Management Review (Kuwait Chapter)*, 6 (10), 40-47.

Ariyani, L. and Ririh, K.R. 2020. Understanding behavior of household food waste management: Food waste hierarchy context. *Jurnal Ilmiah Teknik Industri*, 19 (2), 142-154.

Arumugam, V., Abdullah, I., Yusoff, I.S., Abdullah, N.L., Tahir, R.M., Nasir, A.M., Omar, A.E. and Ismail, M.H. 2021. The impact of COVID-19 on solid waste generation in the perspectives of socioeconomic and people's behavior: A case study in Serdang, Malaysia. *Sustainability*, 13, 13045.

Aryampa, S., Maheshwari, B., Sabiiti, E., Bateganya, N.L. and Bukenya, B. 2019. Status of waste management in the East African Cities: Understanding the drivers of waste generation, collection and disposal and their impacts on Kampala City's sustainability. *Sustainability*, 11 (19), 5523.

Awunyo-Vitor, D., Ishak, S. and Jasaw, G.S. 2013. Urban households' willingness to pay for improved solid waste disposal services in Kumasi Metropolis, Ghana. *Urban Studies Research*, 2013.

Ayeleru, O.O., Dlova, S., Akinribide, O.J., Ntuli, F., Kupolati, W.K., Marina, P.F., Blencowe, A. and Olubambi, P.A. 2020. Challenges of plastic waste generation and management in sub-Saharan Africa: A review. *Waste Management*, 110, 24-42.

Babayemi, J.O., Nnorom, I.C., Osibanjo, O. and Weber, R. 2019. Ensuring sustainability in plastics use in Africa: consumption, waste generation, and projections. *Environmental Sciences Europe*, 31 (1), 1-20.

Balasubramanian, M. 2019. Household willingness to pay for improved solid waste Management Services: Using Contingent Valuation Analysis in India. In: Saleh H.E.M., ed. *Municipal Solid Waste Management*. IntechOpen, London: United Kingdom, 48.

Bardus, M. and Massoud, M.A. 2022. Predicting the intention to sort waste at home in rural communities in Lebanon: An application of the theory of planned behavior. *International Journal of Environmental Research and Public Health*, 19 (15), 9383.

- Bautista, P.R. 2019. Level of awareness and practices on solid waste management (SWM) among college students. *Journal of Biodiversity and Environmental Sciences*, 14 (1), 131-138.
- Bayudan-Dacuycuy, C. and Dacuycuy, L.B. 2018. Urban and rural households' energy use: Sets, shocks, and strategies in the Philippines (No. 2018-01). PIDS Discussion Paper Series.
- Benson, N.U., Fred-Ahmadu, O.H., Bassey, D.E. and Atayero, A.A. 2021. COVID-19 pandemic and emerging plastic-based personal protective equipment waste pollution and management in Africa. *Journal of Environmental Chemical Engineering*, 9 (3), 105222.
- Berge, S. and Von Blottnitz, H. 2022. An estimate of construction and demolition waste quantities and composition expected in South Africa. *South African Journal of Science*, 118 (SPE), 1-5.
- Bergin, R.J., Emery, J., Bollard, R. and White, V. 2019. Research evidence supports cancer policymaking but is insufficient for change: Findings of key informant interviews from five countries. *Health Policy*, 123 (6), 572-581.
- Bhattarai, K. 2015. Households' willingness to pay for improved solid waste management in Banepa Municipality, Nepal. *Environment and Natural Resources Journal*, 13 (2), 14-25.
- Bhawal Mukherji, S., Sekiyama, M., Mino, T. and Chaturvedi, B. 2016. Resident knowledge and willingness to engage in waste management in Delhi, India. *Sustainability*, 8 (10), 1065.
- Boateng, S., Amoako, P., Poku, A., Appiah, D.O. and Garsonu, E.K. 2016. Household willingness to pay for solid waste disposal services in urban Ghana: The Kumasi Metropolis situation. *Ghana Journal of Geography*, 8 (2), 1-17.
- Bob, U., Furusa, M. and Little, W. 2016. *Identity Construction and Mis(perceptions) on being Black in South Africa: Unpacking Socio-economic, Spatial and Political Dynamics in the South Durban Basin*. Peter Lang Publishing: Frankfurt.

Bob, U., Padayachee, A., Gordon, M. and Moutlana, I. 2017. Enhancing innovation and technological capabilities in the management of e-Waste: Case study of the South African Government Sector. *Science, Technology and Society*, 22 (2), 332-349.

Bohlmann, J.A. and Inglesi-Lotz, R. 2018. Analysing the South African residential sector's energy profile. *Renewable and Sustainable Energy Reviews*, 96, 240-252.

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

Brace, I. 2018. *Questionnaire design: How to plan, structure and write survey material for effective market research*. Kogan Page Publishers: Britain and the United States.

Briand, A., Nauges, C., Travers, M. and Travers, M. 2009. The impact of tap connection on water use: The case of household water consumption in Dakar, Senegal. *Environment and Development Economics*, 15 (01), 107-126.

Bucătaru, C., Săvescu, D., Repanovici, A., Blaga, L., Coman, E. and Cocuz, M.E. 2021. The implications and effects of medical waste on development of sustainable society—a brief review of the literature. *Sustainability*, 13 (6), 3300.

Busetto, L., Wick, W. and Gumbinger, C. 2020. How to use and assess qualitative research methods. *Neurological Research and Practice*, 2 (14), 1-10.

Buthelezi, S.A., Kapwata, T., Wernecke, B., Webster, C., Mathee, A. and Wright, C.Y. 2019. Household fuel use for heating and cooking and respiratory health in a low-income, South African coastal community. *In. J. Environ. Res. Public Health*, 16 (4), 550.

Cao, J., Qiu, H. and Morrison, A.M. 2023. Self-identity matters: An extended theory of planned behavior to decode tourists' waste sorting intentions. *International Journal of Environmental Research and Public Health*, 20 (6), 5099.

Chan, S.S., Ng, T.F., Hassan, M.S., Ying, C.K., Tan, M.L., Radzi, S.F.M., Assi, R.A. and Chan, S. 2022. Integrating environmental protection and sustainable waste practices among the communities in higher educational institutions: Case study in a Malaysian University. *Frontiers in Environmental Science*, 10 (886060), 1-10.

Cheng, C., Zhou, Y. and Zhang, L. 2022. Sustainable environmental management through a municipal solid waste charging scheme: A Hong Kong perspective. *Frontiers in Environmental Science*, 785.

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

Chukwuere, J.E. 2021. Theoretical and conceptual framework: A critical part of information systems research process and writing. *Review of International Geographical Education (RIGEO)*, 11 (9), 2678-2683.

Cislaghi, B. and Heise, L. 2019. Gender norms and social norms: differences, similarities and why they matter in prevention science. *Sociology of Health and Illness*, 42 (2), 407-422.

Cleary, J. 2014. A life cycle assessment of residential waste management and prevention. *International Journal of Life Cycle Assessment*, 19, 1607-1622.

Collins, C.S. and Stockton, C.M. 2018. The central role of theory in qualitative research. *International Journal of Qualitative methods*, 17 (1), 1-10.

Cordeiro, M. and Kelly, L. 2019. Research paradigm and why pragmatism worked for us. *Development-Humanitarian Research Group: Development Studies (including Community Development) and Humanitarian Studies at Deakin*. Available at: <https://blogs.deakin.edu.au/devt-hum/2019/12/02/on-selecting-a-research-paradigm-and-why-pragmatism-worked-for-us/>. (Accessed on 30 March 2022)

Cossham, A. and Johanson, G. 2019. The benefits and limitations of using key informants in library and information studies research. *Information Research*, 24 (3).

Creswell, J.W. 2013. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Sage publications: United Kingdom.

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A. and Sheikh, A. 2011. The case study approach. *BMC Medical Research Methodology*, 11, 100.

D'Amato, A., Giaccherini, M. and Zoli, M. 2019. The role of information sources and providers in shaping green behaviors. *Evidence from Europe. Ecological economics*, 164, 106292.

Davis, C. 2019. Tipping point: Turning Africa's waste into energy. *Fieldfisher*. Available at: <https://www.fieldfisher.com/en/insights/tipping-point-turning-africa-s-waste-into-energy>.

(Accessed on 30 March 2022)

Dawadi, S., Shrestha, S. and Giri, R.A. 2021. Mixed-methods research: A discussion on its types, challenges, and criticism. *Journal of Practical Studies in Education*, 2 (2), 25-36.

Debrah, J.K., Vidal, D.G. and Dinis, M.A.P. 2021. Raising awareness on solid waste management through formal education for sustainability: A developing countries evidence review. *Recycling*, 6 (1), 6.

Debrah, J.K., Teye, G.K. and Dinis, M.A.P. 2022. Barriers and challenges to waste management hindering the circular economy in Sub-Saharan Africa. *Urban Science*, 6 (3), 57.

De Jonghe, O. 2022. The state of renewable energy in South Africa. *The Borgen Project*. Available at: <https://borgenproject.org/renewable-energy-in-south-africa/#:~:text=South%20Africa's%20energy%20sector%20is,energy%20sources%20constituting%20just%2013.7%25>. (Accessed on 16 February 2023)

De Lange. 2022. Load shedding probably leads to more fresh food wastage. *News24*. Available at: <https://www.news24.com/citypress/news/load-shedding-probably-leads-to-more-fresh-food-wastage-20220820>. (Accessed on 11 June 2023)

Department of Environmental Affairs (DEA). 2012a. *National waste information baseline report*. Available at: <http://sawic.environment.gov.za/documents/1880.pdf>. (Accessed on 01 February 2022)

Department of Environmental Affairs (DEA). 2012b. *Municipal solid waste tariff strategy*. Available at: <https://libguides.lib.uct.ac.za/c.php?g=194637&p=1395733>. (Accessed on 13 January 2022)

Department of Environmental Affairs (DEA). 2012c. *Municipal waste sector plan*. Available at: <https://libguides.lib.uct.ac.za/c.php?g=194637&p=1395733>. (Accessed on 13 January 2022)

Department of Environmental Affairs (DEA). 2019. *2019 revised and updated National Waste Management Strategy*. Available at: <https://libguides.lib.uct.ac.za/c.php?g=194637&p=1395733>. (Accessed on 13 January 2022)

Department of Environment, Forestry and Fisheries (DEFF). 2011. *National waste management strategy 2011*. Available at: <https://libguides.lib.uct.ac.za/c.php?g=194637&p=1395733>. (Accessed on 13 January 2022)

Department of Environment, Forestry and Fisheries (DEFF). 2020. *National waste management strategy 2020*. Available at: <https://libguides.lib.uct.ac.za/c.php?g=194637&p=1395733>. (Accessed on 13 January 2022)

Dias, S.M. 2016. Waste pickers and cities. *Environment and Urbanization*, 28 (2), 375-390.

Di Vaio, A., Hasan, S., Palladino, R. and Hassan, R. 2023. The transition towards circular economy and waste within accounting and accountability models: A systematic literature review and conceptual framework. *Environment, Development and Sustainability*, 25 (1), 734-810.

Dikole, R. and Letshwenyo, M.W. 2020. Household solid waste generation and composition: A case study in Palapye, Botswana. *Journal of Environmental Protection*, 11 (2), 110-123.

Diprose, G., Lee, L., Blumhardt, H., Walton, S. and Greenaway, A. 2022. Reducing single use packaging and moving up the waste hierarchy. *Kōtuitui: New Zealand Journal of Social Sciences Online*, 1-22.

Dixon, D.S., Mozumder, P., Vásquez, W.F. and Gladwin, H. 2017. Heterogeneity within and across households in hurricane evacuation response. *Networks and Spatial Economics*, 17 (2), 645-680.

Dlamini, B.R., Rampedi, I.T. and Ifegbesan, A.P. 2017. Community resident's opinion and perceptions on the effectiveness of waste management and recycling potential in the Umkhanyakude and Zululand District Municipalities in the KwaZulu-Natal province of South Africa. *Sustainability*, 9 (10), 1835.

