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Challenges of solid waste management in rural areas: a study of Nkomo Village, Greater Giyani Municipality, Limpopo

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A RESEARCH REPORT SUBMITTED TO THE FACULTY OF SCIENCE, UNIVERSITY OF THE WITWATERSRAND, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

School of Geography, Archaeology and Environmental Studies

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DECLARATION

I declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



Nonhlakanipho Hlongwane

08 December 2025

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ABSTRACT

Solid Waste Management (SWM) in rural areas remains a significant challenge due to limited municipal services, weak governance and socio-economic constraints. As a result, rural communities rely on informal waste management methods including open dumping, burning and burying of solid waste as a result. The study explores the challenges, practices and opportunities of solid waste management in Nkomo Village, Greater Giyani Municipality (GGLM), with the purpose of enhancing sustainable waste management practices. To investigate the socio-economic, behavioural and institutional dynamics influencing solid waste management, a mixed methods approach was employed. The approach combined qualitative interviews of municipal officials, household surveys, quantitative observations of participants solid waste management methods and analysis of policy documentation in place. This study highlights limited infrastructure, inadequate policy enforcement, and lack of community engagement as important barriers affecting sustainable solid waste handling, disposal and recycling. Furthermore, waste management methods aligned to cultural and social practices in the village were observed, including alternative approaches for emerging waste types such as hazardous waste, medical waste, nappies, ash and animal caucus. The reuse of organic waste and plastic waste was noted as existing practices that could be further enhanced and promoted. The study recommends enforcement of the Final Integrated Waste Management Plan (IWM Plan) (2024), tailored and socio-economic and culturally sensitive policy reform, to address SWM challenges in villages such as Nkomo Village, thereby promoting environmental sustainability and improved public health.

Keywords: Nkomo Village, Greater Giyani Municipality; Final IWM Plan, 2024; solid waste; solid waste management

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DEFINITION OF KEY TERMS

SOLID WASTE MANAGEMENT (SWM) - collection, treatment, recycling, recovering resources and disposal of solid waste materials generated from residential, industrial and commercial activities, while reducing impacts on environmental and human health through appropriate handling and infrastructure.

INTERGRATED WASTE MANAGEMENT (IWM) – a strategic report for managing various forms of waste to maximise resource by using a system that involves the waste management hierarchy.

EXTENDED PRODUCER RESPONSIBILITY (EPR) – waste management strategy for producers of waste to take responsibility for their product end of life.

PUBLIC-PRIVATE PARTNERSHIPS- agreement involving government entities and private sector companies in collaboration in funding public infrastructure and services.

FISCAL INCENTIVES- grants and subsidies provided by government to promote particular economic behaviours.

CIRCULAR ECONOMY MODEL - a model promoting sustainable reduction, reuse and recycling materials to reduce waste production and environmental impact, through public, cooperates and government partnership.

ILLEGAL DUMPING - disposal of waste in an unauthorised manner.

ENVIRONMENTAL SUSTAINABILITY - responsible management of natural resources to address

DECENTRALISED WASTE MANAGEMENT – management of waste close to its point of generation

POLICY ENFORCEMENT - ensuring proper regulation and compliance with policies, guidelines, rules and standards within an organisation

KNOWLEDGE GAP – difference between what is known and what needs to be known to inform decision making

GOVERNANCE QUALITY INDICATORS – standards including accountability, effective governance and regulatory quality applied to assess the government efficiency in solid waste management

INSTITUTIONAL FRAMEWORKS -systems, policies and organisations governing solid waste management

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

A prevalent challenge faced by many developing nations is the inadequate provision of SWM services and limited financial resources in rural areas, hindering the achievement of sustainable waste collection and proper disposal practices (Vinti & Vaccari 2022). Notwithstanding the comprehensive framework provided by Sustainable Development Goals (SDGs) for tackling global challenges, including SWM in developing nations, globally, rural areas face challenges in waste management infrastructure. This results in common practices like open dumping, burning, and burying due to cost-effectiveness (Fadhullah et al., 2022). The negative impacts on the environment, public health, and sustainable development potential are witnessed in countries in Africa, Latin America, and South Asia (Ferronato & Torretta, 2019).

Sub-Saharan African (SSA) countries have begun integrating sustainable waste management practices into national policies and local initiatives to attain economic development, promote social inclusion, and ensure environmental sustainability (Kadhila et al., 2023). Nevertheless, SSA rural communities, when compared to urban areas, still face distinct challenges, including insufficient waste collection services, infrastructure, and resources, leading to waste burning, open dumping, and environmental degradation (Henry et al., 2006; Mohammed et al., 2013). Challenges such as funding, infrastructure, governance, enforcement, geographical obstacles, and technical expertise shortages hinder progress in effective waste management in the region (Clayton, 2005; Wilson, 2007; UNIDO, 2009; Mahees et al., 2011; Lambrechts & Hector, 2016).

Guided by the constitutional provisions, policies, and regulations, South Africa has progressed in SWM, focusing on cleanliness and sustainability (Dlamini et al., 2017; Nyika et al., 2020; Moyo et al., 2022; Hoosain et al., 2023). The country promotes recycling, waste minimisation, and proper disposal, extending these initiatives to rural areas (UNEP, 2018). The National Environmental Management: Waste Act (2008) plays a central role, highlighting waste minimisation, recycling, resource recovery, and safe disposal methods. In addition, the 2020 National Waste Management Strategy (NWMS) provides clarity on what the goals and aims are for long-term waste

management, and it requires municipalities to make Integrated Waste Management Plans (NEM:WA, 2008). Despite these efforts, challenges, such as insufficient infrastructure and unlawful waste disposal practices, persist in waste management in rural regions (Viljoen et al., 2021). Tailor-made approaches are essential to address these challenges effectively, considering the unique circumstances and traditional waste management practices in rural communities (Mihai & Taherzadeh, 2017; Rodseth et al., 2020; Senekane et al., 2021; World Bank, 2023).

1.1 Rationale of the Study

Services for waste management in South Africa, as per the Constitution, refuse storage, removal, and landfill disposal are governed by local government authority (RSA, 1996). Despite policies in place, challenges persist, with nearly 50% of the population not having proper access to waste management services (DEAT, 2006). Legislation mandates access to basic services for poor households, yet service delivery capacities vary among municipalities. The GGLM, like others, must make efforts for suitable, sustainable service standards appropriate to local circumstances, even though annual reports reveal gaps in waste collection, as areas like Nkomo Village are mostly excluded. Despite the growing research on solid waste management, not enough literature specifically addresses the challenges and actionable waste management strategies relevant to rural communities such as Nkomo Village. To address this gap, the study aims to assess existing practices, constraints, and policy dynamics to support more efficient SWM and to guide the development sustainability orientated, interventions that are tailored to rural community conditions.

1.2 Statement of the Problem

Section 3 of South Africa's National Environmental Management: Waste Act, 2008, mandates municipalities to come up with plans to reduce the production of waste and promote environmentally friendly waste management practices, such as reusing, recycling, and recovering (NEMWA, 2008). This involves initiatives for waste minimisation, promotion of sustainable waste management practices, and establishing systems for waste separation and processing. Local government’s mandate includes management and disposal of solid waste in an environmentally responsible way to safeguard public health and the environment. In addition, Section 9 of the Act

mandates municipalities to deliver solid waste management services in alignment with the national and provincial norms and standards, covering waste collection, storage, and disposal services.

Despite numerous efforts and policy implementation, South Africa continues to encounter challenges in waste management, such as a lack of infrastructure, inadequate rural waste collection services, and issues like open burning of waste and illegal dumping. Oelofse & Godfrey (2008) classifies these SWM challenges into categories such as labour, financial constraints, equipment management, and institutional issues. Consequently, rural communities often resort to self-implemented SWM practices such as open dumping, burning, and burying, leading to adverse impacts on the environment, public health, and the potential for sustainable development as studies indicate (Henry et al., 2006; Mohammed et al., 2013). These practices contribute to environmental contamination, air, soil, and water pollution, as well as the emission of greenhouse gases. Resulting in ecosystem degradation, biodiversity compromised, and communities' exposure to health risks due to the presence of toxins and pollutants (UNEP, 2018; Rodseth et al., 2020; Ramadan et al., 2022).

Notably, Statistics SA (2011) reported that households in Nkomo Village rely on open dumping, burying of waste, and burning to manage their household solid waste. According to Viljoen et al. (2021), there is often lack of knowledge and documentation concerning the status of SWM services in rural areas, which hinders effective planning, monitoring, and improvement of SWM systems in rural areas such as Nkomo Village. This lack of structured data and formalised records hinders an understanding of the extent of service gaps, practices, and the social, environmental and economic implications associated with current SWM behaviours.

Studies show that the establishment of proper data collection and recording mechanisms is important to understand the current situation accurately and implement targeted interventions for sustainable waste management (Rodseth et al., 2020; Dutta-Powell et al., 2023). By systematically examining current practices, policy implementation, and the constraints faced by rural areas such as Nkomo Village, it is possible to evaluate their sustainability and possible development into actionable

strategies suited to the village rural context. Such an examination provides basis for identifying existing practices and policies that can be strengthened and which challenges should be prioritised to develop effective, locally appropriate sustainable SWM strategies.

Therefore, this study aims to improve SWM effectiveness in Nkomo Village, Limpopo, tailored to rural community conditions, by examining challenges, current practices, and policies to identify actionable strategies for sustainable waste management. In view of these gaps highlighted above, the study seeks to answer the following research questions:

1. What challenges does Nkomo Village, Limpopo, face in solid waste management?
2. What solid waste management practices and policies are currently in place within Nkomo Village, Limpopo?
3. What actionable strategies can be identified to improve the effectiveness of solid waste management in Nkomo Village, Limpopo, considering local needs and constraints?

CHAPTER 2: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Concept of a challenge

Understanding the concept of a “challenge” as a conceptual term is essential in examining complex systems, such as SWM, as it captures both obstacles and opportunities for growth. In studies, a challenge is understood not simply as a problem but as a multifaceted concept capturing both obstacles, hindering system performance and the potential opportunities that emerge from addressing those obstacles. As defined by Oxford University Press (2023), challenges refer to tasks or problems that test human abilities. They are inherently multifaceted, encompassing both negative elements like stress and setbacks and positive aspects such as opportunities for innovation and problem-solving (Bjork & Bjork, 2020; Horikoshi, 2022). In various disciplines, challenges are framed as catalysts for improvement. For example, in the health sector, identifying systematic obstacles has driven innovation and efficiency in service delivery (Roncarolo et al., 2017). Similarly, in the financial sector, challenges related to market volatility have spurred the development of robust risk management frameworks (Gololo, 2018; Oleribe et al., 2019).

In the context of SWM, challenges arise from technical, governance, socioeconomic, and environmental dimensions, studies indicate (UNIDO, 2009; Mahees et al., 2011; Clayton, 2005; Wilson, 2007; Lambrechts & Hector, 2016). Dissanayake et al. (2022) emphasise that addressing such challenges requires a holistic approach, integrating policies, infrastructure, and community participation. Moreover, challenges in SWM often serve as a driving force for adopting innovative practices, such as waste-to-energy systems and decentralised waste management models (Sunil & Attar, 2016; Mohammed & Sallam, 2020; Bui et al., 2020).

This dual role of challenges as both barriers and enablers illustrates their significance in fostering resilience and innovation across systems (Basit et al., 2024; Lyng et al., 2024). Recognising and addressing challenges effectively is not only vital for overcoming immediate obstacles but also for achieving long-term sustainability and efficiency in various sectors, including SWM (Debrah et al., 2022; Debnath et al., 2023).

2.1.2 Concept of solid waste

In developed countries, solid waste is often seen as a disposal challenge, whereas in less affluent regions, it may hold value as a resource. This illustrates how perceptions of solid waste are shaped by broader societal, economic, and cultural contexts (McAllister, 2015; Mintz et al., 2019; Omotayo, 2024). Economic factors drive practices like the reuse of discarded materials to generate income (Omotayo 2024), while cultural norms influence how waste is managed or repurposed (Crociata et al., 2015; Kountouris, 2022). This duality, of waste as both liability and resource, underscores the need for tailored waste management solutions that align with local values, economic conditions, and cultural practices, promoting sustainability and inclusivity. Solid waste originates from diverse sources, including residential, commercial, industrial, agricultural, and institutional activities, each producing unique waste types such as food scraps, recyclables, and manufacturing by-products. Among these, household solid waste constitutes a significant fraction of municipal solid waste generation (Suthar et al., 2015). Comprising food waste, paper, plastic, rags, metal, glass, and garden refuse.

2.1.2.1 Definition of solid waste

Solid waste is broadly defined as unwanted or useless materials in solid or semi-solid form, generated from various human activities (USRCRA, 1976). However, contemporary frameworks, particularly in countries like South Africa, reframe solid waste as an asset, promoting recycling, reuse, and reduction strategies (Ndlovu et al., 2017; DFFE, 2020). This perspective aligns with global sustainability principles, conceptualising solid waste as a resource with significant potential utility (Abdel-Shafy & Mansour, 2018). For instance, organic waste transformation into valuable products contributes to local economies and aligns with sustainable development goals.

The definitions and perceptions of solid waste and municipal solid waste (MSW) vary significantly between developed and developing countries due to economic and cultural differences. Studies show that in developed countries, items such as used electronics, furniture, and clothing are often categorised as waste because they pose disposal challenges and require extensive processing (Pensupa et al., 2017; Abalansa et al., 2021; Jacobs et al., 2022). Conversely, developing countries often view these items as valuable resources. After being repaired or having components recovered,

these goods are frequently reused or repurposed. For example, in countries like Scotland and Australia, the perception of the lifespan of consumer goods varies across all economic levels. Used items are often seen as items that can still be sold or donated rather than disposable (Bianchi & Birtwistle, 2010; Scottish Government, 2016). As a result, these goods are rarely found in municipal waste management systems, as they retain economic value.

The concept of waste has evolved from being seen as a mere disposal issue to a valuable resource in modern frameworks like the circular economy (Kirchherr et al., 2023; Sánchez-García et al.,2024). Historically, waste was often discarded with little concern for its environmental impact, reflecting a linear economic model of production and disposal (Neves et al., 2022). However, growing environmental awareness and resource scarcity have led to a shift towards sustainability, with the circular economy promoting the reuse, recycling, and repurposing of materials. Today, waste is increasingly viewed as a resource that can be integrated back into the production process, reducing environmental harm and conserving natural resources. This shift reflects broader societal changes toward sustainability and circularity (Abdel-Shafy & Mansour, 2018).

2.1.2.2 Solid waste generation

Solid waste generation refers to the production of waste materials as a by-product of human activities (Abdel-Shafy & Mansour, 2018). It encompasses various types of waste, including municipal, industrial, agricultural, and hazardous waste, arising from residential, commercial, and institutional activities (Tchobanoglous et al., 1993). While urbanisation and population growth have led to increased consumption, resource use, and waste generation of waste (Chen, 2018; Zhang et al., 2024). As cities expand to accommodate a growing population, studies show that at the household level, rising demands for food, consumer goods, and packaging materials contribute significantly to higher volumes of organic and inorganic solid waste (Geueke et al., 2018; Ncube et al., 2020; Liang et al., 2022). Studies highlight that solid waste generation is influenced by a range of factors, such as socio-economic (Velis et al., 2023; Omotayo, 2024), cultural (Zhang et al., 2024), and involvement of municipal authorities in waste collection (McAllister, 2015; Soysa et al., 2023), making it a dynamic and complex process.

According to Abdel-Shafy & Mansour (2018), waste can be categorised into several types based on its source and composition. MSW comprising household and commercial waste, represents a significant portion of global waste. Industrial waste, including byproducts of manufacturing processes, contributes to the complexity of waste management systems (UNEP, 2015). Literature indicates rising concern over emerging waste categories, such as e-waste and biomedical waste, due to their hazardous nature and disposal challenges (Jha et al., 2022; Jain et al., 2023).

Adeleke et al. (2021) examined various factors influencing the composition of municipal solid waste. Population growth was found to be directly correlated with increased waste output, resulting in greater quantities of materials needing to be managed. Furthermore, urbanisation and economic development have been identified as significant contributors to shifts in waste composition, as wealthier populations tend to generate more waste associated with packaging and non-degradable materials. Additionally, research indicates that consumption patterns, influenced by globalisation and evolving lifestyles, play a crucial role in shaping trends in waste generation (Sharma & Jain, 2019; Shah et al., 2021; Hassan, 2025). This highlights the complex interplay of demographic, economic, and cultural factors in determining the nature and volume of waste produced.

Globally, solid waste generation is projected to increase significantly, with an estimated rise to approximately 2.59 billion tonnes by 2030 and around 3.40 billion tonnes by 2050 (Kaza et al., 2018). The trends are driven largely by urbanisation and ongoing economic growth, which contribute to higher levels of waste production. Moreover, various regions and countries exhibit divergent projections for MSW, indicating that local estimates reflect significant increases aligned with changing demographics and population growth. Developing countries in Asia and Africa from 2013 to 2023 have shown substantial increases in municipal solid waste in line with their evolving population figures (Zhang et al., 2024), where East Asia and the Pacific regions produced the largest amount of solid waste, accounting for 23% of the global total. While the Middle East and North Africa regions produce at least waste at 6% of the global total (Kaza et al., 2018). The global trends not only highlight increase in waste generation but also underscores the importance of understanding the types of solid waste generated and its management.

2.1.2.3 Solid Waste composition and management

The composition of solid waste varies significantly across regions, with developing nations producing a higher proportion of organic waste while developing countries generate more recyclables and hazardous materials (Abdel-Shafy & Mansour, 2018; Awasthi et al., 2023). The quantities and composition of MSW is important for determining the management of solid waste, as solid waste is composed of different materials that exhibit varying physical and chemical properties affecting how waste can be disposed of or recycled effectively (Abdel-Shafy & Mansour, 2018; Zhu et al., 2021). According to Basu (2010) and Peng et al. (2023), solid waste includes various categories such as municipal solid waste, industrial waste, agricultural residues, and construction debris. Ebikapade & Baird (2016) and the U.S. Environmental Protection Agency (2023) further classify waste based on its source, identifying household, commercial, industrial, and agricultural origins, each contributing distinct materials to the overall waste stream. Research by Abubakar et al. (2022) highlights that the composition of municipal solid waste typically consists of organic matter, recyclables, and inert materials. Organic waste, which encompasses food scraps and yard waste, is particularly notable for its decomposition nature, allowing for composting and biogas production. Conversely, recyclables, including glass, paper, metals, and plastics, are critical for resource recovery and minimising landfill waste, thereby emphasizing the importance of effective sorting and recycling programs (Olawade et al., 2024).

The physical properties of solid waste materials, such as size, density, and state, play a fundamental role in the management of waste. Abubakar et al. (2022) noted that physical characteristics, including the density of materials, influence the types of equipment and processes required for effective waste handling. For instance, dense materials, like metals, necessitate specialised machinery for efficient processing, whereas lighter materials like plastics are easier to transport and handle but may require careful sorting to enhance recycling efficacy. The variability in the physical state of waste (solid or semisolid) also impacts waste management strategies (Shahbaz et al., 2023). El-Saadony et al. (2023) describe how solids can compact or degrade at different rates, influencing the choice between landfilling, incineration, or recycling. Therefore, understanding these physical attributes is crucial for policymakers to formulate effective waste management strategies.

The chemical makeup of solid waste further complicates the waste management landscape as certain materials, particularly hazardous waste, pose significant environmental risks and require special disposal methods. As noted by Singh et al., (2024) on medical waste and Moghimi Dehkordi et al., (2024) on hazardous wastes, including batteries and chemicals, stringent regulations must be in place to reduce health and environmental risks, as some of this waste is non-biodegradable. Furthermore, studies indicate that the breakdown of organic matter within landfills generates leachate, a toxic liquid that can potentially seep into groundwater sources (Abdel-Shafy & Mansour, 2018; Parvin & Tareq, 2021). As highlighted by Yaashikaa et al. (2022), this necessitates the implementation of proper leachate management systems in landfill operations to mitigate environmental impacts. Consequently, the chemical properties of waste materials must be thoroughly understood to develop appropriate risk mitigation strategies. The diverse physical and chemical properties of solid waste materials underscore the importance of a systematic approach to SWM.

2.1.3 Concept of SWM

SWM is a critical function that ensures the proper handling of waste, from its generation to final disposal, ensuring environmental protection and public health safety (Abubakar et al., 2022). SWM encompasses a range of activities, including collection, transportation, processing, treatment, and disposal of waste (Tchobanoglous et al., 1993; Das et al., 2019). According to the World Bank, 2017, effective SWM is crucial for sustainable urban and rural development, as improper waste management leads to environmental degradation, health risks, and economic inefficiencies (Vinti & Vaccari 2022; Arteaga et al., 2023).

Solid waste is an inevitable byproduct of our daily activities, arising from households, industries, businesses, and institutions (Abdel-Shafy & Mansour, 2018). The quantity and type of solid waste generated are influenced by factors such as socioeconomic conditions (Soysa et al., 2023; Zhang et al., 2024), consumption patterns (Liu et al., 2019; Zhang et al., 2024), and industrial activities (Hajam et al., 2023). As economic development and urbanisation surge, solid waste generation often increases, presenting significant challenges for effective SWM (Liu et al., 2019).

