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Original Research

An Assessment of the Environmental and Social Impacts of Waste Management Practices in Omuthiya Town and its Disposal Site, Oshikoto Region, Namibia

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ABSTRACT

Rapid urbanisation and population growth have intensified solid waste management challenges in many urban areas, particularly where infrastructure and institutional capacity are limited. This study assessed waste management practices and infrastructure in Omuthiya Town, Namibia, employed a case study research design and used mixed data collection methods. Quantitative data were collected through household surveys, while qualitative insights were obtained from interviews with local authority officials and residents as well as field observations. The findings indicate that although Omuthiya Town has made progress in waste collection services, major challenges remain. These include inadequate waste management infrastructure, low levels of waste separation and recycling, limited community participation, and weak regulatory enforcement. A heavy reliance on plastic bags for waste containment contributes to improper disposal and environmental pollution. Open waste burning, illegal dumping, and the absence of recycling facilities were identified as key drivers of environmental degradation and public health risks, particularly for communities living near the disposal site. The study highlights the urgent need for improved infrastructure, stronger policy enforcement, and community-based education programmes to promote sustainable waste management practices.

INTRODUCTION

Waste management is a broad term that refers to the generation, collection, procession, transportation, and disposal of waste (Ruppel-schlichting 2022). Waste management includes all activities that seek to minimize all potential environmental and social impacts that emanate from all types of wastes. Waste is a global environmental and public health concern in today's rapidly urbanizing world. Globally, 2.01 billion tons of solid waste are generated per annum, of which approximately 33% is managed in a manner that is considered not to be environmentally friendly (Global Waste Management Outlook 2024). According to Schioldborg and Bjørke (2014), environmental concerns such as pollution, habitat destruction, and health hazards are results of improper disposal and mismanagement of waste. They further stated that the global population is growing, and urbanisation is rising, and it is increasingly urgent to transition into effective waste management strategies.

Omuthiya has recently undergone rapid economic development that has transformed it into a bustling commercial hub. Significant population and urban growth are observable, which can be attributed to several factors such as infrastructure development, expanded economic opportunities, and migration from rural to urban areas. Rapid urbanisation, especially in developing countries, outpaces the development of essential waste management infrastructures (United Nations Human Settlements Programme (UN-Habitat) & Ki-moon 2016). Limited essential waste management system leads to deficiencies in municipalities services delivery resulting in the improper disposal of waste, contributing to environmental pollution and health risks. Uncollected waste often accumulates, leading to the spread of diseases and putting the health and safety of the people at risk (Omang et. al 2021).

According to the National Solid Waste Management Strategy (2017), Namibia has only one fully operational solid waste landfill site in Windhoek and two hazardous disposal sites at Windhoek and Walvis Bay. The rest of the country disposes of its waste at sites that have no proper control and management due to the shortage of resources and proper infrastructure. Kaapanda (2023) confirms that Namibia is faced with unsatisfactory waste management as many settlements, villages, towns, and municipalities do not have proper landfills and have resorted to dumpsites for waste disposal.

A study conducted by Amasuomo and Baird (2016) found that waste management practices are influenced by community awareness and engagement. Public education and community involvement are crucial in promoting responsible waste disposal behaviours and reducing littering. Recycling and waste-to-energy initiatives can create jobs, generate income, and contribute to the local economy (Bennett 2017). As Omuthiya Town continues to experience rapid urbanisation and population growth, the implementation of effective and sustainable waste management systems has become increasingly critical. A comprehensive waste management study is a critical step toward evaluating the effectiveness of the current waste management system in Omuthiya Town, assessing infrastructure capacity, and identifying the environmental and social impacts of existing practices. This study

has proposed feasible and sustainable solutions to address the town's waste management challenges, thereby contributing to improved community well-being and the protection of the local environment.

1.1. Context

1.1.1. Sustainable Solid Waste Management as Conceptual Framework

This study developed a Sustainable Solid Waste Management (SSWM) as a conceptual framework, which is structured around key variables and their relationships to address the study's objectives. This conceptual framework was developed based on waste management and the circular economy concepts as outlined by Ellen MacArthur Foundation (2017). This conceptual framework outlines how the four primary components of this study are interrelated in the context of waste management challenges, including waste management practices, social and environmental impacts, regulatory frameworks, and innovative solutions. It serves as a roadmap that guides the researcher to achieve the study's aims by outlining a comprehensive approach to understanding and improving waste management practices. Moreover, it integrates elements of waste management theory and practice, and it is illustrated in Fig. 1 below:

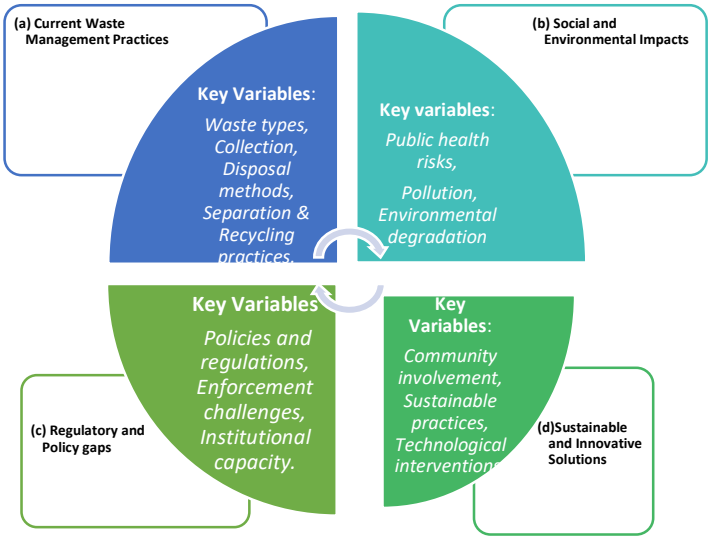

Fig. 1: Breakdown of the study's conceptual framework Source: Authors (2025)

This framework centres around the primary issue of SWM practices in Omuthiya town. It shows how key factors interrelate to inform sustainable management solutions. Below are the main components of the study, their sub-elements, and the linkages.

(a) Current Waste Management Practices

This study is grounded in an assessment of existing waste management infrastructure and practices, which form the foundation of an effective and sustainable solid waste management system. These practices include

waste collection, transportation, disposal, and potential recycling initiatives. According to UNEP (2015), poor infrastructure and inefficient waste management systems in developing regions contribute significantly to waste mismanagement, environmental degradation, and public health challenges. It is therefore essential to evaluate the current state of these systems in order to identify operational gaps and areas of improvement. The study examines the following components among others:

- **Collection Systems:** The extent of waste collection coverage, frequency of service delivery, and challenges experienced by residents.
- **Disposal Methods:** The conditions, management practices, and environmental safety of waste disposal at the Omuthiya disposal site.
- **Waste Separation and Recycling:** The existence and effectiveness of waste segregation and recycling programmes. Although often absent in smaller towns, such systems provide important opportunities to reduce waste volumes and recover valuable resources.