Dlamini, N. 2021. Recycling collection initiative, 'Packa-Ching', wins award. *The Witness*. Available at: <https://www.news24.com/witness/news/kzn/recycling-collection-initiative-packa-ching-wins-award-20211105>. (Accessed on 03 February 2022)

Dugbazah, J., Glover, J., Mbuli, B. and Kungade, C. 2021. What a waste: Innovations in Africa's waste material management. *AUDA-NEPAD*. Available at: <https://www.nepad.org/blog/what-waste-innovations-africas-waste-material-management>. (Accessed on 10 January 2022)

Duru, C.B., Iwu A.C., Diwe, K.C., Uwakwe, K.A., Merenu, I.A., Madubueze, U.C., Okedo-Alex, I.N., Ndukwu, E. and Ohale, I. 2017. Environmental sanitation practices: A case study of solid waste management in semi-urban communities in Orlu, Imo State Nigeria. *Occupational Diseases and Environmental Medicine*, 5, 88-105.

Dzawanda, B. and Moyo, G.A. 2022. Challenges associated with household solid waste management (SWM) during COVID-19 lockdown period: a case of ward 12 Gweru City Zimbabwe. *Environmental Monitoring Assessment*, 194 (7), 501.

Eades, P., Kusch-Brandt, S., Heaven, S. and Banks, C.J. 2020. Estimating the generation of garden waste in England and the differences between rural and urban areas. *Resources*, 9 (1), 8.

Edmond, C. 2019. This is what the world's waste does to people in poorer countries. *World Economic Forum*. Available at: <https://www.weforum.org/agenda/2019/05/this-is-what-the-world-s-waste-does-to-people-in-poorer-countries/>. (Accessed on 09 February 2022)

Elgie, A.R., Singh, S.J. and Telesford, J.N. 2021. You can't manage what you can't measure: The potential for circularity in Grenada's waste management system. *Resources, Conservation and Recycling*, 164, 105170.

El-Ramady, H., Brevik, E.C., Elbasiouny, H., Elbehiry, F., Amer, M., Elsakhawy, T., Omara, A.E., Mosa, A., El-Ghamry, A.M., Abdalla, N., Rezes, S., Elboraey, M., Ezzat, A. and Eid, Y. 2021. Planning for disposal of COVID-19 pandemic wastes in developing countries: A review of current challenges. *Environ Monit Assess*, 193 (9), 592.

Elsaid, S. and Aghezzaf, E.H. 2015. A framework for sustainable waste management: challenges and opportunities. *Management Research Review*, 38 (10), 1086-1097.

Elsheekh, K.M., Kamel, R.R., Elsherif, D.M. and Shalaby, A.M. 2021. Achieving sustainable development goals from the perspective of solid waste management plans. *Journal of Engineering and Applied Science*, 68 (1), 1-15.

Eshete, H., Desalegn, A. and Tigu, F. 2023. Knowledge, attitudes and practices on household solid waste management and associated factors in Gelemso town, Ethiopia. *Plos one*, 18 (2), p.e0278181.

Esmaeilizadeh, S., Shaghaghi, A. and Taghipour, H. 2020. Key informants' perspectives on the challenges of municipal solid waste management in Iran: a mixed method study. *Journal of Material Cycles and Waste Management*, 22, 1284-1298.

eThekwini Municipality. 2016a. *eThekwini Municipality integrated waste management plan 2016-2021 (draft)*. Available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.durban.gov.za/storage/PDF%20Documents/eThekwini%20Municipality%20Integrated%20Waste%20Management%20Plan%202016%202021.pdf. (Accessed on 3 June 2023)

eThekwini Municipality. 2016b. *eThekwini Municipality: Waste removal by-law, 2016*. Available at: (Accessed on 22 November 2023)

eThekwini Municipality. 2019. *Integrated Development Plan. 5 year plan: 2017/18 to 2021/22*. Available at: https://www.durban.gov.za/City_Government/City_Vision/IDP/Documents/IDP2019_2020.pdf. (Accessed on 7 March 2022)

eThekwini Municipality. 2023. *Integrated Development Plan. 5 year plan: 2023/24 to 2027/28*. Available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.durban.gov.za/storage/Documents/Integrated%20Development%20Plans%20IDP%20-%20eThekwini%20Municipality/Integrated%20Development%20Plan%202023-24%20to%202027-28.pdf. (Accessed on 3 June 2023)

Fadhullah, W., Imran, N.I.N., Ismail, S.N.S., Jaafar, M.H. and Abdullah, H. 2022. Household solid waste management practices and perceptions among residents in the east coast of Malaysia. *BMC Public Health*, 22 (1), 1-20.

Fan, 2023. Routing optimization method of waste transportation vehicle using biological evolutionary algorithm under the perspective of low carbon and environmental protection. *Environmental Engineering Research*, 28 (1), 210458.

Farnsworth, B. 2021. How to design a questionnaire. *Imotions*. Available at: https://imotions.com/blog/design-a-questionnaire/. (Accessed on 10 March 2022)

Farzadkia, M., Jorfi, M.F.S., Nikzad, M. and Nazari, S. 2019. Evaluation of industrial wastes management practices: Case study of the Savojbolagh industrial zone, Iran. *Waste Management and Research: The Journal for a Sustainable Circular Economy*, 38 (1), 44-58.

Feris, M. 2021. Waste not, want not: The ethos of upcycling, repurposing and reusing. Daily Maverick. Available at: <https://www.dailymaverick.co.za/article/2021-02-17-waste-not-want-not-the-ethos-of-upcycling-repurposing-and-reusing/>. (Accessed on 01 February 2022)

Ferreira, M.A. and Santana, S. 2021. Low-income people and pro-environmental behavior: beyond money issues, a literature review. *Millenium*, 2 (14), 71-78.

Fiksel, J., Sanjay, P. and Raman, K. 2021. Steps toward a resilient circular economy in India. *Clean Technologies and Environmental Policy*, 23, 203-218.

Filho, W.L., Voronova, V., Kloga, M., Paco, A., Minhas, A., Salvia, A.L., Ferreira, C.D. and Sivapalan, S. 2021. COVID-19 and waste prediction in households: A trend analysis. *Science of the Total Environment*, 777, 145997.

Firmin, S. 2019. Environmental injustice in South Durban: Community caught between toxic polluters and climate shocks. *South Durban Community Environmental Alliance*. Available at: <https://sdcea.co.za/2019/06/04/1969/>. (Accessed on 17 March 2022)

Fishbein, M. and Ajzen, I. 2011. *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press.

Forlani, G. and Njie, L. 2022. In COVID-era trash surge, waste management ingenuity, circularity, and investments are key. *World Bank Blogs*. Available at: <https://blogs.worldbank.org/sustainablecities/covid-era-trash-surge-waste-management-ingenuity-circularity-and-investments-are>. (Accessed on 9 June 2023)

Frith, A. 2011. Bluff: Sub place 599054033 from census 2011. *adrianfrith.com*. Available at: <https://census2011.adrianfrith.com/place/599054033>. (Accessed on 08 March 2022)

Gardner, B. 2015. A review and analysis of the use of ‘habit’ in understanding, predicting and influencing health related behaviour. *Health Psychology Review*, 9, 277-295.

Garrison, A. 2013. Load shedding in South Africa is an energy crisis you might not know about. Greenmatters. Available at: <https://www.greenmatters.com/clean-energy/what-is-load-shedding-south-africa>. (Accessed on 21 November 2023)

Gebremichael, S.G., Yismaw, E., Tsegaw, B.D. and Shibeshi, A.D. 2021. Determinants of water source use, quality of water, sanitation and hygiene perceptions among urban households in North-West Ethiopia: A cross-sectional study. *Plos One*, 16 (4), 1-20.

Getahun, T., Mengistie, E., Haddis, A., Wasie, F., Alemayehu, E., Dadi, D., Van Gerven, T. and Van der Bruggen, B. 2012. Municipal solid waste generation in growing urban areas in Africa: current practices and relation to socioeconomic factors in Jimma, Ethiopia. *Environmental monitoring and assessment*, 184 (10), 6337-6345.

Ghauri, P., Grønhaug, K. and Strange, R. 2020. *Research methods in business studies*. Cambridge University Press.

Githathu, M. 2019. ‘Waste crisis’ in spotlight as SA is running out of landfill space. *Iol*. Available at: <https://www.iol.co.za/news/south-africa/western-cape/waste-crisis-in-spotlight-as-sa-is-running-out-of-landfill-space-36780078>. (Accessed on 24 February 2022)

Godfrey, L., Ahmed, M.T., Gebremedhin, G., Katima, J.H.Y., Oelofse, S., Osibanjo, O., Richter, U.H. and Yonli, A.H. 2019. Solid waste management in Africa: Governance failure or development opportunities. *Regional Development in Africa*, DOI: 10.5772/intechopen.86974.

Goodall, K. 2022. Can solar energy be a solution to load shedding for households? 702. Available at: <https://www.702.co.za/articles/455809/can-solar-energy-be-a-solution-to-load-shedding-for-households>. (Accessed on 16 February 2023)

Gören, S. 2023. Sustainability model for solid waste management to support the global economy. In *Managing Inflation and Supply Chain Disruptions in the Global Economy* (pp. 151-161). IGI Global.

Goundar, S. 2012. *Research methodology and research method*. Victoria University of Wellington.

Govender, T., Barnes, J.M. and Pieper, C.H. 2011. Contribution of water pollution from inadequate sanitation and housing quality to diarrheal disease in low-cost housing settlements of Cape Town, South Africa. *American Journal of Public Health*. 101 (7), e4-e9.

Gradín, C. 2019. Occupational segregation by race in South Africa after apartheid. *Review of Development Economics*, 23 (2), 553-576.

Gross, M. 2017. *Planned behavior: The relationship between human thought and action*. Routledge.

Gupta, N., Yadav, K.K. and Kumar, V. 2015. A Review on Current Status of Municipal Solid Waste Management in India. *Journal of Environmental Sciences*, 37, 206-217

Gupta, B.N. and Gupta, N. 2022. *Research methodology*. SBPD Publications.

Gusti, A. 2016. The relationship of knowledge, attitudes, and behavioral intentions of sustainable waste management on Primary school students in city of Padang, Indonesia. *International Journal of Applied Environmental Sciences*, 11 (5), 1323-1332.

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

Gutberlet, J., Carenzo, S., Kain, J.H. and Mantovani Martiniano de Azevedo, A. 2017b. Waste picker organizations and their contribution to the circular economy: Two case studies from a global south perspective. *Resources*, 6 (4), 52.

Gutberlet, J. 2018. Waste in the City: Challenges and opportunities for Urban Agglomerations. *Urban Agglomeration*, 21, 191-208.

Güven, E.D., Akinci, G. and Temel., D. 2023. Driving forces on household solid waste management behaviors: A research for the city of Izmir, Türkiye. *Industrial and Domestic Waste Management*, 3 (1), 1-16.

Haerani, D., Syafrudin. and Budi, S. 2019. Review modeling of solid waste transportation routes using Geographical Information System (GIS). *E3S Web of Conferences*, 125, 07006.

Hagger, M. S., Cheung, M. W. -L., Ajzen, I., and Hamilton, K. 2022. Perceived behavioral control moderating effects in the theory of planned behavior: A meta-analysis. *Health Psychology*, 41 (2), 155–167

Han, Z., Zeng, D., Li, Q., Cheng, C., Shi, G. and Mou, Z. 2019. Public willingness to pay and participate in domestic waste management in rural areas of China. *Resources, Conservation and Recycling*, 140, 166-174.

Handayani, D., Gitaharie, B.Y., Yussac, R.N. and Rahmani, S. 2018. How does household characteristics influence their waste management? *E3S Web of Conferences*, 74, 1-5.

Harding, T.S., Finelli, C.J., Carpenter, D.D. and Mayhew, M.J. 2006. Examining the underlying motivations of engineering undergraduates to behave unethically. *American Society for Engineering Education (ASEE) Annual Conference and Exposition, 18-21 June 2006*. Chicago, IL, 13.

Harvey, J., Smith, A., Goulding, J. and Illodo, I.B. 2020. Food sharing, redistribution, and waste reduction via mobile applications: A social network analysis. *Industrial Marketing Management*, 88, 437-448.

Harrison, H., Birks, M., Franklin, R. and Mills, J. 2017. Case study research: Foundations and methodological orientations. *Forum Qualitative Social Research*, 18 (1), 1-17.

Haywood, L.K., Kapwata, T., Oelofse, S., Breetzke, G. and Wright, C.Y. 2021. Waste disposal practices in low-income settlements of South Africa. *International Journal of Environmental Research and Public Health*, 18, 8176.

Heidari, A., Kolahi, M., Behraves, N., Ghorbanyon, M., Ehsanmansh, F., Hashemolhosini, N. and Zanganeh, F. 2018. Youth and sustainable waste management: a SEM approach and extended theory of planned behavior. *Journal of Material Cycles and Waste Management*, 20 (4), 2041-2053.