Studies indicate that the most expensive and logistically challenging aspects of SWM are waste collection (Debrah et al., 2022; Kwakye et al., 2023). For instance, a 2017

study in India revealed that local municipalities allocate 70% of their SWM budgets to waste collection and only 30% to transportation (Kumar et al., 2017). The efficiency of waste collection systems largely depends on the availability of infrastructure, financial resources, and active community participation through recycling programmes (Abdel-Shafy & Mansour, 2018; Zhang et al., 2024). In countries like South Africa and India, waste collection is the responsibility of the municipal corporation, and with the failure of municipalities, ineffective SWM is a major concern in many regions, particularly in developing countries due to inadequate infrastructure, insufficient financial resources, and weak governance (Kalina et al., 2024; Mukwevho et al., 2024). Many lack the necessary facilities for effective waste collection and disposal, often resulting in practices like open dumping and burning, which harm public health and the environment (Abubakar et al., 2022; Raphela et al., 2024). Additionally, fragmented governance systems hinder coordinated efforts, while limited community participation in recycling and education programs further exacerbates these issues (Kubanza et al., 2021; Gebrekidan et al., 2024).

After collection, waste undergoes treatment through various methods, including composting, anaerobic digestion, incineration, and mechanical sorting. The choice of treatment depends on factors such as the composition of waste, economic feasibility, and its potential environmental impact (Abdel-Shafy et al., 2018; Shahbaz et al., 2023). Literature on organic waste composting highlights its effectiveness in transforming waste into valuable resources, such as organic fertilizers and biogas. The findings of the study by Sayara et al. (2020) emphasize that composting, as an aerobic decomposition process, enhances soil fertility by increasing organic matter content and nutrient availability, which in turn improves soil structure and agricultural productivity. Furthermore, it plays a crucial role in sustainable waste management by reducing landfill use and greenhouse gas emissions, contributing to a circular economy (Islam & Raihan, 2024; Oo et al., 2024).

Despite advancements in treatment methods, landfilling remains the most common disposal option (Zhang et al., 2024). However, traditional landfills pose significant risks, including groundwater contamination and methane emissions, which contribute to climate change (Kurniawan et al., 2021; Goh et al., 2025). To mitigate these risks, modern engineered landfills equipped with leachate treatment systems have been developed, offering a more environmentally friendly alternative (World Bank, 2017).

These facilities help control pollution while providing a structured approach to waste disposal. Unfortunately, many waste systems, particularly in developing regions and rural areas, face challenges that prevent waste from reaching designated landfills (Viljoen et al., 2021). Inadequate enforcement of waste management regulations further complicates the situation. Even when local governments establish guidelines for waste disposal, weak governance and lack of funding can hinder compliance and implementation (Salvia et al., 2021; Kubanza, 2024). This often results in illegal dumping practices increasing, with communities resorting to open burning or burying of waste when formal disposal options are inaccessible or too costly (Haywood et al., 2021; Ngalo & Thondhlana, 2023; Jakeni et al., 2024).

Given the financial, infrastructural, and community participation challenges affecting SWM, a more comprehensive approach that integrates environmental, social, and economical considerations is essential for enhancing efficiency in waste management.

2.1.4 Concept of SWM in rural areas

In rural areas, SWM presents unique challenges compared to urban areas (Mpofu, 2013), due to limited resources, infrastructure, and governance (Mwesigye et al., 2009). The absence of formal waste collection services in many rural areas leads to open dumping or burning of waste, posing environmental and health risks (Henry et al., 2006, and Mohammed et al., 2013). These challenges are compounded by the disparities between urban and rural contexts, as they significantly influence the implementation of effective waste management strategies (Yukalang et al., 2017; Zhang et al., 2024). While urban areas often benefit from established infrastructure and funding for waste management services, rural communities frequently face additional barriers such as geographical isolation, limited technical expertise, and inadequate governance frameworks (Karthikeyan et al., 2018; Vinti & Vaccari 2022). Understanding these differences is crucial for developing appropriate waste management solutions tailored to the specific needs and circumstances of rural communities.

2.1.4.1 Governance as a framework for addressing SWM challenges

Effective governance is a critical dimension of SWM, reflecting institutional capacity to manage waste efficiently. Studies like Abubakar et al. (2022) and Sasahara et al.

(2023) highlight SWM as an indicator of governance quality, particularly in the Global South. For instance, the Brazilian Municipal Solid Waste Governance Index assesses governance through dimensions like regulatory quality, voice, accountability, and government effectiveness, demonstrating how governance frameworks can drive effective waste management (Lima & Paulo, 2018).

2.1.4.2 Integrating sustainability into the conceptual framework

Sustainability is central to conceptualising SWM challenges and solutions. Strategies that emphasize waste reduction, reuse, and recycling not only mitigate environmental impacts but also promote economic resilience (Hajam et al., 2023; Kirchherr et al. (2023). Abdel-Shafy & Mansour (2018) identified effective strategies for transforming waste into resources across diverse socioeconomic and geographical contexts. The effective strategies identified include integrated waste management approaches that combine recycling, composting, and anaerobic digestion, tailored to local socioeconomic contexts. In this study, community engagement and education were highlighted as important for enhancing participation in waste reduction, while the development of strong policy frameworks supports sustainable practices. In alignment, the systematic approach to waste management adopted in South Africa underscores the importance of sustainability in addressing SWM challenges (Ndlovu et al., 2017). In summary, a robust conceptual framework for SWM challenges must integrate definitions of challenges, governance principles, and sustainability strategies. Understanding waste as both a problem and a resource, and by leveraging governance as a tool for effective management, this framework provides a holistic approach to addressing the complexities of SWM in rural areas.

2.1.5 Integrated Waste Management: Transforming Waste from Problem to resource

The concept of Integrated Waste Management (IWM) is identified as an important framework in addressing SWM challenges, in rural areas and resource deprived contexts. IWM is as a comprehensive, systematic approach combining a number of waste management strategies within an institutional and governance structures that improve environmental, economic, and social outcomes.

A growing body of research aligns waste management with circular economy principles, where waste is reintegrated as a resource (Rajput & Singh, 2019; Frank et

al., 2019; Velenturf & Purnel, 2021; Edirisinghe et al., 2024; Kaur et al., 2024). This conceptual framework is supported by global sustainability literature, which argues that viewing waste as an asset not only reduces environmental impacts but also opens new economic opportunities (Godfrey, 2021; Mngomezulu et al., 2024; Yu et al., 2024). The South African context provides a pertinent case study where policies and practices have begun to reflect this asset-based perspective, moving away from traditional linear models of waste disposal (Godfrey et al., 2017; Ndlovu et al., 2017; DFFE, 2020).

The World Bank, 2025, explore the effectiveness of educational campaigns and policy initiatives, such as extended producer responsibility (EPR), in promoting sustainable practice in Rajshahi City Corporation in Bangladesh. The strategies have demonstrated significant potential in enhancing public awareness and encouraging responsible waste handling behaviours among residents. Furthermore, a thematic analysis of peer-reviewed articles by Mapanga et al. (2024) on plastic pollution mitigation strategies in the global supply chain indicates that even though progressive policy frameworks have been introduced globally, challenges persist in their practical application. Regulatory and enforcement gaps hinder initiatives like EPR, suggesting a need for deeper economic analysis to evaluate cost-benefit dynamics and to explore the roles of public-private partnerships and fiscal incentives (Yeboah et al., 2024).

In addition, innovation waste management technologies, such as smart waste systems, decentralised composting, and waste-to-energy, offer promising solutions to manage growing waste volumes (Olawade et al., 2024), even in developing countries in the Middle East and North Africa (Khawaja et al., 2024). However, they also face challenges like flexibility, infrastructure limitations, and environmental trade-offs that require further research, as illustrated by Anwar et al. (2024) in a systematic literature review, which highlights the importance of advanced recycling techniques, policy interventions, and tailored solutions to effectively manage complex waste streams such as multilayer plastics.

The role of informal waste sectors and public attitudes in developing countries cannot be ignored in positioning waste as a resource within waste reduction initiatives (Simatele et al., 2017; Morais et al., 2022). Their activities not only facilitate resource recovery but also promote economic livelihoods and community engagement in

sustainable practices (Wilson et al., 2006; Mofokeng et al., 2022). Concurrently, public attitudes shaped by awareness, cultural perceptions, and behavioural willingness determine the level of community participation in waste segregation, recycling, and waste reduction efforts (Konstantinidou et al., 2024).

These dynamics highlight the important role of both informal waste activities and community perceptions in strengthening resource recovery. A study by Mofokeng et al. (2022) offers such insight by examining the role of the informal waste economy, particularly waste pickers, in enhancing recycling and waste management within the Mangaung Metropolitan Municipality. The study revealed that policies within the municipality mainly focus on formal waste management practices, excluding the informal sector, limiting the potential economic, social, and environmental benefits. Despite these policy gaps the study reveals the positive contribution of waste pickers who play an important role in diverting recyclable waste from landfills and supporting the circular economy. These activities not only generate income for individual waste pickers but also promote community participation in environmentally responsible behaviours.

In light of the above, an interdisciplinary approach that blends economic, social, and environmental insights is important for a comprehensive understanding of SWM In addition, viewing waste as a resource rather than merely a problem offers significant potential for sustainable development and environmental improvement. However, success depends on overcoming challenges in policy implementation, technological scalability, and socio-cultural integration through a multifaceted and interdisciplinary approach. As highlighted throughout this review, contemporary frameworks that reframe waste as an asset, supported by innovations such as advanced recycling technologies, policy interventions, and inclusive stakeholder engagement, are important for realising the full potential of solid waste as a resource, especially in diverse contexts such as South Africa and other developing countries navigating complex social, economic, and environmental landscapes.

2.2 Theoretical Framework

SWM presents unique challenges in rural areas compared to urban settings, as studies suggest (Mpofu, 2013; Karthikeyan et al., 2018; Vinti & Vaccari 2022; Tajkir-

Uz-Zaman, 2024). Several theories provide insight into these challenges, offering diverse perspectives on the complexities involved.

2.2.1 Institutional and resource dependency theories

Institutional theory suggests that disparities in SWM amongst rural and urban communities stem from the lack of robust institutional frameworks in rural settings compared to urban environments. Research by Karthikeyan et al. (2018), Vinti & Vaccari (2022), and Tajkir-Uz-Zaman (2024) highlights how urban areas often benefit from superior funding and infrastructure, leading to more advanced SWM systems. Kubanza & Simatele, (2019) argue that the institutional gap disproportionately affects impoverished communities, resulting in significant inequities in SWM service effectiveness.

Resource dependency theory further depicts challenges met by vulnerable communities in rural areas in managing waste effectively. Aspects such as economic constraints, lower population density, geographical remoteness, and limited community engagement, as discussed by Boateng et al. (2016), Trotter (2016), and Synowiec (2021), contribute to these difficulties. Sarfo-Mensah et al. (2019) emphasise that these constraints also lead to rural areas being marginalised from national waste policies and programs, leaving them reliant on scarce and inadequate resources. Historically, the absence of efficient waste management services has prompted communities to develop their own management methods, often considered insufficient (Lima & Paulo, 2018; Kubanza, 2024).

Despite the environmental and public health risks associated with these methods (Henry et al., 2006; Mohammed et al., 2013; Gebrekidan et al., 2024), rural communities exhibit resilience and innovation in waste management practices, as highlighted by Henry et al. (2006), Mohammed et al. (2013), and Zondi et al. (2023). For instance, they participate in composting organic waste (Silva et al., 2024) and creatively repurpose materials like ash and old tires into practical products such as black soap, slippers, and garden chairs, as evidenced by Ajibade (2007) and Senekane et al. (2021). In addition to these practices Nath et al. (2023) highlights that feeding of animal from food waste serves as a sustainable strategy in managing food waste, while promoting environmental and economic benefits.

2.2.2 Behavioural and social practice theories

According to Raghu & Rodrigues (2020) and Etim (2024), the idea of planned behaviour, as well as social practice theory, is crucial in understanding the adoption of traditional waste management practices in rural areas. These practices, influenced by socio-economic constraints, such as open dumping, burning, and informal recycling, shape local behaviours and norms (Madonsela et al., 2024; Zhang et al., 2024). Studies indicate that the theory of planned behaviour suggests that attitudes and perceptions of social norms influence the adoption of traditional waste practices compared to conventional practices for waste management. Smith (2020) emphasizes that positive attitudes and awareness about recycling enhance participation in waste initiatives, while a lack of awareness leads to indifference.

According to Saxena et al. (2025), community perceptions play a crucial role in encouraging better waste management behaviours, and understanding the cultural context of traditional practices is essential for effective strategies. Additionally, socio-economic factors, such as education and income, impact individuals' attitudes towards waste management, resulting in varying perceptions and practices across different backgrounds (Gharagozloo & Ghazizade 2023; Daoud et al., 2025). To illustrate this concept, Oduro-Appiah et al. (2022) utilised an adapted version of the planned behaviour theory of to assess the viewpoints of household leaders concerning the separation of municipal solid waste at its origin. Their findings indicated that moral norms and perceived behavioural control were significant determinants of intentions. Furthermore, the presence of waste storage containers, consistent waste collection services, and awareness of the segregation process were crucial in supporting households' intentions.

Meanwhile, Social practice theory suggests that social behaviours are shaped by social contexts, cultural norms, and community practices, indicating that the established traditions and collective behaviours influence how waste is managed in rural communities (Welch, 2016; Frost et al., 2020). Similarly, with waste management, this perspective indicates that waste management is not merely an individual responsibility but a collective practice that is deeply embedded in the social fabric of the community (Viljoen et al., 2021; Zulkifli & Abd Manaf, 2024). For instance, the availability of local resources, community engagement in sustainability initiatives,

and shared values regarding environmental stewardship can significantly impact residents' waste disposal habits (Abubakar et al., 2022).

Additionally, the role of social institutions, such as local organisations and government policies, can either facilitate or hinder the adoption of sustainable waste management practices. To emphasise this point, the descriptive research conducted by Muzvondiwa (2021) on the role of community participation in improving SWM in Nyanga Township, Zimbabwe, found that local organisations such as community health clubs and residents' associations were effective in mobilising residents and raising awareness. The study indicates a reduced rate of illegal dumpsites and increased community engagement. Supporting this, Nguyen et al. (2023) suggest that by fostering a sense of community responsibility and encouraging participation in waste reduction programs, rural communities can cultivate more effective waste management strategies that align with their cultural values and social norms. Conversely, the study in Nyanga Township identified that fragmented and inadequate government policies can hinder these efforts, when there's a lack of comprehensive national guidelines and specific local by-laws necessary for effective waste management.

2.2.3 Circular economy framework

In agreement, the integration of circular economy theory, as emphasised by Celestino et al. (2022), underscores the importance of sustainable waste management in rural settings. Central to effective waste management and the circular economy is the 3Rs approach - reduce, reuse, and recycle, as it remains a cornerstone of waste minimisation strategies (Chowdhury et al., 2014; World Bank, 2025). Circular economy theory highlights the interconnectedness between effective waste practices and broader principles of circularity and resource preservation (Godfrey, 2021; Rodríguez-Espíndola et al., 2022). By adopting circular economy principles, rural communities can enhance their waste management strategies (Mihai, 2023), ensuring that waste is minimised, reused, and recycled, thereby contributing to environmental sustainability and economic resilience. Studies explore factors influencing the adoption of circular economy practices in general, as they highlight the interplay of internal elements like resource availability and organisational culture, alongside external influences such as government policies, market demand, customer pressure, collaboration, technology

advancements, and economic conditions (Rodríguez-Espíndola et al., 2022; Inamutila Kahupi et al., 2024).

Through a Fuzzy Delphi approach, Martin et al. (2024) illustrate that bridging the gap between these theoretical frameworks by combining institutional, behavioural, and circular economy perspectives enables policymakers and stakeholders to develop strategies that address both systematic and community-level barriers. This approach enables sustainable SWM in rural settings.

2.3 SWM Challenges faced by Rural Communities Globally

2.3.1 SWM in developed countries

SWM practices vary significantly between developed and developing countries, with rural communities often facing the greatest challenges. Developed countries like Germany, Sweden, and Japan are frequently cited as models of excellence in SWM, attributed to their sophisticated infrastructure, substantial financial commitments, and rigorous regulatory frameworks (Chaudhary & Vrat, 2018; World Bank, 2023). For instance, Laureti et al. (2024) discuss how Germany, Sweden, and the Netherlands achieved the highest SWM rates in Europe, recycling and reducing 50%-70% of waste between 2013 and 2022. These countries also leverage advanced technologies, such as smart waste bins, automated sorting systems, and data-driven collection methods, to enhance efficiency and sustainability (Babaremu et al., 2024). The adoption of these innovations has been strongly correlated with higher waste management efficiency rates, as they leverage digital platforms and information and communication technologies (ICT) to enhance public engagement and optimise the process of waste collection, sorting, and recycling (Laureti et al., 2024).

2.3.2 SWM in developing countries

In contrast, developing countries face significant hurdles. According to Dlamini et al. (2017) and Kumar et al. (2017), insufficient infrastructure, limited funding, and weak policy enforcement result in practices like unregulated dumping and inadequate recycling, exacerbating environmental and health issues (Henry et al., 2006; Mohammed et al., 2013). These challenges are particularly acute in rural communities, as evidenced by studies in Brazil, South Africa, and India (Lima & Paulo, 2021; Vinti & Vaccari 2022; Zhang et al., 2024). For example, the Quilombola community in Brazil,

which comprises approximately 620 households with a 2171 population, generates 3247.6 kg of waste daily, yet only 24.7% is disposed of in landfills, with 72.9% burned in open dumps. Such practices contribute to health risks, including the proliferation of disease vectors (Lima & Paulo, 2021). Similarly, in Ethiopia, improper waste management creates breeding grounds for mosquitoes and rodents, transmitting zoonotic diseases that endanger human and livestock health (Gebrekidan et al., 2024).

2.3.3 Governance and institutional challenges

Institutional and governance disparities further widen the gap (World Bank, 2021). High-income countries benefit from robust systems that enforce policies and promote innovative strategies like the model of circular economy concept (Lotz et al., 2024; Möslinger et al., 2023), which emphasizes reducing, reusing, and recycling materials to minimise waste (Sakai et al., 2017). Germany exemplifies this approach, integrating sustainability goals into its waste management practices through coordinated efforts by governments, corporations, and the public (Valavanidis, 2018; Madzar, 2022). Conversely, developing nations like South Africa struggle with fragmented governance and resource limitations, hindering cohesive waste management strategies (Kotzé, 2017; Kadhila et al., 2023). For example, South Africa's environmental governance is hindered by significant structural fragmentation across various spheres of government and line functionaries, as well as a legislative framework comprising multiple silo-based and media-specific acts, as studies indicate (Kotzé, 2017). This results in duplication of administrative procedures, jurisdictional overlaps, and inefficiencies that obstruct cohesive waste management strategies.

2.4 SWM Challenges faced by Rural Communities in Sub-Saharan Africa (SSA)

In SSA, the effective transition to sustainable waste management encounters significant barriers, as highlighted by Debrah et al. (2022). A key obstacle is identified as the lack of structured educational initiatives and public campaigns to raise awareness. Debrah et al., 2022 highlight the limited availability of structured educational initiatives on sustainable waste management in countries like Togo, Zimbabwe, Benin, and Angola. This deficiency is indicated to impede the spread of essential knowledge and best practices within rural communities. Elsaid & Aghezzaf (2015); Olawade et al. (2024) suggest that the lack of education and awareness

presents challenges in embracing sustainable waste management practices, thus perpetuating dependence on conventional linear approaches. Despite this, Ajibade (2007); Kosoe et al. (2019), and Hajam et al. (2023) have collectively suggested that traditional waste management methods are deemed effective and sufficient in waste handling and management.

Research underscores the important role of policies and regulations in addressing challenges in waste management (Godfrey et al., 2019). However, the translation of these policies into actionable measures is a significant concern, in Sub-Saharan Africa regions, where enforcement is lacking (Abdulrauf, 2018; Zhang et al., 2024). Studies conducted by Diaz (2017), Somé (2018), and Ayeleru et al. (2020) have highlighted the difficulties arising from the absence of clear directives governing waste management practices in the region. Despite the initiatives of 29 African countries, including Zimbabwe and Ghana, to implement policies and regulations in line with sustainable principles such as transitioning to a circular economy (Debrah et al., 2022), enforcing these measures remains a formidable task. Scholars such as Bowan et al. (2018), Nyakudya et al. (2022), and Mukwevho et al. (2024) have identified enforcement, in rural areas, as a persistent challenge that hampers the execution of sustainable waste management strategies and impedes advancements in waste recycling initiatives.

Debrah et al. (2022) further highlight the significant challenges facing waste management in Sub-Saharan Africa, emphasising the detrimental impact of financial constraints and limited investment in the development of essential infrastructure and technologies necessary for sustainable waste management practices. The author also underscores the barrier posed by the low capacity of personnel involved in waste management, attributing it to inadequate training and skills development that hinder the adoption of innovative and sustainable practices within the region.

2.5 SWM Challenges Faced by Rural Communities in South Africa

Similarly, South Africa faces significant challenges in SWM, where infrastructure deficits and socio-economic disparities create unique obstacles for both urban (Kubanza, 2024) and rural settings (Rodseth et al., 2020). While urban areas receive greater attention and resources. Rural communities remain underserved, contributing to improper waste management practices and environmental pollution (Viljoen et al.,

2021). Research indicates that approximately 87% of municipalities struggle to provide adequate waste collection services, with rural regions disproportionately affected (Rodseth et al., 2020). Studies, such as Zondi et al. (2023), reveal the inadequacy of waste disposal infrastructure, with 98% of respondents in Vulindlela, a rural area within Msunduzi Municipality in KwaZulu-Natal, lacking access to landfills and other facilities, leading to widespread on-site waste burning and illegal dumping.

The challenges of rural SWM in South Africa cannot be fully understood without considering the historical legacies of apartheid, which entrenched socio-economic disparities and restricted access to basic services for marginalised communities (Fakoya, 2014; Dlamini et al., 2017; Mahosi, 2025). This legacy continues to impact governance structures, with rural areas often lacking the infrastructure and resources necessary to develop sustainable waste management systems (Sebola-Samanyanga, 2025). Inequalities in funding allocation and prioritisation further deepen the urban-rural divide, perpetuating environmental injustices (Haywood et al., 2021; Makhaye & Subban, 2024). These persistent inequalities do not only shape the functioning of SWM systems in the country but also affects the broader consequences within rural communities. These effects include environmental and health impacts, socio-economic and geographic disparities, cultural and behavioural dynamics and policy and governance challenges.