(b) Social and environmental impacts

The study also investigates the social and environmental consequences of waste management. Social impacts can be critical as they can directly affect residents' quality of life (WHO 2018). Environmental impacts such as pollution of soil, air, and water resources, as well as loss of biodiversity, are common outcomes of inadequate waste disposal (World Bank 2019). These dimensions are all interconnected, as poor waste management practices often have negative environmental consequences that exacerbate social vulnerabilities. Investigations of these impacts aid in the provision of evidence-based insights into the consequences of current waste management practices and the need for interventions.

(c) Regulatory and policy gaps

Effective waste management depends on well-formulated policies that address all aspects of waste and enforced policies and regulations. In Namibia, EMA, which is the governing regulatory framework of all environmental-related activities, and other related guidelines, will be identified in the study. Gaps in the regulations will be identified, which will be crucial to align local practices with national policies and improve compliance through monitoring.

(d) Sustainable and innovative solutions

This is the final component of the conceptual framework, which aims to propose solutions that address the identified gaps and impacts. Sustainable development refers to the development that satisfies current demands without jeopardising the capacity of future generations to satisfy their own needs. In order to meet the needs of the present as well as the future, Rybaczewska-Błażejowa (2013) argues that sustainable development can be

understood as socio-economic development that integrates political, economic, and social elements while preserving environmental balance and the sustainability of natural processes.

Sustainable waste management has numerous benefits, such as natural resources conservation, pollution reduction, and reduced waste disposal in landfills. It can also improve economy and enhance environmental performance by preventing air, water, and soil pollution (DGB Group). In addition, Namibia is a partner to the global Sustainable Development Goals (SDGs), which remarks its commitment to fighting towards sustainability.

The unsustainable SWM practices, are mostly worsened by rapid urbanisation, and financial and institutional limitations that negatively impact public health and environmental sustainability. Dumping and burning waste in an open space is an unsustainable approach practiced by many developing countries that poses several sustainability problems, including resource depletion, environmental pollution, and public health problems, such as the spread of communicable diseases. In contrast to the prevalent methods of landfilling, open dumps, and open burning, a more sustainable waste management strategy emphasises techniques like reduced production, waste classifications, reuse, recycling, and energy recovery (Abubakar et al 2022). Fig. 2 shows a sustainable waste management hierarchy.

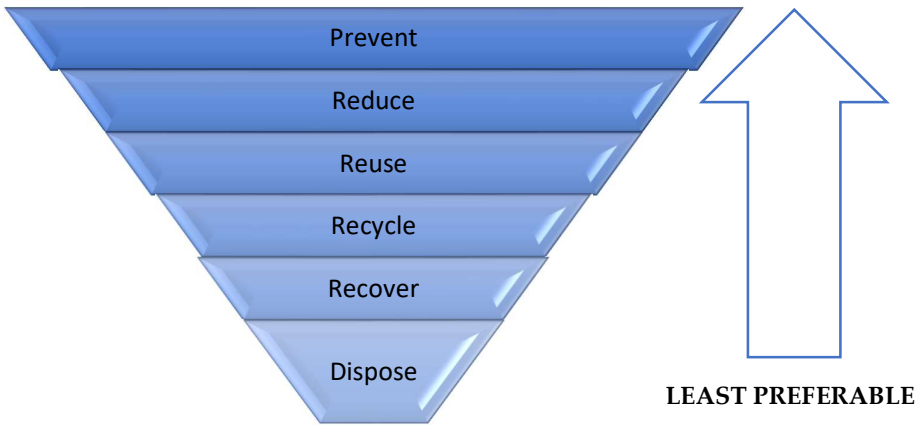

Fig. 2: The waste management hierarchy Source: Abubakar et al., (2022)

The waste management hierarchy (Fig. 2) is a sustainable framework that prioritises waste prevention and resource efficiency by ranking waste management options from the most to the least environmentally preferable (Abubakar et al., 2022; Coenen et al., 2020). At the top of the hierarchy is waste prevention, which focuses on reducing waste generation at the source through responsible consumption, eco-design, and material efficiency (Coenen et al., 2020). This is followed by reuse, where products are used again in their original form, and recycling, which involves processing waste materials into new products. The next level is recovery, including energy recovery from waste that cannot be recycled, while disposal (e.g. landfilling or open dumping) is the least preferred option and should only be used as a last resort. By emphasising reduction, reuse, and recycling before

disposal, the waste management hierarchy supports the transition to a circular economy, conserves natural resources, and minimises environmental and public health risks (European Commission 2017, UNEP 2020).

The conceptual framework presented in Fig. 1 was operationalised by translating each of its key components into measurable variables that guided the data collection and analysis process. The four main components of the framework (current waste management practices, social and environmental impacts, regulatory frameworks, and innovative solutions) were used to design the household questionnaire, observation checklist, and key informant interviews. Table 1 shows how the conceptual framework informed the research instruments and data analysis.

Table 1: Operationalisation of the conceptual framework

Component of the conceptual framework	Variables measured	Data collection method	Section in results
Current waste management practices	Waste collection frequency, waste storage methods, types of waste generated, disposal behaviour	Household questionnaire and field observation	Section 3.1-3.8
Social and environmental impacts	Presence of illegal dumping, health concerns, environmental pollution, community perceptions	Household questionnaire and observation	Section 3.9
Regulatory framework	Awareness of municipal waste policies, satisfaction with municipal services	Questionnaire and key informant interviews	Section 3.6
Innovative solutions / circular economy	Willingness to recycle, willingness to separate waste, suggestions for improving waste management	Questionnaire	Section 3.10

2. MATERIALS AND METHODS

Omuthiya Town is located along the B1 main road in the Oshikoto Region of Namibia (Fig. 3). It was proclaimed a town in 2008 and serves as the regional capital of Oshikoto Region due to its central location. Omuthiya is situated approximately 598 kilometers from Windhoek, the capital city of Namibia. It is home to 7560 residents (Namibia Statistics Agency, 2024). The study focused on the municipal disposal site situated approximately 3km northwest of Omuthiya Town, in Omuthiya Town itself, and in a village known as Omadiva B. The disposal site is located within a former sand mining pit and is enclosed by a fence (Fig. 5).