Heidari, A., Mirzaii, F., Rahnama, M. and Alidoost, F. 2020. A theoretical framework for explaining the determinants of food waste reduction in residential households: a case study of Mashhad, Iran. *Environmental Science and Pollution Research*, 27, 6774-6784.

Hennink, M., Hutter, I. and Bailey, A. 2020. *Qualitative Research Methods*. SAGE Publications Limited: Los Angeles, London, New Delhi, Singapore, Washington DC, Melbourne.

Herdiansyah, H., Brotosusilo, A., Negoro, H.A., Sari, R. and Zakianis, Z. 2021. Parental education and good child habits to encourage sustainable littering behavior. *Sustainability*, 13 (15), 8645.

Herianto, H., Maryono, M. and Budihardjo, M.A. 2019. Factors Affecting Waste Generation: Household Study in Palangka Raya City, Central Kalimantan. In *E3S Web of Conferences* (125, 07007). EDP Sciences.

Hermesnussen, H., Loy, J. and Egamberdiev, B. 2022. Determinants of food waste from household food consumption: A case study from field survey in Germany. *International Journal of Environmental Research and Public Health*, 19 (21), 14253.

Hoornweg, D. and Bhada-Tata, P. 2012. What a waste: a global review of solid waste management. *Urban Development Series Knowledge Papers*, no.15.

Horvat, K.P. and Vendramin, K.S. 2021. Issues surrounding behavior towards discarded textiles and garments in Ljubljana. *Sustainability*, 13 (11), 6491.

Ijjasz-Vasquez, E. and Kaza, S. 2020. Better trash collection for a stronger recovery: Solid waste management as a pillar of urban change. *TheCityFix*. Available at: <https://thecityfix.com/blog/better-trash-collection-for-a-stronger-recovery-solid-waste-management-as-a-pillar-of-urban-change/>. (Accessed on 28 March 2022)

Irfan, M., Cameron, M. and Hassan, G. 2021. Interventions to mitigate indoor air pollution: A cost-benefit analysis. *Plos One*, 16 (9), 1-17.

Islam, R., Nazifa, T.H., Yuniarto, A., Uddin, A.S., Salmiati, S. and Shahid, S. 2019. An empirical study of construction and demolition waste generation and implication of recycling. *Waste management*, 95, 10-21.

Islam, M.T., Huda, N., Baumber, A., Hossain, R. and Sahajwalla, V. 2022. Waste battery disposal and recycling behavior: a study on the Australian perspective. *Environmental Science and Pollution Research*, 1-22.

Iuga, A.N. 2016. Waste management in the circular economy. The case of Romania. *Materials Science and Engineering*, 161, 1-10.

Jacobsen, L.F., Pedersen, S. and Thogersen, J. 2022. Drivers of barriers to consumers' plastic packaging waste avoidance and recycling- A systematic literature review. *Waste Management*, 141, 63-78.

Jacobs-Mata, I.M., De Wet, B., Banoo, I., Meissner, R., De Lange, W.J. and Strydom, W.F. 2018. Understanding residential water-use behaviour in urban South Africa. *Alive2green: The Sustainable Water Resource Handbook, South Africa. The essential guide to resource efficiency in South Africa*, 8, 78-97, CSIR.

Jacometti, V. 2019. Circular economy and waste in the fashion industry. *Laws*, 8 (4), 27.

Jaggernath, J. 2010. Environmental conflicts in the South Durban Basin: Integrating residents' perceptions and concerns resulting from air pollution. *African Journal on Conflict Resolution*, 10 (2).

Jayasinghe, P.A., Jalilzadeh, H. and Hettiaratchi, P. 2023. The Impact of COVID-19 on Waste Infrastructure: Lessons Learned and Opportunities for a Sustainable Future. *International Journal of Environmental Research and Public Health*, 20 (5), 4310.

Joslin, R. and Müller, R. 2016. Identifying interesting project phenomena using philosophical and methodological triangulation. *International Journal of Project Management*, 34 (6), 1043-1056.

Judd, F. 2021. Solid waste transportation methods: Best vehicle and equipment types. *Qv21 Technologies*. Available at: <https://www.qv21.com/blog/solid-waste-transportation-methods>. (Accessed on 09 July 2022)

Jun, J. and Arendt, S.W. 2016. Understanding healthy eating behaviors at casual dining restaurants using the extended theory of planned behavior. *International Journal of Hospitality Management*, 53, 106-115.

Kalonde, P.K., Austin, A.C., Mandevu, T., Banda, P.J., Banda, A., Stanton, M.C. and Zhou, M. 2023. Determinants of household waste disposal practices and implications for practical community interventions: lessons from Lilongwe. *Environmental Research: Infrastructure and Sustainability*, 3 (1), 011003.

Karmakar, G. and Chetty, R., 2023. Tackling Environmental and Epistemic Injustice: Decolonial Approaches for Pluriversal Peacebuilding in South Africa. *Peace Review*, 1-15.

Kawai, K. and Tasaki, T. 2016. Revisiting estimates of municipal solid waste generation per capita and their reliability. *Journal of Material Cycles and Waste Management*, 18, 1-13.

Kaza, S., Yao, L., Bhada-Tata, P. and Van Woerden, F. 2018. *What a waste 2.0: a global snapshot of solid waste management to 2050*. World Bank Publications, Washington, DC.

Kebaili, F.K., Baziz-Berkani, A., Aouissi, H.A., Mihai, F.C., Houda, M., Ababsa, M., Azab, M., Petrisor, A.I. and Fürst, C. 2022. Characterization and Planning of Household Waste Management: A Case Study from the MENA Region. *Sustainability*, 14(9), 5461.

Khan, A.H., López-Maldonado, E.A., Khan, N.A., Villarreal-Gómez, L.J., Munshi, F.M., Alsabhan, A.H. and Perveen, K. 2021. Current solid waste management strategies and energy recovery in developing countries-State of art review. *Chemosphere*, 291 (3), 133088.

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

Khanal, A., Giri, S. and Mainali, P. 2023. The practices of at-source segregation of household solid waste by the youths in Nepal. *Journal of Environmental and Public Health*, 2023.

Khine, M.M. and Langkulsen, U. 2023. The Implications of Climate Change on Health among Vulnerable Populations in South Africa: A Systematic Review. *International Journal of Environmental Research and Public Health*, 20 (4), 3425.

Kibria, M.G., Masuk, N.I., Safayet, R., Nguyen, H.Q. and Mourshed, M. 2023. Plastic Waste: Challenges and Opportunities to Mitigate Pollution and Effective Management. *International Journal of Environmental Research*, 17 (1), 20.

Knickmeyer, D. 2020. Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *Journal of cleaner production*, 245, 118605.

Komakech, A.J., Sundberg, C., Jonsson, H. and Vinneras, B. 2015. Life cycle assessment of biodegradable waste treatment systems for sub-Saharan African cities. *Resources, Conservation and Recycling*, 99, 100-110.

Korneliussen, O.K. 2021. Improving waste management with ISWM. *CLOCC*. Available at: <https://www.cloccglobal.org/post/improving-waste-management-with-iswm>. (Accessed on 04 July 2022)

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

Kurniawan, T.A., Meidiana, C., Othman, M.H.D., Goh, H.H. and Chew, K.W. 2023. Strengthening waste recycling industry in Malang (Indonesia): Lessons from waste management in the era of Industry 4.0. *Journal of Cleaner Production*, 382, 135296.

KwaZulu-Natal Gaming and Betting Board (KZNGBB). 2019. *Saturation study: Undertaken by KwaZulu-Natal Gaming and Betting Board*. Available at: <http://www.kznghbb.org.za/wp-content/uploads/SStudy2019/Saturation-Study-5%20July-2019.pdf>. (Accessed on 08 March 2022)

Lakshmikantha, N. and Malur, D.P.G. 2014. Waste Management Public Awareness and Communication: A Study on Role of Television in Waste Management. *Orient Journal of Law and social sciences*, 8 (6).

LaMorte, W.W. 2019. Behavioral change models: The Theory of Planned Behavior. *Boston University School of Public Health*. Available at: <https://sphweb.bumc.bu.edu/otlt/mph->

modules/sb/behavioralchangetheories/BehavioralChangeTheories3.html. (Accessed on 24 June 2021)

Lazo, D.P.L. and Gasparatos, A. 2022. Factors influencing household-level positive and negative solid waste management practices in rapidly urbanizing cities: Insights from Santa Cruz de la Sierra, Bolivia. *Environmental Research Infrastructure and Sustainability*, 2, 015002.

Leal Filho, W., Voronova, V., Kloga, M., Paço, A., Minhas, A., Salvia, A.L., Ferreira, C.D. and Sivapalan, S. 2021. COVID-19 and waste production in households: A trend analysis. *Science of the Total Environment*, 777, 145997.

Leblanc, R. 2019a. Integrated Solid Waste Management (ISWM)- An overview. *The balance small business*. Available at: <https://www.thebalancesmb.com/integrated-solid-waste-management-iswm-an-overview-2878106>. (Accessed on 3 July 2022)

Leblanc, R. 2019b. The waste management hierarchy. *The balance small business*. Available at: <https://www.thebalancesmb.com/reduce-reuse-and-recycle-the-waste-management-hierarchy-2878202>. (Accessed on 27 February 2022)

Lebleu, T. 2020. Tackling the waste issue: an economic, social and environmental priority. *Solar Impulse Foundation*. Available at: <https://solarimpulse.com/news/tackling-the-waste-issue-an-economic-social-and-environmental-priority#>. (Accessed on 5 June 2023)

Lederman, N.G. and Lederman, J.S. 2015. What is a theoretical framework? A practical answer. *Journal of Science Teacher Education*, 26, 593-597.

Lee, J., Cerreto, F.A. and Lee, J. 2010. Theory of Planned behavior and teachers' decisions regarding use of educational technology. *Educational Technology and Society*, 13 (1), 152-164.

Lee, S. 2020. Role of social and solidarity economy in localizing the sustainable development goals. *International Journal of Sustainable Development and World Ecology*, 27 (1), 65-71.

Leonard, L. and Lidskog, R. 2021. Conditions and constraints for reflexive governance of industrial risks: The case of the South Durban Industrial Basin, South Africa. *Sustainability*, 13 (10), 5679.

Letshwenyo, M., W. and Kgetseymore, D. 2020. Generation and composition of municipal solid waste: case study, extension 7, Palapye, Botswana. *SN Applied Sciences*, 2, 1-8.

Li, S., Kalla, Z., Rahmani, D. and Gil, J.M. 2021. Trends in food preferences and sustainable behavior during the COVID-19 lockdown. Evidence from Spanish consumers. *Foods*, 10 (8), 1898.

Lianwei, Z. and Wen, X. 2021. Urban household energy consumption forecasting based on energy price impact mechanism. *Frontiers in Energy Research*, 9 (802697), 1-16.

Lima, P.M. and Paulo, P.L. 2018. Solid-waste management in the rural area of Brazil: A case study in Quilombola communities. *Journal of Material Cycles and Waste Management*, 20, 1583-1593.

Liu, X., Wang, Z., Li, W., Li, G. and Zhang, Y. 2019. Mechanisms of public education influencing waste classification willingness of urban residents. *Resources, Conservation and Recycling*, 149, 381-390.

Longe, O.M. 2021. An assessment of the energy poverty and gender nexus towards clean energy adoption in rural South Africa. *Energy*, 14 (2), 3708.

Lokot, M. 2021. Whose voices? Whose knowledge? A feminist analysis of the value of key informant interviews. *International Journal of Qualitative Methods*, 20, 1-8.

Lucas, P., Fleming, J. and Bhosale, L. 2018. The utility of case study as a methodology for work-integrated learning research. *International Journal of Work-Integrated Learning, Special Issue*, 19 (3), 215-222.

Ma, J., Yin, Z., Hipel, K.W., Li, M. and He, J. 2023. Exploring factors influencing the application accuracy of the theory of planned behavior in explaining recycling behavior. *Journal of Environmental Planning and Management*, 66 (3), 445-470.

Machate, M. 2021. Reflections on the influence of family demographics on food waste generation among the city of Tshwane households, Republic of South Africa. In: Saleh, H.M, ed. *Strategies of Sustainable Solid Waste Management*. IntechOpen: London: United Kingdom, 11-24.

