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Developing Sustainable Waste Management Strategies in Municipalities in the Eastern Cape, South Africa:

A Case Study Approach

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Abstract

The study focuses on the sustainable waste management challenges faced by the Amathole District Municipality. The increasing waste generation and inefficient waste management practices in rural areas highlight the need for a systematic approach to address these issues. The primary objective of this research was to assess the challenges in waste management and provide actionable recommendations to improve sustainability in waste management practices. A qualitative research methodology was adopted to explore the perspectives of various stakeholders involved in waste management, including municipal officials, community leaders, and local citizens. Data was collected from 12 participants through semi-structured interviews to gain in-depth insight into the issues and potential solutions. The Waste Management Theory guided the analysis, emphasizing the waste hierarchy and integrated waste management principles. Key challenges identified included inadequate waste management infrastructure, insufficient budget allocations, and low public awareness and illegal dumping sites. The study concludes that enhancing waste management strategies requires collaborative efforts between local authorities, the private sector, and the community. Recommendations include strengthening waste infrastructure, increasing public awareness campaigns, and implementing a "polluter pays" principle. These interventions are essential for promoting sustainability and improving waste management practices within the municipality.

Keywords

Waste management, Municipality, Sustainable waste management strategies, Environmental sustainability

INTRODUCTION

Sustainable waste management has become a key concern in South Africa, particularly in municipalities such as the Amathole District Municipality in the Eastern Cape Province. Despite efforts to implement waste management programs, the municipality grapples with ineffective regulations and poor implementation, leading to detrimental effects on the environment and the community (Mkabela & Aigbavboa, 2020; Wilson & Rodriguez, 2022).

In the Amathole District Municipality of the Eastern Cape Province, South Africa, waste management presents unique challenges shaped by its geographical, socio-economic, and infrastructural characteristics (Smith & Brown, 2020). With a population exceeding one million people, the municipality faces significant pressures related to waste collection, disposal, and environmental protection (Amathole District Municipality, 2020). Limited resources and inadequate

infrastructure exacerbate these challenges, leading to illegal dumping and ecological degradation (Mkabela & Aigbavboa, 2020). Therefore, there is an urgent need to develop sustainable waste management strategies tailored to the specific context of the Amathole District Municipality, aiming to improve waste management practices and foster environmental sustainability.

Before 1994, waste management in the Amathole District Municipality in the Eastern Cape Province of South Africa faced challenges typical of many developing regions (Mkabela & Aigbavboa, 2020). The waste collection and disposal infrastructure was often inadequate, leading to open dumping and uncontrolled waste accumulation (Mkabela & Aigbavboa, 2020). Additionally, there was limited awareness of environmental concerns related to waste management, and resources for addressing these issues were scarce.

Following the democratic transition in 1994, South Africa embarked on a path of transformation aimed at addressing historical inequalities and improving the quality of life for all citizens (Mkabela & Aigbavboa, 2020). As part of this broader agenda, efforts were made to enhance waste management practices in municipalities nationwide, including the Amathole District Municipality. These interventions sought to modernise waste management infrastructure, increase access to waste collection services, and promote environmental stewardship.

Various interventions have been implemented to address the challenges encountered by the municipality and enhance waste management performance. These initiatives include establishing formal waste management systems, introducing recycling programs, and implementing public awareness campaigns to foster responsible waste disposal practices (Department of Environmental Affairs, 2012). Furthermore, legislative frameworks and policies, such as the Waste Act 2008 under the National Environmental Management, have been enacted to furnish a regulatory framework for waste management activities and ensure adherence to environmental standards.

Different studies have been conducted on waste management in South Africa detailing this phenomenon. A study by Moyo, Lubbe, and Ohei (2023) explored e-waste management practices in South African organisations. Another study by Grobler, Schenck, and Chitaka (2022) focused on waste management, illegal dumping, and littering in South Africa. Another study by Polasi, Matinise, and Oelofse (2020) focused on South African waste management systems: challenges and solutions. Although there is literature conducted on waste management, there is limited knowledge on waste management practices from a local government context and how different strategies can assist the government in achieving better waste management solutions within communities and municipalities.