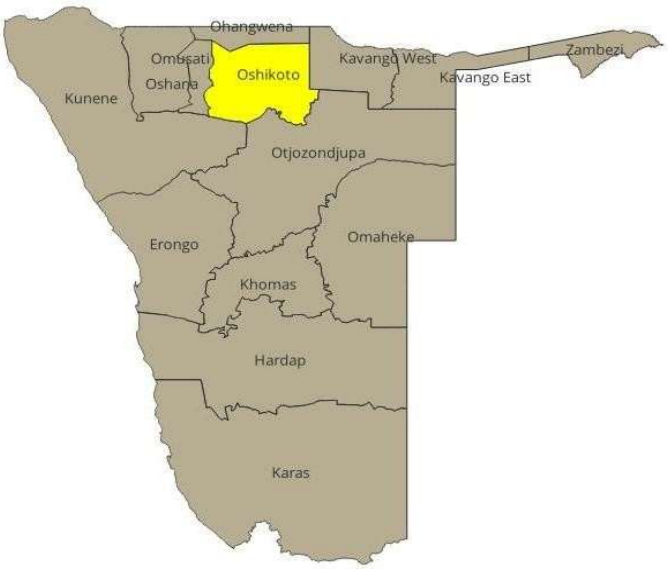

Fig. 3: The Oshikoto Region in the Namibian map Source: Authors (2025)

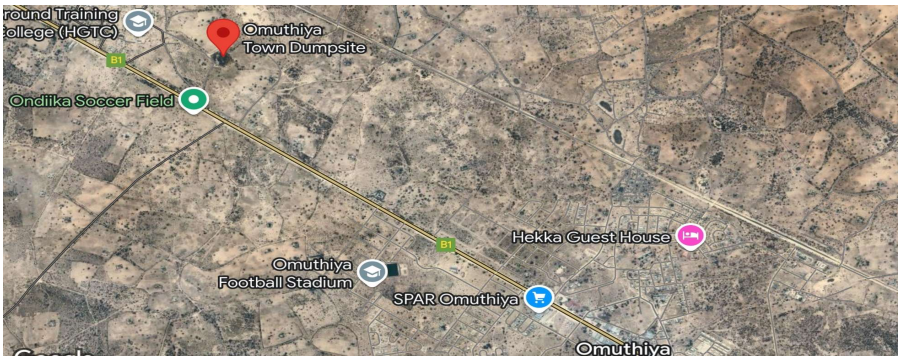

Fig. 4 a: Omuthiya disposal site, Source: Fieldwork (2025); **Fig. 4 b:** Aerial map of Omuthiya Town, Source: Google maps (2025)

The study employed a case study research design and used mixed data collection methods to assess the quantitative impacts of waste generation and disposal, as well as the social and environmental factors influencing waste management practices in Omuthiya Town and its disposal site. Primary data were collected through

household surveys, key informant interviews, and field observations to evaluate the current state of waste management. The target population included Omuthiya Town Council (OTC) officials, residents of Omuthiya Town, residents of Omadiva B village located near the disposal site, and representatives from the industrial zones. Due to practical constraints, including limited time and resources, the study sample comprised of 54 participants. Eligibility criteria included residents who had lived in the area for more than one year and officials directly involved in waste management activities. This sampling approach ensured the inclusion of participants most affected by and knowledgeable about waste management practices in the study area.

An observation checklist was used to systematically identify and examine waste management practices and their associated impacts in Omuthiya Town and at the disposal site. For example, to observe the methods used for collecting and storing waste material before disposal. Quantitative data were analysed using descriptive statistics to summarise key trends in waste management practices. Qualitative data were analysed using thematic analysis to extract patterns and insights from interviews, surveys, and open-ended responses related to waste management practices and community perceptions. Ethical clearance for this study was obtained from the International University of Management. In addition, formal authorization to conduct the research was secured from the Omuthiya Town Council (OTC). Informed consent was obtained from all participants prior to their involvement in the study, with participants required to sign consent forms to confirm their voluntary participation.

3. RESULTS AND DISCUSSIONS

The following section presents the key findings and discusses these findings in detail. The results of this study are presented in accordance with the components of the conceptual framework shown in Fig. 1. The findings are organised into four main themes: (a) current waste management practices, (b) social and environmental impacts, (c) regulatory framework challenges, and (d) potential innovative solutions. This structure ensures that the results directly reflect the conceptual framework that guided the study.

3.1. Waste types

Based on interviews with the residents of Omuthiya Town, Fig. 5 illustrate the different types of waste products generated at the household level.

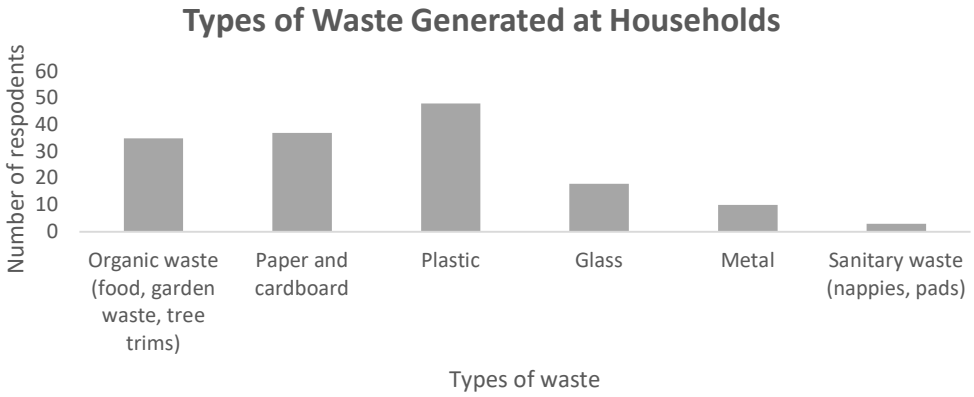

Fig. 5: Types of waste produced at households Source: Research data (2025)

Based on interviews conducted with residents of Omuthiya Town, Figure 5 illustrates the different types of waste generated at the household level. The results show that plastic, paper (including boxes and cartons), and cardboard are the most frequently generated waste types, with 48 and 37 respondents respectively reporting their production (Fig. 5). This indicates that plastic and paper-based materials constitute the dominant components of household waste in Omuthiya Town. Organic waste was also widely reported, with 34 respondents indicating its generation, followed by glass, which was produced by 18 households. In contrast, metal and sanitary waste were reported less frequently, suggesting that these materials are relatively less common within the local household waste stream.

This result aligns with global waste composition patterns, where plastics, paper-based materials, and organic waste are among the major components of municipal solid waste (Vaccari et al., 2021). According to the World Health Organization (WHO, 2025), household waste typically consists of plastics, glass, metals, cardboard, paper, and organic waste such as food remains. Similarly, a systematic review by Vaccari et al. (2021) found that plastic and paper products are among the most common components of household waste in developing countries, largely due to the increasing consumption of packaged goods.

The dominance of plastic waste in Omuthiya Town highlights the urgent need for targeted interventions such as plastic recycling programmes, the promotion of reusable shopping bags, and stricter control or gradual bans on single-use plastics. This is particularly important because, despite the introduction of plastic levies in Namibia (implemented by the Ministry of Environment, Forestry and Tourism (MEFT) to reduce plastic consumption through financial charges on plastic products) plastic waste remains a major environmental challenge in the country. Although the levy represents an important step towards mitigating plastic pollution, its effectiveness largely depends on adequate public awareness, behavioural change, and compliance among consumers and businesses. In addition, there may be gaps in ensuring that the revenue generated through these levies is effectively reinvested into waste management infrastructure, recycling initiatives, and public education programmes.