2.5.1 Environmental and health impacts

The absence of formalised waste management in rural areas has led to widespread unregulated waste disposals, such as open dumping and burning, contributing to significant environmental degradation (Henry et al., 2006; Mohammed et al., 2013; Rodseth et al., 2020). This inadequacy leads to severe environmental and public health risks, including water and soil contamination and air pollution from the burning of waste (Mukwevho et al., 2024). Additionally, many landfill sites in South Africa operate illegally or without proper licensing (Nahman, 2021). Of the estimated 990 general waste landfills nationwide, only 432 are permitted, which accounts for 56.4% of the total general waste landfill sites being licensed, and even these often fail to meet regulatory standards (DEA, 2018).

The inadequacy of infrastructure to support sanitary landfills perpetuates unsustainable disposal methods (Abubakar et al., 2022). Uncontrolled waste burning

and indiscriminate dumping are common practices that not only harm ecosystems but also pose long-term risks to human health, such as respiratory illnesses caused by air pollution (Ogola et al., 2011; Siddiqua et al., 2022; Raphela et al., 2024). Despite lower overall waste generation compared to urban areas (DEA, 2018), rural communities often lack the means to safely dispose of even biodegradable and organic waste, compounding these risks (Vinti & Vaccari 2022; Zhang et al., 2024). These impacts disproportionately affect vulnerable populations, including women and children, who often bear the responsibility for managing household waste in rural communities (Cogut, 2016; Mebratu & Mbandi, 2023). This highlights the need for investment in proper infrastructure to ensure safe and sustainable waste disposal.

2.5.2 Socio-economic and geographic disparities

Data on household refuse removal in South Africa underscores stark disparities between urban and rural regions. While approximately 84.4% of urban households benefit from weekly waste removal services, only 12.5% of rural households receive similar services (Statistics South Africa, 2023). Instead, rural communities often rely on self-managed refuse dumps, with 78.8% of households practicing this method compared to just 7.2% in urban areas. The data presented in Table 2.1 indicate the uneven distribution of services reflects systematic neglect of rural areas and prioritisation of urban centres in resource allocation in South Africa (Haywood et al., 2021).

Table 0.1: Household solid waste removal in South Africa urban settlements vs rural settlement (Statistics South Africa, 2023)

Waste Management Practice	**Urban %**	**Rural %**
Weekly Waste Removal	84.4	12.5
Communal Refuse Dumps	4.9	4.6
Own Refuse Dumps	7.2	78.8
Other Methods	3.5	3.3

Rural areas overwhelmingly rely on their own refuse dumps, reflecting limited formal waste management services. While communal refuse dumps and other methods are used minimally in both urban and rural areas, limited access to municipal services exacerbates waste accumulation and environmental degradation. This situation underscores the need for equitable service delivery, as also reflected in Rodeseth et al., (2020), who analysed household waste removal data from the Statistics South Africa General Household Survey for 2020.

2.5.3 Cultural and behavioural dynamics

In addition, cultural norms and traditional practices influence how rural communities manage solid waste in South Africa (Madonsela et al., 2024). While reuse and informal recycling practices are common amongst rural communities in developing countries (Nxumalo et al., 2020; Zondi et al. (2023), there is a notable lack of awareness and negative attitudes toward formal waste management contribute to littering and illegal dumping (Masood et al., 2014; Manun'Ebo & Ndombe, 2020; Rousta et al., 2020). Kubanza et al. (2021), in a study addressing the significant challenges of SWM in Alexandra, Johannesburg, highlight that engaging local communities in awareness campaigns and fostering behavioural change are crucial for improving SWM practices and alleviating the burdens on local authorities in managing waste. Furthermore, studies have demonstrated that community-driven initiatives, such as waste sorting and composting, can yield positive outcomes when supported by adequate resources and education (Ghazali et al., 2021). Muzvondiwa (2021) illustrates the success of such programs in Nyanga Township, Zimbabwe, where the integration of traditional practices with formal systems has fostered local ownership and promoted collaboration among stakeholders. Additionally, Mawere & Tshamano (2023) explore the role of African Indigenous Knowledge Systems (AIKS) within the Vhavhenda Indigenous community, advocating for these systems as a means to achieve restorative justice through community and cultural engagement.

2.5.4 Policy and governance challenges

Although South Africa has established legal frameworks to promote SWM, implementation remains inconsistent, particularly in rural areas (Kubanza et al., 2024; Mukwevho et al., 2024). In an investigation carried out by Shongwe & Meyer (2023) on service delivery in Nkomazi Local Municipality, it was found that limited

enforcement capacity, fragmented regulations, and inadequate local governance structures significantly hinder progress in effective service delivery. The National Environmental Management: Waste Act (Act 59 of 2008), implementation at the local level is inconsistent, studies reveal (Salvia et al., 2021; Kubanza et al., 2024). Additionally, Integrated Waste Management Plans (IWM Plans), mandated by law, are often poorly executed due to insufficient funding, weak enforcement, and inadequate monitoring systems (Mukwevho et al., 2024). Furthermore, there is often a lack of alignment between policy objectives and the practical realities of rural communities (Ogola et al., 2011; Hebinck et al., 2023). Political interference and corruption further hinder effective service delivery, diverting resources away from critical SWM programs (Resnick, 2014; Mngomezulu, 2020; Mamokhere, 2023). Many municipalities in South Africa lack the skilled personnel required to design and implement effective waste management strategies. Moreover, research indicates that the reliance on unskilled or underqualified staff undermines the operational efficiency across various systems (Hussain et al., 2020; Tamene et al., 2022).

Efforts to deliver effective waste management services are further complicated by the lack of coordination between municipalities and traditional leadership structures (Zondi et al., 2023). Sebola-Samanyanga (2025) highlights the disconnect stemming from continuous tensions and limited cooperation between traditional authorities and local government entities, adversely affecting inclusive planning and decision-making processes in rural development. Moreover, ambiguous legal and policy frameworks create power struggles and hinder collaboration between these entities, further complicating service delivery, such as waste management (du Plessis & Fuo, 2024). However, studies have shown that community-based waste management programs can be successful when they receive support from the government, traditional leadership structures, and non-governmental organisations (Muzvondiwa, 2021; Pratama et al., 2021; Zondi et al., 2023).

Comparing South Africa’s rural SWM challenges to similar regions worldwide reveals best practices that could be adapted locally. For example, community-driven waste management models in India and decentralised waste processing systems in Kenya have demonstrated success in improving waste disposal and recycling in rural contexts (Sunil & Attar, 2016; Awino & Apitz, 2023). These models highlight the importance of integrating cultural values, local knowledge, and affordable technologies

into waste management strategies. While existing studies provide valuable insights, significant research gaps remain. More granular, community-level data on waste generation, composition, and disposal practices are needed to inform targeted interventions. Additionally, longitudinal studies assessing the impact of policy changes and technological adoption in rural SWM could guide future strategies.

SWM in rural South Africa remains a complex challenge shaped by historical inequalities, socio-economic disparities, and governance limitations. Addressing these issues requires a multi-faceted approach that integrates community engagement, technological innovation, and tailored policy interventions. By learning from global best practices and addressing local nuances, South Africa can develop sustainable and inclusive waste management systems that meet the unique needs of its rural communities.

2.6 Conclusion

The literature review demonstrates the complex set of interrelated challenges, shaping SWM in rural areas such as Nkomo Village. Significant gaps, similarities, and disparities continue to affect effective SWM practices across rural contexts. Identified gaps include differences in adopting circular economy principles between developed and developing nations, a lack of educational initiatives and public awareness campaigns in SSA, and insufficient waste management infrastructure particularly in rural South Africa. Common challenges faced by rural communities globally include limited resources and infrastructure, illegal dumping and poor community engagement, further compounding these difficulties.

The above literature highlights the need for integration of economic, social, and environmental perspectives in analysing SWM challenges comprehensively. This approach is seen as important in designing rural context specific interventions, developing evidence-based policy responses and to strengthen rural SWM systems.Economically literature identifies limited resources and infrastructure challenges while emphasizing the opportunities of waste as a resource and a livelihood asset. Socially, literature emphasises the importance of awareness and education and community participation in improving waste behaviours and thereby reducing environmental and health risks. Discussed literature suggests sustainable

strategies such as waste reduction, reuse and recycling to prevent degradation from traditional linear models of waste disposal

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research Approach

In this study, a mixed methods approach that integrated both quantitative and qualitative research methodologies was utilised. This research approach was found to be more appropriate because quantitative data, primarily numerical responses analysed using statistical tools, provided measurable insights. Quantitative data from participant observations, surveys, and document analysis contributed to the understanding of contextual and experiential factors. Creswell (2014), convergent parallel design was employed, where both data types were collected as the same time, analysed separately, and then merged during interpretation to offer a comprehensive perspective. As Shorten & Smith (2017) and Dawadi et al. (2021), describes mixing methods in a study as a great approach to expanding evidence base in order to answer important questions in a study.

3.2 Research Design

A research design was constructed as a comprehensive plan that details the procedures the researcher will follow to carry out the study (Mbulayi, 2014). Surveys and participant observations were the main types of study used in this project. Survey research involved posing questions to individuals across various groups and documenting their responses to gain insights into their traits, opinions, experiences, and points of view (Creswell, 2014; Leedy & Ormord, 2015). The primary aim of the survey research was to enhance understanding of the sampled study population, as suggested by Leedy & Ormord (2015).

Additionally, participant observation was employed as a traditional qualitative approach that focuses on capturing the everyday natural experiences of participants, resulting in non-quantifiable data (de Vos et al., 2005). To meet the research objectives, data collection methods, including questionnaires, interviews, follow-ups, review of secondary documents, and observations, were employed in this study. Qualitative data from participant observations, surveys and analysed documents provided clarity on experiential and contextual factors. Adopting Creswell (2014) convergent parallel design qualitative and quantitative data was collected at the same time, analysed separately and later merged for interpretation for a comprehensive perspective. Data analysis followed by Rubin's (2005) approach, concentrating on

identifying recurring themes and patterns within the collected data. The raw data were deconstructed into smaller units for easier interpretation, with findings presented using graphs, charts, and narratives. To enhance the validity and reliability of this study, the triangulation of data from multiple sources was applied as per Robson et al. (2020), emphasizing that triangulation assists with validating the consistency of information and addressing potential biases by cross-validating findings (Creswell, 2014; Leedy & Ormord, 2015). To comprehensively address the study objectives, quantitative data were complemented by qualitative data.

3.2.1 Description of the study area

Nkomo Village is one of the 94 villages within the GGLM in Limpopo Province in South Africa. The area is located 20 km away from Giyani CBD, 98 km from Tzaneen, and 185 km from Polokwane. During the homeland era, Nkomo village fell under the Gazankulu homeland for Tsonga-speaking communities. Since municipalities have formal demarcati83jklons, traditional areas have their own traditional demarcations referred to as Nkomo A, Nkomo B, and Nkomo C (Refer to Tshamisekani A in figure 3.1). The village falls under the Mahumani Tribal Authority, as the traditional custodian, with a population of 6816 people (Statistics South Africa, 2011). Figure 3.1 below illustrates the location of the study area within the Mopani District Municipality in Limpopo Province. As per the Integrated Development Plan (IDP) of the GGLM, Nkomo Village lacks formal household solid waste removal services (GGLM IDP, 2023/24). The essential infrastructure in Nkomo Village encompasses electricity, schools, a clinic, and local shops, but lacks running water and sewer pipeline connections. Access to Nkomo Village is facilitated by a tarred main road and internal dirt roads that segment households, creating a settlement layout reminiscent of urban areas.

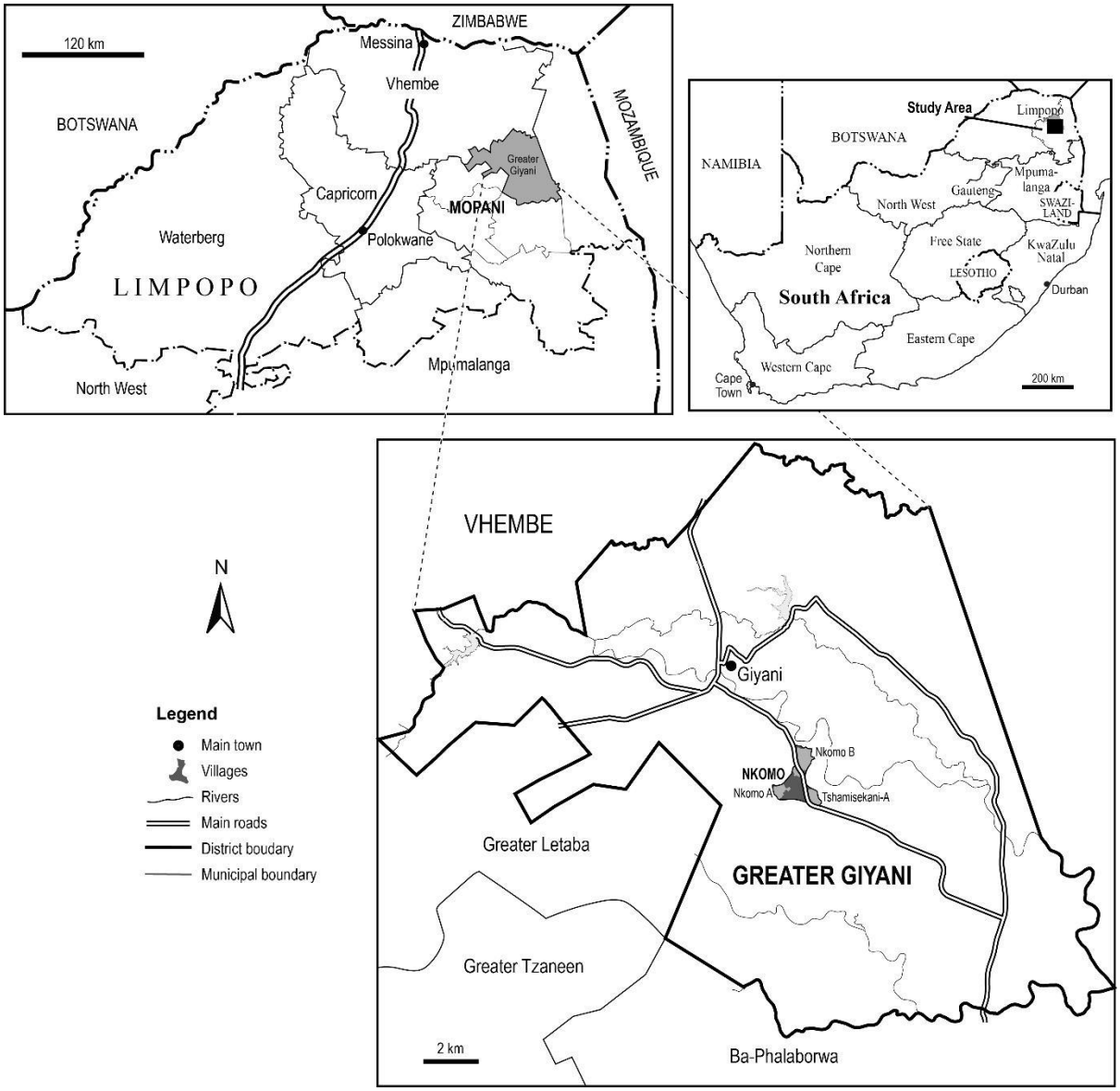


Figure 3.1: Locality of the study area (created using Arc GIS software)

The village is characterised by a mix of savanna and woodland terrain, featuring bushveld vegetation such as Acacia and Mopane trees. The regional climate is subtropical, with hot, humid summers and moderate, dry winters. The Klein Letaba River runs through the area, providing a significant water source. The population primarily engages in subsistence and small-scale commercial farming, cultivating crops like maize and peanuts, and raising livestock.

The selection of Nkomo Village as the study area was justified by the need to fill research gaps in SWM practices in rural communities, particularly in South Africa. The local relevance of waste management issues in Nkomo Village mirrors challenges faced by similar rural areas, making the study pertinent for informing targeted

interventions and policies. Additionally, the feasibility of conducting research in Nkomo Village was enhanced by logistical advantages and a manageable scope compared to larger urban areas. By focusing on Nkomo Village, the study might influence the community directly and positively by identifying areas for improvement and developing tailored strategies for sustainable waste management, ultimately enhancing the well-being of residents and the environment.

3.2.2 Study population and sampling procedure

The most recent census conducted to enumerate the population and number of households in individual villages within the GGLM took place in 2011. According to the 2011 census data, Nkomo Village was reported to have a total of 1670 households. However, it was anticipated that the number of households has since increased and undergone changes post 2011. The accurate count of households holds significance for the research focus on methods of handling and disposing of waste within Nkomo Village, as it served as a fundamental parameter for calculating the sample size. A simple random sampling technique was applied to select households from the three sections of Nkomo Village, effectively mitigating the risk of biased sampling. As advocated by Noor et al. (2022), simple random sampling ensured that each household was selected entirely by chance, thereby providing every individual in the population with an equal opportunity for selection. To have a 95% confidence level and a 5% error range, the sample size was determined based on the household population using the following formula:

n=Sample size.

N=Population size.

e=Margin of error.

Therefore:

$$N = \frac{N}{1+N\,(e)^2}$$

$$= \frac{1670}{(1+1670\,(0.05)^2)}$$

$$= \frac{1670}{1+\,(1670 \times 0.0025)}$$

$$= \frac{1670}{1+\,(9.60)}$$

$$= \frac{1670}{9.60}$$

$$= 173.9$$

Since the sample size could not be a fraction, we rounded up to the next whole number, making the sample size approximately 174 households for this study. Apart from the local communities, information was also collected from the municipal authorities of the GGLM, Limpopo.

3.2.3 Research techniques and instruments of data collection

The data collection tools utilised in this research included semi-structured questionnaires and semi-structured interviews for surveys, along with a checklist used for observations information gathering on waste management practices within Nkomo Village. Research tools include:

3.2.3.1 Participant observation

As a traditional qualitative method, participant observation focuses on the normal, daily experiences of participants, as information gathered in this way cannot be measured (de Vos et al., 2005). The researcher used participant observation as a tool to interact with participants and observe their daily activities, and as such, a prolonged time was spent with the residents of Nkomo Village within GGLM in Limpopo Province in South Africa to attain direct information from the residents of the phenomenon in this study that is being evaluated. The researcher became a part of the daily routine of the participants. Where residents' routines were observed and interactions with disposal practices over an extended period, for an in-depth understanding of cultural norms, behaviours and informal waste practices that quantitative tools could not present. Acquiring notes during the observation process and recording throughout the whole process involved documentation of observed activities, interactions and environmental conditions,

3.2.3.2 Semi-structured questionnaires

Participants were asked to fill out a questionnaire, which is a study tool made up of a list of questions on a form meant to collect information (de Vos et al., 2005). In a semi-structured questionnaire, the interviewer asked a set of planned questions. Other questions were open-ended, meaning that the respondent could go into more detail

without planning. To gather information for this study, semi-structured closed and open-ended surveys were used as recommended by de Vos et al. (2005) and Hainduwa et al. (2013), as they allowed for an unlimited number of questions to be posed, eliciting enough responses, and provided participants with the opportunity to offer additional information not covered in the structured questions.

A household survey was conducted, and questionnaires were distributed to residents for them to complete. Before the actual data collection process, a preliminary pilot questionnaire was distributed to residents. Six questionnaires were used to assess the effectiveness of the chosen method and to determine whether further information should be added or adjusted on the questionnaires to quickly rectify any mistakes. This assisted in assessing whether the questions were overly lengthy for respondents to complete.

3.2.3.3 Semi-structured interviews for surveys with key informants - municipal officials

To gain insights into institutional roles, policies, and challenges related to waste management in Nkomo Village, key informant interviews were conducted with GGLM officials. These officials were identified through the municipal administrative offices, focusing on personnel working in departments directly involved in waste management. Key informants included the Assistant Director-Environment and Waste Management and a waste management officer. Contact details were obtained from the municipal administration, and initial communication was initiated through a participation information sheet and emails that explained the purpose of the study and requested participation. A follow-up phone call was made to confirm willingness to participate and to schedule interview appointments.

Structured interviews were conducted with 02 municipal officials identified during the initial process. Considering the specialised nature of these roles, purposive sampling was used to deliberately select participants based on their specific expertise and responsibilities related to waste management policies, practices, and operational challenges in the study area.

3.2.3.4 Use of documentation

In this study, various forms of documentation were utilised to complement and triangulate data collected through questionnaires and interviews. These documents include government reports, municipal records, academic books, journals, magazines, newspapers, and news articles. The study analysed a number of documents obtained from the GGLM to provide valuable insights into existing waste management policies, service delivery challenges, and infrastructural constraints specific to Nkomo Village. These included:

- Integrated Waste Management Plans (IWM Plans) which provided an outline of the municipality's goals, strategies and regulations for waste management within the municipality.
- GGLM Integrated Development Plans (IDPs) which provided a broader socio-economic development plans to indicate how waste management aligns to local priorities and fiscal allocations towards waste infrastructure, services and environmental programmes
- GGLM Waste Management By-Laws provided the legislative framework currently governing solid waste management within the municipality, including Nkomo Village.
- Relevant national and provincial waste management policies including the NEMA Waste Act, national and provincial waste management strategies to assess alignment.

Additionally, data gathered from reputable internet sources was systematically combined with information from the questionnaires to incorporate any further updates related to SWM issues. All available documentation and data sources collected throughout the research process were thoroughly compiled, organised, and analysed to finalise the data collection phase.