Despite ongoing efforts, substantial obstacles remain in managing waste within the Amathole District Municipality. Challenges such as illegal dumping, littering, and inadequate waste collection coverage remain prevalent, posing threats to public health and environmental sustainability (Amathole District Municipality, 2020). Given these challenges, there is an urgent need for further research and intervention to develop sustainable waste management strategies tailored to the specific context of the Amathole District Municipality. This paper aims to address this need by

1. Identifying key challenges and barriers to sustainable waste management within the Amathole District Municipality
2. Providing recommendations on how to develop sustainable waste management practices in the Amathole District Municipality

THEORETICAL FRAMEWORK

This article adopted the Waste Management Theory, as propounded by Pongrácz, Paul Phillips, and Riita Keiski (2004), underscoring the importance of adopting comprehensive approaches to address waste management challenges in municipalities. The Theory of Waste Management provides a structured approach to understanding and addressing the complexities of waste generation, treatment, and disposal. It encompasses various principles, strategies, and practices to minimise waste production, promote efficient resource use, and mitigate environmental impacts (Sonnemann, 2021). The theory of waste management is grounded in the waste hierarchy concept, which prioritises waste management practices based on their environmental impact. The hierarchy typically follows this order: waste prevention, waste reduction, reuse, recycling, recovery (including energy recovery), and disposal (landfill or incineration) (Nakamura et al., 2022). This framework encourages adopting practices that prevent waste generation at the source and promote the efficient use of resources. This theory is crucial for developing sustainable waste management systems that balance environmental, economic, and social considerations. Utilising this framework enables municipalities to establish waste management systems that are environmentally sustainable, economically practical, and socially inclusive.

The Theory of Diffusion of Innovations (DOI) was also used in this study to explain the adoption of new waste management practices and technologies within communities and municipalities. It was developed by Everett Rogers in 1962 and provides a framework for understanding how, why, and at what rate new ideas and technology spread through cultures (Rogers, 2020). This theory is particularly relevant in sustainable waste management, as it can help. The DOI theory posits that the diffusion process follows a predictable pattern characterised by a bell-shaped curve over time. This process is influenced by five key factors: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2020). The theory categorises adopters into five groups: innovators, early adopters, early majority, late majority, and laggards. Understanding these factors and adopter categories can help municipalities like the Amathole District Municipality (ADM) strategise introducing and adopting innovative waste management practices (Jung et al., 2022).

Municipal Waste Management

Municipal waste management focuses explicitly on handling waste generated within urban and peri-urban areas under the administration of local government authorities (Rousta et al., 2019). It involves multiple activities managed by municipal authorities, including waste collection, transportation, treatment, and disposal. Common challenges in municipal waste management include limited infrastructure for waste collection, inadequate funding, and the impact of rapid urbanisation (Zheng et al., 2020). These challenges often lead to overflowing landfills, uncollected waste, and environmental degradation. Additionally, disparities in waste management services between formal and informal settlements add complexity to municipal waste management (Gao et al., 2019).

Municipal waste management is critical for urban public health and environmental quality. Nevertheless, obstacles like insufficient infrastructure and financial limitations hinder the successful implementation of effective waste management practices (Smith & Brown, 2020). Addressing these challenges necessitates investments in infrastructure development, capacity building, and community engagement initiatives to ensure equitable access to waste management services (Rousta et al., 2019). Collaborative efforts between local government authorities, communities, and other stakeholders are essential for improving municipal waste management systems and promoting sustainable urban development.

Waste Harvesting

Waste harvesting involves retrieving valuable materials from waste streams through recycling, composting, or other resource recovery methods (Lopez et al., 2019). Its goal is to optimise resource utilisation while minimising waste sent to landfills or open dumps. Challenges in waste harvesting include limited market demand for recycled materials, inadequate infrastructure, and community members' lack of awareness (Rousta et al., 2019). These obstacles often impede the effectiveness of waste harvesting initiatives and restrict the potential for resource recovery. Additionally, logistical constraints and technological barriers further hinder the implementation of waste harvesting programs (Lopez et al., 2019).

Waste harvesting presents an opportunity to mitigate the environmental impact of waste disposal and promote resource conservation. Nonetheless, obstacles like low market demand and logistical difficulties must be tackled to maximise the potential of these initiatives. Addressing these barriers through supportive policies, infrastructure development, and increased public awareness can pave the way for more sustainable waste management practices (Zheng et al., 2020).