Furthermore, the presence of a significant proportion of organic waste presents an important opportunity to promote composting initiatives in the town. Studies conducted in many developing countries show that organic waste often constitutes a large share of municipal solid waste, making composting a practical and sustainable waste management strategy. Schübeler et al. (1996) identified composting as one of the most promising methods for recovering organic materials, as it reduces the overall volume of waste while simultaneously producing valuable soil conditioners that can be used in agriculture and horticulture. Similarly, Kadhila and Wit (2022) found that municipal solid waste composition in Namibia contains a high proportion of compostable organic waste as well as recyclable materials such as plastics and paper. These findings suggest that integrated strategies combining recycling and composting could significantly improve the sustainability of solid waste management in towns such as Omuthiya.

3.2. Waste collection frequency and accessibility

Another question focused on waste management practices, specifically the frequency and accessibility of waste collection services. The results, presented in the pie chart below, show that weekly waste collection is the most common practice in Omuthiya Town, with 36 respondents (72%) indicating this frequency (Fig. 6). This suggests that the majority of residents expect waste to be collected on a weekly basis.

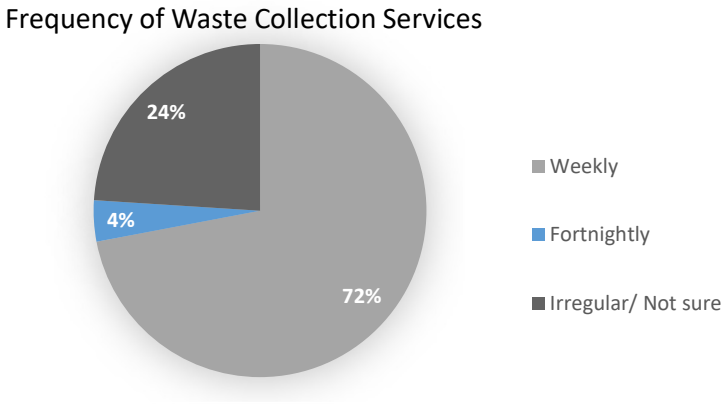

Fig. 6: Frequency of waste collection services Source: Research data (2025)

The Omuthiya Town Council (OTC) waste collection calendar indicates that waste from both residential and commercial areas is scheduled to be collected three times per week. However, the results of this study reveal some inconsistencies between the official schedule and residents' experiences. While 72% of respondents reported receiving regular weekly waste collection services, 24% indicated that collection was either irregular or that they were unaware of the collection schedule (Fig. 6). This suggests that, although the majority of residents are satisfied with the current system, service delivery may not be consistent across all areas of the town. The relatively high satisfaction rate may be attributed to the fact that Omuthiya is a small town and that the town council has recently made efforts to improve waste management services. Nevertheless, dissatisfaction among a minority of residents

indicates that waste collection services may not be uniformly distributed, which could contribute to illegal dumping in areas that are underserved.

Field observations further support these findings, as some skip bins were found to be overflowing at the time of the study, raising concerns about the effectiveness and frequency of waste collection. Ndhlovu (2018) notes that municipal waste collection in developing countries often remains a major challenge due to limited financial resources and inadequate technical capacity. The absence of daily waste collection services may therefore contribute to the accumulation of waste and improper disposal practices, as observed during the field visits. Similar findings have been reported in other studies, which identify irregular waste collection as a key factor contributing to illegal dumping and environmental pollution (Kitole et al., 2024; Kumar et al., 2022; and Grobler et al., 2022).

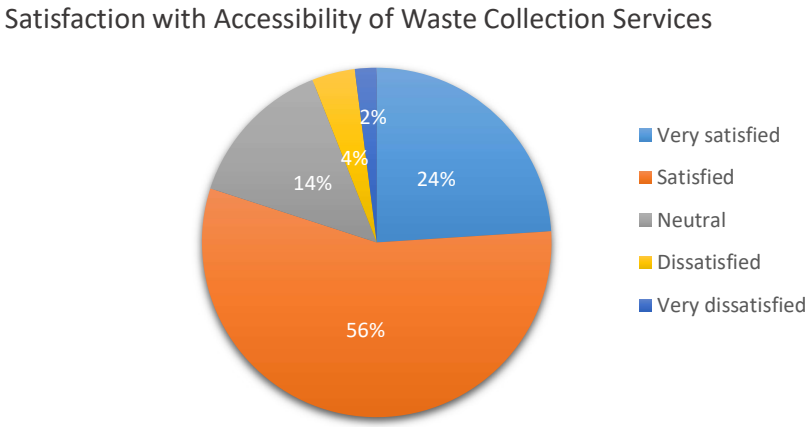

Fig. 7: Satisfaction with accessibility of waste collection services Source: Research data (2025)

Although 56% (Fig. 7) of residents expressed satisfaction with waste collection services, suggesting that the system is generally functional, a proportion of respondents still reported dissatisfaction, indicating that the service does not fully meet the expectations of all residents. Despite the variability in waste collection frequency reported in some areas, most residents indicated that waste collection services are accessible. However, the irregularity reported by some respondents may reflect inconsistencies in service delivery or a lack of clear communication regarding collection schedules, which needs to be addressed by the Omuthiya Town Council (OTC). This is particularly important because inconsistent waste collection can undermine public confidence in municipal services and encourage improper waste disposal practices.

These findings are consistent with previous studies conducted in developing countries. Kaza et al. (2018) found that inconsistent waste collection often disproportionately affects lower-income communities and informal settlements, resulting in higher levels of waste mismanagement and environmental pollution. Similarly, the World Bank report What a Waste highlights that irregular collection schedules in many African cities have contributed

to increased illegal dumping and public dissatisfaction with waste management services. The delayed waste collection reported by some residents in this study therefore requires attention, as improving collection frequency and expanding waste collection coverage have been identified as effective strategies for reducing waste accumulation and illegal dumping (Kaza et al., 2018).

3.3. Waste collection methods

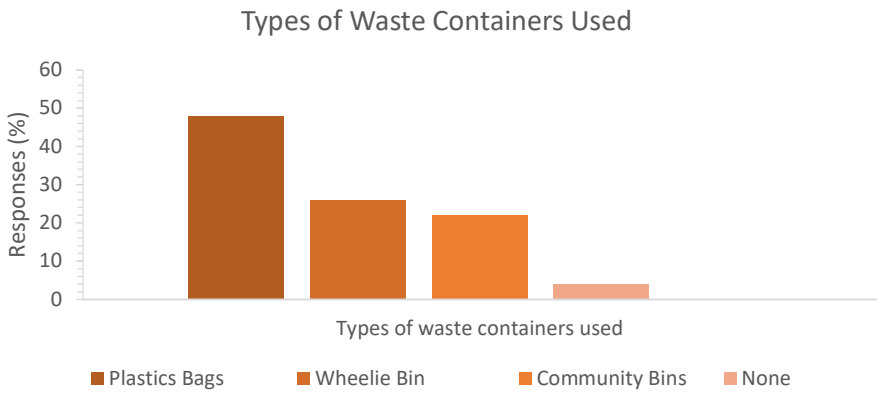

Fig. 8: Types of waste containers used Source: Research data (2025)

Figure 8 presents the types of waste containers used by households in Omuthiya Town. The results show that plastic bags are the most commonly used method of waste storage, with 48% of respondents indicating that they rely on plastic bags for waste collection (Fig. 8). This suggests that many households depend on disposable or single-use plastic materials for storing and disposing of waste, which may further contribute to the increasing problem of plastic pollution.