3.2.4 Data analysis

Data analysis was conducted by systematically organising and interpreting the gathered information to assess and summarise the findings (de Vos et al., 2005). The analysis process was initiated during the interviews, as described by Rubin & Rubin (2005). Raw data was segmented into smaller units to facilitate the identification of characteristics and structures within the data, which simplified the researcher's task of interpreting and explaining the observed phenomena. Additionally, a preliminary pilot

questionnaire was administered to refine data collection methods, ensuring the questions were clear and concise for respondents. The resulting data was presented using graphs and charts to enhance clarity and understanding.

Furthermore, information from GGLM strategic plans, reports and internet sources was systematically collated with findings from surveys and questionnaires. A qualitative, interpretive approach focusing on observing the lived experiences of the participants without quantifying was applied, through systematic coding of notes taken and issues relating to the study objectives.

Recurring themes and patterns were identified through careful examination of the data collection, which validated the information obtained. To further ensure reliability, repetitive questions were used to highlight similar responses and consistencies. The researcher employed three distinct data collection methods, which are semi-structured questionnaires, key Informant Interviews with Municipal Officials, participant observation, and documentation to support the comprehensive nature of the analysis and confirm the validity of the findings.

3.2.5 Scope and limitations of the research

The scope of the research includeded identifying challenges faced by the community, reviewing current waste management practices and policies, and proposing actionable strategies for improvement tailored to local needs and constraints. The study utilised a mix of qualitative and quantitative methods, including surveys, questionnaires, participant observations, and document analysis for data collection and analysis.

However, the research also had limitations that were identified. These limitations include constraints such as biases in sampling techniques. Biases in terms of gender representation, as the Statistics SA 2011 data indicates that 61.4% of households in the village are headed by females. The language barrier was a challenge in the collection of data within this community, as the primary language spoken in the area is XiTsonga, and although the researcher could converse and understand the language, XiTsonga is not their home language. Moreover, a lower percentage of residents in Nkomo Village are recorded to have a lower education level or have attained matriculation (STATSSA, 2011), which presented a challenge in completing questionnaires in English. To overcome this obstacle, the researcher translated the

questionnaire into Xitsonga to enhance understanding. Furthermore, the lack of previous studies in the study area limited the ability to compare findings with existing research.

3.2.6 Ethical consideration

All necessary ethical precautions were diligently followed in this research. Prior consent was obtained from both the residents through the Mahumani Tribal Authority, the GGLM through the Limpopo Premier's office. Furthermore, ethical clearance was obtained from the University and the Limpopo Premier's office – Ethics Committee, before any research activities commenced. Residents had an option to request anonymity, and their names have been kept confidential. Any sensitive information that could potentially harm third parties has not been disclosed in this study. Before conducting interviews and on-site observations or distributing questionnaires, the entire process was thoroughly explained to participants. Ethical considerations, including ensuring informed consent, maintaining confidentiality, and addressing potential conflicts of interest, are crucial aspects that have been carefully managed throughout the research process to ensure the validity and reliability of the study.

CHAPTER 4: RESULTS

4.1 Data Presentation and Analysis

This chapter presents data collected from the sampled population of 155 households, interviews with officials from the Community Services section of the GGLM, observations of participants made, and a review of relevant documentation. The data was analysed and interpreted in accordance with the objectives of the study and the stratified groups guiding the research, which include education level, occupation, monthly income, gender, and age.

4.2 Demographic Factors

Section 1 of the questionnaire provided demographic statistics, which assisted the study in assessing the effects of demographic factors such as age, gender, educational level, occupation, and income on SWM practices within the community. By analysing these variables, the study aimed to identify patterns and correlations that could explain different challenges, participation, and awareness related to solid waste management within the community. This approach enabled a deeper understanding of how socio-economic and demographic characteristics affect attitudes towards waste disposal and recycling initiatives in the village. As summarised in Table 4.1 below, 52.25% of the participants were female and 47.74% were male. Participants aged below 19 years make up 7.74% of the studied population, with the largest group being participants aged between 20 to 29, making up 21.94%, and participants aged 30 to 39 make up 33.55%. Participants aged 40 to 49 account for 20.65 %, while those aged 50 to 59 make up 6.54%. Finally, participants aged above 60 make up 9.68 % of the sampled population.

Table 4.1: Results of demographic factors

Factor	Category	Total of participants	Percentage %
Education level	No schooling	11	7.09%
	Some primary	7	4.51%
	Primary completed,	5	3.22%
	Some secondary	15	9.68%
	Matric	79	50.97%
	Some tertiary	25	16.12%
	Tertiary	13	8.39%
Occupation	Professional	7	4.52%
	Managerial/technical	8	5.16%
	Non-manual / skilled	6	3.87%
	Manual/skilled	3	1.94%
	Partly skilled	2	1.29%
	Unskilled	9	5.81%
	Self employed	7	4.52%
	Does not work	113	72.90%
Monthly income	Under R1 000	74	47.74%
	R1 001 and R3 000	22	14.19%
	R3 001 and R6 000	5	3.23%
	R6 001 and R10 000	6	3.87%
	R10 001 and R12 000	9	5.81%
	R12 001 and R15 000	17	10.97%
	R15 001 and R20 000	7	4.52%
	Above R20 000	15	9.68%
Gender	Female	81	52.25%
	Male	74	47.74%
Age	< 19	12	7.74%
	20-29	34	21.94%
	30-39	52	33.55%
	40-49	32	20.65%
	50-59	10	6.45%

	>60	15	9.68%

From the demographic data analysed majority of respondents earn under R6000 monthly, with 47.74% of respondents earning under R1000, 14.19% of respondents earning between R1001 to R3000, and 3.23% earning between R3001 and R6000. Higher income brackets earning above R6000 monthly, with 3.87% of respondents earning between R6001 and R10 000, 5.81% of respondents earning between R10 001 and R12 000, 10.97% of respondents earning between R12 001 and R15 000, 4.52% of respondents earning between R15 001 and R20 000, and 9.68% of respondents earning above R20 000.

Responses analysed on educational levels within the sampled population indicated that most respondents matriculated at 50% of respondents, followed by some tertiary education at 16.12% of respondents, and tertiary education at 8.39% of respondents. Smaller proportions of the population have completed some secondary at 9.68%, no schooling at 7.09% of the respondents, some primary education at 4.51% of the respondents, and primary completed at 3.22% of the respondents. This data highlights that while a significant proportion of the community has a basic to further educational background, a few still lack formal education, which may impact their awareness and engagement in SWM practices.

4.3 What are the Challenges faced by Nkomo Village, Limpopo, in SWM?

Section 2 of the questionnaire used for the collection of data from participants within Nkomo Village listed several expected waste management's challenges the community might encounter. Participants were required to indicate relevant challenges that apply to their household when managing waste. Participants were allowed to identify more than one challenge and also add challenges not listed in the questionnaire. Table 4.2 below lists these challenges identified among respondents. The most reported challenge is inadequate facilities for composting or recycling, affecting 89.67% of households. Similarly, both a lack of access to waste collection

services and limited space for waste storage are challenges affecting 80% of households, respectively. Negative attitudes towards waste management were reported by 58% of households as a challenge. Moreover, insufficient knowledge about recycling is reported by 69.67% of respondents as a challenge faced within the village, which greatly influences attitudes towards waste management in the Village. Though fewer, 7.7% respondents indicated that the lack of waste storage containers is a challenge for their households, many indicated that in the absence of proper storage, they resort to open dumping until there's enough waste for burning and burying.

Table 4.2: Challenges faced by Nkomo Village, in SWM

Challenges faced by Nkomo Village, Limpopo, in SWM	**Number of households**	**% of the overall 155 households**
Lack of access to waste collection services	124	80%
Insufficient knowledge about recycling	108	69.67%
Limited space for waste storage	124	80%
Negative attitudes towards waste management	90	58%
Inadequate facilities for composting or recycling	139	89.67%
Other: Lack of waste storage containers	12	7.74%

At 97.41% of the households indicated never receiving formal training on waste management. Among the small proportion (2.58%) who have received training, the methods were not connected to community-based initiatives, as indicated during follow-up interviews. This suggests the presence of socio-cultural hurdles that may undermine waste management efforts. Only 4 participants recalled being involved in past initiatives organised by the municipality in the area, while 151 participants reported no awareness of any local initiatives or programs aimed at improving waste management in their community. Interviews conducted with Municipal officials further

backed the notion that a waste collection initiative aimed at cleaning up illegally dumped waste was conducted in the village. The officials indicated poor communication efforts when it comes to informing the community of such initiatives in rural communities. Participants expressed the following:

'I still remember helping collect litter across the village when the officials from the municipality came. We picked up around the entire village and since then such initiatives have never happened.'

'I have never heard of any initiative for the community to participate in regarding waste management, maybe it was meant for a selected few.'

'If such an initiative existed, the tribal authority would have instructed the Nduna to inform us, I have never heard of it, nor have I ever been involved.'

Furthermore, in terms of waste management training, only 6 respondents (at 4%) out of 155 respondents have been trained formally on waste management issues. Most respondents indicated that they got exposure through their schooling and not by the municipality. One participant indicated:

'My basic understanding of proper waste management practices came from formal schooling rather than any training provided by the tribal authority or the municipality.'

4.3.1 Cross-tabulation of waste management challenges with demographic factor variables in Nkomo Village

a) Lack of access to waste collection services

The challenge of a lack of waste collection services affects the entire population of Nkomo Village. Table 4.2 indicates that out of the 155 respondents, 124 respondents, 80% of the respondents indicated that this is a challenge, highlighting that this challenge is widespread regardless of socioeconomic and demographic factors. Even though data indicates 80% of respondents identified this as a challenge, 100% of respondents indicated that they are not aware of any waste collection services within the village. Furthermore, information obtained from the municipal official interviews indicates that there are no provisions for Nkomo village regarding waste collection

services. The Assistant Director-Environment and Waste Management expressed that:

'Greater Giyani Municipality has 96 villages under its jurisdiction, with six (06) compactor trucks, one (01) 4-ton truck and one (01) Bakkie for collection of the solid waste in the area. Due to lack of enough waste fleet to cover the area, municipality is unable to collect in all villages.'

b) The influence of income, gender, education, and occupation on insufficient knowledge about recycling as a key challenge

Data indicates that insufficient knowledge on recycling is a widespread challenge amongst the various categories within the different demographic factors, as 108 respondents out of the 155 sampled population indicated this as a challenge. A majority of female respondents (52%) indicated this as a challenge, compared to 48% male respondents. While the 30 to 39 years age group has the highest percentage at 33.33% of the respondents, indicating that there's insufficient knowledge about recycling, followed by the 20-to-29-year age group with respondents, 22.22% of respondents, and the 40 to 49 years age group with 20.37% of respondents. The youngest and oldest age groups, below 19 and above 60 age groups, indicate a smaller number of respondents challenged by insufficient knowledge on recycling at 7.41% and 9.26% respectively.

Matric is the most concentrated education level, with 50.93% of the respondents indicating insufficient knowledge about recycling as a challenge. Among low education levels, lower percentages were indicated. No schooling indicated that 8 respondents (7.41%), some primary at 5 respondents, 4.63%, primary completed 3 respondents, 2.77% out of the 108 respondents indicated insufficient knowledge about recycling as a challenge. Even though a smaller number amongst the tertiary educated and some tertiary educated respondents, at 8.33% respondents and 15.74% respondents respectively.

As represented in Table 4.3, a very high percentage (73.15%) of those respondents who do not work indicated that insufficient knowledge of recycling is a challenge. While other occupations have relatively low percentages of respondents indicated insufficient knowledge on recycling as a challenge, professionals at 4.63%

respondents, managerial/technical at 5.56%, non-manual / skilled at 3.70% respondents, unskilled at 5.56% respondents, and self-employed at 4.63% respondents. With manual/skilled and partly skilled categories reporting the lowest percentages at 1.85% and 0.93% respectively.

Table 4.3: Triangulation of the influence of income, gender, education, occupation on insufficient knowledge about recycling as a key challenge

Demographic factor	**Category**	**Respondents indicated insufficient knowledge about recycling as a challenge**	**Percentage %**
Gender	Female	56	52%
	Male	52	48%
Age	< 19	8	7.41%
	20-29	24	22.22%
	30-39	36	33.33%
	40-49	22	20.37%
	50-59	7	6.48%
	>60	10	9.26%
Education	No schooling	8	7.41%
	Some primary	5	4.63%
	Primary completed	3	2.77%
	Some secondary	10	9.26%
	Matric	55	50.93%
	Some tertiary	17	15.74%
	Tertiary	9	8.33%
Occupation	Professional	5	4.63%
	Managerial/technical	6	5.56%
	Non-manual / skilled	4	3.70%
	Manual/skilled	2	1.85%

	Partly skilled	1	0.93%
	Unskilled	6	5.56%
	Self employed	6	4.63%
	Does not work	7	73.15%
Income	Under R1 000	74	47.74%
	R1 001 and R3 000	22	14.19%
	R3 001 and R6 000	5	3.23%
	R6 001 and R10 000	6	3.87%
	R10 001 and R12 000	9	5.81%
	R12 001 and R15 000	17	10.97%
	R15 001 and R20 000	7	4.52%
	Above R20 000	15	9.68%

There is a correlation between the high percentage of respondents who do not work (73.15%) and the under R1,000 income group; both identify insufficient knowledge on recycling as a challenge. Accordingly, under R1 000 income group is expected to have a higher percentage compared to other income groups, with 47.74% (74 respondents) as indicated in Table 4.3. Similarly, income group does not influence knowledge in this village as all income groups in the sampled income groups has some level of insufficient knowledge across all groups with R1 001 to R3 000 income group presenting with 14.19% of respondents as presented in Table 4.3, R3 001 to R6 000 income group presenting with 3.23% of respondents, R6 001 to R10 000 income group presenting with 3.87% of respondents, R10 001 to R12 000 income group presenting with 5.81%, R12 001 to R15 000 income group presenting with 10.97% of respondents, R15 001 to R20 000 income group presenting with 4.52% of respondents and Above R20 000 income group presenting with 9.68% of respondents.

These results indicate that income alone does not determine awareness or understanding of recycling in villages such as Nkomo, as knowledge disparities about recycling are observed across all demographic factors in the village.

c) *The influence of income, gender, education, occupation on Limited Space for waste storage as a key challenge*

A slightly more females (65 respondents) than males (59 respondents) reported space for storage of waste as a challenge in their yards. While the age group 30 to 39 years recorded the highest portion with 42 respondents, at 33.87% of limited space for waste storage was a challenge. This age group is followed by the 20 to 29 years and 40 to 49 years age groups, at 21.78% and 20.96% of respondents, respectively. A relatively low percentage for age groups below 19 years, 50 to 59, and above 60 age groups, respectively, was recorded for respondents reporting limited space for the storage of waste as a challenge, as presented in Table 4.4.

Table 4.4: Triangulating the influence of Income, Gender, education, and occupation on limited space for waste storage as a key challenge

Demographic factor	**Category**	**Limited space for waste storage**	**Percentage %**
Gender	Female	65	52.41%
	Male	59	47.58%
Age	< 19	10	8.06%
	20-29	27	21.78%
	30-39	42	33.87%
	40-49	26	20.96%
	50-59	8	6.45%
	>60	12	9.67%
Education	No schooling	9	7.26%
	Some primary	6	4.84%
	Primary completed	4	3.23%
	Some secondary	12	9.68%
	Matric	63	50.81%
	Some tertiary	20	16.13%
	Tertiary	10	8.06%
Occupation	Professional	6	4.84%
	Managerial/technical	6	4.84%

	Non-manual /skilled	5	4.03%
	Manual/skilled	2	1.61%
	Partly skilled	2	1.61%
	Unskilled	7	5.65%
	Self employed	6	4.84%
	Does not work	90	72.58%
Income	Under R1 000	54	44%
	R1 001 and R3 000	17	13.71%
	R3 001 and R6 000	4	3.23%
	R6 001 and R10 000	5	4%
	R10 001 and R12 000	20	16%
	R12 001 and R15 000	6	4.84%
	R15 001 and R20 000	11	8.87%
	Above R20 000	7	5.65%

Similarly, respondents who have matriculated make up 50.81% of respondents who reported limitations in space for storage of waste when compared to other education levels. A very low number of respondents in some primary, primary completed, secondary, and tertiary educational levels, ranging between 4 to 10 respondents, as presented in Table 4.4. The 72.58% respondents who do not work reported limited space as a challenge. Those employed span different roles, including professional and managerial/technical 4.84% each, non-manual/skilled (5.403%), manual/skilled, partly skilled at 1.61% respondents each, unskilled at 5.65% respondents, and self-employed at 4.84% respondents.

Among those employed, the roles reported include professional and managerial/technical positions, each with 4.84% of respondents, non-manual/skilled with approximately 4.03% of respondents, manual skilled and partly skilled roles with 1.61% of respondents each, unskilled workers with 5.65% of respondents, and self-employed individuals with 4.84% of respondents. The largest income group, which is

under R1000, has 54 respondents, indicating that limited space is a challenge to waste disposal, exceeding other income groups at 44%. Observations among households also confirmed that households rely on disposing of waste in various locations both within and just outside their yards through open dumping, burning, and burying. Over time, these waste pits become full, prompting the need to find new disposal spots.

Collectively, these findings underscore the need for effective waste disposal solutions tailored to demographics and socio-economic factors to mitigate challenges in waste disposal in Nkomo Village.

d) The influence of income, gender, education, and occupation on negative attitudes towards waste management as a key challenge

In this study, the term “negative attitudes” was used as a conceptual category describing unwillingness, and limited motivation to engage in recommended waste management practices. This construct was identified through survey responses and participant observation where participants expressed perceptions such as:

‘Recycling is useless if there’s no place to take it’

‘Waste management programs don’t reach us’

‘We’ve always disposed of waste this way’

In addition, data collected from household questionnaires indicate that negative attitudes towards waste management in Nkomo Village is influenced by several demographic factors, as detailed in Table 4.5. Slightly more females (52.22%) than males (47.77%) reported negative attitudes towards waste management. Negative attitudes towards waste management are predominant amongst females, adults in the working age groups (20-49 years), with the highest percentage of 33% for the age group 30 to 39 years. Followed by 20 to 29 and 40 to 49 age groups, with 22% respondents each. Lower percentages were recorded for the below 19, 50 to 59, and above 60 age groups for this challenge, at 7%,6% and 9% respectively.

Table 4.5: Triangulating the influence of Income, Gender, education, and occupation on negative attitudes towards waste management as a key challenge

Demographic factor	**Category**	**Negative attitudes towards waste management**	**Percentage %**
Gender	Female	47	52.22%
	Male	43	47.77%
Age	< 19	7	8%
	20-29	20	22%
	30-39	30	33%
	40-49	19	22%
	50-59	6	6.67%
	>60	9	10%
Education	No schooling	6	6.7%
	Some primary	4	4%
	Primary completed	3	3%
	Some secondary	9	10%
	Matric	46	51%
	Some tertiary	15	17%
	Tertiary	8	9%
Occupation	Professional	4	4.44%
	Managerial/technical	5	6%
	Non-manual / skilled	3	3%
	Manual /skilled	2	2%
	Partly skilled	1	1%
	Unskilled	5	5.55%
	Self employed	4	4%
	Does not work	66	73%
Income	Under R1 000	43	48%
	R1 001 and R3 000	13	14%
	R3 001 and R6 000	3	3%

	R6 001 and R10 000	3	3%
	R10 001 and R12 000	5	6%
	R12 001 and R15 000	10	11%
	R15 001 and R20 000	4	4%
	Above R20 000	9	10%

Among those with some level of education, particularly those with matric, 51% of the respondents highlighted negative attitudes towards waste management as a challenge amongst households in the village. Even though negative attitudes exist across educational levels but are recorded lower among those with no schooling (6.7%) or with some primary education (4%) or some primary education (4%) or primary completed (3%), and with some secondary (10%), some tertiary (17%), and tertiary (9%).

Employment status showed that 73% of respondents who do not work reported negative attitudes towards waste management as a challenge, compared to smaller percentages across employed categories. Among those employed, negative attitudes are found across various occupational categories, but at much lower proportions: professionals (4.44%), managerial/technical (6%), non-manual/skilled (3%), manual/skilled (2%), partly skilled (1%), unskilled (5.55%), and self-employed (4%).

Negative attitudes towards waste management exist across all income groups, with a significant proportion of respondents earning under R1000 monthly, 43 (48%) indicating negative attitudes towards waste management as a challenge. Followed by R1 001 to R3 000 and R12 001 to R15 000, at 14% and 11% respectively. Those earning above R20,000 at 10% indicate negative attitudes towards waste management as a challenge. While R15 001 to R20 000, R10 001 to R12 000, R3 001 to R6 000, and R6 001 to R10 000 income groups record 4%, 6%, 3% and 3% respectively.

e) The influence of income, gender, education, and occupation on inadequate facilities for composting or recycling as a key challenge

The data collected is present in Table 4.6 and indicates that there is a high percentage (73%) of female's respondents (53%) who feel that there are not enough facilities for composting or recycling when compared to men at 66 respondents (47%), suggesting that women might be more impacted or perhaps more aware of these inadequacies. The 30 to 39 years age group is the most affected at 34%, followed by 40 to 49 years (20%) and 20 to 29 years (22%). The elderly above 60 years and youth below 19 years have a low percentage of 9% and 8% respectively.