Magaisa, T. 2021. The legacy of racism in South Africa: Institutional violence by security forces recalls apartheid abuses. *Human Rights Watch*. Available at: <https://www.hrw.org/news/2021/03/09/legacy-racism-south-africa>. (Accessed on 25 November 2023)

Magubane, T. 2023. eThekweni's orange bag recycling programme to be revamped. *IOL*. Available at: <https://www.iol.co.za/mercury/news/ethekwinis-orange-bag-recycling-programme-to-be-revamped-0d0d7ea3-d0bc-40f9-93ce-f88017e99f6a>. (accessed on 21 November 2023)

Malinauskaite, J., Jouhara, H., Czajczynska, D., Stanchev, P., Katsou, E., Rostkowski, P., Thorne, R.J., Colon, J., Ponsa, S., Al-Mansour, F., Anguilano, L., Krzyzynska, R., Lopez, I.C., Vlasopoulos, A. and Spencer, N. 2017. Municipal solid waste management and waste-to-energy in the context of a circular economy and energy recycling in Europe. *Energy*, 141, 2013-2044.

Majola, N. 2021. Heaps of rubbish causing a stink in Durban's informal settlements. *Elitsha*. Available at: <https://elitshanews.org.za/2021/08/20/heaps-of-rubbish-causing-a-stink-in-durbans-informal-settlements/>. (Accessed on 14 March 2022)

Makgae, M. 2011. Key areas in waste management: A South African perspective. *Integrated waste management*, 2, 1169.

Mamady, K. 2016. Factors influencing attitude, safety behavior, and knowledge regarding household waste management in Guinea: A cross-sectional study. *Journal of Environmental and Public Health*, 9.

Mandpe, A., Paliya, S., Gedam, V.V., Patel, S., Tyagi, L. and Kumar, S. 2023. Circular economy approach for sustainable solid waste management: A developing economy perspective. *Waste Management and Research*, 41 (3), 499-511.

Mannarini, T., Talò, C. and Rochira, A. 2017. How diverse is this community? Sense of community, ethnic prejudice and perceived ethnic heterogeneity. *Journal of Community and Applied Social Psychology*, 27 (3), 181-195.

Mapani, M.B., Muthimba, W.H.M., Sikidi, Y.D. and Maseko, L. 2022. Circular Economy: A Sustainable Approach to Waste Management in the City of Johannesburg. In *Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster, Development: Proceedings of the 15th Built Environment Conference* (pp. 3-14). Cham: Springer International Publishing.

Mason, M.C., Pauluzzo, R. and Umar, R.M. 2022. Recycling habits and environmental responses to fast-fashion consumption: Enhancing the theory of planned behavior to predict Generation Y consumers' purchase decisions. *Waste Management*, 139, 146-157.

Matiwane, N. 2022. Candles, fire drums and open flames- how to keep your home during fire season. *News24*. Available at: <https://www.news24.com/drum/news/local/candles-fire-drums-and-open-flames-how-to-keep-your-home-safe-during-fire-season-20220701>. (Accessed on 31 January 2023)

Matheson, T., 2022. Disposal is not free: Fiscal instruments to internalize the environmental costs of solid waste. *International Tax and Public Finance*, 29(4), pp.1047-1073.

McCusker, K. and Gunaydin, S. 2015. Research using qualitative, quantitative or mixed methods and choices based on the research. *Perfusion*, 30 (7), 537-542.

Menyuka, N.N., Sibanda, M. and Bob, U. 2020. Perceptions of the Challenges and Opportunities of utilizing organic waste through urban agriculture in the Durban South Basin. *International Journal of Environmental Research and Public Health*, 17 (4), 1158.

Middleton, F. 2019. Reliability vs validity in research: Differences, types and examples. *Scribbr*. Available at: <https://www.scribbr.com/methodology/reliability-vs-validity/>. (Accessed on 25 March 2022)

Mihai, F.C. and Taherzadeh. M.J. 2017. Introductory chapter: Rural waste management issues at global level. *Solid Waste Management in Rural Areas; Mihai, F., Ed.; In Tech: Rijeka, Croatia*, pp. 1-10.

Miller, Z.D. 2017. The enduring use of the theory of planned behavior. *Human Dimensions of Wildlife*, 22 (6), 583-590.

Miner, K.J., Rampedi, I.T., Ifegbesan, A.P. and Machete, F. 2020. Survey on household awareness and willingness to participate in e-waste management in Jos, Plateau State, Nigeria. *Sustainability*, 12 (3), 1047.

Mintz, K.K., Henn, L., Park, J. and Kurman, J. 2019. What predicts household waste management behavior? Culture and type of behavior as moderators. *Resources, Conservation and Recycling*, 145, 11-18.

Moduka, O. 2020. Upcycle empowers community to help themselves. *Randburg Sun*. Available at: <https://randburgsun.co.za/400895/upcycle-empowers-community-to-help-themselves/>. (Accessed on 01 February 2022)

Monterrubio, C., Andriotis, K. and Rodríguez-Muñoz, G. 2020. Residents' perceptions of airport construction impacts: A negativity bias approach. *Tourism Management*, 77, 103983.

Mosepele, K. 2022. Alternative power sources during load shedding- What are the options? *CapeTalk*. Available at: <https://www.capetalk.co.za/articles/448984/alternate-power-sources-during-load-shedding-what-are-the-options>. (accessed on 16 February 2023)

Mthembu, N. 2021a. Uncollected waste sparks concern in Bluff. *Southlands Sun*. Available at: <https://southlandssun.co.za/163261/uncollected-waste-sparks-concern-in-bluff/>. (Accessed on 17 March 2022)

Mthembu, N. 2021b. Bluff residents urged to dump waste accordingly. *Southlands Sun*. Available at: <https://southlandssun.co.za/175430/bluff-residents-urged-to-dump-waste-accordingly/>. (Accessed on 17 March 2022)

Mudombi, S. 2020. Access to water and sanitation in South Africa: A renewed call for more action. *Daily Maverick*. Available at: <https://www.dailymaverick.co.za/article/2020-04-02-access-to-water-and-sanitation-in-south-africa-a-renewed-call-for-more-action/>. (Accessed on 29 March 2022)

Muniandy, G., Anuar, M.M., Foster, B., Saputra, J., Johansyah, M.D., Khoa, T.T. and Ahmed, Z.U. 2021. Determinants of sustainable waste management behavior of Malaysian academics. *Sustainability*, 13, 4424.

Mutumbi, U., Thondhlana, G. and Ruwanza, S. 2021. Reported behavioural patterns of electricity use among low-income households in Makhanda, South Africa. *Sustainability*, 13, 7271.

Mutungwe, E., Tsvere, M., Dondo, B. and Pedzisai, C. 2014. A study of the level of awareness and practices of solid waste management in Chinhoyi, Urban, Zimbabwe. *International Journal of Advanced Research in Management and Social Sciences*, 3 (9), 71-79.

Muzenda, E. 2014. A discussion on waste generation and management trends in South Africa. *International Journal of Chemical, Environmental and Biological Sciences*, 2 (2), 2320-4087.

Muzvondiwa, R. 2021. The role of community participation in solid waste management in Zimbabwe: The case of Nyanga township. *The Dyke*, 15 (1), 116-130.

Mwanza, B.G. and Mbohwa, C. 2017. Drivers to sustainable plastic solid waste recycling: a review. *Procedia Manufacturing*, 8, 649-656.

Naidoo, R.N., Robins, T.G., Batterman, S., Mentz, G. and Jack, C. 2013. Ambient pollution and respiratory outcomes among schoolchildren in Durban, South Africa. *South African Journal of Child Health*, 7 (4), 127-134.

Naidoo, D. 2021. For waste pickers, one man's trash becomes another one's treasure. *Iol*. Available at: <https://www.iol.co.za/news/environment/for-waste-pickers-one-mans-trash-becomes-another-ones-treasure-52886b8f-2243-4d55-b108-4eca0f90693c>. (Accessed on 24 February 2022)

Narmilan, A., Puvanitha, N., Niroash, G., Sugirtharan, M. and Vassanthini, R. 2020. Domestic water consumption pattern by urban households. *Drinking Water Engineering and Science Discussions*, 1-0.

Naughton, C.C. 2020. Will the COVID-19 pandemic change waste generation and composition?: The need for more real-time waste management data and systems thinking. *Resources, Conservation and Recycling*, 162, 105050.

Ncube, L.K., Ude, A.U., Ogunmuyiwa, E.N., Zulkifli, R. and Beas, I.N. 2021. An overview of plastic waste generation and management in food packaging industries. *Recycling*, 6 (1), 12.

Ndanu, M.C. and Syombua, M.J. 2015. Mixed methods research: The hidden cracks of the triangulation design. *General Education Journal*, 4 (2), 46-67.

Ndebele, NE. and Du Plessis, R. 2018. The effectiveness of waste management services offered by eThekweni Municipality: A case study of Ntuzuma Township in Durban: *WasteCon 2018 Implementing the Waste Hierarchy Conference and exhibition, 15-19 October 2018*. Johannesburg.

Nell, C., Schenck, C., Blaauw, D., Grobler, L. and Viljoen, K. 2022a. A three-pronged approach to waste composition determination. *Journal of Environmental Management*, 303, 114203.

Nell, C.M., Schenck, C. and Waal, J.D., 2022b. Waste characterisation in Stellenbosch Local Municipality, South Africa. *South African Journal of Science*, 118(SPE), 1-12.

Newaz, M.S. and Appolloni, A. 2023. *Evolution of Behavioral Research on E-Waste Management: Conceptual Framework and Future Research Directions* (No. 9860). EasyChair.

Nisha, B., Shajil, S., Dutta, R. and Jain, T. 2022. Consumer awareness and perceptions about e-waste management in semi-urban area of northern Tamil Nadu: A mixed-method approach. *Journal of Family and Community Medicine*, 29 (2), 132.

Novriadhy, D., Komalasari, O., Hatta, H. and Oktarina, R. 2021, August. The Effect of Household's Age Structure to Waste Generation in Palembang City. In *IOP Conference Series: Earth and Environmental Science* (Vol. 810, No. 1, p. 012024). IOP Publishing.

Ntsoane, M. 2022. Waste pickers need formal recognition, and full and fair remuneration for their services. *Daily Maverick*. Available at: <https://www.dailymaverick.co.za/article/2022-04-20-waste-pickers-need-formal-recognition-and-full-and-fair-remuneration-for-their-services/>. (Accessed on 04 February 2023)

Nukusheva, A., Rustembekova, D., Abdizhami, A., Au, T. and Kozhantayeva, Z. 2023. Regulatory obstacles in municipal solid waste management in Kazakhstan in comparison with the EU. *Sustainability*, 15, 1034

Nuraini and Pertiwi, W.E. 2019. Behavior factors in waste management in Mangunreja village. *KnE Life Sciences*, 4 (13), 609-618.

Nyika, J.M., Onyari, E.K., Mishra, S. and Dinka, M.O. 2020. Waste Management in South Africa. In *Sustainable Waste Management Challenges in Developing Countries* (pp. 327-351). IGI Global.

Odonkor, S.T., Frimpong, K. and Kurantin, N. 2020. An assessment of household solid waste management in a large Ghanaian district. *Heliyon*, 6 (1), 1-7.

Odonkor, S.T. and Sallar, A.M. 2021. Correlates of household waste management in Ghana: implications for public health. *Heliyon*, 7 (11), p.e08227.

Ogbu, S.U., and Ezeodili, W.O. 2021. Influence of Rural-Urban Migration on Waste Management in the Enugu Metropolis. *Cross Current International Journal of Economics, Management and Media Studies*, 3 (2), 5-16.

Omole, D.O., Isiorho, S.A. and Ndambuki, J.M. 2016. Waste management practices in Nigeria: Impacts and mitigation. *Geological Society of America Special Papers*, 520, pp.SPE520-33.

Omotayo, A.B., Omotoso, A.B., Daud, A.S., Ogunniyi, A. I. and Olagunju, K.O. 2020. What drives households' payment for waste disposal and recycling behaviours? Empirical evidence from South Africa's General Household Survey. *International Journal of Environmental Research and Public Health*, 17 (19), 7188.

Organization for Economic Co-operation and Development (OECD). 2020. *Circular economy, waste and materials*. Available at: <https://www.oecd.org/environment/environment-at-a-glance/Circular-Economy-Waste-Materials-Archive-February-2020.pdf>. (Accessed on 28 January 2022)

Orhorhoro, E.K. and Oghoghorie, O. 2019. Review on solid waste generation and management in Sub-Saharan Africa: A case study of Nigeria. *Journal of Applied Sciences and Environmental Management*, 23 (9), 1729-1737.