Wheelie bins were identified as the second most commonly used method, reported by 26% of respondents (Fig. 8), indicating that a smaller proportion of households have access to more formal waste containment systems. In addition, 22% of residents reported using community bins, while skip bins were the least utilised method. The relatively low use of communal bins and skip containers may reflect limited availability of shared waste infrastructure, as well as challenges in accessing private waste containers in Omuthiya Town.

This observation is in line with earlier research findings which show that households in developing countries often rely on plastic bags for waste storage due to limited access to proper waste containers such as bins and skip containers (Kadhila and de Wit, 2022). The World Health Organization (WHO, 2025) also reports that excessive dependence on plastic packaging and plastic waste contributes significantly to environmental pollution, particularly in areas where waste collection systems are weak.

3.4. Residents involvement in waste sorting and recycling

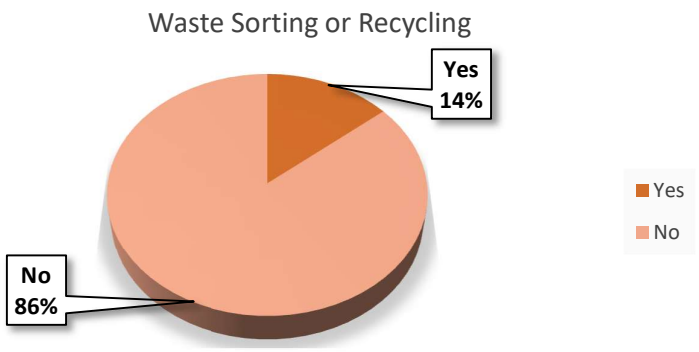

Fig. 9: Waste sorting or recycling responses Source: Research data (2025)

Figure 9 presents the responses of residents regarding waste sorting and recycling practices in Omuthiya Town. The results indicate that the majority of respondents (86%) do not separate their household waste (Fig. 9). Only a small proportion of respondents (14%) reported that they practice some form of waste sorting, mainly separating cans for sale to scrap yards. Other types of waste, such as plastics, small plastic containers, and organic food waste, are generally disposed of without any form of separation. These findings highlight a significant gap in household-level waste separation and recycling practices in Omuthiya Town. However, they also suggest a strong potential for introducing and expanding waste sorting initiatives at the household level, which could substantially reduce the volume of waste transported to disposal sites and improve the overall sustainability of the waste management system. The findings of this study correspond with those reported in previous studies conducted in developing countries, where waste separation at source remains very low due to limited public awareness, lack of recycling facilities, and weak municipal support systems (Barshe and Agme, 2023). In addition,

research shows that waste separation in many developing countries is often driven more by economic incentives, such as selling recyclable materials, rather than by environmental awareness (Vaccari et al., 2021).

3.5. Challenges of waste management in Omuthiya

Based on responses provided by respondents, the following are the main challenges that are hindering sustainable waste management practices in Omuthiya Town.

Fig. 10: Challenges hindering sustainable waste management practices Source: Research data (2025)

Based on responses provided by participants, several key challenges were identified as major barriers to sustainable waste management practices in Omuthiya Town. Figure 10 illustrates the main challenges reported by respondents. Waste management infrastructure remains a significant challenge in many developing towns, including Omuthiya. Medina (2010) highlights that cities in developing countries often face infrastructural constraints such as inadequate investment in waste management systems, which leads to increased environmental pollution and reduced efficiency in waste collection services. These findings are consistent with those reported by Omuthiya Town Council (OTC) officials and residents, who identified a range of challenges pointing to systemic weaknesses in both infrastructure and operational practices. Such challenges contribute to persistent issues, including illegal dumping and environmental degradation, as observed in the study area—even in locations where anti-littering signage is present. Addressing these issues requires a multifaceted approach that includes infrastructure development (e.g., provision of adequate skip containers and household bins), strengthened policy enforcement (such as the application of the polluter pays principle), regular clean-up campaigns, and enhanced community engagement to encourage active participation in sustainable waste management practices.

Illegal dumping, as observed during the study, undermines the overall cleanliness and environmental integrity of the town. It reflects not only gaps in infrastructure but also low levels of public compliance with waste management regulations. In addition, improper use of waste collection facilities, such as overfilled skip bins and incorrect disposal practices, contributes to litter accumulation and creates conducive conditions for pests such as flies, thereby posing public health risks. These challenges can be mitigated through more frequent waste collection, improved monitoring, and public education on proper waste disposal practices. Furthermore, OTC identified financial constraints and limited human resources as major barriers to effective waste management, as these factors hinder the implementation of advanced waste management strategies and limit the council's capacity to enforce regulations. The lack of community incentives also points to the need for more inclusive and participatory approaches that consider residents' socio-economic conditions. These challenges align with national-level observations. The Namibian Minister of Environment, Forestry and Tourism noted that many local authorities lack properly engineered landfills and still rely on dumpsites for waste disposal (Namibia Daily News, 2023). These results also support earlier research which found that irregular waste collection, insufficient infrastructure, illegal dumping, and lack of recycling facilities as major barriers to sustainable waste management in developing countries (Kadhila and de Wit, 2022). Furthermore, the World Health Organization (WHO, 2025) emphasizes that poor waste management systems in small towns are often linked to limited funding, weak institutional capacity, and low levels of public awareness.

3.6. Awareness and effectiveness of current waste management regulations

Questions were included in the survey to assess residents' awareness of existing waste management regulations in Omuthiya Town and their perceptions of how effectively these regulations are enforced. The results, illustrated in Figure 11 a & b, show that only 34% of respondents are aware of the regulations governing waste management in the town. This indicates a significant gap in communication and public education regarding existing waste management policies.

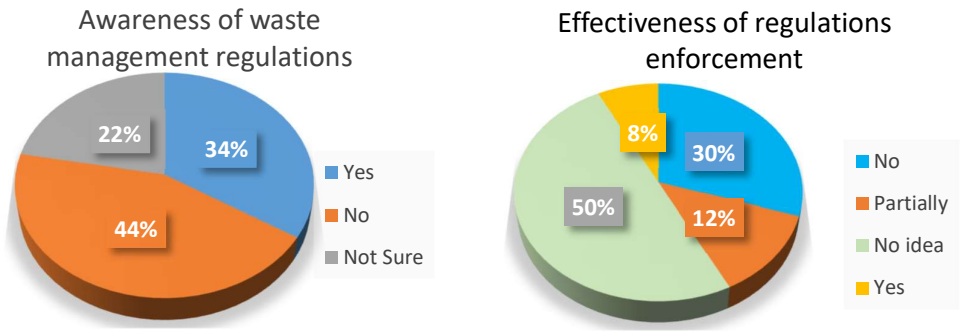

Fig. 11 a & b: Awareness and effectiveness of waste regulations Source: Research data (2025)

A large proportion of respondents (44%) reported that they are not aware of any such regulations, while a further 22% indicated that they are unsure (Fig. 11 a). These findings suggest that waste management policies are not sufficiently visible or accessible to the general public. Limited awareness of regulations may reduce community participation in proper waste management practices and weaken compliance with existing policies. With regard to enforcement, only a small proportion of respondents (8%) believe that waste management regulations are effectively enforced (Fig. 11 b). In contrast, 30% of respondents indicated that the regulations are not enforced at all, while 50% reported that they have no knowledge of the level of enforcement. The remaining 12% indicated that enforcement is only partially effective. These results highlight weak public confidence in the enforcement of waste management regulations in Omuthiya Town.