Table 4.6: Triangulating the influence of Income, Gender, education, and occupation on inadequate facilities for composting or recycling as a key challenge

Demographic factor	**Category**	**Inadequate facilities for composting or recycling**	**Percentage %**
Gender	Female	73	53%
	Male	66	47%
Age	< 19	11	8%
	20-29	30	22%
	30-39	47	34%
	40-49	29	20%
	50-59	9	6%
	>60	13	9%
Education	No schooling	10	7%
	Some primary	6	4%
	Primary completed	4	3%
	Some secondary	13	9%
	Matric	71	51%
	Some tertiary	22	16%
	Tertiary	12	9%
Occupation	Professional	6	4%
	Managerial/technical	7	5%

	Non-manual/skilled	5	4%
	Manual /skilled	3	2%
	Partly skilled	2	1%
	Unskilled	8	6%
	Self employed	6	4%
	Does not work	101	73%
Income	Under R1 000	66	48%
	R1 001 and R3 000	20	14%
	R3 001 and R6 000	4	3%
	R6 001 and R10 000	5	4%
	R10 001 and R12 000	8	6%
	R12 001 and R15 000	15	11%
	R15 001 and R20 000	6	4%
	Above R20 000	13	9%

Above half (51%) of those affected by the inadequacy of facilities for composting or recycling have completed matric, and 16% have some tertiary education, with 9% holding tertiary qualifications. The lower educational level categories have a lower percentage of these inadequacies: no schooling (7%), some primary (4%), and primary completed (3%). A notable 73% of respondents who do not work are affected by the inadequacies of composting or recycling facilities. The working class of respondents shows lower percentages, such as partly skilled (1%), manual skilled (2%), and professional (4%). Similarly, those who earn less than R1000 a month are mostly affected (48%) by the inadequacies of facilities for composting and recycling when compared to slightly higher income brackets: R1001 to R3000 (14%), R3001 to R6000 (3%). A gradual decline on respondents affected by inadequate composting and recycling facilities is observed, with increase in income. Higher income groups record lower percentages of these inadequacies being a challenge to waste management: R6001 to R10000 (4%), R10 001 to R12 000 (6%), R12 001 to R15 000 (11%), R15 001 to R20 000 (4%), and above R20 000 (9%).

Discussions held with participants and observations conducted revealed that composting is a traditional practice where garden waste and food scraps are normally left on the ground to decompose or used as mulch to improve the quality of soil. However, recycling is a problem for participants, as it is indicated that there are no facilities within the village for recycling. Participants expressed that:

'There are no facilities where we can take recyclable waste in the village.'

This was also confirmed through observations that participants keep recyclable waste for recycling when they go to town, where recycling facilities are available. Interviews conducted with officials from the municipality also confirm that there is a lack of facilities for waste recycling in the village, which contributes to illegal dumping of recyclables within the village. Interviews conducted with municipal officials also confirm that recycling facilities are provided by private companies far from Nkomo Village.

'These facilities accept waste from papers, glass, metals, and plastics.'

In addition, the Final IWM Plan, 2024, lists facilities existing within the municipality that accept recyclables, however these are not accessible to the community of Nkomo Village.

f) The influence of income, gender, education, and occupation on the lack of waste storage containers as a key challenge

Data collected with questionnaires, as presented in Table 4.7, indicates that only 12 respondents out of 155 are affected by the lack of waste storage containers in their households. Both females (50%) and males (50%) are affected at equal numbers where the younger age group below 19 and older age groups 50 to 59 and above 60 years are less represented (8% each) among other groups mostly affected 30 to 39 age group (33%), followed by 20 to 29 years (25) and 40 to 49 years age group (17%). A large percentage of unemployed respondents (75%) and respondents with matric (50%) are affected by the lack of waste storage containers. Similarly, respondents who earn less than R1000 monthly are the most affected at 50%. Followed by R1 001 and R3 000 income groups (16%), made up of pensioners and social grants respondents.

Table 4.7: Triangulating the influence of Income, Gender, education, and occupation on Lack of waste storage containers as a key challenge

Demographic factor	**Category**	**Lack of waste storage containers**	**Percentage %**
Gender	Female	6	50%
	Male	6	50%
Age	< 19	1	8%
	20-29	3	25%
	30-39	4	33%
	40-49	2	17%
	50-59	1	8%
	>60	1	8%
Education	No schooling	1	8%
	Some primary	1	8%
	Primary completed	0	0%
	Some secondary	1	8%
	Matric	6	50%
	Some tertiary	2	17%
	Tertiary	1	8%
Occupation	Professional	1	8%
	Managerial/technical	1	8%
	Non-manual/skilled	0	0%
	Manual/skilled	0	0%
	Partly skilled	0	0%
	Unskilled	1	5.55%
	Self employed	1	4%
	Does not work	9	75%
Income	Under R1 000	6	50%
	R1 001 and R3 000	2	16%
	R3 001 and R6 000	0	0%

	R6 001 and R10 000	0	0%
	R10 001 and R12 000	1	8%
	R12 001 and R15 000	1	8%
	R15 001 and R20 000	1	8%
	Above R20 000	1	8%

Insight collected on participant observation exercise, indicates that most households rely on reusing waste plastics to keep waste until such time it can be disposed of. It was observed that no household has an enclosed type of container for the storage of waste. Information provided by the municipal officials also indicates that there is no provision of such waste storage containers to households of Nkomo Village, even though the municipal official indicated that in some areas, communal skips are placed for the community to utilise. Upon observation, no such skips were observed in Nkomo Village. The municipal officer reported:

'The municipality does not provide refuse bins for Nkomo Village as the village falls outside of the municipal waste service areas.'

Furthermore, the GGLM Waste Management By-Laws (2022) stipulate tariffs imposed on the provision and supply of refuse bins.

g) The influence of income, gender, education, and occupation on training and awareness on proper waste management as a key challenge

Data presented in subsection 4.3 above, indicate a significant challenge in the local initiatives led by the municipality on waste management programmes within the village, as out of 155 respondents, only 4 respondents (3%) have been involved in an initiative organised by local authorities. They mentioned that they vividly remember being involved in an initiative by the municipality where litter was collected around across the village.

This combination of minimal training and poor awareness suggests that many community members are either unaware of opportunities to participate or that the municipality has not effectively raised awareness on proper waste management practices within the village. Furthermore, information collected through interviews from the municipal officials contradicts the findings from questionnaire results. While the officials reported that the municipality conducts training and awareness initiatives on waste management practices, it was revealed during interviews that these trainings and awareness initiatives do not reach villages such as Nkomo village. A large percentage (97%) of the respondents reported that they do not have any knowledge of such initiatives within the village. Additionally, the municipal officials indicated that plans for initiatives for collecting illegally dumped waste exist; however, these initiatives are not adequately communicated to the community. This is evident from the fact that a very low percentage of respondents reported participating in an illegal dump waste collection event in the village.

4.4 Current SWM Practices and Policies in Place Within Nkomo Village, Limpopo

Section 2 of the questionnaire required that participants provide the type of waste generated and how each type is disposed of per household. Households generate various types of waste, including organic, plastic, paper, glass, metal, electronic, hazardous, and other waste categories were revealed by participants. Sanitary pads, nappies, animal caucus, and ash as other waste categories revealed by respondents. The questionnaire provided disposal methods for each waste stream; however, participants also provided other methods, and the following methods were recorded overall: municipal waste collection, open dumping, burning, burying, recycling, reuse, animal feeding, composting, special hazardous waste collection, pit toilet dumping, disposing in town skips, and storage. In addition, qualitative data was collected through observations on waste disposal observed in these households to also validate information obtained through questionnaires.

Furthermore, data obtained from interviews with officials from the GGLM provided insight as to the influencing factors towards waste management practices adopted in Nkomo Village, as it revealed exclusion of villagers in the provision of services, whether collection, provision of communal skips, waste storage containers, waste recycling facilities, and proper waste management awareness training.

Documents reviewed include the GGLM Integrated Development Plan for 2025/2026 obtained from the municipal website, the GGLM IWM Plan (2024), and the GGLM approved Waste Management By-Laws (2022), obtained from municipal officials. These documents provided insight into how waste management is governed within the GGLM and the effects on villages like Nkomo Village.

4.4.1 SWM Practices

Data as presented in table 4.8 below, indicates a mix of traditional and more sustainable waste management practices, with a notable reliance on informal disposal methods like open dumping and burying for most waste types at 8 waste streams for each disposal method. Followed by the burning of waste as a disposal method for 7 waste streams. Data indicate that these three disposal methods are significantly more prevalent than proper methods like recycling and reuse across most waste types, with these informal methods being used in around 3 and 4 waste streams, respectively. Data collected through questionnaires revealed that municipal waste collection is not an option at all, as these services are not provided for the villagers, as also confirmed through interviews with municipal officials and participants' observations that households rely on backyard pits for waste management in the village.

Some respondents indicated the use of municipal skips in town for disposal of their household waste for 06 waste streams. This practice is observed as influenced by participant occupation, as it is mostly done by participants who work in town and who drive to work.

‘I sometimes take my solid waste to municipal town skips, it easier for me as I use my car every day to work’.

Animal feeding involves 1 waste stream, specifically, scrap foods being given to animals such as chickens, goats, sheep, and dogs. This practice is common among households as noted during participant observation. Additionally, some households consider open dumping of food, ash, and garden waste as composting, which involves 3 waste streams in this case. This method is perceived to produce nutrients for the soil, useful for ploughing purposes amongst respondents.

'Waste from food scraps ash and garden waste is valuable for us who plough for vegetables.'

A total of 4 waste streams, including hazardous chemicals, medical waste, sanitary pads, and ash, are identified for disposal through pit toilet dumping. As discovered during discussions with participants, pit toilet disposal involves depositing this specific waste into the pit with the expectation that the waste will biodegrade along with the sewage and will be less toxic over time.

Data revealed that waste like glass bottles, waste streams, and electronic waste streams in some households are stored as a result of not knowing how they can be managed or due to inadequate options like recycling in the village, as established during open discussions with respondents. Observations of participant also confirmed that some households opt for storing old appliances and bottles in their yards. Interestingly, a total of 6 waste streams, animal caucus, old appliances, sanitary pads, nappies, medical waste, and hazardous chemicals were recorded as not being produced by some households in the village.

Table 4.8: Data collected on each waste stream against the above-listed disposal methods.

	Municipal waste collection	Open dumping	Burning	Burying	Recycling	Reuse	Animal feeding	Composting	Special hazardous waste	Pit toilet dumping	Disposed in town skips	None	Storage	Number of methods used per
Organic waste (food scraps, garden waste)		**18**					**13 7**	**13 7**						**3**

Plastic waste (bottles, bags, containers)		**36**	**7**	**7**		**108**					**4**			**5**
Paper waste (newspapers, cardboard, packaging)		**79**	**139**			**12**					**4**			**4**
Glass waste (bottles, jars)		**63**	**13**	**7**	**11**	**9**					**3**		**15**	**7**
Metal waste (cans, foil)		**102**	**39**	**39**	**11**						**3**			**5**
Electronic waste (batteries, old appliances)		**14**	**33**	**55**	**2**	**72**					**2**	**68**	**43**	**8**
Hazardous waste (chemicals, paints)				**127**						**28**		**35**		**3**
Other wastes:			**86**							**69**		**102**		**3**

Sanitary pads														
Other wastes: Nappies			**77**	**111**							**4**	**44**		**4**
Other wastes: Medical waste				**5**						**3**		**147**		**3**
Other wastes: Animal caucus				**17**								**138**		**2**
Other wastes: Ash		**43**						**58**		**7**				**3**
Number of waste streams per waste management method used	**0**	**8**	**7**	**8**	**3**	**4**	**1**	**2**	**0**	**4**	**6**	**6**	**2**	

4.4.1.1 Waste streams and disposal practices

a) Waste management practices for Organic waste (garden waste and food scraps)

Organic waste has three types of disposal methods in the village. Animal feeding and composting are the common means of managing organic waste in the village, with 137 respondents each indicating that food scraps are either fed to chickens, goats, sheep and dogs in their household. Respondents highlighted the benefit also from garden waste in generating compost for their fields. Respondents expanded and linked these

practices to their traditional value recovery methods of seeing value in food scraps and garden waste. Only 18 respondents indicated that they use open dumping as a disposal method for organic waste, as indicated in Table 4.8.

b) Waste Management Practices for Plastic, Paper, Glass, and Metal Waste Streams

Table 4.8 show that plastic waste is primarily managed through reuse, with 108 respondents reporting the use of plastic waste such as bottles, bags, and plastic containers for the storage of food, water, and waste. This practice was also observed during participants' observation of waste management practices within the households. Followed by open dumping at 36 respondents, indicating that they dispose of their plastic through open dumping, together with paper waste (79 respondents) and glass (63 respondents). Open dumping is a common practice for paper waste; however, respondents indicated that to prevent paper waste from littering, burning is the normal second step to open dumping over time (139 respondents). Similarly, with metal waste, 102 respondents indicated that open dumping is the common practice (102 respondents), followed by burning (39 respondents), burying (39 respondents), and sometimes recycling (11 respondents).

Glass waste is commonly dumped (63 respondents) and burned (13 respondents), but also has significant recycling (11 respondents), reuse (9 respondents), and storage (15 respondents). A notable number of respondents indicated that they dispose of their plastic waste (4 respondents), paper waste (4 respondents), glass waste (3 respondents), and metal waste (3 respondents) in the municipal skips in town. Overall, the waste management practices for these waste streams among respondents show a reliance on multiple methods depending on the waste type. However, open dumping and burning practices are widespread across all waste streams, while reuse and recycling occur to varying extents depending on the waste stream.

c) Waste management practices for electronic waste and hazardous waste

Data from respondents revealed that the common waste management practices for hazardous waste are burying, with 127 respondents indicating that they bury hazardous waste, such as pesticides, to prevent poisoning and improper use within households, as illustrated in Table 4.8. A total of 28 respondents indicated that they dispose of such hazardous chemicals in the pit toilet with an expectation that it will

degrade with sewage. Some households (35 respondents) indicated that they don't produce hazardous waste within their households. When comparing electronic waste to hazardous waste, electronic waste has a variety of waste management practices utilised among respondents. The common practices are burying (55 respondents) and storage (43 respondents). Participants explained that they typically store electronic waste, such as old appliances, for some time in the hope that the item may still be of use once the appliances become very old and begin to deteriorate.

Burying is chosen as the preferred disposal method, since at this stage, the electronic waste poses a potential hazard. A notable 14 respondents indicated that they dispose of electronic waste like fridges through open dumping in the field electronic waste like fridges. They explained that this type of electronic waste poses a hazard as children play around with it. A large number of respondents indicated that they fix and reuse electronic waste, with 72 respondents indicating such. Only 2 respondents indicated that they dispose of their old appliances in the waste kips in town, and 68 respondents indicated that they don't produce electronic waste.

d) Waste management practices for other wastes (sanitary pads, nappies, medical waste, animal caucus, and ash)

Other waste streams generated among households, having varying disposal methods include sanitary pads, nappies, medical waste, animal caucus, and ash. Figure 4.1 compares the prevalence of each practice against each waste stream. The most common waste among the waste types is the nappies, where burning (77 respondents) and burying (111 respondents) are more prevalent when compared to sanitary pads disposal methods second common waste, with 86 respondents burning this waste and 69 respondents disposing in pit toilets. The generation of nappies as waste among households is higher than the generation of sanitary pads among households, as 102 out of 155 households indicated that they don't generate such waste, while 44 households indicated that they don't generate nappies as waste.

Other wastes generated in smaller quantities are medical waste (8 respondents), animal caucus (17 respondents), and ash (108 respondents). Among the three waste types, only ash is used in a beneficial practice involving composting, with 58 respondents indicating that ash is useful for composting and 43 respondents indicating that open dumping of ash is beneficial to the soil for ploughing purposes. A total of 17

respondents explained that animal caucus are buried upon discovery. Similarly, with medical waste, 5 respondents indicated that they bury waste like bloody bandages, syringes, and expired medication. Some participants (3 respondents) indicated that it is much safer for them to dispose of waste in a pit toilet to avoid children being exposed to this type of waste. Most respondents expressed that:

'With the lack of proper support from the municipality, through provision of waste storage containers, communal waste skips and also collection, we have no choice but to utilise what is already available and has been working for us over the years'.

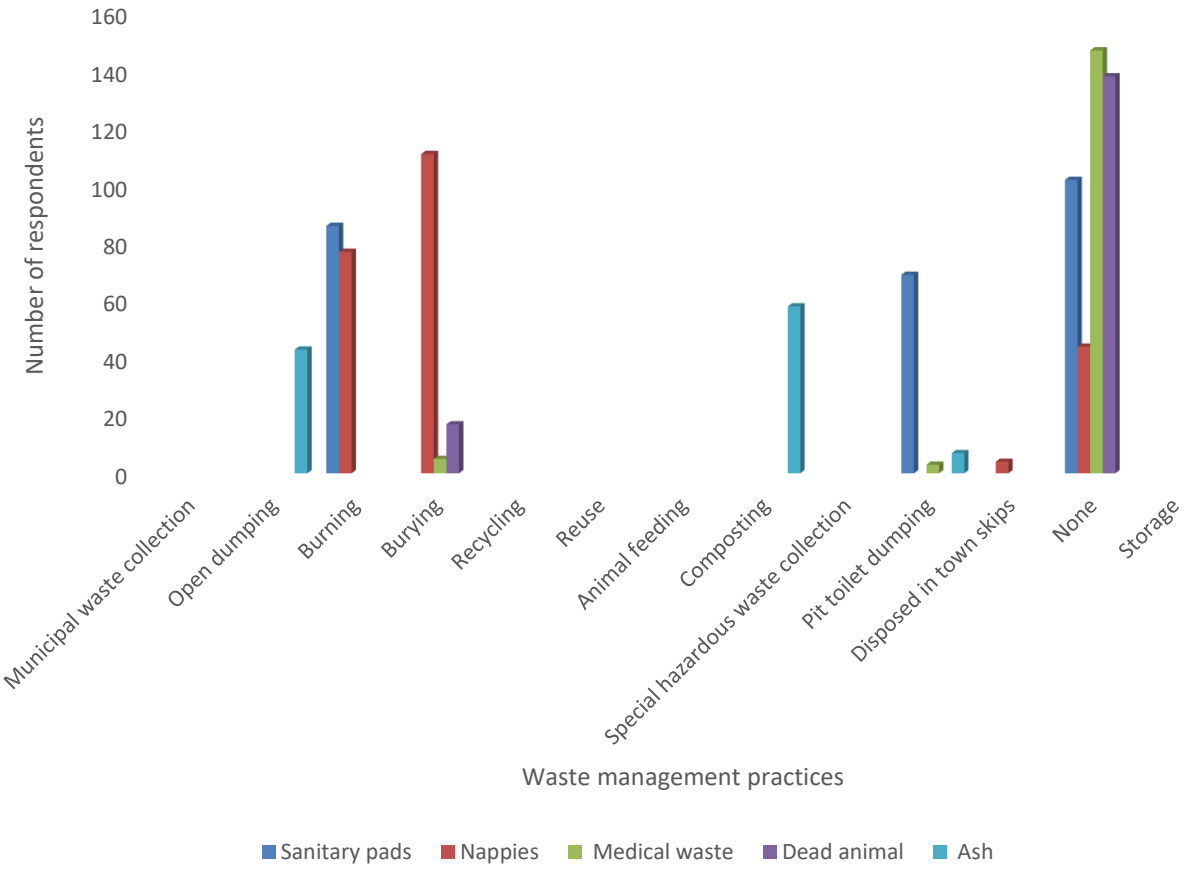


Figure 4.1: Waste Management practices for other wastes (sanitary pads, nappies, medical waste, animal caucus, and ash)

4.4.2 Frequency of waste disposal per household

The frequency of disposal of waste among respondents is mostly weekly. A total of 144 respondents indicated that they dispose of their waste weekly. Respondents explained that waste is kept in plastics and old baskets as fewer households were

observed storing waste in enclosed bins, until such time it can be disposed of, whether by open dumping, burying, burning, or recycling. The observation of participants discovered that larger households tend to dispose of waste daily. Respondents indicated that burning and burying of waste is a weekly exercise, as illustrated in Figure 4.2.

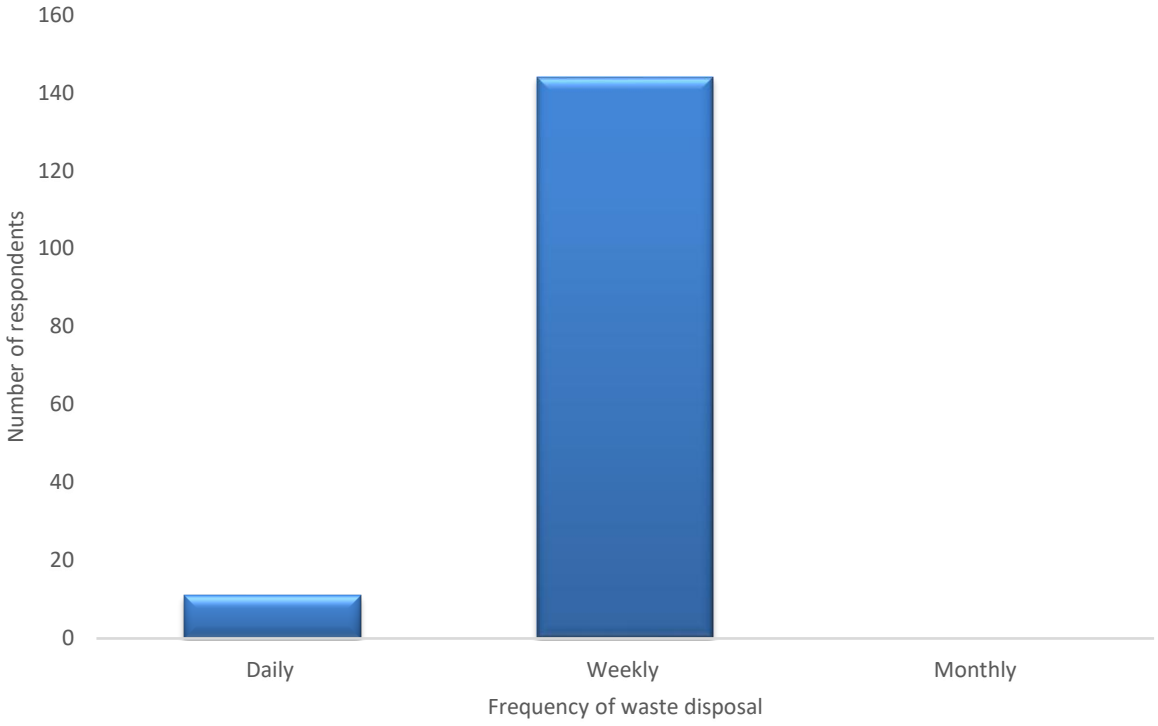


Figure 4.2 : Frequency of waste disposal per household

4.4.3 SWM policies in place within Nkomo Village, Limpopo

In compliance with the National Environmental Management Waste Act, Act 59 of 2008 (NEMWA), as amended, the GGLM developed IWM Plan approved in 2024. This plan aims to identify gaps and needs in current waste management practices and to establish goals and objectives aligned with the National Waste Management Strategy, 2020. One key objective of the Final IWM Plan, 2024, objective focuses on expanding waste service coverage within a 4 to 7-year timeframe. This involves identifying areas currently lacking waste collection services and gradually extending these services to those areas through a phased approach, increase of drop-off facilities such as communal skips, and providing waste by-back centres to villages for waste recycling. However, interviews with municipal officials reveal that this expansion remains conceptual at this stage. The municipality has yet to allocate a budget or assign

specific activities to operationalise the expansion of waste services to unserved areas such as Nkomo Village. The 2025/2026 IDP indicates that these activities have not been budgeted for the current and the two coming financial years. Currently, it is unclear whether Nkomo Village will be included in these future service expansions.