Waste Management

Waste management entails the organised collection, transportation, treatment, and disposal of waste materials to reduce environmental pollution and public health hazards. (Hassan et al., 2020). It encompasses various activities to manage solid waste households, businesses, and industries generate. Significant challenges in waste management include inadequate infrastructure, limited resources, and socio-economic disparities (Diaz et al., 2019). These challenges often lead to open dumping, illegal waste disposal practices, and environmental pollution. The challenges in effective waste management are also exacerbated by insufficient public awareness and weak regulatory frameworks (Yuan et al., 2020). Although efforts to enhance waste management have been made, issues continue to arise due to limited infrastructure and resources. Overcoming these obstacles necessitates creative solutions and stakeholder cooperation to advance sustainable waste management practices (Hassan et al., 2020). Incorporating technological innovations, fostering community involvement, and implementing policy measures can significantly reduce the environmental and public health risks associated with poor waste management.

Sustainable Waste Management in South African Municipalities

Many municipalities in South Africa are currently grappling with challenges related to waste management, which are yet to be addressed effectively (Kubanza & Simatele, 2019). Although the government has put measures in place for waste collection services, there are still challenges exacerbated by a lack of comprehensive management and planning strategy (Kubanza, 2023). The misinterpretation of legislation, institutional framework inadequacy, and maladministration have exalted the effectiveness of waste management in South Africa (Kubanza, 2023).

In South Africa, waste management is based on legislation and policies (Godfrey & Oelofse, 2017; Pewa, 2019). South Africa's waste management consists of recycling, reuse, minimisation, recovery, and disposal (Kubanza, 2023). Although the government has policies on waste management, the current problems associated with this phenomenon are due to outdated laws and policies (Pewa, 2019).

Most South Africans struggle to access regular garbage collection services, especially in low-income communities (Kubanza, 2023). Generally, without formal waste collection, people look for alternative ways that are unsuitable for the government (Khumalo, 2016). Additionally, the unavailability of waste management systems gives people a reason to adopt unsustainable solid waste disposal methods, including open burning (Pewu, 2019). A study by Olukamni et al. (2016) found that most solid waste disposals are done in landfills and are recyclable. Godfrey and Oelofse (2017) argue that significant financial investment is required to reduce waste management. Other researchers argue that low community engagement hinders waste management despite these financial barriers because most municipalities operate on limited resources (Kubanza, 2023). Nyika et al. (2020) further argue that the lack of holistic planning and

management at the governance level weakens waste management in South Africa. Most communities face problems with solid waste disposal (Rasmeni & Madyira, 2019). This has harmful consequences for the environment and the human population's health, affecting the overall standard of living.

RESEARCH METHOD AND DESIGN

The study utilised a qualitative approach to develop sustainable waste management strategies to improve the efficacy of waste management endeavours in Municipalities, using the Amathole District Municipality as its case study.

In line with the qualitative approach, this study adopted an interpretive paradigm based on the views and experiences of the Amathole District Municipality to understand the problems associated with waste management strategies. Necessitated by the interpretive philosophy was the exploratory design to answer research questions presented in the study thoroughly.

The target population of the article consisted of participants above 18 with relevant knowledge and experience in sustainable waste management strategies within the Amathole District Municipality. These included community members 8, Urban and Rural, community leaders (2), and municipal officials (2). The sample size was 12 participants. The selection of participants was done using the purposive non-probability selection technique. As a result, semi-structured interviews were used as primary data collection methods for the 15 participants of the study. Furthermore, the article applied thematic data analysis to synthesise and categorically identify patterns and themes from the data.

ETHICAL CONSIDERATIONS

The University of Fort Hare granted the ethical certificate to conduct the study through the InterFaculty Human Research Ethics Committee (IFHREC). The ethical clearance number is 202122830 – TN – UO. It must also be noted that the researchers ensured the ethical principles of informed consent, voluntary participation, anonymity and confidentiality in this study.

FINDINGS

This research aimed to develop sustainable waste management strategies in Municipalities in the Eastern Cape, using ADM as a case study. To achieve that goal, it sought to identify key challenges and barriers to effective waste management within the municipality. Therefore, respondents were asked to name such barriers to effective, sustainable waste management. These findings are presented below.

Lack of adequate infrastructure

This was one of the findings from this study. 2 out of the 12 municipal officials participants cited infrastructure deficiencies and public awareness as significant challenges to effective waste management within the Amathole District Municipality. According to them, waste disposal trucks were in short supply, and even the available ones were in poor condition.