Overall, the findings point to low levels of regulatory awareness and perceived weak enforcement, which underscores the need for stronger public communication strategies, improved community engagement, and more transparent enforcement mechanisms. Similar findings have been reported in earlier studies which show that lack of public awareness of waste management policies is a major challenge in many developing countries (Vaccari et al., 2021; WHO, 2022). In addition, weak enforcement of waste management regulations has been identified as one of the key factors contributing to poor waste management performance in developing countries (Vaccari et al., 2021).

3.7. Findings from Omuthiya Town Council (OTC) Officials

Solid Waste Management (SWM) in Omuthiya Town is administered by the Health Section under the Department of Technical Services. The service is overseen by an Environmental Health Practitioner supported by a team of five municipal employees, and two contracted service providers. The municipality also allocate financial resources specifically for SWM-related activities. Table 2 highlight the key waste collection stakeholders in Omuthiya Town.

Table 2: Summary of OTC key waste collectors and their roles.

Entity	Mode of collection	Frequency of Collection	Responsibilities
Contractors 1.Nakathigona Trading CC	Collect and transport waste from wheelie bins and plastics to the disposal site. Clean up illegally dumped waste	Monday, Wednesday, and Friday Thursday and Friday	Collect waste from designated areas within the town including residential, businesses, hospitals, offices, schools etc.

2. ST. Events & Cleaning Services			
OTC	Waste collection from skip containers to the disposal site.	Monday and Friday	Collect waste from designated areas within the town including residential, businesses, hospitals, offices, schools etc.
Temporary Workers	Collect and transport waste from wheelie bins and plastics to the disposal site.	Tuesday and Thursday	Hired on temporary contracts to assist with town cleaning and bush cutting

Source: Research data (2025)

Findings from Omuthiya Town Council (OTC) officials indicate that waste collection is carried out through a combination of contractors, council employees, and temporary workers. Two contractors are responsible for collecting and transporting waste from residential areas, businesses, and public institutions, while the council handles the transportation of waste from skip containers to the disposal site and supports general cleaning activities within the town. OTC also applies multiple waste management practices such as litter picking, skip containers, waste caging, and trucking. However, officials identified several major challenges, including illegal dumping, limited public awareness about proper waste disposal, financial constraints, and damage to recyclable materials by waste reclaimers. Although the council reported having a Solid Waste Management Plan and complying with environmental regulations, implementation is constrained mainly by insufficient funding, limited technical expertise, and inadequate human resources. To improve sustainability, officials proposed solutions such as establishing buy-back centres, introducing waste-sorting cages, and strengthening community engagement and stakeholder participation.

Field observations and interviews conducted in Omuthiya Town and at the disposal site confirmed many of the issues raised by OTC officials. Various waste collection methods are used in the town; however, plastic bottles were the most common type of waste observed in public spaces, indicating weak recycling and waste separation

practices. Illegal dumping and littering were frequently observed, even in areas with warning signs, while community participation in waste sorting and recycling was generally low. Although some businesses contribute to town cleanliness by cleaning their premises daily, most residents do not actively participate in sustainable waste management practices. At the disposal site, which is located approximately 3 km from the town, waste mainly consists of plastics, paper, glass, tins, construction materials, and agricultural waste. The site is fenced and managed according to environmental requirements, but challenges such as lack of waste audits, financial limitations, and insufficient human capacity continue to affect effective waste management.

3.8. Field observations

Waste storage and collection methods used by OTC are illustrated in Fig. 12 a, b, c & d below. These methods reflect the council's efforts to maintain cleanliness and manage waste effectively within existing resource constraints.

Fig. 12 a, b, c & d: Methods of waste collection Source: Fieldwork (2025)

Fig. 13 a & b: Illegal dumping Source: Fieldwork (2025)

Field observations conducted in Omuthiya Town revealed that residents generally do not actively engage in waste management practices such as waste sorting or recycling. Illegal dumping of waste materials was also observed (Fig. 13b). This indicates limited awareness and motivation to adopt sustainable waste management practices. Similar findings have been reported in developing countries, where low public participation in waste segregation is often linked to inadequate awareness, lack of incentives, and insufficient infrastructure (Kaza et al., 2018; Guerrero et al., 2013). However, it was observed that business owners regularly clean their premises before opening, which contributes positively to the overall cleanliness of the town. In addition, the community utilises a WhatsApp group to communicate hygiene-related issues, serving as an informal platform for information sharing and coordination. The use of such digital communication tools has been recognised as an effective mechanism for enhancing community engagement and environmental awareness in local governance contexts (United Nations, 2020).

Observations at the Omuthiya disposal site further revealed that waste is not compacted but is instead openly burned to reduce its volume (Fig. 14 a & b). After burning, the remaining ash and non-combustible materials, such as glass, construction debris, and metal tins, are pushed into heaps using a front loader. Although this method helps reduce the volume of waste, it poses serious environmental and health risks due to air pollution and unsafe waste handling practices. These findings are consistent with recent scientific and policy reports which show that open burning of household waste is still widely practiced in many developing countries due to limited waste disposal infrastructure (WHO, 2022; WHO, 2025). Open waste burning has also been identified as a major source of air pollution and a significant threat to public health, particularly for communities living close to disposal sites (WHO, 2025).

Fig. 14 a & b: Waste before and after burning Source: Fieldwork (2025)

Further observations showed that the disposal site is fenced and has a lockable gate; however, the fence has been vandalized, allowing unauthorized access (Fig. 15). A security guard is present only during daytime hours (08:00–17:00), leaving the site unprotected after hours. This limited security increases the risk of illegal dumping and unsafe disposal practices.

Fig. 15: Fence of the disposal site Source: Fieldwork (2025)

Vulnerable groups, including children, were observed scavenging at the disposal site without protective clothing, exposing them to hazardous materials (Fig. 16). There was no evidence of waste separation, particularly for hazardous and medical waste, which was found mixed with general waste (Fig. 17 a & b). This lack of segregation increases the risk of exposure to dangerous substances for both human and environment.