The Final IWM Plan, 2024 also outlines longer-term (4-7 years) goals that could directly benefit communities like Nkomo Village. These include the establishment of waste drop-off facilities within the municipality, composting, recycling, and training and educational campaigns to raise awareness, which could benefit areas like Nkomo village. Additionally, the plan proposes updating the GGLM Waste Management By-Laws (2022) to improve enforcement against waste-related offences. The existing by-laws impose tariffs on refuse collection and removal services, provision and supply of refuse bins, and Chapter 7 explicitly prohibits open dumping of waste, prescribing penalties of either a R2000.00 fine or imprisonment for the offender.

Despite these policies, interviews and review of the Final IWM Plan, 2024 and 2025/2026 IDP reveal significant enforcement gaps. The findings indicate that there is currently a gap in the enforcement of laws in particularly for illegal dumping. Furthermore, the policies and bylaws do not adequately address the current waste management practices or the socio-economic realities of Nkomo Village, as detailed in Section 4.2 above. This disconnection highlights the need for policies that are better tailored to local conditions and challenges faced by the community.

4.5 Actionable strategies proposed for improving the effectiveness of SWM in Nkomo Village, Limpopo, considering local needs and constraints?

Section 4 of the questionnaire asked participants to identify strategies they have employed over the years to cope with the challenges they face in managing their waste. As shown in Figure 4.3, participants were required to select from a list of strategies and specify any additional approaches not included. These strategies include reducing waste generation, reusing materials instead of discarding, participating in community clean-up initiatives, composting organic waste, utilising recycling services or facilities, and educating others about effective waste management practices.

Additionally, participants reported other methods such as disposing of waste in town waste skips and using pit toilets for the disposal of specific waste types, including sanitary pads, medical waste, and hazardous substances. However, many of these approaches are not sustainable or easily replicable across the Nkomo Village demographic and logistical factors. For example, disposing of waste into waste skips in town is viable only for households that frequently travel to town and have access to vehicles for transporting waste. Such strategies largely stem from the respondents' limited alternatives for waste management within the village.

Given these constraints, it is crucial to develop sustainable strategies that build upon existing waste management practices within Nkomo Village, practices that are safer and exert less environmental impact. The data demonstrate that some of these community-adopted strategies hold promise for wider implementation.

Data obtained from questionnaires was corroborated through direct observations of the existing makeshift waste management practices. Participants further highlighted the insufficient efforts by the municipality and tribal authorities in enhancing waste management services in Nkomo Village. When asked whether these authorities are effectively addressing waste management improvements, 155 participants overwhelmingly indicated a lack of action. Participants expressed the following:

'These authorities are not doing anything that we can point. We are left to deal with issues that require services from the municipality, and nothing ever changes.'

'We are not a priority to the government.'

Municipal official interviews revealed that challenges in the current SWM system in Nkomo Village are directly linked to broader municipal issues, including limited facilities, budgetary constraints, and insufficient personnel, which collectively hinder effective service delivery. Municipal officials stressed that actionable strategies should focus on assessing and optimising existing resources, while advocating for increased governmental support and funding to ensure that rural communities like Nkomo Village get to benefit from basic services, through duplicating programs which have been observed as successful in other villages within the municipality, with communal waste skips to Nkomo Village. The municipal officials expressed that:

‘*Successful initiatives have been witnessed in other areas within the municipality that could be replicated in Nkomo Village. If more skip bins are placed and Extended Public Works Programme (EPWP) participants deployed to monitor and clean the surrounding of the skip bins daily and participation of community members in clean-up campaigns and awareness education programmes.’*

‘Our priority is to strengthen existing resources and advocate for better funding so that rural villages like Nkomo can finally access basic waste services. What has worked in other villages, like communal waste skips should also be extended to Nkomo.’

‘At the end of the day, our biggest limitation is the budget. Without adequate funding, even well-designed waste management plans cannot be implemented effectively in villages like Nkomo.’

‘As a long-term goal, villages like Nkomo must be included for household collection of refuse.’

In addition, the Final IWM Plan, 2024 provides a comprehensive framework to guide both short and long-term strategies aimed at addressing the challenges effectively. This plan sets out clear objectives that hold significant potential to benefit villages such as Nkomo Village if implemented effectively.

4.5.1 Reduce waste generation

Data collected from questionnaires indicates that 37 out of 155 respondents have consciously adopted the strategy to reduce waste generation within their households. This reflects a proactive approach among a significant portion of the community towards reducing volumes produced at source. Furthermore, Table 4.8 shows that repurposing of plastic material, paper, glass, and composting and feeding of animals with scrap food are some of the practices that respondents have adopted to reduce waste generation. This quantitative data is corroborated by qualitative insights gathered through participant observation, where it was noted that many households in Nkomo Village inherently produce relatively small amounts of waste.

Observations indicate that due to socioeconomic factors, limited consumption practices, and cultural practices, residents tend to generate less waste compared to their urban counterparts. For example, Table 4.8 present that many households rely on reusable containers, avoid single-use plastics, as they use these for storage of food, waste, water, and other storable substances. In addition, most respondents highlighted that they consume primarily unpackaged foods or minimally packaged food items:

'We rely on variety of dark green leafy vegetables (morogo) and other vegetables, packaged food from the shops is not consumed as much.'

'Shopping bags and plastic containers are reusable for us; we use them to store food and waste.'

This naturally lower volumes of waste suggests that community members may be predisposed towards sustainable waste habits, even if driven by necessity. These findings highlight the existence of basic sustainable waste management practices that can be enhanced through education, access to sustainable alternatives, and policy interventions.

4.5.2 Reuse materials instead of discarding

Data obtained from questionnaires indicate that 96% of respondents in Nkomo Village, regardless of demographics and socioeconomic differences, engage in practices of reusing materials instead of discarding, as illustrated shown Table 4.8. This widespread behaviour represents foundational sustainable waste management practices already present within the community, offering a strong basis for further enhancement and promotion.

Glass, paper, plastics, and electronic waste are the most commonly reused materials among respondents as recorded in Table 4.8. Further discussions with respondents indicate that plastic waste is the most reusable material among participants (108 respondents) as it provides storage, plastic containers provide storage for food and waste, plastic bottles provide storage for liquids, and plastic bags provide storage for valuables to waste.

In contrast, paper waste was less common, with 9 respondents reporting the reuse of this material, mostly newspaper and magazines. These paper products are primarily reused for tasks cleaning, sanitary purposes, storage, and for educational projects, particularly in households with school-going children.

4.5.3 Participate in community clean-up initiatives

Only a small proportion, 3% of respondents, indicated participation in community clean-up programmes planned by the municipality as one of the strategies they have employed over the years to cope with the challenges faced in illegal waste dumping within the village. Specifically, just 4 out of 155 respondents, indicated involvement in these initiatives. Despite the current participation rate, community engagement in waste management remains a key priority within the municipality's Final IWM Plan, 2024 and is explicitly identified as a realistic and important objective in the 2025/2026 IDP. In addition, municipal officials suggested the formal training for youth within the village as a strategy to build long term awareness and to strengthen community participation in proper waste management:

'Giving formal training to youth within Nkomo village will alleviate illegal dumps and enhance capacity building within the community, and ongoing waste management programmes will assist in addressing the environmental problems.'

4.5.4 Compost organic waste and ash

A significant majority of 93% of respondents reported actively composting organic waste (food scraps and garden waste) and ash, as shown in Table 4.8. Respondents highlighted that composting these materials has been a longstanding traditional practice within the village, valued for its ability to enrich soil and support cultivation. This is further evidenced in Table 4.8, where 137 respondents for organic waste and 58 respondents for ash identified composting as their primary waste management method compared to other practices. These findings indicate that composting is a widely adopted and practical strategy for improving waste management in the village, underscoring the need to support and promote its sustainable expansion. Some participants expressed:

'Food scraps, garden waste and ash are beneficial because they help enrich the soil.'

In addition, the Municipality's Final IWM Plan, 2024 recognises household composting promotion as its long-term plan objective within a 4 to 7-year timeframe, alongside plans to establish community-scale composting facilities. These efforts aim to better manage organic waste and alleviate pressure on landfill sites.

4.5.5 Use recycling services or facilities

Out of the 155 respondents, 17 acknowledged that their recycling efforts not only contribute to their socio-economic wellbeing but also contribute to waste management in the village. Although recycling facilities are either inaccessible or are located far from the village, the incentive attached to recycling has nonetheless encouraged this small group of respondents, as shown in Figure 4.3. One participant who practices recycling reported.

"I collect cans and keep them until I can go to town to recycle them for cash.'

Furthermore, the Final IWM Plan, 2024 also outlines longer-term (4-7 years) goals that could directly benefit communities like Nkomo Village. These include the establishment of waste drop-off facilities within the municipality, conveniently located near villages like Nkomo Village.

'The municipal officers highlighted this need for construction of buyback centre and recycling centre.'

However, the current 2025/2026 IDP lacks adequate planning and budgeting for these initiatives in the coming years. Provide proper planning and budgeting for the coming years. Prioritising and integrating such measures into the IDP will enhance waste recycling efforts in the village, potentially boosting both recycling rates and associated socio-economic benefits.

4.5.6 Educate others about waste management practices

Nearly half of the respondents believe that the awareness shared among family members and within the community on proper waste management practices has played a significant role in the coping strategies they have adopted over the years.

'We have always known that waste must be covered with soil after disposal into the open pit, that is what we tell our children to also do when disposing waste in the open pit.'

However, out of 155 respondents, only 4% of respondents reported receiving formal waste management training through schooling. This contrasts with the municipality reports claiming that waste management awareness training sessions are conducted in Nkomo Village. This discrepancy highlights a clear gap between reported municipal activities and on the ground realities. With effective and well-implemented waste management awareness programs by the municipality, the community could be better empowered to share among family members and community members proper, sustainable waste management practices.

4.5.7 Dispose of waste in town waste skips

A low percentage (5% respondents) consider that the efforts to take waste to town waste skips contribute to waste management in their households. This strategy is considered an alternative to open dumping, burning, and burying of waste among these households. One respondent indicated the following:

'I use my bakkie to collect our household waste for disposal in municipal town skips, weekly when I go to town.'

This strategy is not sustainable, and it is influenced by socio-economic factors among respondents. The practice is mainly a response to challenges highlighted in Table 4.2.

4.5.8 Use of pit toilets for the disposal of specific waste types, including sanitary pads, medical waste, and hazardous substances

Pit toilet disposal has become a solution for certain waste types, including sanitary pads, medical waste, hazardous substances, and ash in Nkomo Village. A total of 69 respondents consider this practice a strategic response to challenges faced in disposing of such waste in their households. Although the use of pit toilets for disposing of specific waste types is a long-standing practice, it may not be sustainable due to potential environmental and health risks. Alternative waste management methods should be explored and implemented. The Final IWM Plan, 2024 proposes

several goals achievable in 4-7 years for the provision of public drop-off locations for household hazardous waste and the goal to run public awareness campaigns to inform households on the handling of hazardous waste and available collection systems.

4.5.9 Animal feeding (food scraps)

An impressive 89% of respondents reported utilising food scraps for feeding animals, a rate comparable to composting as shown in Figure 4.3 below. Specifically, 137 respondents indicated that food scraps are either fed to chickens, goats, sheep, and dogs or used as compost in their household, as shown in Table 4.8. This practice is deeply embedded in the village's cultural traditions, reflecting a view that food scraps are seen as a valuable reusable resource. With appropriate support and guidelines, promoting this method could significantly reduce the quantities of food waste disposed of through open dumping, burying, and burning, contributing to more sustainable waste management.

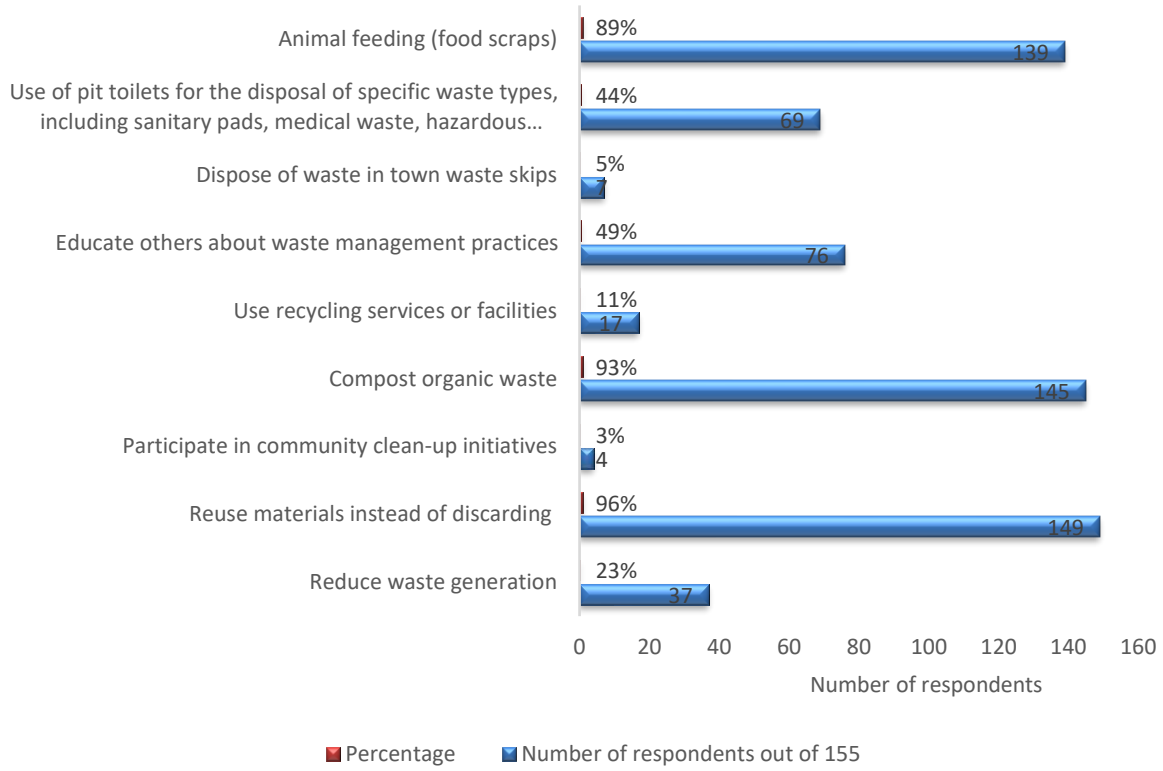


Figure 4.3: Actionable strategies adopted within Nkomo Village

4.6 Conclusion

This chapter presents data collected representing the demographic dynamics of Nkomo Village, while highlighting the challenges faced by the community in managing their waste. Inadequate facilities for composting or recycling, limited space for waste storage, and a lack of access to waste collection services are highlighted as the biggest challenges faced by this community across all demographic factors. These challenges predominantly affect unemployed, matriculated females aged between 30-39, as illustrated by the results above. These challenges have a link to the waste management practices adopted within this community. Data collected from both the community and the municipal officials, and documentation indicate that there is not much intervention from the municipality in assisting the community to improve recycling, composting, and waste collection services.

Residents of Nkomo Village resort to informal disposal methods such as open dumping, burning, and burying of waste. There is a lack of training in the handling of specific wastes, as a variety of disposal practices are adopted by households, which pose an environmental and health risk. These include disposal of hazardous waste in pit toilets and the exposure of children to hazards from waste appliances. Even though the municipality has several documents aiming to improve waste management within the municipality, the Final IWM Plan, 2024 has been identified as a tool in this study, when implemented, can influence policy review, implementation, and enforcement.

CHAPTER 5: DISCUSSIONS

5.1 Demographic Factors

The demographic data as presented in Section 4.2 introduces an important understanding into characteristics of the community of Nkomo Village and the prospective effect they have toward waste management. The demographic factors highlight the socio-economic factors as barriers slightly influencing practices and attitudes towards waste management in the community.

Studies revealed that women and children, often bear the responsibility for managing household waste in rural communities (Cogut, 2016; Mebratu & Mbandi, 2023). Similarly, the results of this study indicate that 52.25% of respondents were women as compared to 47.75% of respondents being male. Highlighting the role of females in household waste management. Age distribution indicate that the highest percentage of respondents were aged between 30-39, at 33.55% respondents, highlighting the age group's active role in household waste management and its potential contribution to future sustainable waste management initiatives in Nkomo Village (Raphela et al., 2024).

The study reveals that over half of the respondents had some level of education, with 50.97% respondents with matric qualification and others having tertiary education. Research highlights that education is an important factor in influencing sustainable waste management practices. Scholars such as Oduro-Appiah et al. (2022); Gharagozloo & Ghazizade (2023); Daoud et al. (2025) emphasises the idea that socio-economic factors, such as education and income, impact individuals' attitudes towards waste management. This high level of education demonstrates the community's potential to adopt and sustain effective waste management practices.

Conversely, the largest proportion of respondents at 47.74% reported earning less than R1000 per month. The low-income level presents both positive and negative implications. On one hand, it may reflect limited affordability and lower consumption leading to lower levels of household waste generation. Studies such as Liu et al. (2019); Soysa et al. (2023); Zhang et al. (2024) indicate that socio-economic conditions such as income, influences consumption patterns, amounts and type of solid waste generated. On the other, low-income groups may indicate strong potential

for participation in future recycling initiatives to generate income and contribute to the community socio-economic development, as highlighted by Mofokeng et al. (2022); Omotayo (2024); Raphela et al. (2024).

Moreover, the unemployment rate of 72.90% among residents, further aggravate the socio-economic constraints while highlighting the need for tailored, context sensitive strategies that observe the socio-economic realities within Nkomo Village. Such solutions could take advantage of the community's demographic attributes to promote sustainable and comprehensive waste management practices aligning to the local needs and capacity.

5.2 Challenges Faced by Nkomo Village, Limpopo, in SWM

The results indicate that the village does not receive any formal waste management services from the municipality, as all respondents 100% indicated that they are not aware of any waste collection services within the village. In addition, 80% respondents highlighted the lack of waste collection services as a challenge within the village, indicating that there is an assumption that waste collection is required amongst households in the village. This finding verifies the data published by Statistics South Africa, 2023, which reported that 78.8% of rural households do not receive waste collection services.

These gaps in service provision contribute directly to the SWM challenges faced by the community of Nkomo Village reflecting broader disparities between urban and rural contexts urban areas. Studies indicate that urban areas often benefit from established infrastructure and funding, while rural communities face additional barriers such as geographical isolation, limited technical expertise, and inadequate governance frameworks (Karthikeyan et al., 2018; Vinti & Vaccari 2022).

Furthermore, the legacy of apartheid continues to impact governance structures in these municipalities, as Villages like Nkomo Village still lack basic services, as studies indicate (Fakoya, 2014; Dlamini et al., 2017; Mahosi, 2025; Sebola-Samanyanga, 2025). The GGLM Waste Management By-Laws (2022) governing Nkomo Village puts the rural-urban disparities into context. The By-Laws do not cater specifically for Nkomo village. Furthermore, the By-Laws disregards the fact that such villages are excluded from the municipality servicing areas hence, the reliance to open dumping,

burning and burying of solid waste is prevalent in these villages. Moreover, the By-Laws poses hush penalties for these types of SWM practices. Therefore, enforcing the current by-laws on villages like Nkomo Village would affect the community's socio-economic wellbeing and would be unfair considering that no provisions are made to cater for sustainable SWM in such villages.

The identification of limited space for solid waste storage as a significant challenge for 80% respondents is closely linked to the same proportion reporting a lack of access to formal waste collection services (80%), alongside 7.74% respondents citing the absence of proper waste storage containers. Due to their exclusion from formal municipal waste management, households in the village are compelled to rely on informal disposal methods such as open dumping, burning, and burying, all of which require available space within their yards, as highlighted by previous studies (Henry et al., 2006; Mohammed et al., 2013). The practices do not only contribute to environmental contamination, air, soil, and water pollution but also result in emission of greenhouse gases. Consequently, leading to ecosystem degradation, compromising biodiversity, and increases community exposure to health risks associated with the presence of toxins and pollutants (UNEP, 2018; Rodseth et al., 2020; Ramadan et al., 2022).