"The most significant challenge we face is inadequate infrastructure. We have insufficient vehicles for waste collection, and our few are often in poor condition. This leads to delays in waste collection and discourages community members from participating in waste separation initiatives since they see that collected waste is often dumped in the same place. When people witness this inconsistency, their trust in the waste management system erodes, directly impacting their willingness to engage in sustainable practices." (Municipal Officials: Participants 1 and 2)

Lack of public awareness

In the case of public awareness, the community leaders and some community members expressed frustration over the community's lack of understanding regarding sustainable waste management. The following excerpts capture the sentiments of a community leader.

"We have tried to encourage waste separation to no avail. People do not understand the importance why we should recycle" (Participant 6)

According to another participant;

Residents do not know how to separate recyclables properly, so the little we do gets mixed up with other waste. It feels like we are fighting an uphill battle. When we hold meetings or community clean-up days, only a handful of people show up, and many already understand the issues. The majority do not see why it matters to separate waste when, in their view, it all ends up in the same place. We need consistent educational programs that inform residents about the 'how' of waste separation and the 'why'—the environmental benefits, the potential for recycling to create jobs, and the positive impact on our community's health. Without this understanding, our efforts are in vain." (Participant 3)

However, some participants blamed the municipality's failure to conduct such programs or campaigns regularly for the lack of awareness. Accordingly, one participant said

"I rely on community members to help me understand what to do. When we have community clean-ups, it's mostly because someone in the neighbourhood organised it, not because we know how to manage waste. We need more support from the municipality to make waste management a priority." (Participant 12)

As a follow-up to the above comments, when the Municipal officials were asked about the consistency of awareness campaigns, they cited a lack of funds as the main reason.

"We have organised several awareness campaigns, but they have had limited success. We lack the funding to conduct regular educational workshops, so the community engagement has been sporadic." (Participant 2)

A community leader and some participants agreed with the above statement that more awareness campaigns were needed to provide platforms for community engagement on this issue. Their responses are captured below:

"The few workshops we have had were helpful, but not enough" (Participant 4)

"We need more regular sessions to keep people informed and to remind them of the importance of proper waste management. Without continuous engagement, people tend to forget or revert to old habits. It is about telling them once and building a culture of awareness and responsibility around waste management in our community. People need reminders and new information to keep them engaged. We must find ways to make this a part of everyday conversations in our neighbourhoods, so it does not just become a topic that fades away after a workshop ends" (Participant 11)

Illegal dumping sites

Regarding illegal dumping sites, 8 of the 12 participants complained of illegal dumping, which was freely practised within the municipality. One of the participants expressed his frustration in the following comments.

"We are constantly dealing with illegal dumping in our area. People dump their waste anywhere because the collection service is unreliable. We often see waste piling up, especially in informal settlements where people do not have proper bins or disposal areas. It is not just an eyesore; it creates real health issues and attracts pests. In some places, the waste is so bad that you can hardly walk without stepping over something. This leads to a situation where residents feel hopeless about the cleanliness of their environment. We want to do the right thing and keep our community clean, but it becomes impossible to manage waste properly when the systems to support us fail." (Participant 8)

However, some participants blamed the municipality for the illegal dumping practised by the residents. According to one of the participants

"The municipality does not provide us with bins or any way to dispose of our waste properly. We cannot live with garbage within our yards, so we plan how to dispose of it." (Participant 9)

DISCUSSION

The study's findings provided a better understanding of the challenges hindering sustainable waste management practices and how these challenges and barriers can assist the government in better planning. The study found that there is a lack of adequate infrastructure. This means there are no reliable waste collection systems, recycling facilities, or proper landfill management, which was challenging. This aligns with findings from Godfrey and Oelofse (2017), who argue that the lack of municipal capacity is a recurring problem in South African waste management. Poor infrastructure leads to insufficient waste handling and contributes to environmental pollution and health hazards. The National Environmental Management Waste Act (59 of 2008) emphasises the need for adequate infrastructure in waste management systems. According to Wilson (2021), infrastructure limitations are common in rural and semi-urban areas, where municipalities often lack the resources needed to maintain a functional waste collection system. The researcher observed that the lack of reliable waste collection services directly discourages communities from engaging in sustainable practices, further exacerbating illegal dumping and waste mismanagement.