Oskam, M.J., Pavlova, M., Hongoro, C. and Groot, W. 2021. Socio-economic inequalities in access to drinking water among inhabitants of informal settlements in South Africa. *International Journal of Environmental Research and Public Health*, 18 (19), 10528.

Oteng-Ababio, M. 2014. Rethinking waste as a resource: Insights from a low-income community in Accra, Ghana. *City, Territory and Architecture*, 1 (10), 1-14.

Otumawu-Apreku, K. 2020. Solid waste management: A socio-economic perspective of urban and peri-urban communities in Honiara. *International Journal of Environmental Sciences and Natural Resources*, 25 (3), 556173.

Oyedotun, T.D.T., Kasim, O.F., Famewo, A., Oyedotun, T.D., Moonsammy, S., Ally, N. and Renn-Moonsammy, D. 2020. Municipal waste management in the era of COVID-19: Perceptions, practices, and potentials for research in developing countries. *Research in Globalization*, 2, 1-10.

Pakpour, A.H., Zeidi, I.M., Emamjomeh, M.M., Asefzadeh, S. and Pearson, H. 2014. Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour. *Waste Management*, 34 (6), 980-986.

Papathanasiou, D. 2022. Renewables are key to green. Secure, affordable energy. *World Bank Blogs*. Available at: <https://blogs.worldbank.org/energy/renewables-are-key-green-secure-affordable-energy>. (Accessed on 16 February 2023)

Parikh, P., Bisaga, I., Loggia, C., Georgiadou, M.C. and Ojo-Aromokudu, J. 2020. Barriers and opportunities for participatory environmental upgrading: Case study of Havelock informal settlement, Durban. *City and Environment Interactions*, 5, 100041.

Parliamentary Monitoring Group. 2022. *Status of waste management in South Africa*. Available at: <https://pmg.org.za/committee-meeting/34368/>. (Accessed on 7 June 2023)

Pather-Elias, S., Euston-Brown, M., Ferry, A. and Giljova, S. nd. Bisasar Road and Mariannhill landfill sites grid-tied electricity generation. *Cityenergy*. Available at: https://www.cityenergy.org.za/uploads/resource_340.pdf. (Accessed on 20 November 2023)

Patten, M.L. and Newhart, M. 2017. *Understanding Research Methods: An Overview of the Essentials*. 10th ed. Taylor and Francis: New York.

Perera, F. 2018. Pollution from fossil-fuel combustion is the leading environmental threat to global pediatric health and equity: Solutions exist. *International Journal of Environmental Research and Public Health*, 15 (1), 1-17.

Peula, F.J., Martín-Lara, M.Á. and Calero, M. 2023. Effect of COVID-19 pandemic on municipal solid waste generation: a case study in Granada city (Spain). *Journal of Material Cycles and Waste Management*, 1-13.

Picard, H.L. 2020 Waste management and electricity generation in Africa: Developing waste-to-energy to the benefit of sustainable cities? *G20 Insights*. Available at: https://www.g20-insights.org/policy_briefs/waste-management-and-electricity-generation-in-africa-developing-waste-to-energy-to-the-benefit-of-sustainable-cities/. (Accessed on 11 January 2020)

Pirtle, W.N.L. 2022. “White People Still Come Out on Top”: The Persistence of White Supremacy in Shaping Coloured South Africans’ Perceptions of Racial Hierarchy and Experiences of Racism in Post-Apartheid South Africa. *Social Sciences*, 11 (2), 70.

Preston, F., Lehne, J. and Wellesley, L. 2019. An inclusive circular economy: Priorities for developing countries. *The Royal Institute of International Affairs: Chatham House*, 82.

Purchase, C.K., Al Zulayq, D.M., O’Brien, B.T., Kowalewski, M.J., Berenjian, A., Tarighaleslami, A.H. and Seifan, M. 2022. Circular economy of construction and demolition waste: A literature review on lessons, challenges, and benefits. *Materials*, 15 (1), 76.

Qu, H., Suphachalasai, S., Thube, S.D. and Walker, S. 2023. South Africa Carbon Pricing and Climate Mitigation Policy. *Selected Issues Papers*, 2023 (040), 19.

Raab, K., Tolotti, G. and Wagner, R. 2021. Challenges in solid waste management: Insights into the disposal behavior of suburban consumers in Guatemala City. *Frontiers in Sustainable Cities*, 3 (683576), 1-8.

- Raghu, S.J. and Rodrigues, L.L.R. 2020. Behavioral aspects of solid waste management: A systematic review. *Journal of the Air and Waste Management Association*, 70 (12), 1268-1302.
- Ramayah, T., Lee, J.W.C. and Lim, S. 2012. Sustaining the environment through recycling: An empirical study. *Journal of environmental management*, 102, 141-147.
- Ramchander, M. 2018. Shortcomings in case study research design in master's dissertations at South Africa universities. *The Independent Journal of Teaching and Learning*, 13 (1), 5-16.
- Ramela, A. 2023. Listen: Load shedding forces South Africans to find alternative power sources. *Eye Witness News*. Available at: <https://ewn.co.za/2023/05/22/listen-load-shedding-forces-south-africans-to-find-alternative-power-sources>. (Accessed on 11 June 2023)
- Ramulongo, L., Nethengwe, N.S. and Musyoki, A. 2017. The nature of urban household water demand and consumption in Makhado Local Municipality: A case study of Makhado Newtown. *Procedia Environmental Sciences*, 37, 182-194.
- Rao, X., Qiu, H., Morrison, A.M. and Wei, W. 2022. Extending the theory of planned behavior with the self-congruity theory to predict tourists' pro-environmental behavioral intentions: A two-case study of heritage tourism. *Land*, 11 (11), 2069.
- Räsänen, A., Lein, H., Bird, D. and Setten, G. 2020. Conceptualizing community in disaster risk management. *International Journal of Disaster Risk Reduction*, 101485.
- Rasmeni, Z.Z. and Madyira, D.M. 2019. A review of current municipal solid waste management practices in Johannesburg city township. *Procedia Manufacturing*, 35, 1025-1031.
- Redman, A. and Redman, E. 2022. Possibilities for sustainable household waste management: A case study from Guanajuato, Mexico. *Cleaner Waste Systems*, 2, 100016.

Reetsch, A., Kimaro, D., Feger, K.H. and Schwärzel, K. 2020. Traditional and adapted composting practices applied in smallholder banana-coffee-based farming systems: Case studies from Kagera and Morogoro regions, Tanzania. *Organic Waste Composting through Nexus Thinking*, 165.

Regoniel, P.A. 2015. Conceptual framework: A step by step guide on how to make one. *SimplyEducate*. Available at: <https://simplyeducate.me/2015/01/05/conceptual-framework-guide/>. (Accessed on 5 July 2021)

Rodseth, C., Notten, P. and Von Blottnitz, H. 2020. A revised approach for estimating informally disposed domestic waste in rural versus urban South Africa and implications for waste management. *South African Journal of Science*, 116 (1-2), 1-6.

Ronaghi, M. and Scorsone, E., 2023. The Impact of COVID-19 Outbreak on CO₂ Emissions in the Ten Countries with the Highest Carbon Dioxide Emissions. *Journal of Environmental and Public Health*, 2023, 10.

Roopa, S. and Rani, M.S. 2012. Questionnaire designing for a survey. *Journal of Indian Orthodontic Society*, 46 (4), 273-277.

Roser, M. 2021. Energy poverty and indoor air pollution: a problem as old as humanity that we can end within our lifetime. *Our World in Data*. Available at: <https://ourworldindata.org/energy-poverty-air-pollution>. (Accessed on 25 January 2022)

Rouhani, L. 2017. Unpacking Community Participation: A Gendered Perspective. *Current Issues in Comparative Education*, 20 (1), 31-44.

Russell, S.V., Young, W., Unsworth, K.L. and Robinson, C. 2017. Bringing habits and emotions into food waste behaviour. *Resources, Conservation and Recycling*, 125, 107-114.

Sabri, N.R., Jaber, R.Y. and Haniya, D. 2013. Private partnership of solid waste management in the Palestinian municipalities. *Public and Municipal Finance*, 2 (2), 7-14.

Saleh, H.M. and Koller, M. 2019. Introductory chapter: municipal solid waste. *Municipal Solid Waste Management*, 3 (10.572).

Santoso, A.N. and Farizal. 2019. Community participation in household waste management: An exploration study in Indonesia. *E3S Conferences*, 125, 07013.

Sarfo-Mensah, P., Obeng-Okrah, K., Arhin, A.A., Amaning, T.K. and Oblitei, R.T. 2019. Solid waste management in urban communities in Ghana: A case study of the Kumasi metropolis. *African Journal of Environmental Science and Technology*, 13(9), 342-353.

Sarkodie, S.A. and Owusu, P.A. 2021. Impact of COVID-19 pandemic on waste management. *Environment, Development and Sustainability*, 23, 7951-960.

Saunders M, Lewis P and Thornhill A. 2019. *Research methods for business students*. Eighth edition. London: Pearson.

Saseanu, A.S., Gogonea, R., Ghita, S.I. and Zaharia, S. 2019. The impact of education and residential environment on long-term waste management behavior in the context of sustainability. *Sustainability*, 11, 3775.

Sasol. 2020. *Sasol funds innovative packa-ching recycling initiative*. Available at: <https://society.sasol.com/sasol-funds-innovative-packa-ching-recycling-initiative/>. (Accessed on 03 February 2022)

Schoeman, D.C. and Rampedi, I.T. 2022. Drivers of household recycling behavior in the city of Johannesburg, South Africa. *International Journal of Environmental Research and Public Health*, 19, 6229.

Schröder, P., MacEwen, M., Barrie, J., Wetterberg, K. and Wallace, J. 2021. What is the circular economy? *Chatham house*. Available at: <https://www.chathamhouse.org/2021/06/what-circular-economy>. (Accessed on 27 February 2022)

Scott, A., Oates, C. and Young, W. 2015. A conceptual framework of the adoption and practice of environmental actions in households. *Sustainability*, 7, 5793-5818.

Selvakumaran, Y. and Wahid, R.B. 2022. Human behavior in the practice of waste segregation at source. *Academic Research in Business and Social Sciences*, 12 (2), 130-143.

Septiningtiyas, D.T., Sakinah, W. and Listriyana, A. 2018. The estimation of volume and type of household waste in the coastal village, Besuki Region, Situbondo, East Java. *MATEC Web of Conferences*, 177, 1-8.

Shaban, A.R.A. 2018. Ethiopia opens Africa's first waste-to-energy facility. *Africa news*. Available at: <https://www.africanews.com/2018/08/20/the-reppie-project-ethiopia-opens-africa-s-first-waste-to-energy-facility/>. (Accessed on 01 February 2022)

Shahi, D.K., Rijal, H.B. and Shukuya, M. 2019. Study on household energy usage patterns in urban and rural areas of Nepal. *Journal of the Institute of Engineering*, 15 (3), 402-410.

Siddiqi, A., Haraguchi, M. and Narayanamurti, V. 2020. Urban waste to energy recovery assessment simulations for developing countries. *World Development*, 131, 104949.

Sileyew, K.J. 2019. Research design and methodology. In: Abu-Taieh., Mouatasim, A.E. and Al Hadid, I.H., eds. *Cyberspace*. IntechOpen, London, United Kingdom, 27-38.

Silva, A., Rosano, M., Stocker, L. and Gorissen, L. 2017. From waste to sustainable materials management: Three case studies of the transition journey. *Waste management*, 61, 547-557.

Simiyu, S.N., Kweyu, R.M., Antwi-Agyei, P. and Adjei, K.A. 2020. Barriers and opportunities for cleanliness of shared sanitation facilities in low-income settlements in Kenya. *BMC Public Health*, 20 (1632), 1-12.

Singh, C.R. and Dey, M. 2015. Role of NGO's in Solid Waste Management: A Study in Different Municipalities of Manipur, India. *Current World Environment*, 10 (1), 161.

Singh, A. and Sushil. 2017. Developing a conceptual framework of waste management in the organizational context. *Management of Environmental Quality: An International Journal*, 28 (6), 786-806.

Singh, E., Kumar, A., Mishra, R. and Kumar, S. 2022. Solid waste management during COVID-19 pandemic: Recovery techniques and responses. *Chemosphere*, 288, 132451.

Sinthumule, N.I. and Mkumbuzi, S.H. 2019. Participation in community-based solid waste management in Nkulumane suburb, Bulawayo, Zimbabwe. *Resources*, 8 (1), 30.