Fig. 16: People scavenging at Omuthiya disposal site Source: Fieldwork (2025)

In addition, no evidence of waste separation was observed at the disposal site. Hazardous and medical waste was found mixed with general waste (Fig. 17 a & b), which increases the risk of exposure to dangerous substances for both humans and the environment. Expired food waste was also observed being dumped without burial and left accessible to scavengers and pests. Overall, these observations indicate serious shortcomings in waste handling, site security, and environmental protection at the Omuthiya disposal site.

Fig. 17 a: Medical disposable waste at Omuthiya disposal site, Source: Informante, (2022); **Fig. 17 b:** Expired food, Source: Fieldwork, (2025)

Expired food waste (Fig. 17 b) was also observed being dumped without burial and left accessible to scavengers and pests. Overall, these observations indicate serious shortcomings in waste handling, security, and environmental protection at the Omuthiya disposal site.

3.9. Environmental and social impacts

The environmental and social impacts reported in this study are largely based on residents' perceptions and field observations rather than quantitative environmental measurements. Residents living near the disposal site indicated concerns about reduced crop productivity, presence of pests such as snakes, and occasional livestock

deaths. While these observations provide valuable insights into community experiences, they were not supported by empirical data such as soil quality analysis, crop yield assessments, or veterinary records. Similarly, concerns regarding air pollution were based on visual observations and reported experiences of odours and smoke, without supporting measurements such as air quality monitoring or wind direction analysis. Therefore, these findings should be interpreted as perception-based rather than scientifically verified environmental impacts.

The results further revealed several environmental and social impacts associated with the disposal site in Omuthiya Town. Residents reported that the disposal site contributes to soil degradation, which is reflected in reduced crop productivity in fields located near the site. The presence of the disposal site has also attracted stray animals and predators, including birds, snakes, insects, and other pests. These animals reportedly migrate into nearby agricultural fields, damaging crops, posing safety risks to the community, and disrupting the local ecosystem. In addition, residents indicated that livestock, particularly cattle, have died after ingesting plastic waste from the disposal site.

Air pollution was identified as one of the most serious environmental impacts associated with the disposal site. The practice of open waste burning releases large amounts of smoke and harmful emissions, which may spread into surrounding residential areas (Fig. 18). Community members, especially those living within approximately 500 metres of the disposal site, reported breathing difficulties and sleep disturbances caused by persistent smoke. Furthermore, the disposal site is located about 300 metres from the B1 main road, and smoke from burning waste was reported to reduce visibility for road users, creating traffic hazards. This could highlight poor planning and inappropriate siting of the disposal facility in close proximity to both residential areas and a major transport route.

Fig. 18: Smoke from burning waste at Omuthiya disposal site Source: Fieldwork (2025)

In addition, the disposal site emits unpleasant odours and is heavily infested with flies (Fig. 19 a & b). These conditions reflect poor waste management practices and may contribute to deteriorating air quality and increased

health risks for nearby residents. It was also observed that vegetation in close proximity to the site is sparse, with more vigorous plant growth occurring further away from the disposal area. This pattern suggests that the disposal activities may be negatively affecting soil quality and local vegetation health. Moreover, residents reported experiencing unpleasant odours resulting from waste accumulation in various parts of Omuthiya town. These findings are consistent with existing research, which indicates that decomposing waste emits gases such as ammonia, sulphides, methane, and carbon dioxide. Some of these gases contribute to climate change, while others are primarily responsible for foul odours and the deterioration of air quality (Elago, 2019). The presence of such emissions not only affects environmental quality but also reduces the overall livability of affected areas.

In addition, the accumulation of waste creates an unsanitary and aesthetically undesirable environment, which can attract pests and disease-carrying vectors such as flies and rodents. This further increases the risk of disease transmission and poses a threat to public health. Therefore, ineffective waste management practices not only degrade environmental conditions but also have indirect implications for human health and well-being, highlighting the need for improved waste handling and disposal systems.

Fig. 19 a & b: Flies in the cooking pot and a plate of food Source: Fieldwork (2025)

Interestingly, the majority of residents reported that they had not observed any direct health impacts associated with current waste management practices in Omuthiya town. This perception may suggest that the immediate effects of improper waste handling are not readily visible or are underestimated by the community. However, the absence of reported health problems does not necessarily imply the absence of risk. Poor waste management practices can have significant long-term health implications that may not be immediately recognised by residents.

Existing literature indicates that prolonged exposure to inadequately managed waste is associated with increased health risks (Elago, 2019). Such risks include the spread of infectious diseases and the occurrence of skin, respiratory, and gastrointestinal conditions, often resulting from exposure to contaminated environments, pests, and pollutants. Therefore, even though residents may not currently perceive waste management as a direct health threat, there remains a critical need for increased awareness and preventive measures to mitigate potential long-term social and public health impacts.

Fig. 20: Waste trapped on a nearby fence Source: Fieldwork (2025)

It was observed that various waste types, particularly plastic materials, are blown from the disposal site and become trapped in nearby fences (Fig. 20). This results in environmental pollution and poses serious risks to both wildlife and domestic animals in the surrounding area. he results showed that the disposal site contributes to air pollution, soil degradation, livestock deaths, and health problems among nearby residents. These findings are strongly supported by previous research. These findings are consistent with previous research which shows that communities living near waste disposal sites face increased risks of air pollution, soil degradation, livestock deaths, and public health problems (Vaccari et al., 2021). The World Health Organization (WHO, 2025) also reports that open waste burning releases harmful pollutants that can cause breathing problems, poor air quality, and environmental degradation, particularly in communities located close to disposal sites.

A key limitation of this study is that environmental impacts were not assessed using quantitative scientific measurements. Data on issues such as air quality, soil contamination, crop productivity, and ecological effects were based primarily on field observations and community perceptions. While such qualitative data provide important contextual insights, they do not allow for definitive conclusions regarding causality or magnitude of environmental impacts. Future studies should incorporate empirical methods such as soil testing, air quality monitoring, and spatial analysis to validate and quantify these impacts.

3.10 Innovative Solutions/Circular Economy Concept

According to Upadhyay and Alqassimi (2019), as cited in Nambahu (2023), the circular economy (CE) is a business model that promotes a transition from the traditional linear economy to a restorative and regenerative system. This approach emphasises extending the life cycle of products in order to maximise resource efficiency and extract maximum value from materials throughout their use. Furthermore, the circular economy is designed

to minimise environmental harm by addressing the negative impacts associated with resource extraction and ensuring that waste generation is reduced across all stages of the product life cycle (Upadhyay & Alqassimi, 2019).

Within this framework, waste is reconceptualised as a valuable resource rather than a by-product, and product life is extended through strategies such as recycling, reuse, and remanufacturing. The European Union's Circular Economy Action Plan supports this approach by promoting closed-loop systems, where discarded materials are reintroduced into production cycles, thereby maintaining resource circulation and enhancing environmental sustainability (Ellen MacArthur Foundation, 2017). For instance, in the Netherlands, companies such as Philips have adopted product-as-a-service models, whereby used electronic products are returned, refurbished, and resold, reducing waste and extending product lifespan (Ellen MacArthur Foundation, 2017).