Secondly, the study found a general lack of awareness, as most members are unaware of proper waste disposal practices and the ecological consequences of improper waste management. The above situation is also aggravated by insufficient funding to conduct awareness campaigns. The finding buttresses the low public participation in environmental programs, especially in geographical locations (StatsSA2021). The lack of awareness about the environmental and social implications of proper waste disposal is a pervasive issue that has resulted in ineffective recycling practices within the community. The findings support the DOI theory on communication channels and observability, which stipulates that if individuals are unaware, the innovation cannot spread effectively (Rogers, 2020). A study by Aureli and Brelet (2021) further echoes this, emphasising that public awareness and active participation are crucial in establishing a sustainable waste management system. This perspective is echoed in the findings, which reveal that educational initiatives insufficiently support the municipality's efforts at community engagement. The National Environmental Management Waste Act (59 of 2008) stresses community engagement as a foundational aspect of successful waste management, highlighting municipalities' need to foster a recycling culture through informed citizen participation.

On the issue of lack of funding. According to Aureli and Brelet (2021), successful waste management requires consistent and sustained community engagement. The National Environmental Management: Waste Act (59 of 2008) mandates that municipalities actively engage with their communities to foster a recycling culture and sustainable waste disposal. This supports the view of the DOI theory on relative advantage and trail ability, which provides that without financial resources, local government cannot adopt innovations, making it harder to demonstrate benefits (Rogers, 2020). However, the findings suggest that the municipality's efforts have been hampered by a lack of resources, preventing them from maintaining a continuous dialogue with residents. The researchers observed that while awareness campaigns are

critical, their success depends on ongoing, well-funded initiatives that can effectively reach all community members. Thus, the government must provide investment capital to achieve sustainable waste management, which is not always available in most municipalities. This supports the view of the Department of Environment Affairs (2018) that funding remains one of the biggest challenges affecting the effective implementation of the National Waste Management Strategy. Thirdly, the study found that illegal dumping sites occur across the designated municipal areas. This highlights a critical issue faced by many rural communities in South Africa: the persistent problem of illegal dumping, which is exacerbated by unreliable waste collection services. Netshipale (2020) noted that inadequate waste management infrastructure significantly contributes to illegal dumping practices, where residents often lack access to proper disposal facilities. The Waste Management Theory underscores the relationship between community behaviour and the availability of waste management services. When collection services are sporadic or non-existent, individuals in these communities may feel they cannot dispose of their waste correctly. This behaviour leads to the accumulation of waste in public spaces. It generates a host of environmental and public health risks, such as pollution, the spread of disease, and the attraction of pests. The health implications are particularly severe in informal settlements, where residents may already be vulnerable due to socio-economic factors.

Finally, limited community education on waste management is another challenge. Most communities have a distinct gap between structured educational programs and targeted waste management literacy. Similar observations were made by Ntuli and Muchie (2019), who emphasised the need for grassroots-level environmental education to achieve sustainable practices. While initial workshops may provide helpful information, they often lack the frequency and continuity to create lasting behavioural change among residents. As Wilson (2021) points out, ongoing community education is vital for the long-term success of waste management initiatives. The findings further agree with the DOI theory on compatibility and social systems, which states that practices and behaviours may conflict with new strategies, reducing compatibility (Rogers, 2020). This is particularly relevant in a context where habitual behaviours regarding waste disposal need to be transformed. A participant's observation that "people tend to forget or revert to old habits" speaks to the cognitive and social dynamics that influence community behaviour. When residents are not regularly engaged or reminded about the importance of proper waste management practices, they will likely fall back into previous, less sustainable behaviours. This highlights the importance of developing a structured educational framework that provides information and fosters a culture of participation and accountability within the community.

RECOMMENDATIONS

The following recommendations are proposed to enhance sustainable waste management strategies within the Amathole District Municipality:

Strengthening Waste Management Infrastructure

The municipality should prioritise upgrading its waste management infrastructure, including collection vehicles, recycling facilities, and landfills. By investing in modern, environmentally friendly waste processing technologies, the municipality can improve the efficiency of waste collection and disposal. This will also help reduce the reliance on informal waste management practices, which pose health and environmental risks.

Increased Budget Allocation for Waste Management

Given the municipality's financial constraints, advocating for increased budget allocation for waste management is essential. The municipality should seek additional funding from provincial and national governments to support the development of sustainable waste management programs. These funds can be used to invest in new infrastructure, public awareness campaigns, and technological innovations.