Smith D. and Carrington, D. 2015. Residents blame Durban oil refineries for health problems. *The Guardian*. Available: <https://www.theguardian.com/environment/2015/may/26/residents-blame-durban-oil-refineries-for-health-problems> (Accessed on 09 April 2020)

Smith, J and Noble, H. 2014. Bias in research. *Evidence-Based Nursing*, 17 (4), 100-101.

Smith, K.R. and Pillarisetti, A. 2018. Household air pollution from solid cook fuels and its effects on health. In: Mock, C.N., Nugent, R., Kobusingye, O. and Smith, K.R., eds. *Injury prevention and environmental health*. Disease control priorities. 3rd ed. World Bank Group: Washington DC, 133-152.

Smith, E.E. 2020. Attitudes and practices of households toward waste management and recycling in Nelson Mandela Bay. *Journal of Contemporary Management*, 17 (2), 573-600.

Sniehotta, F.F., Presseau, J. and Araújo-Soares, V. 2014. Time to retire the theory of planned behaviour. *Health psychology review*, 8 (1), 1-7.

Soltani, M., Rahmani, O., Pour, A.B., Ghaderpour, Y., Ngah, I. and Misnan, S.H. 2019. Determinants of variation in household energy choice and consumption: Case from Mahabad City, Iran. *Sustainability*, 11, 4775.

Sogari, G. and Van Loo, E.J. 2023. The theory of planned behavior and healthy diet: Examining the mediating effect of traditional food. *Food Quality and Preference*, 104, 104709.

South African Government. nd. How do I access free basic municipal services? Available at: <https://www.gov.za/faq/government-services/how-do-i-access-free-basic-municipal-services>. (Accessed on 22 November 2023)

Souza-Piao, R., de Vincenzi, T.B. and de Carvalho, M.M. 2023. Strategies for social inclusion in circular economy. In: *The Social Dimensions of the Circular Economy*. Cham: Springer International Publishing, 265-282.

Soysa, R.N.K., Pallegedara, A., Kumara, A.S., Jayasena, D.M. and Samaranayake, M.K.S.M. 2022. Factors affecting waste generation and segregation behaviour. An analysis using data from the educated communities in the Western and the North-Western provinces of Sri Lanka. *Munich Personal RePEc Archive (MPRA)*, no. 114508, 38.

Srun, P. and Kurisu, K. 2019. Internal and external influential factors on waste disposal behavior in public open spaces in Phnom Penh, Cambodia. *Sustainability*, 11, 1518.

Stahel, W.R. 2016. The circular economy. *Nature*, 531 (7595), 435-438.

Statistics South Africa (Stats SA). 2011. *eThekwini*. Available at: http://www.statssa.gov.za/?page_id=1021&id=ethekwini-municipality#:~:text=eThekwini%20Municipality%20is%20located%20on,some%203%2C5%20million%20people. (Accessed on 17 March 2022)

Statistics South Africa (Stats SA). 2017. *General Household Survey 2017*, Available at: www.statssa.gov.za/publications/P0318/P03182017.pdf (Accessed on 13 July 2019)

Statistics South Africa (Stats SA). 2018a. *Only 10% of waste recycled in South Africa*. Available at: www.statssa.gov.za/?p=11527. (Accessed on 14 September 2021)

Statistics South Africa (Stats SA). 2018b. Four facts about indigent households. Available at: <https://www.statssa.gov.za/?p=11722>. (Accessed on 22 November 2023)

Statistic South Africa (Stats SA). 2019a. *General household survey 2019*. Available at: <https://www.statssa.gov.za/publications/P0318/P03182019.pdf>. (Accessed on 27 January 2022)

Statistics South Africa (Stats SA). 2019b. *Household access to services stabilized*. Available at: <http://www.statssa.gov.za/?p=12211#:~:text=GHS%20data%20show%20that%20households,behind%20at%2066%2C4%25>. (Accessed on 29 March 2022)

Statistics South Africa (Stats SA). 2021. *Families and parents are key to well-being of children*. Available at: <https://www.statssa.gov.za/?p=14388#:~:text=Nationally%2C%20an%20estimated%2039%2C9,such%20as%20parents%20or%20siblings>. (Accessed on 21 November 2023)

Statistics South Africa (Stats SA). 2022a. *General Household survey (GHS), 2021*. Available at: https://www.statssa.gov.za/?page_id=1854&PPN=P0318&SCH=73293. (Accessed on 13 September 2022)

Statistics South Africa (Stats SA). 2022b. *Quarterly employment statistics (QES)*. Available at: <https://www.statssa.gov.za/publications/P0277/P0277September2022.pdf>. (Accessed on 22 November 2023)

Strauss, M. 2019. A historical exposition of spatial injustice and segregated urban settlement in South Africa. *Fundamina*, 25 (2), 135-168.

Strydom, W.F. 2018a. Applying the theory of planned behaviour to recycling behaviour in South Africa. *Recycling*, 3 (43), 1-20.

Strydom., W.F. 2018b. Barriers to household waste recycling: Empirical evidence from South Africa. *Recycling*, 3 (3), 41.

Stubbs, K. 2021a. Circular economy thinking can transform South Africa's waste into treasure. *Mail and Guardian*. Available at: <https://mg.co.za/special-reports/2021-09-03-circular-economy-thinking-can-transform-south-africas-waste-into-treasure/>. (Accessed on 31 January 2022)

Stubbs, K. 2021b. Reimagining the potential of waste in South Africa. *Interwaste*. Available at: <https://blog.interwaste.co.za/know-waste/reimagining-the-potential-of-waste-in-south-africa>. (Accessed on 01 February 2022)

Sunarti, Tjakraatmadja, J.H., Ghazali, A. and Rahardyan, B. 2021. Increasing resident participation in waste management through intrinsic factors cultivation. *Global Journal of Environmental Science and management*, 7 (2), 287-316.

Suthar, S. and Singh, P. 2015. Household solid waste generation and composition in different family size and socio-economic groups: A case study. *Sustainable Cities and Society*, 14, 56-63.

Swarna, S.K., Tezeswi, T.P. and Siva Kumar, M.V.N. 2022. Implementing construction waste management in India: An extended theory of planned behavior approach. *Environmental Technology and Innovation*, 27, 102401.

Swart, K. 2022. Sound advice on surviving loadshedding. *IOL*. Available at: <https://www.iol.co.za/lifestyle/home-garden/home/sound-advice-on-surviving-loadshedding-86136fa3-4ca2-4832-b2d9-801d619e04eb>. (Accessed on 31 January 2023)

Szymkowiak, A., Borusiak, B., Pieranski., Kotyza, P. and Smutka, L. 2022. Household food waste: The meaning of product's attributes and food-related lifestyle. *Frontiers in Environmental Science*, 10, 1-10.

Taelman, S., Tonini, D., Wandl, A. and Dewulf, J. 2018. A holistic sustainability framework for waste management in European cities: Concept development. *Sustainability*, 10, 2184.

Taherdoost, H. 2022. Measurement and scaling techniques in research methodology; survey/questionnaire development. *International Journal of Academic Research in Management*, 6 (1), 1-5.

Tahulela, A.C. and Ballard, H.H. 2020. Developing the circular economy in South Africa: Challenges and opportunities. *In: Sustainable Waste Management: Policies and Case Studies*. Springer: Singapore, 125-133.

Takahashi, A.R.W. and Araujo, L. 2020. Case study research: Opening up research opportunities. *RAUSP Management Journal*, 55 (1), 100-111.

Tassie, K. and Endalew, B. 2020. Willingness to pay for improved solid waste management services and associated factors among urban households: One and one half bounded contingent valuation study in Bahir Dar city, Ethiopia. *Cogent Environmental Science*, 6 (1), 1-26.

Taylor, G.A. and Blake, B.J. 2015. Key interviews and focus groups. *In: De Chesnay, M., ed, Nursing research using data analysis: Qualitative designs and methods in nursing*. Springer: New York, 153-165.

Taylor, M.L. and S ndergaard, M. 2017. *Unraveling the Mysteries of Case Study Research: A Guide for Business and Management Students*. Edward Elgar Publishing: UK USA.

Teherani, A., Martimianakis, T., Stenfors-Hayes, T., Wadhwa, A. and Varpio, L. 2015. Choosing a qualitative research approach. *Journal of Graduate Medical Education*, 7 (4), 669-670.

Tenny, S., Brannan, G.D., Brannan, J.M. and Sharts-Hopko, N.C. 2017. *Qualitative study*. StatPearls Publishing: Treasure Island (FL).

Thakur, A., Sangle, S.T., Rao, S., Vaz, R.P., Singh, P. and Rasania, S.K. 2021. An online study to assess the disposal of personal protective equipment at home amid COVID-19 pandemic in India. *Indian Journal of Community and Family Medicine*, 7 (1), 55.

Thattamparambil, N. 2020. How to choose the research methodology best suited for your study. *e.insights*. Available at: <https://www.editage.com/insights/how-to-choose-the-research-methodology-best-suited-for-your-study>. (Accessed on 12 March 2022)

Thusi, L. 2020. Space running out at landfills. *Comaro Chronicle*. Available at: <https://comarochronicle.co.za/227915/space-running-out-at-landfills/>. (Accessed on 24 February 2022)

Titz, A., Cannon, T. and Krüger, F. 2018. Uncovering ‘community’: Challenging an elusive concept in development and disaster related work. *Societies*, 8 (3), 71.

Tripa, S. and Indrie, L. 2021. Households textile waste management in the context of a circular economy in Romania. *Environmental Engineering & Management Journal (EEMJ)*, 20 (1), 81-87.

Tsai, W.T. and Lin, Y.Q. 2021. Analysis of Promotion Policies for the Valorization of Food Waste from Industrial Sources in Taiwan. *Fermentation*, 7 (2), 51.

Tsheleza, V., Ndhleve, S., Kabiti, H.M. and Nakin, M.D. 2022. Household solid waste quantification, characterisation and management practices in Mthatha City, South Africa. *International Journal of Environment and Waste Management*, 29 (2), 208-229.

Tuovila, A. 2020. Sampling. *Investopedia*. Available at: <https://www.investopedia.com/terms/s/sampling.asp#:~:text=Sampling%20is%20a%20process%20used,random%20sampling%20or%20systematic%20sampling>. (Accessed on 12 March 2022)

Ugwu, C.O., Ozoegwu, C.G., Ozor, P.A., Agwu, N. and Mbohwa, C. 2021. Waste reduction and utilization strategies to improve municipal solid waste management on Nigerian campuses. *Fuel Communications*, 9, 100025.

Uhunamure, S.E., Nethengwe, N.S., Shale, K., Mudau, V. and Mokgoebo, M. 2021. Appraisal of households' knowledge and perception towards e-waste management in Limpopo province, South Africa. *Recycling*, 6 (39), 1-17.

Uma, K.E., Nwaka, I.D., Nwogu, M.U. and Obidike, P.C. 2020. What are the triggers of household decision-making on waste disposal choices? A gender differentiated analysis. *Heliyon*, 6 (12), e05588.

Umhlathuze. 2021. *Umhlathuze integrated waste management plan 4th review 2021*. Available at: <https://www.umhlathuze.gov.za/images/x52531-1.pdf>. (Accessed 04 February 2022)

United Nations Environmental Programme (UNEP). 2018. *Green warriors in Durban convert trash to treasure*. Available at: <https://www.unep.org/news-and-stories/story/green-warriors-durban-convert-trash-treasure>. (Accessed on 14 March 2022)

Venter, Z.S., Shackleton, C.M., Van Staden, F., Selomane, O. and Masterson, V.A. 2020. Green Apartheid: Urban green infrastructure remains unequally distributed across income and race geographies in South Africa. *Landscape and Urban Planning*, 203, 103889.

Vesere, R., Kalnins, S.N. and Blumberga, D. 2021. Role of green jobs in the reduction of waste and waste management. *Environmental and Climate Technologies*, 25 (1), 1128-1141.

Vetter-Gindele, J., Braun, A., Warth, G., Bui, T.T.Q., Bachofer, F. and Eltrop, L. 2019. Assessment of household solid waste generation and composition by building type in Da Nang, Vietnam. *Resources*, 8 (4), 171.

Viljoen, J.M.M, Schenck, C.J., Volschenk, L., Blaauw, P.F. and Grobler, L. 2021. Household waste management practices and challenges in a rural remote town in the Hantam Municipality in the Northern Cape, South Africa. *Sustainability*, 13, 5903.