The triangulation of variables such as gender, age, income, education, and occupation reveals significant correlations and disparities in how different groups experience SWM challenges within Nkomo Village. While waste management issues affect the village overall, the study highlights that the interplay of these demographic and socio-economic factors significantly influences knowledge levels, attitudes, access to resources, and the adequacy of infrastructure across the community. The majority of respondents were female (52.25%) and under 40 years old, with unemployment standing at 72.90%. Most households subsist on low monthly incomes, often below R1000, limiting their capacity or motivation to participate actively in proper waste management.

These findings resonate with extant literature emphasizing the important role of socio-economic status in shaping household waste behaviours and environmental perceptions. Scholars such as Madonsela et al. (2024) and Zhang et al. (2024) have demonstrated how poverty, unemployment, and low educational attainment correlate

with low environmental awareness and low participation in recycling or composting initiatives. This interplay mirrors the observations from Nkomo Village, where economic constraints restrict access to waste storage solutions and formal waste services, thereby reinforcing cycles of inadequate waste disposal and environmental degradation. In addition, a theoretical perspective, social practice theory, provides a valuable insight for interpreting these dynamics by indicating that social behaviours are shaped by social contexts, cultural norms, and community practices, indicating that the established traditions and collective behaviours influence how waste is managed in rural communities such as Nkomo Village (Welch, 2016; Frost et al., 2020).

In Nkomo Village, insufficient recycling knowledge is predominantly reported by unemployed respondents, with 73% acknowledging inadequate understanding, a level significantly higher than that among employed groups. Although individuals with matric-level education tend to be more aware of recycling challenges, yet still exhibit significant gaps, indicating that formal education alone does not fully address the important deficiencies in recycling awareness within rural communities like Nkomo Village. This situation is exacerbated by limited community participation in recycling and education programs; a problem linked to fragmented governance structures highlighted by studies by Kubanza et al. (2021); Viljoen et al. (2021). Moreover, nearly half of respondents earning less than R1000 monthly report shortcomings in recycling knowledge, while some higher-income groups also express concerns. These findings strongly reflecting the lack of accessible recycling facilities and programs in the village influencing the negative attitudes towards participants.

The findings highlight the failure of the GGLM in providing adequate infrastructure and lack of support suitable for Nkomo Village in promoting effective sustainable waste management practices. Furthermore, the findings of the study contradict literature aligning the lack of awareness and negative attitudes toward formal waste management with littering and illegal dumping (Masood et al., 2014; Manun'Ebo & Ndombe, 2020; Rousta et al., 2020). In alignment with Rodseth et al., 2020, the study established that even though the community still rely traditional waste management practices, the village remains aesthetically clean with no litter as compared to urban townships.

Similarly, limited space for waste storage disproportionately affects unemployed and low-income groups, particularly those aged 30 to 39, earning under R1000 monthly, with women slightly outnumbering men in reporting this constraint. This finding aligns with studies highlighting women traditional roles in household waste management, as females often bear the responsibility for managing household waste in rural communities (Cogut, 2016; Mebratu et al., 2023). Participant observations further corroborated this, revealing that households rely on disposing of waste in various locations for open dumping, burning, burying and even storage, both within and just outside their yards.

Overtime, these waste pits become filled, prompting the need to find new disposal spots. Such practices not only lead to environmental contamination, air, soil, and water pollution but also result in emission of greenhouse gases as studies indicate (Henry et al., 2006; Mohammed et al., 2013; Rodseth et al., 2020; Mukwevho et al., 2024). Consequently, leading to ecosystem degradation, compromising biodiversity, and increases community exposure to health risks associated with the presence of toxins and pollutants (UNEP, 2018; Rodseth et al., 2020; Ramadan et al., 2022).

Studies conducted by Oduro-Appiah et al. (2022); Gharagozloo & Ghazizade (2023); Daoud et al. (2025) education and income, was found to impact individuals' attitudes towards waste management, resulting in varying perceptions and practices across different backgrounds. In contrast, negative attitudes towards waste management in Nkomo Village exist across all demographic groups and more pronounced among females (52.22%) compared to males (47.77%). The working-age adults in the 30-39 age bracket being the most dissatisfied. These attitudes do not imply intentional disregard but reflect a combination of limited awareness and absence of municipal services that make formal practices seem impractical. This trend displays municipal service failures as the main contribution to the attitudes of participants on waste management. Socio-economic difficulties such as poverty and unemployment compound this challenge among the residents, as they tend to rely on waste management practices guided by African indigenous knowledge. Therefore, in this study negative attitudes are understood as context driven behavioural responses rather than inherent attribute of the community of Nkomo Village.

African Indigenous Knowledge Systems when explored in indigenous communities such as Nkomo Village, provides restorative justice through community and cultural engagement as studies indicate (Muzvondiwa, 2021; Mawere & Tshamano, 2023). Data regarding provision of training and awareness and programs on waste management indicates a disconnect between the municipality and the residents of Nkomo Village. The results indicate that as much the municipality plans such initiatives, they do not reach villages like Nkomo Village. The actionable strategies adopted within Nkomo Village (Figure 4.3) provides insight that regardless of the exclusion of residents of Nkomo Village in municipal waste management initiatives, the community has adopted coping waste management mechanism.

Furthermore, the absence of essential facilities, such as composting, recycling infrastructure and waste storage containers, further compounds to the frustration of Nkomo Village residents. The study established that the village lacks sufficient infrastructure for composting, recycling, and proper waste storage. The absence of accessible recycling infrastructure compounds waste management difficulties. This finding aligns with studies conducted on rural communities in developing countries, highlighting lack of waste management infrastructure among rural communities as a major challenge affecting SWM (Kalina et al., 2024; Mukwevho et al., 2024).

A greater lack of access to proper composting and recycling infrastructure is a challenge experienced by both genders (53% females and 47% males). The challenge is common among individuals with matric-level education (51%), and those earning less the R1000, including 73% who are unemployed. The study reveals an important synergy between modern and traditional waste management practices within the village.

While composting using garden waste and food scraps remain a common practise in the village, indicating that facilities for composting are primarily not a challenge within this community. Muzvondiwa (2021); Mawere & Tshamano (2023), emphasises the integration of traditional practices with formal systems. Lack of accessible recycling facilities is a major challenge as it forces the community members to accumulate recyclable materials until there are able to travel to town, where such infrastructure exists. This creates inconvenience and limits an effective recycling rate.

The find resonates with the broader research by Simatele et al. (2017); Morais et al. (2022), highlighting the important role and the need for prioritisation of informal waste sectors in waste recovery and waste reduction. This study highlights the socio-economic vulnerabilities associated to lack of waste management services in Nkomo Village. Emphasising the missed opportunities within the community from benefiting from informal waste economy as a result of the lack of recycling facilities accessible to the community of Nkomo Village.

Furthermore, the absence of waste storage containers predominantly affects unemployed households (75%), those with matric education (50%), and low-income earners below R1000 monthly (50%). Nkomo Village's exclusion from waste service areas, including the lack of household refuse bins and communal skips, further promote challenges in effective waste management. These situations compounded by limited space for waste storage as a challenge, frequently result in open dumping, burning and burying of recyclables like plastic, glass, paper, and metal waste within the village as presented in Table 4.8. This practice does not align with the principles of circular economy where waste is reintegrated as a resource, as studies highlight its importance in reducing environmental impacts and generation of economic opportunities. This infrastructural gap aligns with challenges documented in the literature, where rural waste management faces persistent issues such as inadequate infrastructure and illegal waste disposal practices (Viljoen et al., 2021).

A notably low level of participation and awareness in municipal waste initiatives was observed, with only 4 out of 155 respondents recalling any involvement and a mere 6 having received formal training, mainly through schooling rather than municipal programs. The findings highlight a significant disconnect between municipal efforts and community engagement. Despite reports by the GGLM officials on ongoing training and initiatives, this disparity suggests that communication strategies and implementation within the village are inadequate to mobilise residents effectively. Communication and implementation gaps between municipal plans and local realities are evident. Even though municipal officials have designed interventions to address illegal dumping and provide waste management training, the negligible community participation in such initiatives reflects poor dissemination and engagement strategies. This gap indicates the fragmented governance systems within GGLM, hindering coordinated efforts, while limited community participation lack of involvement in

education programs further exacerbates these issues (Kubanza et al., 2021; Gebrekidan et al., 2024).

5.3 Current SWM Practices and Policies in Place Within Nkomo Village, Limpopo

Nkomo Village households generate diverse waste types, including organic waste (food scraps and garden waste), plastics, paper, glass, metal, electronic waste, hazardous waste, and other specific categories such as sanitary pads, nappies, animal caucus, and ash (Table 4.8).

Organic waste is mostly managed through animal feeding, where scrap food is given to chickens, goats, sheep, and dogs, as 137 respondents reported. This aligns with literature that recommends feeding of animal from food waste as a sustainable strategy in managing food waste (Nath et al., 2023). Food scraps are used as compost together with garden waste; however, composting as a disposal method is mostly used for garden waste, where garden waste is used as mulch. Literature on organic waste composting promotes the effectiveness of composting of organic waste as it transforms waste into valuable resources, such as organic fertilizer (Sayara et al., 2020). Studies by Islam & Raihan, 2024; Oo et al., 2024, further highlights its role in sustainable waste management and its contribution to a circular economy.

The study identified a smaller group of respondents (18) who resort to open dumping for either food scraps or garden waste, thereby missing the opportunity to leverage the benefits of organic waste. Studies align with the cultural perception existing in Nkomo Village, that proper use of organic waste can enhance soil fertility and agricultural productivity from the natural organic matter content and nutrient availability provided by organic waste (Sayara et al., 2020).

Plastic, paper, glass, and metal wastes are handled through a combination of reuse, recycling, burning, burying, and open dumping. Open dumping and burning seem to be common across all four waste types, with a significant number of respondents reporting this practice: 36 for plastic, 79 for paper, 63 for glass, and 102 for metal waste. This common use of open dumping points to the community's lack of access to formal waste management systems (Henry et al., 2006, and Mohammed et al., 2013). Burning of waste is also a prevalent method, particularly for paper and metal

waste, where burning follows open dumping as a secondary step, as indicated by respondents. The method of burning waste is adopted by 139 respondents for paper and 39 respondents for metal waste. While burning reduces the volume of waste, as participants highlighted, it poses adverse environmental and health risks from fumes. As literature indicates that uncontrolled waste burning not only harms ecosystems but also poses long-term risks to human health, such as respiratory illnesses caused by air pollution (Ogola et al., 2011; Siddiqua et al., 2022; Raphela et al., 2024). This practice points to the community's struggles to manage waste sustainably in the absence of safe disposal alternatives.

In contrast, reuse emerges as the most practiced method for plastic waste, with 108 respondents repurposing items such as bottles, bags, and containers for storage in their households. Glass waste is also reused, though to a lesser extent, with 9 respondents reporting this practice. These findings align with the waste hierarchy embodied in the 3Rs approach - reduce, reuse, and recycle, that aims for effective waste minimisation (Chowdhury et al., 2014; World Bank, 2025). Reuse in Nkomo Village reflects traditional value recovery practices within the village and plays a positive role in waste minimisation. The minimal reuse of paper and metal waste reflects the varying perceptions of material utility across waste types. The adoption of this waste management practice is consistence with the social practice theory which suggests that social behaviours are shaped by social contexts, cultural norms, and community practices, highlighting how established traditions and collective behaviours influence how waste is managed in rural communities (Welch, 2016; Frost et al., 2020).

Recycling of waste remains limited as a result of limited infrastructure and the absence of formal services within Nkomo Village. Consequently, only a small number of respondents recycle plastic (10), glass (11), metal (11), and paper waste. This limited recycling suggests that while some members of the community recognise the benefits, systemic barriers prevent widespread adoption of recycling practices. Establishment of recycling facilities and introduction of awareness campaigns within Nkomo Village could potentially build on this developing practice to improve waste management outcomes in the village. This perspective aligns with global sustainability principles, conceptualising solid waste as a resource with significant potential utility (Abdel-Shafy & Mansour, 2018). Furthermore, insight from a systematic literature review by Anwar

et al. (2024) highlights the potential benefits with the introduction of advanced recycling techniques, policy interventions, and tailored solutions to effectively manage complex waste streams, in communities like Nkomo Village. The community would not only mitigate environmental impacts but also promote economic livelihoods from resource recovery (Simatele et al., 2017; Morais et al., 2022).

Burying as a waste disposal method is practiced particularly for metal waste, where 39 respondents reported burying of metal waste, whereas burying is less common for plastic, paper, and glass (Figure 4.2). Storage of waste, particularly glass and metal waste, is also a significant practice, owing to a lack of disposal options and uncertainty about waste management methods as revealed by the study. Fifteen respondents reported storing glass waste, and many households keep old metals and bottles in their yards as spotted during participants observation. Participants highlighted that storage of glass and metal waste is sometimes for potential future use or due to the unavailability of proper disposal services. These practices highlight the missed opportunity in resource recovery, promotion of economic livelihoods and community engagement in sustainable practices (Wilson et al., 2006; Mofokeng et al., 2022).

Again, the results demonstrate the unavailability of proper disposal services, as some respondents choose to dispose of their waste in municipal waste skips, located in town. This practice is limited and generally limited to respondents who commute to town and have transport access. This practice highlights underlying socio-economic difficulties compounded by the lack of municipal support in providing waste management infrastructure for communities such as Nkomo Village. As shown in Table 4.8, only a handful of respondents indicated discarding plastic, paper, glass, or metal waste in these skips, highlighting the limited use of formal waste collection points and spatial exclusion of Nkomo Village from municipal infrastructure over urban areas within GGLM. This finding aligns with Statistics South Africa, 2023 and studies reflecting broader disparities between urban and rural areas, highlighting the prioritisation of urban areas over rural areas (Haywood et al., 2021 Makhaye & Subban, 2024). Furthermore, this limited access to SWM facilities promotes dependence on informal disposal methods such as burning due to its cost effectiveness (Zondi et al., 2023; Fadhullah et al., 2022).

Waste management methods for electronic and hazardous waste in Nkomo Village reflect a variety of informal and preventative disposal methods, shaped by a lack of formal waste services and the assumed risks linked to these waste types. In Nkomo Village hazardous waste includes chemicals like pesticides, mostly managed through burying, with 127 respondents reporting these methods of disposal. The study established that this method is used as a culturally embedded precautionary measure for avoiding poisoning and improper household use or consumption. Studies such as Mawere & Tshamano (2023), acknowledges the role of these practices in indigenous communities such as Nkomo Village and emphasises their integration into formal systems.

A small portion of households reported disposal of hazardous waste in pit toilets (28 respondents), based on the perception that such waste would degrade along with sewage over time. However, El-Saadony et al. (20230) explains, the rate at which solids compact or degrade depends on their physical attributes, influencing the choice of disposal or treatment. This suggests that while households may be of the idea that natural degradation does take place, controlled waste management approaches coupled with public awareness will encouraging responsible waste-handling behaviours among residents (Konstantinidou et al., 2024). On the contrary, 35 respondents reported not generating hazardous waste within their households, which may imply that there are limited use and storage of such waste types in some households.

The study demonstrates that electronic waste management is more diverse, reflecting diverse perceptions and practices on reuse and disposal in Nkomo Village. The study found that electronic waste is mostly buried in Nkomo Village, with 55 respondents indicating burying as the preferred disposal method, in cases when electronic waste becomes a hazard. Storage is the second most common disposal method adopted by 43 respondents, with the hope of repairing these items eventually. Reuse of electronic waste is the most common disposal method within Nkomo Village, with 72 respondents indicating they repair and reuse electronic waste in their households. Both storage and reuse indicate an interest in extending the useful life of appliances rather than disposal within the community. This practice aligns with perceptions adopted by Scotland and Australia on the lifespan of consumer goods, where used appliances are often seen as items that can still be sold or donated rather than

disposable (Bianchi & Birtwistle, 2010; Scottish Government, 2016). Furthermore, within the context of the village, this practice highlights the traditional value of waste minimisation and resourcefulness embraced by local households (Nxumalo et al., 2020; Zondi et al., 2023; Madonsela et al., 2024).

Nevertheless, the open dumping of electronic waste such as refrigerators, reported by 14 respondents, poses specific risks, especially to children playing with these discarded appliances. Studies by Jha et al. (2022) and Jain et al. (2023), indicate that this emerging waste type is increasingly concerning due to its hazardous nature and disposal challenges associated with its proper disposal. In Nkomo Village, disposal of electronic waste through municipal skips in uncommon, with only 2 respondents reporting this practice. Notably, a substantial number of 68 respondents indicating that they do not generate electronic waste at all, highlights the differences in waste generation patterns. These differences are shaped by a range of factors, socio-economic factors (Velis et al., 2023; Omotayo, 2024), cultural practices (Zhang et al., 2024), and the level of municipal authority involvement in waste management services (McAllister, 2015; Soysa et al., 2023).

Interestingly, the community of Nkomo Village generates a range of other wastes, including sanitary pads, nappies, medical waste, animal caucus, and ash, with varying and diverse disposal practices adopted. Among these, nappies are the most produced waste type, with 111 respondents indicating that burying is the most common disposal method, and 77 respondents indicating burning as a second common disposal method. Sanitary pads are less commonly generated, however, significantly, 86 respondents indicated burning, and 69 respondents indicated disposing in pit toilets for this waste type. The prevalence of burning for both sanitary pads and nappies points to a common method of disposal, despite the associated health and environmental risks (Henry et al., 2006; Mohammed et al., 2013).

Furthermore, the study reveals medical waste is one of the least generated waste types in Nkomo village, with only 8 respondents indicating this waste type as generated within their households. Disposal methods adopted for this type of waste involves only 2 types of methods: burying (5 respondents) and disposal into a pit toilet (3 respondents) of items like contaminated bandages, syringes, and expired medication. The study indicates that these practices are preferred methods to reduce

the risk of exposure to children, and respondents perceive these methods as safer because they limit direct contact with hazardous chemical waste. The findings align with behaviour and social practice theory, which highlights how attitudes, perceptions, and social norms influence management choices (Smith, 2020). Social practice theory further suggests that social behaviours are shaped by cultural norms, and community practices, indicating that established traditions and collective practices influence how rural communities manage waste (Welch, 2016; Frost et al., 2020).

In addition, waste types such as animal caucus and ash, in Nkomo Village is managed through practices that reflect cultural norms and reuse within the community. Animal caucus is mostly buried, with 17 respondents confirming this method as consistent with the community's cultural and hygienic disposal practices. Studies by Welch (2016), Frost et al. (2020), and Madonsela et al. (2024) indicate that communities like Nkomo Village establish waste management traditions deeply rooted in social behaviour, cultural norms, and community practices. However, this culturally embedded approach contrasts with broader literature, where burying of waste is often identified as posing potential risks to the environment, public health, and sustainable development (Henry et al., 2006; Mohammed et al., 2013).

Ash is one of the most commonly generated waste type in Nkomo Village, reported by 108 out of 155 respondents, with only 7 respondents indicating disposal into pit toilets. Ash is considered for its beneficial reuse among respondents in the study. For instance, 58 respondents use ash as compost, while 43 respondents also consider open dumping of ash as still beneficial to the soil nutrients for ploughing (Sayara et al., 2020). These practices reflect the resilience and innovation existing within rural community's waste management strategies. As Henry et al. (2006) observed, such communities often adopt resourceful approaches to cope with limited infrastructure, repurposing material like ash into useful products as evidenced by Ajibade (2007) and Senekane et al. (2021).

Moreover, the study found that waste disposal typically occurs weekly, with respondents indicating that burying and burning of waste are weekly activities. The findings align with the This further emphasizes the urgent need for adequate waste storage containers, accessible waste drop-off facilities, and the provision of communal

waste skips. It vividly illustrates the tangible consequences that the absence of municipal services has on waste management practices within the village.

The study reveals that the frequency of waste disposal among respondents is weekly, with larger households disposing daily due to volumes of waste generated. However, despite the frequency of disposal being mostly weekly, several factors influence how effectively waste is managed in the village. The lack of enclosed waste storage containers highlighted as a waste management challenge in the study, leads to most households storing waste in plastic and baskets. Which may impact the timing and method of disposal. Additionally, limited waste storage space within households influences the urgency of disposal, in particular for larger households generating more waste. The type of waste also dictates disposal methods and frequency; for instance, organic waste is reused as compost in the village. In contrast, medical waste requires more cautious handling, such as burial or pit toilet disposal, among respondents (Abdel-Shafy et al., 2018; Shahbaz et al., 2023).

The findings highlight the urgent need for specific disposal methods for the hazardous and emerging waste types, as the pose significant environmental and health risks in Nkomo Village (Jha et al.,2022; Jain et al.,2023). The findings emphasise the need for the implementation of strategies reflecting sustainable SWM practices that are responsive to the village's unique challenges identified in the study.

5.4 Waste Management Policies in Place Within Nkomo Village, Limpopo

Nkomo Village falls under GGLM, a local government entity under Mopani District Municipality in Limpopo. Nkomo Village is governed by policy frameworks developed by the GGLM in alignment with NEMWA, 2008. The municipality's Final IWM Plan, approved in 2024, is central to these policies. It aims to identify existing gaps and needs in waste management and set goals in line with the National Waste Strategy (DFFE, 2020).

A key objective outlined in the GGLM's Final IWM Plan (2024) is the gradual expansion of waste service coverage to currently unserved areas like Nkomo Village, anticipated over a 4–9-year time frame. This expansion intends to be phased to include the establishment of waste drop-off facilities (communal skips), establishing waste buy-

back centres for recycling at the villages, and improving waste management infrastructure. These objectives remain conceptual, with no budget allocation or operational plans for expanding these services to Nkomo Village in the immediate future, making the inclusion of Nkomo Village in such future expansion uncertain (2025/2026 IDP). Oelofse & Godfrey (2008) classifies SWM challenges in categories such as financial constraints among others and this study reflects municipal financial constraint as a SWM challenge affecting communities such as Nkomo Village. Furthermore, literature comparing SWM between developing and developed countries, highlights the lack of substantial financial commitment as a barrier in developing countries towards sustainable SWM (Chaudhary & Vrat, 2018; Debrah et al., 2022; World Bank, 2023).