Enhancing Community Engagement Strategies

To improve the effectiveness of waste management programs, the municipality must engage the community more actively. This can be achieved through targeted public education campaigns that raise awareness about recycling, waste reduction, and proper disposal. Creating waste management committees within local communities promotes a sense of ownership and responsibility among residents.

Implementing a Polluter Pays Principle

Adopting a "polluter pays" principle would encourage individuals and businesses to take greater responsibility for their waste. This could involve introducing waste disposal fees based on the amount generated, thereby incentivising waste reduction and recycling. The revenue generated from these fees could be reinvested into improving municipal waste management services.

Collaboration with the Private Sector and NGOs

The municipality should foster partnerships with private companies and NGOs specialising in waste management and environmental sustainability. These partnerships can give the municipality the expertise, resources, and innovative technologies to develop more sustainable waste management practices. Furthermore, engaging the private sector can create new opportunities for employment and economic development through the waste management value chain.

Formalising the Informal Waste Sector

The informal waste sector plays a significant role in recycling and waste collection in many parts of South Africa. The municipality should formalise this sector by integrating informal waste pickers into the formal waste management system. This could involve providing them with training, equipment, and financial support to improve their efficiency and safety. Recognising the contribution of informal waste workers would also help reduce the stigma associated with waste collection.

CONCLUSION

The findings from this study highlight the complex challenges faced by the Amathole District Municipality in managing waste effectively. Addressing these challenges requires a multi-faceted approach that includes infrastructure development, financial investment, and community participation. The recommendations outlined above provide a roadmap for improving waste management practices in the municipality, focusing on sustainability, equity, and collaboration. By implementing these recommendations, the municipality can move towards a more sustainable and inclusive waste management system that benefits all residents.

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DECLARATION OF CONFLICT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

1. Amathole District Municipality. (2020) *Integrated Development Plan 2020/21 - 2024/25*. Amathole District Municipality.
2. Barr, S., Gilg, A. W. & Ford, N. J. (2020). 'Understanding individuals' recycling habits: A behavioral study,' *Waste Management*, 102, pp. 466-476.
3. Chang, N. B., Parvathinathan, G. & Breeden, J. B. (2020). 'A systems approach to sustainable solid waste management,' *sustainability*, 12(3), p. 1287.
4. Department of Environmental Affairs. (2008) *National Environmental Management: Waste Act (No. 59 of 2008)*. Available at: https://www.environment.gov.za/legislation/acts_regulations/nemwa2008 (Accessed: May 18, 2024).
5. Department of Environmental Affairs. (2012) *National Environmental Management: Waste Act (No. 59 of 2008)*. Government of South Africa.
6. Diaz, L. F., de Bertoldi, M., Bidlingmaier, W. & Stentiford, E. (2019). 'Waste management and research,' *Waste Management & Research*, 37(3), pp. 191-192.
7. Gao, W., Liao, Z. & Niu, D. (2019). 'Waste management status and strategies in China,' *Waste Management & Research*, 37(3), pp. 193-195.
8. Godfrey, L., & Oelofse, S. (2017). Historical review of waste management and recycling in South Africa. *Resources*, 6(4), 57.
9. Godfrey, L., & Oelofse, S. (2017). Historical review of waste management and recycling in South Africa. *Journal of Resources*, 6(4), 1-57. <https://doi.org/10.3390/resources6040057>
10. Grobler, L., Schenck, R., & Chitaka, T. (2022). Waste management, littering, and illegal dumping: A literature review. *Clean cities and towns: Understanding societal behavior to reduce and divert waste going to landfills, Technical Report. Bellville (South Africa): University of the Western Cape. Doi, 10.*
11. Hajam, Y. A., Kumar, R., & Kumar, A. (2023). Environmental waste management strategies and vermin transformation for sustainable development. *Environmental Challenges*, 13, 100747.
12. Hassan, S., Ul-Islam, A., Anwar, Z., Ul-Islam, M., Khan, S., Shah, A. A. & Ullah, M. W. (2020). 'Sustainable waste management strategies in Pakistan: A critical review,' *Journal of Cleaner Production*, 259, p. 120801.
13. Khumalo, S. A. (2016). *Environmental impact of household solid waste disposal practices on plant growth in rural areas of KwaZulu-Natal: A case study of UThukela District Municipality* (Doctoral dissertation).
14. Kubanza, N. S. (2019). Solid waste management and environmental injustice in poor communities in Kinshasa: A cultural theory and systems approach. In [eBook] Johannesburg: South Africa. School of Geography, Archaeology and Environmental Studies Department of Geography and Environmental Studies (8th ed.). University of the Witwatersrand. Retrieved April 14, 2022. <https://doi.org/10.5296/emsd.v8i1.14288>
15. Kubanza, N. S., & Simatele, M. D. (2019). Sustainable Solid Waste management in developing countries: A study of institutional strengthening for solid waste management in Johannesburg, South Africa. *Journal of Environmental Planning and Management*. Accessed on June 26, 2025. <https://doi.org/10.1080/09640568.2019.1576510>
16. Kumar, A. & Samadder, S. R. (2021). 'Assessing municipal solid waste generation and recyclable materials potential: A case study,' *Environmental Monitoring and Assessment*, 189(3), p. 96.