Vinti, G., Bauza, V., Clasen, T., Tudor, T., Zurbrügg, C. and Vaccari, M. 2023. Health risks of solid waste management practices in rural Ghana: A semi-quantitative approach toward a solid waste safety plan. *Environmental Research*, 216, 114728.

Von Massow, M., Parizeau, K., Gallant, M., Wickson, M., Haines, J., Ma, D.W., Wallace, A., Carroll, N. and Duncan, A.M. 2019. Valuing the multiple impacts of household food waste. *Frontiers in nutrition*, 6, 143.

Wahba, S., Kaza, S. and Ionkova, K.M. 2019. A new phenomenon- realizing economic growth while cutting waste. How? *World Bank Blogs*. Available at: <https://blogs.worldbank.org/sustainablecities/new-phenomenon-realizing-economic-growth-while-cutting-waste-how>. (Accessed on 25 March 2022)

Walford, L. 2019. Dispose of waste correctly, says DSW. Berea Mail. Available at: <https://bereamail.co.za/151908/dispose-of-waste-correctly/>. (Accessed on 30 March 2022)

Wan, C., Shen, G.Q. and Choi, S. 2019. Waste management strategies for sustainable development. In: *Encyclopedia of sustainability in higher education*. Cham: Springer International Publishing, 2020-2028.

Wani, M.A., Dada, Z.A. and Shah, S.A. 2018. Sustainable integrated solid waste management in the Trans-Himalayan accommodation sector. *African Journal of Hospitality, Tourism and Leisure*, 7 (2), 1-17.

Wee, S.T., Abas, M.A., Chen, G.K. and Mohamed, S. 2017. The constraints of good governance practice in national solid waste management policy (NSWMP) implementation: A case study of Malaysia. *AIP Conference Proceedings*, 189, 020127.

White, G., Cabrera, C., Palade, A., Li, F. and Clarke, S. 2020. WasteNet: Waste classification at the edge for smart bins. *arXiv preprint arXiv:2006.05873*, 8.

Whitmarsh, L., Haggard, P. and Thomas, M. 2018. Waste reduction behaviours at home, at work, and on holiday: What influences behavioral consistency across contexts? *Frontiers in Psychology*, 9, 1-13.

Wilson, D.C., Velis, C.A. and Rodic, L. 2013, May. Integrated sustainable waste management in developing countries. In: *Proceedings of the Institution of Civil Engineers-Waste and Resource Management*, 166 (2), 52-68. ICE Publishing.

Windfeld, E.S. and Brooks, M.S.L. 2015. Medical waste management—A review. *Journal of environmental management*, 163, 98-108.

World Bank. 2015. *Generating electricity from landfill gas in Durban*. Available at: <https://www.worldbank.org/en/results/2015/10/21/powering-electricity-landfill-gas-durban>. (Accessed on 14 March 2022)

World Bank. 2019. *Solid waste management*. Available at: <https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>. (Accessed on 25 September 2021)

World Bank. 2022. *Solid waste management*. Available at: <https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>. (Accessed on 30 June 2022)

World Health Organization (WHO). 2021. *Household air pollution and health*. Available at: <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>. (Accessed on 25 January 2022)

Wu, L., Zhu, Y. and Zhai, J. 2022. Understanding waste management behavior among university students in China: environmental knowledge, personal norms, and the theory of planned behavior. *Frontiers in Psychology*, 12 (771723), 1-13.

Yadav, R., Panda, D.K. and Kumar, S. 2022. Understanding the individuals' motivators and barriers of e-waste recycling: A mixed-method approach. *Journal of Environmental Management*, 324, 116303.

Yadav, H., Soni, U. and Kumar, G. 2023. Analyzing challenges to smart waste management for a sustainable circular economy in developing countries: A fuzzy DEMATEL study. *Smart and Sustainable Built Environment*, 12 (2), 361-384.

Yalcintas, M. and Kaya, A. 2017. Roles of income, price and household size on residential electricity consumption: Comparison of Hawaii with similar climate zone states. *Energy Reports*, 3, 109-118.

Yang, M., Chen, L., Wang, J., Msigwa, G., Osman, A.I., Fawzy, S., Rooney, D.W. and Yap, P.S., 2023. Circular economy strategies for combating climate change and other environmental issues. *Environmental Chemistry Letters*, 21 (1), 55-80.

Yin, R.K. 2011. *Application of Case Study Research*. 3rd ed. Sage: Los Angeles.

Yoda, R.M., Chirawurah, D. and Adongo, P.B. 2014. Domestic waste disposal practice and perceptions of private sector waste management in urban Accra. *BMC Public Health*, 14, 697.

Yoon, C.W., Kim, M.J., Park, Y.S., Jeon, T.W. and Lee, M.Y. 2022. A review of medical waste management systems in the Republic of Korea for hospital and medical waste generated from the COVID-19 pandemic. *Sustainability*, 14 (6), 3678.

Youjin, L. 2019. Trash talk: No time to waste in dealing with Singapore's mounting trash problem. *Today online*. Available at: <https://www.todayonline.com/features/trash-talk-no-time-waste-dealing-singapores-mounting-trash-problem>. (Accessed on 25 February 2022)

Young, T.J. 2015. Questionnaires and surveys. In Zhu Hua (ed), *Research methods in intercultural communication: A practical guide*. Oxford: John Wiley and Sons, 165-180.

Yukalang, N., Clarke, B. and Ross, K. 2017. Barriers to effective municipal solid waste management in a rapidly urbanizing area in Thailand. *International Journal of Environmental Research and Public Health*, 14 (9), 1013.

Yuriev, A., Dahmen, M., Paillé, P., Boiral, O. and Guillaumie, L. 2020. Pro-environmental behaviors through the lens of the theory of planned behavior: A scoping review. *Resources, Conservation and Recycling*, 155, 104660.

Zia, A., Batool, S.A., Chauhdry, M.N. and Munir, S. 2017. Influence of income level and seasons on quantity and composition of municipal solid waste: A case study of the capital city of Pakistan. *Sustainability*, 9, 1568.

Zhang, D., Huang, G., Yin, X. and Gong, Q. 2015. Residents' waste separation behaviors at the source: Using SEM with the theory of planned behavior in Guangzhou, China. *International Journal of Environmental Research and Public Health*, 12 (8), 9475-9491.

Zhang, C., Hu, M., Di Maio, F., Sprecher, B., Yang, X. and Tukker, A. 2022. An overview of the waste hierarchy framework for analyzing the circularity in construction and demolition waste management in Europe. *Science of the Total Environment*, 803, 149892.

Zhou, K. and Yang, S. 2016. Understanding household energy consumption behavior: The contribution of energy big data analytics. *Renewable and Sustainable Energy Reviews*, 56, 810-819.

Zhou, C., Fang, X., Wang, Y. and Zhang, Q. 2022. The influence mechanism of household waste separation behavior among college students in the post COVID-19 pandemic period. *Journal of Material Cycles and Waste Management*, 24, 784-800.

Zikali, N.M., Chingoto, R.M., Utete, B. and Kunedzimwe, F. 2022. Household solid waste handling practices and recycling value for integrated solid waste management in a developing city in Zimbabwe. *Scientific African*, 16, p.e01150.

APPENDIX 1

Household waste management questionnaire: Bluff

Date:	
Questionnaire#	

I am undertaking a survey of household waste management in your community on behalf of a student, Miss Amanda Gumede, for her PhD degree at the University of KwaZulu-Natal. May I ask you a few questions in this regard? Please note that your answers will be treated with confidentiality and anonymity. If at any point during the interview you feel that you do not wish to continue, please feel free to let me know. Thank you for agreeing to be interviewed.

SECTION A: SOCIO-ECONOMIC AND DEMOGRAPHIC PROFILE OF RESPONDENTS

A1. What is the current household size?

No. of males		No. of females		Total household size		Sex of respondent (to be noted)	
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A2. What age categories do members of the household belong to? (insert number in each category- check that it all adds to the total)

Age category	<5 years	5-10	11-18	19-25	26-35	36-45	46-55	56-65	66-75	76-85	85<
Male											
Female											
Respondent											

A3. What is the highest level of formal education attained by members of household?

Education category	No formal education	Partial primary	Primary completed	Partial secondary	Secondary completed	Certificate / Diploma	Undergraduate degree	Postgraduate degree	Adult Based Education (ABED)	Other (specify)
Male										
Female										
Respondent										

A4. What is the employment status of the members of the household?

Employment status category	Employed	Part-time employed	Unemployed	Self-employed	Retired	Medically boarded	Student	Other (specify)
Male								
Female								
Respondent								

A5. List of the household sources of income and the actual monthly income amount? (in Rands)

Household sources of income	Monthly income amount
Employment	
Remittances	
Old age pension	
Child grant	
Disability grant	
Sale of agricultural produce	
Other (specify)	

A6. Who generally makes decisions in the household?

1. Adult male	2. Adult female	3. Adult male and female jointly	4. Male younger than 18 years	5. Female younger than 18 years	6. Male and female jointly younger than 18 years	Other (specify)

SECTION B: PROFILE OF WATER AND SANITATION, ENERGY AND SELECTED SOLID MATERIAL OF THE HOUSEHOLDS

B1. Which sources of water does the household currently use?

Water sources	Main source (<i>only one response</i>)	Additional source (<i>multiple responses permitted</i>)	Frequency of use (Use scale) (<i>only one response</i>)
Piped/ tap water			
Neighbors tap			
Roadside communal tap			
Water tankers (trucks)			
Rainwater			
Bottled water			
Other (specify)			

Scale
 01.Daily
 02.Weekly
 03.Bi-weekly
 04.Monthly
 05.Only when necessary/ during shortages

B2. Which sanitation facilities does the household currently use?

Sanitation facilities	Main source (<i>only one response</i>)	Additional source (<i>multiple responses permitted</i>)	Frequency of use (Use scale) (<i>only one response</i>)
Flush toilet			
Pit latrine			
Bucket toilet			
ecological (urine diversion/ separation or composting) toilet			
Other (specify)			

Scale
 01.Daily
 02.Weekly
 03.Bi-weekly
 04.Monthly
 05.Only when necessary/ during shortages

B3. Which sources of energy does the household currently use?

Energy sources	Main source (<i>only one response</i>)	Additional source (<i>multiple responses permitted</i>)	Frequency of use (Use scale) (<i>only one response</i>)
Electricity			
Fuelwood			
Gas			
Paraffin			
Candles			
Wind			
Solar			
Other (specify)			

Scale
 01.Daily
 02.Weekly
 03.Bi-weekly
 04.Monthly
 05.Only when necessary/ during shortages

B4. How often does the household generate the following waste types?

Waste types	Never	Rarely (once every few weeks)	Sometimes (once a week)	Often (Once every few days)	Always (everyday)
1.Paper and cardboard					
2.Plastic					
3.Aluminum cans and glasses					
4.Food waste					
5.Electrical and electronic waste (e.g. light bulb, batteries, old devices)					
6.Waste water					
7.Garden refuse					
8.Medical/ health related waste (PPE)					
9.Construction and demolishing waste					

B5. What waste disposal facilities/ services/ methods does the household currently use for the following waste types? M= Main and A= Additional (multiple responses permitted)

Waste types	Dustbin for refuse collection	Segregating from other waste sources	Sealing potentially contaminate waste in containers and disposing of it immediately/within 72hours	Repurpose	Reducing waste produced	Recycling	Burying	Burning	Illegal dumping site	Composting	Local drop-off site	Down the drain	Other (specify)
1.Paper and cardboard													
2.Plastic													
3.Aluminum cans and glasses													
4.Food waste													
5. Electrical and electronic waste (e.g. light bulb, batteries, old devices)													
6.Waste water													
7.Garden refuse													
8.Construction and demolishing waste													
9.Disposable masks													
10.Reusable masks													
11.Sanitizers containers													
12.Cleaning detergent containers													
13.Cleaning cloths													
14.Disinfectant wipes													
15.Gloves													
16.Tissue paper													
17.Waste generated by infected family members													

B6. Indicate for each waste type the changes in amounts of waste generated by the household during the COVID-19 pandemic
PC= Paper and cardboard, P= Plastic, AG=Aluminum cans and glasses, FW= Food waste, EW= Electrical and electronic waste,
WW= Waste water, GR= Garden refuse, PPE= Medical/ health related waste, CD= Construction and demolishing waste

Statements	PC	P	AG	FW	EW	WW	GR	PPE	CD
1.Increased									
2. Decreased									
3.Remained the same									

B7. Does the household separate different waste streams (e.g. for recycling)?