Beyond immediate services expansion, the Final IWM Plan, 2024 proposes longer-term initiatives that could benefit Nkomo Village. These initiatives include creating waste drop-off facilities, promoting composting and recycling programs, and implementing training and educational campaigns to raise awareness about proper waste management in communities.

In addition, the Final IWM Plan, 2024 highlights the need for the updating of the GGLM by-laws (2022) to tighten enforcement against waste-related offenses. The by-laws impose tariffs for household solid waste removal services and waste bin provision, explicitly prohibiting open dumping, with penalties of R2000.00 attached to open dumping-related offences or imprisonment for offenders. However, the GGLM Waste Management By-Laws (2022) presuppose the existence of formal waste services, which are not provided in Nkomo Village, making enforcement of these by-laws practically impossible.

Literature indicates that while the countries policy recognises waste as a resource and is moving away from linear from traditional linear models of waste disposal (Godfrey et al., 2017; Ndlovu et al., 2017; DFFE, 2020), the inclusion of rural context remains weak. Ogola et al. (2011) and Hebinck et al. (2023), provides evidence that the realities of rural areas, including lack of infrastructure, cultural practices and socio-economic vulnerabilities are often insufficiently included into policy frameworks. Thus, rural areas are not completely overlooked by policy but are indirectly marginalised because of the

lack of meaningful engagement of existing frameworks to their local context, needs and resource limitations.

Municipal waste collection services are not provided for Nkomo Village, leading to traditional ways of waste disposal method such as open dumping, burning, and burying of waste in Nkomo Village. In addition, while the by-laws are legally binding on paper, they are not effectively enforceable in areas like Nkomo Village due to the absence of service provision. The findings from this study therefore reinforces the misalignment. This misalignment has been observed in the findings of a study conducted within the Mangaung Metropolitan Municipality, where policies within the municipality were found to mainly focus on formal waste management practices, excluding the informal sector, limiting the potential economic, social, and environmental benefits (Mofokeng et al., 2022).

The disconnect between policy frameworks intended for broader municipal application and the specific local conditions in Nkomo Village highlights the importance of tailored approaches. Furthermore, the study indicates that ineffective governance within GGLM and highlights that effective governance is a critical dimension of SWM and an indicator of governance quality, reflecting institutional capacity to manage waste efficiently (Abubakar et al., 2022; Sasahara et al., 2023). The case of Nkomo Village demonstrates gaps in governance capacity within GGLM, where policy ambitions are not complemented by resources and continuous support for rural communities.

5.5 Proposing Actionable Strategies for Improving the Effectiveness of SWM in Nkomo Village, Limpopo, Considering Local Needs and Constraints

The study reveals that actionable strategies need to focus on sustainable, locally adapted solutions to address the identified challenges to attain economic development, promote community inclusion, and ensure environmental sustainability within Nkomo Village (Kadhila et al., 2023). Based on the community’s current coping measures and municipal constraints, several practical strategies were highlighted. These strategies combine Nkomo Village's indigenous practices with municipal support through, improved and implementation of waste management policies, awareness and training, and improved infrastructure. These will offer the best pathway toward effective SWM tailored to Nkomo Village’s socio-economic realities and

environmental needs, as studies suggest (Senekane et al., 2021; Mawere & Tshamano, 2023); Madonsela et al., 2024).

Data reveals that a noteworthy portion of Nkomo Village's population, 37 out of 155 respondents, have deliberately embraced waste reduction strategies at household level, reflecting a proactive approach to minimising waste generation at the source. Waste reduction is achieved through repurposing plastics and glass and other materials (23% of the respondents), partly out of necessity due to limited resources. This finding aligns with global sustainability principles that conceptualise solid waste as a resource (Abdel-Shafy & Mansour, 2018). As evidenced in this study, plastic waste is predominantly managed through reuse across households, also addressing the challenge of absence of proper waste storage containers among households. For example, 108 respondents reported reusing plastic items such as bottles, bags, and plastic containers for the storage of food, water, and waste. This practice of reuse as observed during participants' observation reflects the broader circular economy approach and the conceptual framework of transforming waste into a resource (Ndlovu et al., 2017; DFFE, 2020).

Table 4.8 outlines the various waste reduction behaviours, including repurposing and composting, while Table 4.8 depicts widespread reliance on reusable containers and avoidance of single-use plastics. The qualitative insights in this study indicate that many residents consume unpacked or minimally packaged foods like morogo (green leafy vegetables) obtained through household subsistence farming, further contributing to naturally lower volumes of waste compared to urban counterparts. This behaviour aligns with a broader shift in perspective that regards waste as a resource, as noted in prior studies (Ndlovu et al., 2017; DFFE, 2020) and supports the waste hierarchy embodied in the 3Rs approach - reduce, reuse, and recycle, that aims for effective waste minimisation (Chowdhury et al., 2014; World Bank, 2025).

Plastic containers serve multipurpose roles, providing storage for food, liquids, valuables, and even waste, making plastic the most reused material among participants compared to other disposal methods. These ingrained practices demonstrate an existing cultural and practical foundation for sustainable waste management within the community. Together, the quantitative and qualitative findings underscore that Nkomo Village residents are inclined towards sustainable waste

habits, some shaped by necessity but others aligning with environmental stewardship principles. Similarly, Nguyen et al. (2023) argue that by building a sense of shared responsibility and stimulating participation in waste reduction initiatives, rural communities can create more effective waste management strategies that works with their cultural values and social norms.

Similarly, culturally embedded practices such as feeding animals with food scraps and composting show high participation rates, specifically, 89% of respondents use food scraps for animal feeding. Despite limited literature supporting the culturally linked practice (Nath et al., 2023), it represents an environmentally beneficial approach to reducing food waste and improving sustainability. Tailor-made approaches are essential to address these challenges effectively, considering the unique circumstances and traditional waste management practices in rural communities (Mihai & Taherzadeh, 2017; Rodseth et al., 2020; Senekane et al., 2021; World Bank, 2023). With appropriate support and guidelines, promoting this method could significantly reduce the quantities of food waste disposed of through open dumping, burying, and burning, contributing to more sustainable waste management.

The data reveal that composting organic waste, such as food scraps, is deeply entrenched and widely practiced in Nkomo Village, with a significant number of respondents (93%) actively engaging in it (Table 4.4). This cultural tradition, valued for its benefits in soil enrichment and supporting local cultivation, is the primary waste management method for the majority, as indicated by 137 respondents (Table 4.8). Such strong community uptake demonstrates the practicality and effectiveness of composting as a sustainable waste management strategy tailored to local conditions. The popularity of composting in Nkomo Village aligns well with the Municipality's Final IWM Plan, 2024, which prioritises the promotion of household composting over a 4 to 7-year period. Additionally, the plan includes the development of community-scale composting facilities aimed at enhancing the organic waste handling capacity. These municipal initiatives seek not only to support and scale existing composting behaviours but also to reduce organic waste open dumping, mitigating environmental impacts and improving resource recovery (Leknoi et al., 2024; Oo et al., 2024). Literature also supports the positive outcomes brought by community-driven initiatives on composting when supported by adequate resources and education (Ghazali et al., 2021),

highlighting the gap existing in the collective reinforcement of traditional composting practices through support, education, and infrastructure investment in Nkomo Village.

As noted by Saxena et al. (2025), community perceptions play an important role in encouraging better waste management behaviours, and understanding the cultural context of traditional practices is essential for designing effective strategies. This perspective aligns with the conceptual framework of transforming waste into a resource and the broader circular economy approach, in promoting recycling, reuse, and reduction principles supported by both global literature and in South African policy (Ndlovu et al., 2017; DFFE, 2020). However, fragmented governance systems, as established in this study of Nkomo Village, have hindered coordinated efforts, and limited community participation in recycling and education programs further compounds these challenges (Kubanza et al., 2021; Gebrekidan et al., 2024). Specifically, officials from the GGLM claim that waste management training and illegal waste collection initiatives do exist; however, these programs have not effectively reached or engaged residents of Nkomo Village, as evidenced by only 3% of respondents reporting participating in an illegal dump waste collection event in the village, underscoring the fragmentation within the governance systems.

The study has revealed a clear gap between municipal efforts, education, awareness, and community perceptions in waste management. Data indicated that there are not many trainings afforded to the community on waste management practices, either from the local or tribal authorities, households share information on mostly what is the norm amongst households as best practice (Madonsela et al., 2024). Those who know (4% of respondents) are informed through their schooling and mostly resort to disposing of their waste in waste skips in town, which is not a sustainable way. Enhancement of waste management education through formal training and community awareness programs is important in addressing the knowledge deficits of unemployed and low-income groups in Nkomo Village. This approach would empower residents with knowledge in embracing and adopting sustainable waste management practices, thus reducing dependence on conventional linear approaches (Elsaid & Aghezzaf, 2015; Olawade et al., 2024). This can be extended to the participation of communities in clean-up initiatives and create local waste committees to foster ownership and responsibility among resident, enhancing sustainability and monitoring of waste management practices as seen in studies done in Nyanga Township, Zimbabwe and

amongst the Vhavhenda Indigenous community in Limpopo South Africa that the integration of traditional practices with formal systems does foster local ownership and restore justice to previously disadvantaged villages such as Nkomo Village (Muzvondiwa, 2021; Mawere & Tshamano, 2023)

Effective planning and budgeting must be implemented without delay for waste drop-off facilities, provision of communal waste skips. In addition, regular collection services tailored to the rural context of Nkomo Village must be phased in as well, as envisioned by the Final IWM Plan, 2024. The 2025/2026 IDP, lacks detailed activities and budgeting towards these planned provisions. GGLM must advocate for increased government funding and leverage successful programs from other villages. Studies indicate that limited financial resources and institutional issues prevent municipalities like GGLM from implementing sustainable waste disposal practices (Vinti & Vaccari 2022; Kalina & Schenck, 2024; Mukwevho et al., 2024). Furthermore, inequalities in funding allocation and prioritisation as noted in the 2025/2026 IDP, further deepen the urban-rural divide within GGLM, further perpetuating environmental injustices (Haywood et al., 2021; Makhaye & Subban, 2024).

While approximately 5% of respondents indicate that transporting waste to town waste skips as a strategy serves as an alternative to open dumping, burning, and burying of waste, it remains largely unsustainable and inaccessible for most community members due to socioeconomic constraints. Therefore, fully implementing the strategies proposed in the Final IWM Plan, 2024 is essential to provide locally accessible, sustainable waste management solutions that reflect the socioeconomic realities of Nkomo Village residents.

Similarly, the practice of disposing of sanitary pads, medical waste, hazardous substances, and ash in pit toilets has emerged as a coping strategy for households in Nkomo Village, with 69 respondents identifying it as a practical solution to their waste disposal challenges. While this method may offer immediate relief from handling problematic waste, it raises significant concerns regarding environmental sustainability and public health (Henry et al., 2006; Mohammed et al., 2013). Pit toilets are primarily designed for human waste and are not engineered to safely contain hazardous materials or non-biodegradable items, which can lead to soil and groundwater contamination, posing long-term risks to both human health and local

ecosystems (UNEP, 2018; Rodseth et al., 2020; Ramadan et al., 2022). Given the potential hazards, reliance on pit toilets for hazardous waste disposal is not a sustainable solution. It underscores the pressing need to introduce alternative waste management strategies tailored to the village's context. The Final IWM Plan, 2024, however, recognises these challenges and proposes actionable goals aimed at improving the handling of hazardous waste over a 4–7-year period. Key objectives include establishing public drop-off locations specifically for household hazardous waste and conducting comprehensive public awareness campaigns to educate the community about safe waste handling practices and the availability of formal collection systems. Decentralised waste processing systems have been tested to be efficient in countries such as Kenya and India where such practices are community-driven improving waste disposal and recycling in rural contexts (Sunil & Attar, 2016; Awino & Apitz, 2023). Such models can be adopted in communities such as Nkomo Village by integrating cultural values, local knowledge, and affordable technologies into waste management strategies to foster local ownership in the community (Muzvondiwa, 2021; Mawere & Tshamano, 2023).

Bridging the gap between municipal strategies and community participation in Nkomo Village necessitates boosting communication efficacy and tailoring engagement to local demographic specifics. Studies indicate that developed countries leverage advanced technologies including digital platforms and information and communication technologies (ICT) to enhance public engagement and optimise the process of waste collection, sorting, and recycling (Laureti et al., 2024). Such platforms can be explored in communities such as Nkomo Village to improve communication to a certain extent.

Establishing local recycling facilities could help mitigate open dumping, burning and burying of solid waste and foster responsible waste disposal in Nkomo Village. Studies suggest the exploring the potential roles of public-private partnerships and fiscal incentives to support such initiatives (Yeboah et al., 2024). By collaborating with private companies and using financial tools, such as tax breaks, local authorities could encourage compliance with EPR regulations. However, Mapanga et al. (2024) note in their study of plastic waste mitigation strategies within the global supply chain, practical application remains a challenge, despite progress in policy frameworks both globally and in South Africa. Initiating these strategies at a local level could therefore provide the municipality with a feasible, context-specific approach, that involves local

businesses in addressing and improving waste management outcomes in communities such as Nkomo Village.

Furthermore, targeted training programmes addressing the knowledge deficits of unemployed and low-income groups is important, through formal training of youth within the village and EPWP participation. Aligning municipal actions with the lived experience of residents is essential to transform awareness into sustainable waste management practices, consistent with the broader literature advocating for integrated, community-sensitive waste governance in rural South African contexts (Mihai & Taherzadeh, 2017; Rodseth et al., 2020; Senekane et al., 2021; World Bank, 2023).

5.6 Conclusion

Chapter 5 outlines SWM context in Nkomo Village, by depicting how demographic factors, socio-economic challenges, cultural practices and governance have moulded local waste management practices. The chapter outlines the dependence on informal solid waste disposal method, as result of lack of municipal services and inadequate infrastructure. The chapter discusses the resilience of the community in adopting innovative waste management strategies as a coping mechanism. These strategies include reuse, composting and animal feeding. The chapter reveals gaps between Nkomo community's leaved experiences and policy frameworks in place. It further points out actionable strategies that infuse traditional practices with formal intervention, education and awareness, an suggests infrastructure improvements to promote sustainable, tailor-made and community-driven waste management in Nkomo Village.

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Introduction

The study aimed to establish the current state of SWM in rural areas by focusing on Nkomo Village, GGLM, Limpopo, to identify specific challenges faced by the communities, while examining the existing SWM practices and policies governing the village. The study further proposes actionable strategies for improving the effectiveness of SWM, based on the existing constraints.

The study employed a mixed methods design combining quantitative and qualitative techniques, where a simple random sampling; 174 households were selected from a total of 1670 for questionnaire distribution; however, a total of 155 responses were considered for this study. Research tools used in this study were an important factor in obtaining data addressing the questions raised in this study. These include a semi-structured questionnaire, participant observations, interviews with municipal officials, and documentation review. Statistical tools were then used to analyse the data obtained, and results were presented with the use of figures and tables.

6.2 Conclusion

The results of the study reveal that addressing SWM challenges experienced by the community of Nkomo Village requires varied strategies that combine the integration of indigenous waste management practices, improved municipal waste management services, community education on sustainable waste management practices, and resource allocation.

The SWM challenges faced by the community of Nkomo Village are a result of the absence of municipal waste collection services in the area. Respondents reported being unaware of waste collection services in the village, with 80% highlighting this lack as a major challenge. Participants' observations, interviews with municipal officials, and documentation on waste management within the municipality collaborated this challenge. The unavailability of municipal waste collection services in the area forces residents in this village to rely on informal waste disposal methods, such as open dumping, burning, and burying of solid waste within their yards. This indicates the need for adequate waste storage containers and accessible communal waste facilities to improve sustainable waste handling urgently.

Socio-economic factors have shaped waste management behaviours in the village, the study reveals. The majority of households are female-headed and under 40 years of age, with a high unemployment rate of 73.15% and a monthly income often below R6000. The socio-economic limitations have a direct implication on the residents' capacity to engage actively in proper waste management, perpetuating the low levels of environmental awareness and practice. This pattern corresponds to existing literature on the relationship of poverty, low education levels, and inadequate environmental stewardship.

The study identifies a high dependence on pit toilets for the disposal of hazardous waste, including sanitary pads, medical waste ash, used by a significant number of residents as a coping disposal method. Despite that this method reduces challenges for handling and disposal of such waste, it is unsustainable and poses environmental and public health risks, including potential soil and groundwater contamination. Pit toilets are not designed for containing hazardous substances; they are designed to handle human waste. There is a need for alternative waste management methods relevant to the needs and circumstances of Nkomo Village, and that are also safe.

Institutional shortcomings compound waste management challenges experienced by the community in Nkomo Village. Notwithstanding the GGLM Waste Management By-Laws (2022) and the Final IWM Plan, 2024 in place, there is a disconnect between the waste management strategies and their implementation in the village. Budget constraints, lack of community engagement, and poor communication have hindered effective waste management initiatives from reaching the community. This is observed from the municipal environmental awareness training and illegal waste dumping collection initiatives, reported to be existing; however, they have failed to engage the community in a meaningful way, as revealed by the lack of participation. The municipality must take advantage of the existing communication channels within the village and also establish community engagements that consider the community's socio-economic factors, to promote sustainable behaviour change in waste management.

Notwithstanding the challenges, Nkomo village depicts attributes of sustainable SWM practices entrenched in indigenous knowledge, cultural practices and necessity.

These attributes aligning with literature which suggests that acknowledgement of indigenous knowledge systems is critical for implementation of sustainable waste management practices in villages like Nkomo Village (Senekane et al., 2021; Mawere & Tshamano, 2023; Nath et al., 2023; Madonsela et al., 2024). The study reveals that there are a lot of residents already implementing waste reduction strategies in their households, involving repurposing plastic and glass material and using food scraps for animal feeding and composting. These practices reveal that both cultural embeddedness and practical responses adopted in response to limited resource availability, as observed in Nkomo Village, provide a foundation for the introduction of formal waste management systems as proposed in the Final IWM Plan, 2024. Tailored, culturally sensitive approaches, integrating traditional practices with municipal support and education, are crucial to promote environmental stewardship in this village.

The Final IWM Plan, 2024 proposes important objectives to improve hazardous waste handling over a 4 to 7-year timeframe, such as the establishment of public drop-off facilities for hazardous waste, communal waste skips, and the introduction of community wide waste management awareness campaigns, as long lasting and effective solutions. In addition, the enhancement of local recycling infrastructure and offering training programs focused on unemployment and low-income groups would be beneficial to the community. The municipality must align its measures with the lived experience of residents to transform awareness into practical, sustainable SWM, in particular with the broader context of rural South African communities experiencing similar challenges to Nkomo Village.

In conclusion, SWM in Nkomo Village is hampered by the lack of municipal collection services, weak municipal support, and socio-economic constraints; as a result, residents are compelled to rely on traditional disposal methods. Notwithstanding these challenges, necessity-driven and indigenous practices like reuse, animal feeding, and composting indicate potential sustainable solutions with proper support from culturally sensitive municipal interventions, infrastructure, and education. Moreover, while sustainable practices exist, sustainability itself has not been systematically measured. This is a key limiting factor in this study, as clear indicators are needed to evaluate whether these practices truly contribute to long-term environmental and social resilience.

6.3 Recommendations

The findings of the study as presented in Chapter 4 and discussed in Chapter 5 revealed a lack of provision of SWM services to Nkomo Village by the GGLM, resulting to the community adopting self-managed waste disposal methods. Literature categories these waste management practices as traditional and unsustainable posing negative impacts on the environment and public health. Moreover, the community has adopted strategies to cope with the SWM challenges faced. Based on those the study suggests the following recommendations to improve SWM in Nkomo Village:

- Promotion of indigenous and sustainable waste practices by leveraging the high levels of composting and feeding of animals with food scraps, through provision of technical guidance to maximise these practices safely and effectively.
- Encourage widespread reuse of materials such as glass, paper, and plastic by providing community awareness and education programs that strengthens repurposing in alignment with the waste hierarchy principles circular economy and waste hierarchy principles (3Rs approach - reduce, reuse, and recycle).
- Encourage existing household waste minimisation behaviours. These initiatives can be expanded to include household who have not already adopted this behaviour. These can be extended to schools and health facilities within Nkomo Village.
- Integrate socio-economic benefits with waste management practices such as reuse and informal waste recovery and explore methods to formalise and establish income-generating activities within the solid waste sector, through provision of waste by-back centres.
- Develop partnerships between municipalities, NGOs and community groups to encourage local investment, technical expertise, and resources to sustain the community-based initiatives.
- Initiate and support community led clean-up programs and waste reduction initiatives, aligning to social norms and cultural values within Nkomo Village to promote collective action and a sense of responsibility.
- Develop mechanisms to encourage participation in planning between the municipality and the community, to collectively create practical, acceptable and waste management solutions addressing the needs of the village.

- Strengthen policy through promoting enforcement strategic objectives in the Final IWM Plan, 2024.
- Strengthen policy through updating waste management policies (SWM By-Laws) to reflect rural realities and local cultural practices, thereby bridging gaps between municipality mandates and community needs.
- Promote behavioural change campaigns to discourage improper disposal of problematic waste including hazardous waste, medical waste and nappies, emphasising health and environmental risks. While presenting practical alternatives built on local context.
- Improve municipal engagement and infrastructure support, by providing communal waste skips and access to recycling facilities to increase community efforts.
- Targeted training programmes to address the gap among the youth, unemployed and low-income groups. Through formal training within the community, complemented by structured participation in EPWP.

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