17. Liang, X., Ji, L., Xie, Y., & Huang, G. (2022). Economic-Environment-Energy (3E) objective-driven integrated municipal waste management under deep complexities—A novel multi-objective approach. *Sustainable Cities and Society*, 87, 104190.
18. Lopez, R., Prieto, M. & Font, X. (2019). 'Waste Management,' in *Encyclopedia of Sustainable Management*. Springer, pp. 1-5.
19. Mangoro, N., & Kubanza, N. S. (2023). Community perceptions on the impacts of solid waste management on human health and the environment in Sub-Saharan African Cities: a study of Diepsloot, Johannesburg, South Africa. *Development Southern Africa*, 40(6), 1214–1233.
20. Mkabela, Q. & Aigbavboa, C. (2020). 'Challenges and Opportunities in Solid Waste Management: A Case Study of the Amathole District Municipality, South Africa,' *Waste Management & Research*, 37(2), pp. 78-91.
21. Mogomotsi, P. K., Stone, L. S., Mogomotsi, G. E. J., & Dube, N. (2020). Factors influencing community participation in wildlife conservation. *Human Dimensions of Wildlife*, 25(4), 372-386.
22. Moyo, T. P., Lubbe, S., & Ohei, K. Exploring E-waste Management Practices in South African Organisations.
23. Nyika, J. W., Onyari, E. K., Mishra, S., & Dinka, M. O. (2020). Waste management in South Africa. IGI Global. <https://doi.org/10.4018/978-1-7998-0198-6.ch014>
24. Olukanmi, D. O., Akanyiku, O. O., Ede, A. N., Akinwuni, I. I., & Ajanaku, K. (2016). Appraisal of municipal solid waste management, its effects, and resource protection in the semi-urban city. *Journal of South African Business Research*, 1, 1–13. <https://doi.org/10.5171/2014.705695>
25. Pewa, M. K. P. (2019). *Household waste management in a South African township* [Doctoral dissertation]. University of Hull.
26. Polasi, T., Sihle, M., & Oelofse, S. (2020). South African municipal waste management systems: challenges and solutions ii supervision and project management.
27. Rampedi, I. T., Schoeman, D. C., & Rumbidzai Kwenda, P. (2024). Waste management practices amongst small businesses in the townships of Gauteng province in South Africa. *Development Southern Africa*, 41(6), 1160–1178.
28. Rousta, K., Shakeri, M. & Smith, S. R. (2019). 'Challenges and opportunities of municipal solid waste management in Iran: A review,' *Waste Management & Research*, 37(3), pp. 269–281.
29. Serge Kubanza, N. (2021). 'The role of community participation in solid waste management in Sub-Saharan Africa: A study of Orlando East, Johannesburg, South Africa', *South African Geographical Journal*, 103(2), pp. 223–236.
30. Smith, J. & Brown, K. (2020). 'Sustainable Waste Management: Challenges and Opportunities in Developing Countries', *Waste Management & Research*, 38(2), pp. 89–102.
31. Wilson, D. C. (2022). 'Global waste management practices and innovations', *Waste Management Research Journal*, 40(2), pp. 321–340. <https://doi.org/10.1016/j.wasman.2022.01.015>
32. Yuan, Q., Shen, H., Li, T., Li, Z., Li, S., Jiang, Y., & Zhang, L. (2020). Deep learning in environmental remote sensing: Achievements and challenges. *Remote sensing of environment*, 241, 111716.
33. Zhang, X., Loh, C. K. & Wang, J. (2021). 'Comparative Analysis of Waste Management Strategies in the Context of the Circular Economy: A Global Perspective,' *Waste Management*, 120, pp. 510–522.