1. Yes	2. No
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B7.1. If yes, which waste streams does the household separate? (multiple responses permitted)

1.Paper and cardboard	2.Plastic	3.Aluminum cans and glasses	4.Food waste	5. Electrical and electronic waste (e.g. light bulb, batteries, old devices)	7.Garden refuse	Medical/health related waste (PPE)	Construction and demolishing waste	9.Other (specify)
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B7.2. If no, why not? (multiple responses permitted)

1.Don't have access to the necessary facilities	2.Do not see the need to separate	3.It's too time consuming	4.Don't know how to do it	5.Not sure where to take the waste once separated	Other (specify)
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B8. What lessons has the household learnt from the COVID-19 pandemic on how to manage household waste (multiple responses permitted)

1.To regularly clean/sanitize bins	2.To try reduce food waste by not buying more food than needed	3.To use reusable items where possible	4.To handle contaminated waste separately and with care	Other (specify)
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B9. Does the household engage in any of the following practices? (Please tick) (Multiple responses permitted), if not, give a reason why.

	If engage	Frequency of engagement (Use scale) (only one response)	Reason for not engaging (use codes)
1.Taps are properly closed after use			
2.If communal taps are used, report/fix when not working properly/ leaking			
3.Reuse dish- and/ or bathwater to flush the toilet			
4. Reuse dish- and/ or bathwater in the garden			
5.Use an ecological (urine diversion/ separation or composting) toilet			
6.Use fresh water to flush the toilet after every use			
7.Separate different waste streams			
8.Use drop-off facilities for recyclables and electrical and electronic waste			
9.Recycle			
10.Composting of food			
11.Collect and use rainwater			
12.Repurpose reusable materials			
13.Use energy saving lightbulbs			
14.Use renewable energy (e.g. solar water geyser)			

Scale

- 01.Never
- 02.Rarely
- 03.Sometimes
- 04.Often
- 05.Always

Codes

- 01.Not of interest to me
- 02.Don't know how to
- 03.Never remember to
- 04.Too inconvenient
- 05.Time consuming
- 06.Too expensive to do so
- 07.Wasn't aware of this

SECTION C: RESPONDENTS' AWARENESS AND PERCEPTIONS OF SUSTAINABLE WASTE MANAGEMENT PRACTICES

C1. Are you aware of sustainable waste management?

1. Yes	2. No
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C1.1. If yes, how would you define the term sustainable waste management?

C1.2. Have you heard of the following types of sustainable waste management practices? (multiple responses permitted)

1. Repurposing	2. Reducing	3. Recycling	4. Composting	5. Other (specify)
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C2. Where did you get information about these types of energy? (multiple responses permitted)

1. Television	2. Radio	3. Newspaper	4. Magazine	5. Books	6. Internet	7. School
8. Relative/ friend/ neighbor	9. Place of work	10. Other (specify)				

Sustainable waste management is the process of using waste management practices that aim to reduce the amount of waste created and is going into landfills while also reducing pollution and protecting vulnerable resources

C3. Has the household previously used the following sustainable waste management practice/s, but have currently stopped? (multiple responses permitted)?

Sustainable waste management practices	Yes	No
Take products that could be thrown away and use them for other purposes (repurpose)		
Buying and using less products (Reducing)		
Separate waste types into different streams and put each in a specifically labelled bin (Recycling)		
Put food waste in the garden (Composting)		

C3.1. Why did the household discontinue using the sustainable waste management practice/s? (multiple responses permitted)

1. Don't know	2. Not easily accessible/ available	3. Too expensive	4. Inconvenient to use
5. Time consuming	6. Didn't know how to use it	7. Other (specify)	

C4. Rate the statements below with regards to the household waste management practices listed using the scale below.

(1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree)

D= Dust bin, R= Repurposing, RE= Reducing, RC= Recycling, B= Burying, BU= Burning, I= Illegal dumping, C= Composting, L= Local drop-off sites, O=Other (specify)

Statements	D	R	RE	RC	B	BU	I	C	L	O
1. Is expensive										
2. Has associated negative health implications										
3. Is unreliable										
4. Is inconvenient to use										
5. Causes pollution										
6. Is time consuming to do										
7. Is an environmentally friendly practice										
8. Is easy to use/ access										
9. Is safe to use/ access										

C5. Is the household aware of any problems associated with the use of sustainable waste management practices?

3. Yes	4. No
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C5.1. If yes, what are the problem/s? (multiple responses permitted)

1. Not easily accessible/ available	2. Inconvenient to use	3. Too expensive	4. Time consuming	5. Difficult to use
6. High maintenance cost	7. Inadequate supply of equipment and facilities	8. Not reliable	9. Other (specify)	

C6. What are the benefits of using sustainable waste management practices? (multiple responses permitted)

1.None	2.Don't know	3.Easy to use	4.Environmentally friendly
5.Reliable	6.Cheaper to use	7.No negative health impacts	8.Other (specify)

C7. Does the household currently use any of the following sustainable waste management practices? If not currently used, would you be willing to use in the future? (multiple responses permitted)

Sustainable waste management practices	Yes	No	If not used currently, future interest
Take products that could be thrown away and use them for other purposes (repurpose)			
Buying and using less products (Reducing)			
Separate waste types into different streams and put each in a specifically labelled bin (Recycling)			
Put food waste in the garden (Composting)			

C7.1. If not used currently, why not? (multiple responses permitted)

1.Don't know	2.Not easily accessible/available	3.Too expensive	4.Inconvenient to use
5.Time consuming	6. Don't know how to use it	6.Other (specify)	

C7.2. If being used, which of the following sustainable waste management facilities/equipment does the household currently have access to, and if the household does not currently use, which would you like to have access to in future? (tick all that apply)

Types of facilities/ equipment	Facilities/ methods used	How facility/ equipment was acquired? (use codes)	Would like access to in future
1.Renewable energy equipment			
2.Storm water harvesting equipment			
3.Recycling bins/ plastic bags			
4.Composting equipment			
5.Repurposing/ reusing			
6.Drop-off center			
7.Other (specify)			

Codes for how acquired

- 01.Don't know
- 02.Purchased
- 03.Given by friend/ family
- 04.Part of house when purchased/ allocated
- 05. Donated by government/ municipality
- 06. Donated by non-governmental organization
- 07.Other (specify)

C7.3. If being used, how much did the household spend as a startup costs for sustainable waste practice/s (in Rands)?

1.Not applicable	2.None	3.Don't know	1.<R100	2.R101-R500
3.R501-R900	4.R901-R1300	5.R1301-R1700	6.>R1701 (specify)	

C7.4. If being used, how much does the household pay monthly on sustainable waste practice/s (in Rands)?

1.Not applicable	2.None	3.Don't know	1.<R100	2.R101-R500
3.R501-R900	4.R901-R1300	5.R1301-R1700	6.>R1701 (specify)	

C7.5. If not being used and not interested to use in future, why not? (multiple responses permitted)

1.Not easily accessible/ available	2.Inconvenient to use	3.Too expensive	4.Time consuming	5.Difficult to use
6.High maintenance cost	7.Inadequate supply of equipment and facilities	8.Not reliable	9. Other (specify)	

C7.6. How much would the household be willing to spend as a startup costs for sustainable waste management practices in the future? (in Rands)

1.Not applicable	2.None	3.Don't know	1.<R100	2.R101-R500
3.R501-R900	4.R901-R1300	5.R1301-R1700	6.>R1701 (specify)	

C7.7. How much would the household be willing to pay monthly on sustainable waste management practices in the future? (in Rands)

1.Not applicable	2.None	3.Don't know	1.<R100	2.R101-R500
3.R501-R900	4.R901-R1300	5.R1301-R1700	6.>R1701 (specify)	

C8. What challenges has the household experienced that have constrained the shift to embracing sustainable waste management practices?
(multiple responses permitted)

1.None	2.Don't have the necessary equipment	3.Too expensive to do	4.Too difficult to do
5.Time consuming to do	6.No drop-off centers in the community	7.Lack of knowledge	8.Other (specify)

SECTION D: GENERAL QUESTIONS

D1. Are there any other comments/ issues that you would like to raise in relation to waste management practices in the household?

D2. Are there any other comments/ issues that you would like to raise in relation to waste management practices in the community?

THANK RESPONDENT FOR TIME AND COOPERATION AND END INTERVIEW

APPENDIX 2

Interview schedule eThekweni Municipality waste management officials

1. Interviewee's position and profile
2. What is the Municipality's current procedure for managing general solid household/ domestic waste?
3. What is the Municipality's current procedure for managing household/ domestic wastewater and sanitation waste?
4. What is the Municipality's current procedure for managing household/ domestic organic/ refuse waste?
5. What is the Municipality's current procedure for managing household/ domestic electrical and electronic waste?
6. How has the Municipality's waste management procedure changed/ been impacted in light of the COVID-19 pandemic?
7. What efforts/ initiatives is the Municipality making/ putting in place to establish and improve community member's awareness and understanding of sustainable waste management practices and the benefits thereof?
8. What efforts is the Municipality making to encourage community members to use sustainable waste management practices and eliminate traditional/ improper waste management practices?
9. What resources/ facilities has the Municipality provided for communities within the South Durban Basin to ensure that the community members use sustainable waste management practices?
10. Is the Municipality working together with any NGOs or civil society organizations in the South Durban Basin area to combat improper waste management practices?
11. How is the Municipality managing sustainable waste management facilities/ resources within the South Durban Basin?
12. What challenges has the Municipality encountered regarding the establishment of sustainable waste management facilities or practices within the communities in the South Durban Basin?

APPENDIX 3

Interview schedule Non-government/ civil society organizations in Bluff/ the South Durban Basin

1. Profile of organization and the interviewee's role/ position
2. How has the organization been of benefit to the community since inception?
3. Has the organization received any support from the government or private entities?
4. Is the organization aware of the current Municipality procedure for managing general solid household/ domestic waste?
5. Is the organization aware of the current Municipality procedure for managing household/ domestic wastewater and sanitation waste?
6. Is the organization aware of the current Municipality procedure for managing household/ domestic organic/ refuse waste?
7. Is the organization aware of the current Municipality procedure for managing household/ domestic electrical and electronic waste?
8. What is the organization's involvement/ role in the local waste management practices (including sustainable waste management practices)?
9. Is the organization aware of any impacts that the COVID-19 pandemic has had on waste management and practices thereof in the area?
10. What are the organization's concerns pertaining to the current waste management practices in the area? Also considering the impacts of COVID-19.
11. What actions has the organization taken to mitigate those concerns?
12. Is the organization involved in any municipal or community initiatives aimed at improving community awareness and understanding of sustainable waste management practices and benefits thereof?
13. Is the organization aware of or a part of any sustainable waste management facilities/ resources in Bluff/ the South Durban Basin?
14. What challenges has the organization encountered regarding working towards sustainable waste management within Bluff/ the South Durban Basin?
15. What areas still need to be improved on by the community and Municipality in terms of sustainable waste management practices within Bluff/ the South Durban Basin?

APPENDIX 4

Interview schedule Academics who have undertaken/ are undertaking environmental sustainability research in the South Durban Basin

1. Interviewee's profile and research interests
2. What were your main findings related to household waste management practices in the South Durban Basin?
3. Do you think that community members were/ are aware of or understand sustainable waste management practices and the benefits thereof?
4. Was there any evidence of municipal efforts made to encourage community members to use sustainable waste management practices?
5. Are there any sustainable waste management facilities/ resources within the community that have been provided for the residents and are these being utilized effectively?
6. How has the COVID-19 pandemic affected any sustainable waste management initiatives in the area?
7. Based on your findings, was/ is there any evidence of sustainable waste management practice among residents? If so, what was/ is the extent of these?
8. What challenges do you think were/ are preventing residents from partaking in sustainable waste management practices?
9. What recommendations do you have regarding sustainable waste management practices in the South Durban Basin?

APPENDIX 5

Ethical approval letter



10 May 2021

Miss Amanda Naledi Gumede (214506359)
School Of Agri Earth & Env Sc
Westville Campus

Dear Miss Gumede,

Protocol reference number: HSSREC/00002709/2021

Project title: A comprehensive audit of household waste management practices within the Bluff area (eThekweni municipality, South Africa) to assess sustainability considerations and inform future intervention strategies

Degree: PhD

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 22 April 2021 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**.

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 10 May 2022.

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,



Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee

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