Similarly, in China, circular economy principles have been incorporated into national development strategies. The "Zero Waste Cities" initiative aims to reduce landfill dependency by promoting recycling and resource recovery programmes in urban areas (Kawai & Tasaki, 2016). These global examples demonstrate the relevance of the circular economy in addressing challenges related to resource depletion and waste pollution. Therefore, transitioning towards a circular economy model (Fig. 21) offers a viable and sustainable solution to contemporary waste management challenges.

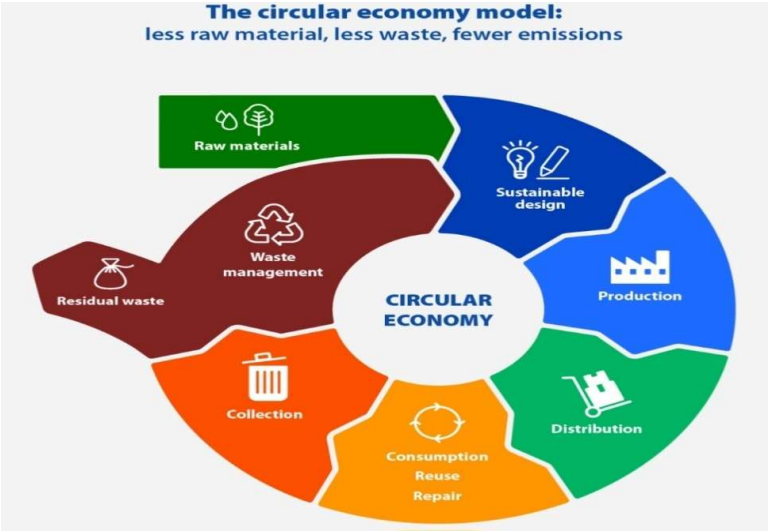

Fig. 21: Circular Economy model, Source: Ellen MacArthur Foundation (2017)

A study by Kadhila et al. (2022) reports that CE has economic, environmental, and social benefits. The economic benefits include reducing the use of primary resources, job creation, reduced environmental pollution, and livelihood improvement. They recommend that policy has a significant impact on whether the transition to

a CE is possible. They further recommend that policymakers in small municipalities should revise the existing regulatory instruments to promote transitioning to circular waste management, in line with the proposed waste management framework to promote the CE model.

The transition to a circular economy (CE) presents a practical and innovative pathway for improving solid waste management in Omuthiya Town Council (OTC). To achieve this, OTC can begin by promoting waste segregation at source through the provision of labelled bins and public awareness campaigns, enabling the separation of recyclables such as plastics, paper, and glass from organic waste. This would support the establishment of local recycling systems and reduce the volume of waste disposed of at the dumpsite. In addition, OTC can operationalise proposed buy-back centres, where residents are incentivised to return recyclable materials in exchange for financial rewards. Such initiatives not only encourage community participation but also create local economic opportunities, particularly for informal waste collectors. Furthermore, organic waste (which constitutes a significant portion of municipal waste) can be diverted to composting programmes, producing organic fertiliser for agricultural use and contributing to both waste reduction and local food systems.

To strengthen the transition, OTC should integrate CE principles into its policy and planning frameworks by aligning its Solid Waste Management Plan with circular economy objectives. This includes fostering partnerships with private sector actors and small enterprises to support recycling, reuse, and remanufacturing activities within the town. Capacity building, technical support, and investment in infrastructure such as material recovery facilities and waste sorting cages will be essential to operationalise these initiatives. Moreover, the council can adopt regulatory instruments such as the polluter pays principle and incentives for businesses that implement sustainable waste practices. As highlighted by Kadhila et al. (2022), policy support is critical in enabling the shift towards a circular economy, particularly in small municipalities. By adopting a comprehensive approach that combines infrastructure development, community engagement, and policy reform, OTC can transition from a linear waste management system to a more sustainable, resource-efficient circular model.

4. Conclusions

This study demonstrates that while Omuthiya Town has made measurable efforts to provide waste collection services and maintain public cleanliness, its solid waste management system remains largely inadequate and unsustainable. Significant gaps were identified, including lack of waste management infrastructure such as recycling centres, Waste-to-Energy (WTE) Plants, Buy-Back Centres, lack of waste segregation at source, inconsistent service delivery, lack of community participation programmes related to waste management, and weak enforcement of existing waste management regulations. These shortcomings collectively undermine the effectiveness of the town's waste management system.

Although most residents within the town reported general satisfaction with waste collection accessibility, serious environmental and health impacts were observed and reported in communities located near the disposal

site. These include air pollution from open waste burning, pest infection, unpleasant odours, soil degradation, reduced crop productivity, and risks to both humans and animals. The contrast between conditions within the town and those near the disposal site highlights an environmental justice concern, where vulnerable communities bear a disproportionate burden of pollution and health risks.

The findings further reveal critically low public awareness of waste management regulations, coupled with weak and inconsistent enforcement. This regulatory gap, together with financial constraints and limited human resources, has hindered effective policy implementation. The continued practice of open burning, illegal dumping, lack of medical and hazardous waste separation, and unsecured access to the disposal site reflect systemic governance and operational failures that require urgent intervention.

To address the challenges identified in this study, it is essential to implement a comprehensive and well-coordinated waste management strategy in Omuthiya Town. The study therefore recommends the mobilisation of financial and technical resources through mechanisms such as public–private partnerships (PPPs), international funding opportunities, and innovative initiatives such as waste banks. In addition, there is a need to improve waste management infrastructure through the establishment of modern recycling centres, waste-to-energy (WTE) facilities, and automated waste-sorting systems.

Furthermore, stricter enforcement mechanisms, including the introduction of a Pay-As-You-Throw (PAYT) system, should be considered to encourage responsible waste disposal practices. The study also highlights the importance of strengthening community participation through innovative engagement strategies, such as community-based source-separated organic composting programmes.

These recommendations should be facilitated and coordinated by the OTC, which serves as the primary authority responsible for waste management within the town. The Council is therefore expected to play a leading role in mobilising resources, improving infrastructure, strengthening regulatory enforcement, and promoting community participation in sustainable waste management practices. Regular public education and awareness programmes, facilitated by Omuthiya Town Council (OTC) waste management officials, are essential for promoting responsible waste management practices, including waste separation, recycling, and proper disposal. In instances where household-level waste separation and recycling cannot be fully implemented, the establishment of a Waste-to-Energy (WTE) facility could provide an alternative solution by converting waste materials into electricity. Such a facility has the potential to reduce the volume of waste sent to disposal sites by up to 90%, thereby alleviating pressure on existing disposal infrastructure and mitigating environmental pollution.

Ultimately, strengthening institutional capacity, empowering communities (i.e., through community-based source-separated organic composting programs), and enforcing environmental regulations are critical steps to-

ward building a sustainable and inclusive waste management system in Omuthiya Town. If these recommendations are implemented, Omuthiya has the potential to transform its waste management practices and serve as a model for other towns facing similar environmental and public health challenges.

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